COVER SHEET FOR PROPOSAL TO THE NATIONAL SCIENCE FOUNDATION

PROGRAM ANNOUNCEMENT/SOLICITATION NO./CLOSING DATE:

NSF 08-580 04/30/09

FOR CONSIDERATION BY NSF ORGANIZATION UNIT(S):

IIA - SCI & TECH CTRS (INTEG PTRS)

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Los Angeles, CA 900890701
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SMALL BUSINESS FOR-PROFIT ORGANIZATION MINORITY BUSINESS WOMAN-OWNED BUSINESS

IF THIS IS A PRELIMINARY PROPOSAL THEN CHECK HERE

TITLE OF PROPOSED PROJECT

Center for Dark Energy Biosphere Investigations (C-DEBI)

REQUESTED AMOUNT PROPOSED DURATION (1-60 MONTHS) REQUESTED STARTING DATE SHOW RELATED PRELIMINARY PROPOSAL NO. IF APPLICABLE

$ 24,874,312 60 months 06/01/10

CHECK APPROPRIATE BOX(ES) IF THIS PROPOSAL INCLUDES ANY OF THE ITEMS LISTED BELOW

BEGINNING INVESTIGATOR (GPG I.G.2)

DISCLOSURE OF LOBBYING ACTIVITIES (GPG II.C.1.e)

PROPRIETARY & PRIVILEGED INFORMATION (GPG I.D, II.C.1.d)

HISTORIC PLACES (GPG II.C.2.j)

EAGER* (GPG II.D.2) RAPID** (GPG II.D.1)

VERTEBRATE ANIMALS (GPG II.D.6) IACUC App. Date

PHS Animal Welfare Assurance Number

HUMAN SUBJECTS (GPG II.D.7) Human Subjects Assurance Number Exemption Subsection or IRB App. Date

INTERNATIONAL COOPERATIVE ACTIVITIES: COUNTRY/COUNTRIES INVOLVED (GPG II.C.2.j)

HIGH RESOLUTION GRAPHICS/OTHER GRAPHICS WHERE EXACT COLOR REPRESENTATION IS REQUIRED FOR PROPER INTERPRETATION (GPG I.G.1)

PI/PD DEPARTMENT

Biological Sciences

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CERTIFICATION PAGE

Certification for Authorized Organizational Representative or Individual Applicant:

By signing and submitting this proposal, the Authorized Organizational Representative or Individual Applicant is: (1) certifying that statements made herein are true and complete to the best of his/her knowledge; and (2) agreeing to accept the obligation to comply with NSF award terms and conditions if an award is made as a result of this application. Further, the applicant is hereby providing certifications regarding debarment and suspension, drug-free workplace, and lobbying activities (see below), nondiscrimination, and flood hazard insurance (when applicable) as set forth in the NSF Proposal & Award Policies & Procedures Guide, Part I: the Grant Proposal Guide (GPG) (NSF 09-29). Willful provision of false information in this application and its supporting documents or in reports required under an ensuing award is a criminal offense (U. S. Code, Title 18, Section 1001).

Conflict of Interest Certification

In addition, if the applicant institution employs more than fifty persons, by electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative of the applicant institution is certifying that the institution has implemented a written and enforced conflict of interest policy that is consistent with the provisions of the NSF Proposal & Award Policies & Procedures Guide, Part II, Award & Administration Guide (AAG) Chapter IV.A; that to the best of his/her knowledge, all financial disclosures required by that conflict of interest policy have been made; and that all identified conflicts of interest will have been satisfactorily managed, reduced or eliminated prior to the institution’s expenditure of any funds under the award, in accordance with the institution’s conflict of interest policy. Conflicts which cannot be satisfactorily managed, reduced or eliminated must be disclosed to NSF.

Drug Free Work Place Certification

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Drug Free Work Place Certification contained in Exhibit II-3 of the Grant Proposal Guide.

Debarment and Suspension Certification

(If answer “yes”, please provide explanation.)

Is the organization or its principals presently debarred, suspended, proposed for debarment, declared ineligible, or voluntarily excluded from covered transactions by any Federal department or agency?  
Yes ☐  No ☒

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant is providing the Debarment and Suspension Certification contained in Exhibit II-4 of the Grant Proposal Guide.

Certification Regarding Lobbying

The following certification is required for an award of a Federal contract, grant, or cooperative agreement exceeding $100,000 and for an award of a Federal loan or a commitment providing for the United States to insure or guarantee a loan exceeding $150,000.

Certification for Contracts, Grants, Loans and Cooperative Agreements

The undersigned certifies, to the best of his or her knowledge and belief, that:

(1) No federal appropriated funds have been paid or will be paid, by or on behalf of the undersigned, to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with the awarding of any federal contract, the making of any Federal grant, the making of any Federal loan, the entering into of any cooperative agreement, and the extension, continuation, renewal, amendment, or modification of any Federal contract, grant, loan, or cooperative agreement.

(2) If any funds other than Federal appropriated funds have been paid or will be paid to any person for influencing or attempting to influence an officer or employee of any agency, a Member of Congress, an officer or employee of Congress, or an employee of a Member of Congress in connection with this Federal contract, grant, loan, or cooperative agreement, the undersigned shall complete and submit Standard Form-LLL, “Disclosure of Lobbying Activities,” in accordance with its instructions.

(3) The undersigned shall require that the language of this certification be included in the award documents for all subawards at all tiers including subcontracts, subgrants, and contracts under grants, loans, and cooperative agreements and that all subrecipients shall certify and disclose accordingly.

This certification is a material representation of fact upon which reliance was placed when this transaction was made or entered into. Submission of this certification is a prerequisite for making or entering into this transaction imposed by section 1352, Title 31, U.S. Code. Any person who fails to file the required certification shall be subject to a civil penalty of not less than $10,000 and not more than $100,000 for each such failure.

Certification Regarding Nondiscrimination

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative is providing the Certification Regarding Nondiscrimination contained in Exhibit II-6 of the Grant Proposal Guide.

Certification Regarding Flood Hazard Insurance

Two sections of the National Flood Insurance Act of 1968 (42 USC §4012a and §4106) bar Federal agencies from giving financial assistance for acquisition or construction purposes in any area identified by the Federal Emergency Management Agency (FEMA) as having special flood hazards unless the:

(1) community in which that area is located participates in the national flood insurance program; and

(2) building (and any related equipment) is covered by flood insurance.

By electronically signing the NSF Proposal Cover Sheet, the Authorized Organizational Representative or Individual Applicant located in FEMA-designated special flood hazard areas is certifying that adequate flood insurance has been or will be obtained in the following situations:

(1) for NSF grants for the construction of a building or facility, regardless of the dollar amount of the grant; and

(2) for other NSF Grants when more than $25,000 has been budgeted in the proposal for repair, alteration or improvement (construction) of a building or facility.

AUTHORIZED ORGANIZATIONAL REPRESENTATIVE       SIGNATURE       DATE

NAME
Jean B Chan          Electronic Signature       Apr 30 2009  7:11PM

TELEPHONE NUMBER       ELECTRONIC MAIL ADDRESS     FAX NUMBER
213-740-2934               jchan@ooc.usc.edu     213-740-6070

* EAGER - Early-concept Grants for Exploratory Research
** RAPID - Grants for Rapid Response Research

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Center for Dark Energy Biosphere Investigations (C-DEBI)

A center for resolving the extent, function, dynamics and implications of the Subseafloor Biosphere

Katrina J. Edwards, Director, University of Southern California, Lead-Institution

The Earth’s “deep biosphere” includes a variety of subsurface habitats on Earth, such as mines, aquifers, and soils in the continental realm, and sediments and igneous rock in the marine realm. It has been estimated that nearly half of total biomass on Earth resides in the deep biosphere [1]. Subsurface biosphere sites examined to date have been selected for scientific interest and opportunity, but have been limited to relatively few locations and shallow drilling, because of technological hurdles and a lack of interdisciplinary coordination during the early phases of project design and development. These problems have hindered deep biosphere research, skewing data sets towards environmental accessibility, and precluding the development of a more accurate global census. Even less is known about the identity of these subsurface microbial communities or the critical abiotic and biotic processes within this biosphere. The last decade has produced a tremendous increase in deep biosphere studies, proposals, publications, working groups, field opportunities, and technologies available for sampling, monitoring, and experiments (e.g., [2-10]). Although the field is still young, it is maturing from principally isolated, opportunistic investigations toward coordinated, targeted research. We lack the infrastructural coordination mechanisms, however, to guide and support the research for transformational advance.

The largest potential subsurface biome is also the least accessible: the subseafloor biosphere, harboring an estimated 1/3 of all biomass on Earth [1]. Owing to it’s vast size and intimate connection with the water cycles, the subseafloor biosphere has enormous potential for influencing global-scale biogeochemical processes, including carbon, energy, climate, and nutrient cycles. The subseafloor biosphere may extend to a depth of 5-10 km or more, depending on local geothermal gradients, and occupy a volume several orders of magnitude greater than the continental biosphere [1]. Rock outcrops serve as conduits of fluid flow between the “sub-seafloor ocean” and the ocean basins, and offer windows into the subseafloor (e.g., [8, 11-13]). Fluid flow in the global basaltic rock aquifer—considered a superhighway of fluid flow—mediates elemental exchange between crust and seawater, and as consequence, the chemical composition of the oceans [14, 15]. The fractured rock medium that provides conduits for the superhighway of fluids may also serve as an incubator for life. Examinations of the rock-hosted oceanic deep subseafloor biosphere as a realm of study is just beginning [16], but similar to deeply buried sedimentary habitats (e.g., [5]), it holds promise for revealing new and remarkable information about uniquely remote life on Earth and the possibilities for life on other planetary bodies.

INTELLECUAL MERIT

C-DEBI proposes to seize a unique opportunity to bundle US-lead diverse deep subseafloor biosphere projects, coordinate them with international partner project, to accomplish an integrated, global scientific mission to solve the most vexing problems of this field. This virtual center will be multi-institutional with international partnerships, with additional science and engineering liaisons and partnerships from a host of for- and not-for-profit agencies and a national laboratory. C-DEBI will integrate scientific projects across two deep subseafloor biosphere environments (igneous ocean crust and sediments) that have historically been studied independently, and among locations that span the globe.

Life in deeply buried marine sediments. Marine sediments can accumulate in km thick sequences in coastal areas, margin terrain, and abyssal plains of the ocean. These sediments are mineralogical and geochemical reservoirs of information about the environment in which each layer was deposited. Chemical processes in sediments are often dictated by diffusion and reaction kinetics, which operate very slowly over long length scales. As such, sediments record Earth’s history, containing information about, for example, past glaciations and deglaciations and climactic and geochemical events. However, since the discovery of extant, metabolically active microbial life harbored within deeply buried sediments to at least 1km depth below the seabed [2], it is now known that they represent a complex reservoir of past and present life processes and biogeochemical activity, as well as localized time-capsules of microbial evolution.
**Life in igneous ocean crust.** The igneous ocean crust is composed of porous and permeable volcanic rock, principally basalt, which outcrops at mid-ocean ridges (MORs) where frequent eruptions build new crust. The crust moves off-axis and typically remains uncovered by sediments for thousands to millions of years on the flanks of the MORs, before being blanketed in the abyssal plains of the ocean, and eventually subducted at trenches. The upper ~500 m of igneous crust is fractured and permeable to fluid, and hosts the largest aquifer on Earth. Most of the oceanic crust is hydrologically active (at least 60%; [17]) and the fluid flux through the ocean crust rivals global riverine input to the oceans [18]. Solutes and colloids—microbes included in this fraction—circulate actively through the crustal aquifer, but the degree to which microbes “take seed”, colonize, alter, and evolve in subsurface rock is not known.

**An integrative approach to deep subseafloor biosphere research: A community-initiated vision for C-DEBI.** C-DEBI will catalyze research that will bridge the crust and sediment marine realms, through scientific integration of independently-developed US-lead deep subseafloor biosphere projects that have recently progressed through the Integrated Ocean Drilling Program System, in order to conduct an integrated global mission: to resolve the extent, function, dynamics and implications of the subseafloor biosphere. The three US-lead that form the core of our mission were developed by the PI group: Edwards (USC) and Wheat (UAF) (North Pond, mid-Atlantic); Fisher (UCSC) and Cowen (UH) (Juan de Fuca, Pacific NW); D’Hondt (URI) and Edwards (USC) (South Pacific Gyre). C-DEBI will serve as: (1) a coordination and cyber infrastructural hub for an international community of researchers; and (2) a scientific incubator that will and revolutionize efforts to develop additional field, laboratory, and modeling experiments. C-DEBI will integrate and collaborate with German, Japanese, Danish, and Chinese researchers on this project, and bring deep subseafloor marine biosphere projects developed in those countries into the C-DEBI framework. C-DEBI will serve as a bridge between the scientific community of subseafloor biosphere researchers and drilling partners (Integrated Ocean Drilling Program, Ocean Leadership, industry). **C-DEBI comprises an international model for project coordination and integration, establishing the intellectual, educational, technological, cyber-infrastructural, and collaborative framework needed for transformative experimental and exploratory research on the subseafloor biosphere.**

**BROADER IMPACTS**

C-DEBI creates distinctive educational programs at the K-12, undergraduate, graduate, and postdoctoral levels in order to train and foster the next generation of deep subseafloor biosphere researchers. This is a highest priority to ensure the robust continued development of this new field, and will arm the field with the brightest and most creative young minds that can take what has been built over the past decade, to expand it in this decade via C-DEBI. C-DEBI researchers feel strongly that it is also fundamentally crucial that to translates knowledge of the deep subseafloor biosphere and ocean sciences to the broader public. We will accomplish this in part through core education programs (which will interact with public policy, administration, and other education fields) and also by diverse lecture programs and other outreach mechanisms that promote broad dissemination of information and increased awareness of the existence and potential importance of the subseafloor biosphere.

C-DEBI will support undergraduate, graduate, postdoctoral studies and research broadly across with collaborating investigator laboratories. C-DEBI will develop programs within the COSEE-WEST framework, and those of other existing programs in order to integrate C-DEBI faculty, postdoctoral, and graduate students into K-12 science education. As part of C-DEBI, faculty will work with COSEE-West staff and K-12 teachers to create new curriculum elements and lesson plans that explore the topics of C-DEBI research and link it directly to the California State Science Standards. In addition, Co-PI institutions will each contribute distinct components to these objectives. Example additional programs that will be lead at C-DEBI collaborating institutions include as teacher-at-sea programs and partnerships with REU projects such as the Transforming Undergraduate Laboratory Experiences project for underrepresented groups (TULES at UCSC), the Summer Undergraduate Research Fellowships in Oceanography (SURFO at URI), and K-12 technology outreach at C-DEBI affiliated marine technology centers (Monterey Bay Aquarium Research Institute).
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*Proposers may select any numbering mechanism for the proposal. The entire proposal however, must be paginated. Complete both columns only if the proposal is numbered consecutively.
Center for Dark Energy Biosphere Investigations (C-DEBI)

(A) Rationale for Center Concept

**WHY a deep subseafloor biosphere STC?** In a provocative 1992 essay, Thomas Gold postulated the existence of a “deep, hot biosphere”, supported by geological energy sources [19]. Whitman et al., [1] expanded this concept, collating available data on aquatic, soil, and subseafloor microbes, and concluded that the majority of biomass on Earth may be harbored below the surface of the Earth. The ramifications of a massive buried biosphere of “intraterrestrial microbes” are significant (e.g., global carbon budgets and cycling), leading to paradigm shifts in our thinking in the biosciences and geosciences [20, 21].

Owing to the vast size of the subseafloor reservoir in the global Earth system, most intraterrestrial microbes reside below the bottom of the OCEANS, in sediments and rock. The potential for the oceanic deep biosphere to influence global biogeochemical processes scales with the size of the subseafloor as a habitat. Oceans cover over 70% of the Earth’s surface, and 70% of the rock underlying the ocean represents an actively flowing aquifer system—the largest on Earth. Fluid flow in the oceanic aquifer mediates elemental exchange between crust and seawater, and consequently, affects global ocean chemistry [14, 15]. Herein, we propose to create a Science and Technology Center to resolve the extent, function, dynamics and global implications of what may be the largest biome on Earth, the subseafloor intraterrestrial deep biosphere. This center will have the capability of affirming or concretely re-defining the conjectures of Gold, Whitman and others with unprecedented global impact.

**WHY now?** Over the past decade, deep biosphere studies have focused on enumerating cells in relatively shallow marine sediments or in terrestrial mines, wells, and drill-core samples. Sites have been targeted based on interest and opportunity, but have been limited because of technological hurdles and a lack of interdisciplinary coordination during the early phases of project design. Consequently, despite the potentially profound implications for the existence of a deep biosphere, existing data are skewed toward accessibility and do not permit significant refinement of the global census of subseafloor biomass [1]. Little information exists about the identity of these microbial communities or the abiotic and biotic processes within this biosphere—information that is critical to link intraterrestrial microbes with global processes and to understand the significance of subseafloor biomes in the development and evolution of life. These shortcomings, in their essence, reduce to a lack of prior integration and coordination within this new field; C-DEBI will allow transformative advancement through collaboration, coordination, and support, enabled by recent opportunities.

We are at a crossroad in our quest to resolve the major questions in deep subseafloor biosphere research. Only one dedicated subseafloor biosphere-focused drilling project has been mounted to date [22]. However, three new US-lead IODP projects for deep subseafloor biosphere research are poised for drilling before 2013, headed by our executive committee members and involving many of our science participants. These projects developed independently, with specific sites and scientific objectives. C-DEBI will seize a unique opportunity to bundle these diverse projects, to accomplish an integrated, global scientific mission. **Our first major science objective is to coordinate, integrate, support, and extend** the science associated with these three projects, establishing a new model for conducting internationally coordinated collaborative research in the deep subseafloor biosphere. C-DEBI will establish the technological, collaborative, and cyber-infrastructure that is needed to effectively plan, execute, and maximize returns for deep subseafloor biosphere research—now and into the future. **Our second major science objective is to foster and educate an interdisciplinary community of researchers in deep subseafloor biosphere research,** with a focus on students and junior researchers. C-DEBI will nurture new projects, through collaboration and networking between new deep subseafloor biosphere enthusiasts and researchers with experience in the logistical and technological “how’s” for mounting and executing an IODP project—thereby ensuring precision use of scarce resources and well-informed project development for answering critical global science questions. Our education and diversity objectives are to educate, inform, and translate knowledge of the deep subseafloor biosphere via a coordinated program across primary, secondary, and higher education programs, and for C-DEBI scientific participants to learn how to be more effective in communicating scientific and technical results to a broader audience.
(B) Management Plan
Our management plan will facilitate the achievement of the principal scientific, education, and diversity goals for C-DEBI:

1. Support and intertwine the science associated with our three main field projects (yrs 1-5) at North Pond (NP), Juan de Fuca (JDF), and South Pacific Gyre (SPG) in order to conduct a global-scale, international, coordinated mission on the subseafloor biosphere;

2. Grow, educate and nurture the community of deep subseafloor biosphere researchers, advance the suite of scientific tools brought to bear on questions concerning this biosphere, and develop the next phase (yrs 5-10) of project development;

3. Train and educate a new, diverse generation of undergraduate, graduate students and postdoctoral deep subseafloor biosphere researchers within an integrated and collaborative multidisciplinary community;

4. Translate knowledge of the deep subseafloor biosphere and ocean sciences generally to a broad and diverse community, through targeted programs with K-12 teachers and informal science venues throughout the country.

The major administrative and science committees for C-DEBI members are presented in Table 1; Interactions between C-DEBI groups are depicted in Figure 1.

Executive Committee. The Executive Committee (ExCom) is comprised of the STC co-PI group,

| Table 1. Listing of the principal membership of the research, administrative, and education committees. Note full C-DEBI science participants, liaisons, evaluators, industry, national laboratory, and international participants are included in the required supplemental “Institutions and Affiliations” document. |
|---|---|---|
| ExCom | Institution | C-DEBI Science and Administration Role(s) |
| Katrina Edwards | USC | North Pond Research Project Lead |
| Jim Coven | UH | JDF Associate Lead; Instrument and Technology |
| Steve D’Hondt | URI | South Pacific Gyre Research Group Lead |
| Andy Fisher | UCSC | Juan de Fuca (JDF) Group Lead |
| Geoff Wheat | UAF | NP Associate Lead; CORK development |
| C-DEBI Administration | | |
| Katrina Edwards | USC | C-DEBI Director/DEBI RCN co-Director |
| Jan Amend | WUSL | DEBI RCN co-Director/C-DEBI meetings coordinator |
| Ann Close | USC | C-DEBI Managing Director |
| Linda Duguay | USC | C-DEBI Research Coordinator |
| Rosalyn Lee | USC | C-DEBI Associate Managing Director |
| TBN | USC | C-DEBI Education Administrator |
| TBN | USC | C-DEBI Diversity Administrator |
| Education Instructors & Advisors | | |
| Steven Finkel | USC | Minority Course Advisor |
| John Heidelberg | USC | Minority Course Instructor |
| Eric Webb | USC | Minority Course Instructor |
| Jennifer Biddle | UDel | Postdoctoral Committee |
| Dave Caron | USC | Postdoctoral Committee |
| SciCom | | Crust Steering Committee |
| Wolfgang Bach | Bremen | Geochemistry |
| Brian Glazer | UHI | Biogeochemistry |
| Julie Huber | MBL | Microbial Ecology |
| Olivier Rouxel | WHOI | Isotope Geochemistry |
| Everett Shenk | ASU | Geochemistry |
| Matthew Schrenk | ECU | Geomicrobiology |
| William Berelson | USC | Geochemistry |
| Pete Girgis | Harvard | Geochemistry |
| Kai Hinrichs | Bremen | Geomicrobiology |
| Karla Heidelberg | USC | Organic Geochemistry |
| Steve Lund | USC | Genomics |
| Axel Schippers | BGR | Sedimentology |
| Theme Team Leaders | | |
| Wiebke Ziebis | USC | Theme 1 Lead: Activity of the Deep Biosphere |
| Andreas Teske | UNC | Theme 2 Lead: Biogeography and Dispersal |
| Tom McCollom | UCO | Theme 3 Lead: Limits of Life in the Deep Biosphere |
| Bill Nelson | USC | Theme 4 Lead: Evolution and Survival |
charged with overseeing the C-DEBI research and education programs, and is ultimately responsible for making sure that the STC is run efficiently and effectively in close coordination and communication with
C-DEBI administration (Fig. 1). *ExCom* is comprised of leaders from diverse disciplines that have spearheaded the major US-lead deep subsurface biosphere research projects that comprise the core initial focus for C-DEBI. The primary responsibility of the *ExCom* is to lead our major scientific projects that are described herein. D’Hondt, Edwards, and Fisher are the research project leaders for the SPG, NP, and JDF IODP projects, respectively. They are the “lead proponents” (PI) of these IODP projects and as such are the principal contacts and coordinators for them. This involves project coordination with the IODP, Ocean Leadership, Texas A&M University (TAMU), and NSF. Co-PIs Wheat and Cowen will serve as associate leads for the technically and logistically complex NP and JDF observatory projects, respectively. Wheat will serve as lead for CORK technological development (section F), and will be the C-DEBI knowledge transfer coordinator for the scientific portion of these objectives (section F). Cowen will serve as lead of instrument and technology development for ocean crust observatories, also coordinating with our liaisons and industry partners.

In addition to leading and managing the science of our core projects, *ExCom* will (1) work with other C-DEBI members (see supplement listing) and groups (science steering committee (*SciCom*) and theme teams (*TT*)), which are our principal mechanisms for project integration and science oversight; and (2) foster and nurture the development of competitive new projects, as discussed below. This role is based on the *ExCom*’s experience in navigating the IODP system, including, project development and coordination, proposal preparation and scientific planning, site surveys, engineering design and implementation, experiments, and observatory creation. C-DEBI will serve as a "scientific incubator" for both existing and newly developed projects (see pg. 6-7). *ExCom* will also oversee the development of an external advisory committee (EAC) comprised of leaders in oceanography and other leaders in Center-level programs. *ExCom* will ensure NSF diversity in representation criteria are met for this committee. For succession of the director, nominations should come from *SciCom* and *TT* leaders; a voting majority within *ExCom* will decide new directorship.

**Administration**. Day-to-day C-DEBI administration will rest with Edwards (Director). Edwards has lead efforts to organize this community, first with the NP project (initiated in 2005), followed by the activities (meetings and coordination efforts discussed below) that have coalesced and are herein expressed as the community scientific vision for C-DEBI. Edwards will benefit from close collaboration with an experienced administration team represented by Ann Close (Managing Director), Dr. Linda Duguay (Research Coordinator), and Dr. Rosalynn Lee (Associate Managing Director). Close has played a similar role at the USC Wrigley Institute for Environmental Studies (WIES; $3-$5 million per year with a faculty of 20 and a staff of 45), and has organized and managed the daily activities of that center for over a decade. Duguay has years of experience in leading local and national programs at USC, NSF, and other organizations. Currently she is the Research Director of WIES, and director of SeaGrant COSEE-West (see below and biosketch). Lee was recently recruited due to her experience in the development of the NSF denitrification research coordination network at Rutgers (lead by Dr. Seitzinger), with particular expertise on cyber infrastructure and meeting planning.

Close and Duguay will coordinate and integrate the daily activities of C-DEBI. Close will oversee site communication and coordination. Close will direct the education and diversity administrators at USC in coordination with the education, outreach and communications liaisons at Partner Institutions. Duguay will integrate the research themes into the education, diversity and knowledge transfer components of our programs. Duguay, with assistance from Lee, will also manage fiscal aspects of research proposals from C-DEBI community members (as described below), *i.e.*, student, postdoctoral support and etc. Lee will be
responsible for web site development and management (see section F). The Education and Diversity administrators (positions to be filled) will work with our external education program evaluator, Dr. Beth Rabin, to insure timely evaluations and rapid implementation of any recommendations on our education programs (sections D & F).

Yearly C-DEBI STC meetings will be coordinated and managed by C-DEBI administrative personnel. Dr. Jan Amend and Edwards are Co-Directors of the NSF-funded DEBI Research Coordination Network, which has partial support for yearly meetings in each of the next five years starting in 2009 (see section F). Amend is the principal meeting coordinator, and will work closely with Lee, Edwards, and local organizing committees on program development, fundraising, advertisement, and venue logistics.

Drs. John Heidelberg and Eric Webb, who have experience in teaching related classes at USC, will teach our undergraduate minority summer course. Dr. Steve Finkel will advise them on the development of this course; Finkel has run a summer course that similarly targeted undergraduate minorities and has five years of experience with all aspects of development, implementation, evaluation, networking and advertising. Drs. Jennifer Biddle and Dave Caron represent our postdoctoral committee; they will be responsible for oversight and management of the postdoctoral fellowships to ensure implementation of our mentoring program (see supplemental document), and will be overseen by ExCom.

Science Steering Committee (SciCom). The crust and sediment SciCom are advisory committees to ExCom, and have two principal charges: (1) Review proposals and applications for C-DEBI sponsored support (research, instrument, travel, etc) and make recommendations to the ExCom; and (2) Meet at the annual C-DEBI meeting and at another yearly event (major national scientific meeting) to discuss the confluence or lack thereof between the science proposals and C-DEBI objectives. Each SciCom member also will participate in a TT, and make recommendations to ExCom during conference calls. Each advisory committee consists of six members that span a range of disciplines. Members will serve two-year terms, after which new SciCom members will be identified by ExCom with input from current SciCom. This model—small groups, with targeted missions and short terms—will enable broad-based participation and supply a constant flux of fresh perspectives to science proposal evaluations and to ExCom. Members presently identified have, and will in the future, be chosen from the broader listing in the supplemental “Institutions and Affiliations” document, which delineates C-DEBI science personnel. For the sediments group, we have initially selected several “local” (USC) SciCom members for this team, for accessibility to the director during the building phase of the center (first 2 yrs). C-DEBI is intended to integrate across the sediment/crust division for deep subseafloor biosphere projects—two sub-fields in the subseafloor biosphere that have historically operated independently. However, four members of ExCom, including the director, focus on crust. Local access and expertise on sediments within SciCom during C-DEBI formation is critical to insure balance and representation in project development and science support. SciCom includes currently, and will in the future, two continental drilling liaisons (Schippers and Shock) for science coordination and knowledge transfer between continental and marine drilling projects.

Science Theme Team (TT) Leaders. Four C-DEBI cross-project research “Themes” are discussed below; they aim to integrate research projects within C-DEBI. C-DEBI science participants affiliate with one of these themes, becoming part of a TT. Each TT will have a leader, charged with creating the means to (1) develop core science foci for the particular theme they lead; and (2) bring new researchers—i.e., those not already associated with one or more of our specific field projects, as well as outside experts from related fields (e.g., continental deep biosphere) to C-DEBI—to broaden existing projects and develop new ones. Specific mechanisms for accomplishing these charges are discussed in section F. TT leaders will also consult experts from the broader research community to establish new partnerships for effective response to new challenges in the field. TT leaders will form ad-hoc task forces to formulate technical advisory panels (TAPs). TAPs will be used to focus and advance research, tools and advisory activities in each area, for science advancement in the four Theme areas. Community membership in themes may change (see supplemental listing) but it is anticipated that to achieve these objectives, TT leaders will hold these positions for at least three years.
(C) Research Objectives of the Center

Preamble.

In February 2008, the University of Southern California (USC) with support from WIES, sponsored an international workshop with the participation of 30 pre-eminent American and German deep subseafloor biosphere researchers. This community proposed an NSF Center in order to coordinate, integrate, and collaborate on research to resolve the critical outstanding research questions concerning the largest biome on Earth, its biological implications and its consequence for the balance of present, future, and past global biogeochemical cycles and elemental budgets. C-DEBI science is global in scale, international in scope, and transformative in impact; the deep marine subseafloor biosphere is a global-scale enigma that requires an internationally coordinated research Center to tackle it comprehensively.

Director Edwards and Jan Amend successfully acquired an NSF grant for a DEBI Research Coordination Network (RCN)—critical for the realization of C-DEBI by partially funding future annual meetings, based on the Catalina workshop model but to be held at C-DEBI partner institutions (across the US and Germany). The next DEBI meeting will be Oct. 09 (section F) in Hawaii (Cowen, host); Amend, Cowen, Fisher and Glazer submitted a proposal for supplemental funding for this meeting April 1, 2009 to Ocean Leadership’s US-Science Support program.

Overview.

The most pressing questions in marine deep subseafloor biosphere research. Deep subseafloor biosphere studies seek to answer questions that range in nature from exploratory and census-level to the most complex and fundamental in the Earth and life sciences. Deep subseafloor habitats are vast in scale—it is estimated that up to 1/3 of the Earth’s biomass is harbored in the deep marine subseafloor [1]—and are physically and chemically vastly diverse. A common feature among all deep subseafloor biosphere habitats is that they exist in the dark, one or more steps removed from the photosynthetic activity that fuels the surface biosphere. Energy and carbon cycling in the deep subseafloor biosphere are potentially important issues in solving global redox and carbon budgets [23]. However, quantification of the magnitude and activity of this dark biosphere and its organic versus inorganic energy and carbon sources is difficult, owing to a dearth of data concerning the nature of these deep ecosystems. Fundamental questions that have far reaching consequences for life on Earth and beyond include: What is the nature and extent of life on Earth? What are the physico-chemical limits of life on Earth? How metabolically active is the deep subseafloor biosphere, and what are the most important redox processes? Are there exotic metabolic processes occurring? How are microbes dispersed in the deep subseafloor biosphere? How does life evolve in deeply buried geological deposits beneath the ocean floor? These questions are diverse and demand interdisciplinary research approaches in microbiology, molecular biology, geology, geochemistry, engineering, hydrology and more. Our research findings have the potential to impact major current questions such as energy creation, climate change, and the very nature of evolution of life on Earth. To address these challenges, we focus and integrate across four broad C-DEBI research Themes:

1. Activity in the deep subseafloor biosphere: function & rates of global biogeochemical processes;
2. Extent of life: biomes and the degree of connectivity (biogeography & dispersal);
3. Limits of life: extremes and norms of carbon, energy, nutrient, temperature, pressure, pH;

We propose to address questions within these themes by linking deep subseafloor biosphere projects into a coherent deep-biosphere program, C-DEBI. The linked C-DEBI projects will embrace a strategy of "contrast, compare, and integrate" between deep subseafloor biosphere sites where specific environmental controls, processes, and dynamics relating to C-DEBI research themes can be resolved. Our ambitious cross-site research agenda can only be accomplished via an integrative center infrastructure, which will fundamentally change the nature of how deep subseafloor biosphere research is conducted, resulting in transformative advances in this field. Integrating multiple projects within C-DEBI allows us to adapt to changing field schedules (which we cannot control), new discoveries (which we cannot always
predict), and to set strategic research priorities for C-DEBI. The C-DEBI field projects can be completed in virtually any sequence, and will dovetail (and involve participation) with new projects as they develop.

**Research projects that will address key questions over the next 5+ years.** Study of life in the deep subseafloor biosphere is technologically and analytically among the most challenging in the Earth and life sciences. Accessing samples requires a **drill ship** supported by the IODP. The US has emerged as a leader in developing projects in the deep subseafloor biosphere. Only four deep subseafloor biosphere projects internationally are ranked within the IODP system as “ready to drill”, to be scheduled before 2013; we refer to these project herein as “mature”. Three of these projects are led by US PIs, with significant collaborations with scientists from other countries such as Germany and Japan:

1. **JDF; Co-PI Fisher (UCSC; lead) & Co-PI Cowen (UHI)**
2. **NP - Mid-Atlantic Ridge; PI Edwards (USC; lead) & Co-PI Wheat (UA)**
3. **SPG; Co-PI Steven D’Hondt (URI; lead), & PI Edwards (USC)**

These projects emerged independently with well-developed hypotheses, objectives, additional collaborators (many C-DEBI investigators), and specialized components. Each has been through the complete IODP review process and is ranked “Tier 1”, which represents the highest priority IODP projects for scheduling. While the full proposal and evaluation process cannot be described here in detail, briefly, **all proposals have been:** i) through multiple iterations of science review (many years); ii) requiring preliminary data, or “site-survey” sea-going data (with support from NSF for science and/or ships); the sea-going site-surveys are complete for all projects; (iii) additionally considered by IODP technology and safety panels; (iv) ranked globally with all other IODP proposals (from all disciplines and countries that have similarly passed these other panels).

Our international C-DEBI partner, Ken Takai, is the lead proponent of the only other mature deep-biosphere IODP project in the IODP system, focused on the Okinawa Trough. We fully intend to use C-DEBI as a coordinating mechanism to integrate the research and personnel engaged in that project into this global subseafloor biosphere mission, and to foster additional international collaboration.

**IODP Science: Drilling Platform vs. Research Support.** These mature projects bring **drill ship access** to C-DEBI for all three of the above projects, which enables them to be mounted, samples accessed, and experiments started; however, the IODP does not support **science costs** associated with drilling, which instead is supported by normal grants to individuals or small groups of PIs within the countries involved. Presently, no mechanism exists for coordinating and planning between scientists **before a drilling expedition**, or performing the science after an expedition beyond individual small **research grants** (2-3 yrs). Hence, drilling projects have historically operated independently of one another, addressing limited sets of specific, relatively short-term research objectives relating to a single site or region that can be accomplished rapidly. **C-DEBI represents a novel approach to deep-drilling science, because it enables us to integrate data from many sites and conduct experiments/monitor conditions for long time frames** (see below), **which is paramount for comprehensive understanding of the deep subseafloor biosphere**.

This is a critical interval of time for deep subseafloor biosphere research. Never before have so many deep-biosphere IODP projects reached maturity simultaneously, which motivates us to capitalize on this rare opportunity to create C-DEBI. We intend to establish a new model for deep subseafloor biosphere research, adopting an **Earth system science** approach to addressing key questions in our field, which are embodied within our themes. **C-DEBI will enable transformative science to emerge through research integration in a collaborative environment where complex logistical, technological, scientific and analytical know-how, research, and developments are supported and coordinated.**

**Research projects that will address key questions over the next 6-10 years.** From the brief description above of the IODP proposal process, it may be appreciated that it is complex and lengthy.

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1 IODP supports limited operational planning in coordination with drilling engineers and technicians, generally with the lead PI for a project.
The three C-DEBI projects described above were initiated in IODP between 2003 and 2005. The length and complexity of this process has hindered the rise of new deep biosphere projects internationally, even though the IODP research theme “Deep Biosphere and Subseafloor Ocean” has been prioritized since 2003 [24]: the four projects discussed above are the only ones that have emerged globally during IODP. The lack of deep biosphere proposals has concerned the IODP and supporting agencies (e.g., Ocean Leadership) enough to support measures to help specifically encourage this community, including support for numerous workshops, for example one on “Subseafloor life” (Lead by Co-PI D’Hondt and others; [25]), another on the “Energy Limits of Life” (lead by B. Jørgensen & T. Hoehler; [26]), and one on “Exploring the Deep Biosphere” (lead by J.A. McKenzie; [27]). Additionally, the IODP has developed a standing “Task Force” for the deep subseafloor biosphere (D’Hondt, Edwards, Ferdelman, Inagaki, Kallmeyer, Orphan, and Takai are members). It is our assessment that this community may be best fostered by direct support and collaboration within the community; C-DEBI is the community-initiated means of providing the collaborative framework and support that we believe is needed for new research projects to be developed in the deep subsurface biosphere.

C-DEBI will support research that leads to the development of key new projects during the first five years, with the goal of moving them toward scheduling of drilling expeditions by phase II (yrs 6-10). The scientific rationale for these sites and projects has been emerging within the community for several years (not discussed in detail here), and through C-DEBI support, they may most effectively build the preliminary and justifying datasets, and develop/coordinate the IODP objectives for a proposal that will successfully traverse the IODP system. These projects include, but are not limited to:

4. Guaymas Basin; Lead by Andreas Teske (UNC) and Adam Soule (WHOI)
5. Dorado Seamount; lead by co-PIs Wheat and Fisher

A pre-proposal was submitted to the IODP April 1, 2009 for Guaymas, and a US-lead site-survey proposal was submitted to the NSF Feb. 15, 2009 for Dorado. As with our core projects (above), broad community interest in these sites exists among C-DEBI participants. Other opportunities for project development include the South Chamorro Seamount on the Mariana forearc; this is a system that has been extensively studied by geologists and geochemists, but has not received significant attention from microbiologists. C-DEBI participants (Moyer, Takai, and Inagaki) are beginning to mount efforts that could develop into major C-DEBI-wide field project. Additionally, international participants have recently initiated proposals for projects in the Arabian sea (Schippers) and the Shimokita Peninsula, Japan (Inagaki, Takai), that would benefit, and benefit from, C-DEBI as an international coordinating entity.

C-DEBI will generally support new and emergent field studies; the afore examples of where momentum appears to be gathering (note as with our three core projects, 3-5 year “incubations” are normal), but they are not exclusive; other areas C-DEBI would support include deep subseafloor H_{2}-based ecosystems associated with water-rock reactions in ultramafic crust (e.g., Lost City hydrothermal field [28]), and other timely topics. C-DEBI will reach out to continental drilling programs and projects (see sections B and F) and aid in coordinating technology transfer and science integration as appropriate. C-DEBI will provide the logistical, networking, and research support to enable microbiology-led objectives to emerge as leading charges in drilling science. The creation of a center to provide this overarching support role backed by experience and fundamental science is wholly novel.

Emergent new research within Deep Biosphere research. Though our field is inherently interdisciplinary, there are clear absences in the suite of tools and questions in deep biosphere research. For example, questions of evolution in microbiology: the time frame over which the deep subseafloor biosphere operates (geological) and long-term conditions of starvation and isolation of living cells, immediately bring to mind questions of evolution, [29], survival [30], paleobiology [31] and paleosignatures [32] to the forefront. These questions are not being addressed explicitly through existing projects. C-DEBI will support these new directions among current and future members of our community. The impact of this field is dependent on adaptation to new questions about the functionality and consequence of the deep subseafloor biosphere, rather than being only a field of research involved in a “census” of subseafloor life.
C-DEBI Research Themes and Unique Features of the Deep Subseafloor Biosphere.

(a) Background: Subseafloor characterization

The deep subseafloor biosphere falls into two overarching provinces: (i) igneous crust systems (crust); and (ii) sedimentary systems (sediments). Our means of accessing samples and studying these biome end-members differ significantly. For example, drilling in crust is technologically challenging and slow, and as consequence, only a few holes are generally drilled for any project over a limited geographical region. Studies in the crust also use observatories (NP, JDF) as a key research tool (see below). In contrast, sediments can be drilled more easily, and observatories for study of the sedimentary subseafloor biosphere have not yet been used. Sites targeted for sedimentary drilling can also cover an extensive area, and dozens of drill holes can be spudded in a typical 60 day drilling voyage; for example, an area twice as large as North America was traversed for the SPG site-survey cruise in Jan. 2007.

We summarize briefly the objectives for these projects, focusing on topics that relate most directly to our research themes (outlined below). We highlight areas of overlap, synergy, and intersection between projects, and emphasize the natural environmental continuum that exists among them, presenting opportunity for comparisons and broader meaning to be extracted. This distillation of research across projects can only be accomplished via C-DEBI. We focus on hallmark experimental approaches that exemplify the power of project integration, which will enable rapid and transformative advances.

Crust Overview. The JDF ([33] and refs therein), NP ([34] and refs therein), Dorado (e.g.,[12]), and SPG [35] projects represent a continuum of crust habitats, or biomes, with regional-scale environmental parameters (temperature, pH, salinity, oxygenation, hydrological regime) influencing the microbial communities inhabiting them. JDF is the youngest (~3Ma), warmest (~60°C) and most chemically reducing (sulfidic) crustal biome, with these latter properties resulting from heavy sedimentation at the continental margin of the Pacific northwest of the US (sediments act as a thermal insulator) and sluggish fluid flow, resulting in long transport times between inflow and outflow. JDF is the best-studied crust system among all sites (e.g., [8, 10, 36-39]). NP, by contrast, is older (~8 Ma), colder (~15°C), with rapid fluid flow, shorter residence time, and chemically oxidizing conditions [40-43]. Dorado is a seamount that outcrops basement on the Cocos Pacific plate; this seamount is vigorously venting cold water (4°C) from old, sedimented crust (~ 24 Ma) [12]. Finally, the SPG sites include the oldest (~100 Ma) and most oxidized crustal biome on Earth, with O2 penetrating through much of the overlying sediment [44], and with active fluid flow occurring throughout the entire span of crustal ages to be cored (7 Ma to ~100Ma) [35]. This diversity of sites and range of conditions provides ripe opportunity for joint analysis and cross comparisons via C-DEBI.

Sediments Overview. Our knowledge of sedimentary microbial communities, while more extensive compared to crust, is highly skewed towards shallow depths (<1 m) and coastal/continental margin sampling. Collectively, marginal sites are just one small part of the range of sedimentary conditions that exist globally, from extremely low nutrient and carbon regimes to extremely high organic matter regimes. Oligotrophic regimes by area represent the largest sedimentary habitats on Earth. Data available on the microbiology and activity in sediments from continental-margin to open-ocean sites based on ODP Leg 201 sediment coring indicates major distinctions in population size (biomass), structure (taxa), and activity (low), with major consequence to global biogeochemical activities (e.g., [5, 7, 45-48]). C-DEBI will focus on those environments most poorly represented in deep sedimentary subseafloor biosphere studies to-date: the carbon and nutrient starved “open ocean gyres” such as the SPG and the Tropical North Atlantic Gyre (NP sediments). We will compare and contrast these oligotrophic sites from these two separate major ocean basins to address questions about the major drivers in dictating oligotrophic deeply buried sediments in the global Earth system. We will compare these carbon-starved biomes with the distinct environments represented by Guaymas Basin (e.g., [49, 50]), a sediment-covered, organic-rich hydrothermal vent site in the central Gulf of California, characterized by hydrothermal alterations of buried sedimentary organic matter [51], and JDF, a sediment-covered organic-poor hydrothermal vent site.
(b) Specialized Methods for Observatory Science in the Deep Subseafloor Biosphere

Major components of our crust projects rely on subseafloor observatories known as “CORKs”. **CORK observatories**, or “Circulation Obviation Retrofit Kits”, are essentially undersea labs that put hardware and experimental instrument packages into boreholes that are sealed (CORKed) so that **in situ** conditions can develop post-drilling. CORKs have been used for over a decade, but their technology is constantly evolving in response to new needs in the research community and new capabilities in drilling techniques and instrumentation (e.g., recent CORK installations on the JDF: [52]). In ocean crust, solutes and colloids (such as microbes) are transported advectively, principally along fissures, cracks, and pore spaces. Drilling fluids also take this exact path during drilling operations, hence contaminating rock in most regions where microbes are likely to occur indigenously. CORK observatories have been adopted recently by deep subseafloor biosphere researchers (e.g., [53, 54]) because they allow **in situ** conditions to be re-captured post drilling and thereby circumvent some of the contamination problems. Furthermore, the realization by deep subseafloor biosphere researchers that observatories could be used to do **time-series experiments in situ** – coupled with measurements and monitoring – suggests **CORK observatories potentially represent the most powerful and scientifically transformative means of studying the deep subseafloor crust biosphere**. Observatory science in oceanography is well established, for example, the Hawaiian Ocean Time Series (HOTS), and the Bermuda Atlantic Time-series study (BATS) stations, but it is completely new to subseafloor biosphere studies. For example, **in situ** aquifer fluids can be pumped through borehole experiments or to the ocean floor to conduct experiments to examine transport times for fluids and colloids, microbial colonization rates on crustal rocks, and activities of endolithic microbes in the crust. Such studies are essential to answering fundamental questions about microbial life in crust—for example, determination of how large the crustal biome is. The oft-cited paper by Whitman et al.[1] does not consider any life that may exist in crust, either within the fluids or on the surfaces of the porous rock matrix. The opportunities afforded by CORK observatories in the challenging-to-access crust underscore the significant, groundbreaking discoveries that are certain to be made through these projects.

Our industry partner Pettigrew and several of our liaisons at TAMU (Miller) and IODP-MI (Myers) represent our core CORK engineering and science partners. Pettigrew, an engineer, designed and developed all CORKs in use today. Myers supports the development of new tools and technologies for scientific drilling within IODP. Miller manages projects associated with IODP drilling. These are critical partnerships for observatory creation: Over the past 17 years CORK technology has evolved rapidly, requiring upgrades and modifications to previously deployed CORKS. We recognize the need to expand upon the engineering capacity offered by the C-DEBI institutions to develop new tools, sensors, and experiments. We have, for example, engaged the engineering faculty at USC, which has supported underwater acoustics, communications, and robotics programs, to tackle C-DEBI-related related needs for experimental system design. C-DEBI will exploit this collaborative model to explicitly encourage the development of new tools and technology that will be needed for the next generation of CORKed observatories, to answer the next generation of deep biosphere researchers most critical questions.

(c) C-DEBI Research Themes

Our C-DEBI research themes will cut across our projects, providing a common basis for making key comparisons. *This will transform the original scope of each project*—with individualized science objectives and sometimes provincially derived questions—into a truly integrated global-scale scientific mission for understanding the deep subseafloor biosphere. Additionally, these themes provide mechanisms for growth in our investigator base. Some of our participants, such as some of the engineering and genomics researchers, are not associated with any particular site, but may get involved via participation in these themes—and grow the type of scientific questions considered.

Research Theme I. Activity in the deep subseafloor biosphere: function & rates of global biogeochemical processes. Subseafloor microbial processes exert fundamental influence on the biogeochemistry of the ocean and atmosphere. For example, sulfate reduction coupled to metal sulfide (e.g., pyrite) precipitation in sediments is a major sink of sulfate from the world ocean and potentially a significant source of ocean alkalinity on geological timescales (ka to Ma) [55]. Oxidation of organic
carbon leads to a major source of dissolved inorganic carbon (DIC) to the ocean. Because the geographic
distribution of organic carbon degradation as well as sulfate reduction and sulfide precipitation is poorly
quantified, the global effect of these coupled processes is not well known. As another example, water-
rock weathering reactions in the ocean crust impose significant negative feedback on atmospheric CO₂,
accounting for ~30% of the silicate-drawdown globally [56]. Microbes are known to promote these
reactions in the laboratory [57], and at the seafloor [58], but the degree to which they influence these
processes in situ in the subseaflor remains unknown. Through targeted support of research aiming to
quantify geographic distributions of subseaflor sedimentary respiration, rates and magnitude of
microbial crustal alteration, energy sources and carbon flow, C-DEBI will enable robust analyses linking
subseaflor processes to global scales and biogeochemical cycles.

The paradigm of the global carbon cycle, distilled to its most simplistic form, involves the net
balance between photosynthesis and respiration, and what escapes this efficient cycle via export from the
upper ocean to deep marine sediments. As a first-order bookkeeping approach, this paradigm works well
for establishing mass-balances. However, the apparent success of such simplifications does not establish
their adequacy—the magnitude and consequence of a viable and active deep subseaflor biosphere is not
considered at all. We emphasize that this is problematic and not scientifically justified. For example,
states based on the few measurements of respiration rates in the deep sedimentary subseaflor biosphere [5],
by comparison to projected estimates of chemosynthetic primary production in the crust [59], suggest a significant subseaflor carbon cycle, but the balance between production and respiration is
too poorly constrained for solid implications to be inferred. There is also increasing evidence that the
global redox state of the near Earth’s surface (atmosphere, oceans, and upper lithosphere) is unbalanced,
in part influenced by processes in the deep subseaflor biosphere such as ocean crust alteration, with
consequence for the evolution of both the near surface (atmosphere) and deep Earth (upper mantel) [60].

Pore water chemical profiles from sediments in low productivity regions in the SPG, the Dorado
outcrop and sediment filled ponds at the Mid-Atlantic Ridge (NP) suggest a range of diffusive, advective,
and diagenetic influences, including evidence for upward fluid seepage, sea water intrusion and flow
along basaltic aquifers [5, 61]; this “bottom up” supply of electron acceptors—involves paradigm shift in
our understanding of sediment biogeochemistry: Do autotrophic pathways play a much greater role and
mass and energy transfer than is recognized (e.g., [21])? These hypotheses can only be tested explicitly
through comparative studies at the different sites planned via C-DEBI. Further, with information on the
extent, limits and biogeochemical processes occurring in the deep subseaflor biosphere, conceptual
models can be developed and expanded holistically to quantitative models. This will enable true
predictions about the consequence of biogeochemical activity in the deep subseaflor biosphere and the
role microbes play in global sulfur, carbon, and iron cycles.

Research Theme II. Extent of life: biomes and the degree of connectivity (biogeography and
dispersal). We are now aware of the basic fact that there is a deep subseaflor biosphere—intraterrestrial
microbes that appear to represent a significant biosphere in sediments (e.g., [5]) and rock (e.g., [16])
below the bottom of the ocean. How microbes are transported and dispersed in the deep subseaflor
biosphere—the biogeography of microbes—is an open and intriguing problem. Questions concerning
biogeography speak to the most fundamental problems in microbiology (e.g., as discussed in [62, 63]),
and date at least back to the Baas-Becking hypothesis that ‘everything is everywhere, but, the environment
selects’ [64]. The variety of dispersal mechanisms for microbes to deep subseaflor habitats, and the vast
spatial- and time-scales we consider, presents opportunities to address fundamental questions in this field.

As discussed above, it is well documented that tremendous volumes of seawater infiltrate the
crust and hence, seawater is likely a source of inoculum “seeding” subseaflor biomes. The transport time
for fluid to travel through different crustal aquifers varies enormously, as do the physical and chemical
conditions of these fluids and any microbiology they carry [14]. Deep sea sediments remain in exchange
with seawater at their top and bottom layers via the overlying water column and deep crustal aquifers.
What microbes take seed and why? What are the most significant physical and chemical controls of these
colonization processes? How similar or different are the resulting crustal and sedimentary ecosystems
from deep subseaflor ecosystems and from each other? We expect that geochemical and physical site
parameters will shape the patterns of archaeal and bacterial community compositions. Questions relating to biogeography are a cornerstone component of C-DEBI, because it is only through inter-project comparisons that true headway in comparing these ecosystems may be made. Each site and project is an island in and of itself, but when compared with this disparate set of habitats, will coalesce as a global model for biogeography of microbes below the ocean floor.

These examples and others can potentially be tested, and we are working on datasets that test and support specific pathways. For example, the International Census of Marine Microbes (ICoMM) has been supporting the development of datasets for these types of cross comparisons (see http://icomm.mbl.edu/microbis/icomm_status/) among some C-DEBI participants (Biddle, Caron, D’Hondt, Edwards, Huber, Teske). Similar integrative and cross comparative studies will be a major focus of C-DEBI and we emphasize that ultimate resolution of issues relating to transport and biogeography appear to hinge on comparisons between sites: Comparisons between deeply buried sediment communities that are in similar carbon/nutrient regimes and comparisons between ocean crust biomes and the sediments that directly overly them; such as the planned projects at NP and the SPG sites. C-DEBI will specifically enable and foster these cross-comparisons so that critical issues relating to biogeography and dispersal in the deep subseafloor biosphere can be resolved.

**Research Theme III. Limits of life: extremes and norms of carbon, energy, nutrient, temperature, pressure, pH.** What are the factors that fundamentally limit the existence and diversity of life within seafloor sediments and ocean crust? High temperature is probably a critical limitation in many areas, although the impact of temperature on the distribution of life is likely to be convolved with other factors. For example, survival at high temperatures may depend on the capacity of organisms to repair the damage caused by thermal degradation of cellular components [65], so it may be possible for microbes to exist at higher temperatures in environments that supply more metabolic energy than in those where the supply is less. Most seafloor sediments exhibit low thermal gradients (1–30°C per km), but the highest temperature documented for microbial activity to date (~122°C) [66] is exceeded at shallow depths at certain sediment-covered mid-ocean ridges such as the JDF, Okinawa Trough, and Guaymas Basin. Drilling along a temperature gradient in deeply buried, organic rich sediments, such as at Guaymas Basin (where the availability of organic C should not be a limiting factor) will enable questions relating to the thermal limit of life in deeply buried sediments to be addressed empirically.

Low availability of electron donors may limit the distribution of life in the subseafloor within marine sediments. In sediments, buried organic matter from the surface photosynthetic world is the principal source of electron donors (e.g., [5, 67]). Within the SPG, where the burial rate of organic matter is two orders of magnitude lower than in other regions that have previously been explored for life in subseafloor sediments, analyses of shallow cores obtained as part of an NSF-sponsored site survey cruise in 2007 revealed that only $10^3$–$10^4$ cells/m$^3$ survive in shallow sediments [68]. If low organic matter availability ultimately sets a limit to life in marine sediments, active cells may be absent from the deeper sediment column in the SPG.

Different factors are likely to define the ultimate limitation to life in the igneous ocean crust and in marine sediments. Sources of metabolic energy may not be a limiting factor in the ocean crust, as reactions between the reduced ocean crust and circulating fluids may supply chemical energy to support primary carbon fixation in situ (e.g., [59]). One proposed hypothesis is that microbes may be active throughout the upper ocean crust wherever there is active hydrology with temperatures below ~120°C, until the crust undergoes subduction in ocean trenches. In one study supporting this idea, textural and isotopic evidence suggested that microorganisms are active in ocean crust aged over 1000 Ma [69]. However, another study that examined textural features thought to be attributable to microbial activity suggested that the features were established early in the history of the crust (~<10 Ma) and then changed little afterwards [70]. Evidence for the timing of oxidative alteration of the ocean crust, which may support chemosynthetic biological activity, also indicates that most alteration appears to occur early and then slows or ceases as the crust ages [59]. Thus, an alternative hypothesis is that life may be most active early in crustal evolution, and fades out well before subduction. The C-DEBI related projects and field
sites, which span nearly the entire age range of ocean crustal rock, will allow these conflicting possibilities to be directly and explicitly tested.

In addition to field observations, unraveling the limitations on growth and existence in the subseafloor will require contributions from both laboratory and theoretical approaches. For instance, laboratory studies on the rates of chemical reactions and on microbial energy requirements will provide constraints on the balance between the supply and demand of metabolic energy sources in subseafloor environments [26, 71]. Questions about the role of pH and pressure on limiting deep subseafloor communities may similarly be augmented via laboratory investigations. Activities within C-DEBI will bring together scientists working in these different disciplines, providing opportunities to develop new insights into the **defining drivers** that effect the distribution of life in the subseafloor, which will link findings concerning the limits of life to other themes, such as Theme I, the global biogeochemical consequence of the deep subseafloor biosphere, and Theme II, the biogeography of microbes.

**Research Theme IV. Evolution and survival: adaptation, enrichment, and repair.** The subseafloor environments being investigated by C-DEBI present challenges to life that are distinct from most other known Earth habitats. This raises questions of how microbes survive in the face of these challenges, and what evolutionary forces are at work in the deep subseafloor biosphere.

The question of persistence of life from the perspective of metabolic processes and growth can be distilled to the concept of survival at the edge of bioenergetics and redox processes [26]. The metabolic rates proposed for subsurface microbes are up to six orders of magnitude below respiration rates observed in microbial cultures and in environmental microbes in surface sediments [72] and challenge our current understanding of the functioning of life (i.e., having enough energy to maintain charge potential across a cell membrane). Observations of living cells [48] with intact polar membrane lipids [73] leads to the inference that subseafloor sedimentary microbes must persist at extremely low rates of activity per cell. Additionally, studies have shown that the subseafloor hosts extremely unique microbial communities that are distinct from surface habitats [73-75]. Why are these microbial groups so prevalent in the subsurface? Are there distinct adaptations that are common to the subseafloor biosphere?

Since most subsurface microbes are recalcitrant to cultivation, answers to questions about their adaptation, evolution and survival need to be answered through genetic analysis. Genetic-based studies of deep subseafloor biosphere to date have used targeted polymerase-chain reaction (PCR) based approaches to examine phylogenetic genes (e.g., [45]) and on occasion, ribosomal sequencing and analysis has been performed [76]. More rarely, PCR based approaches for looking at functional genes encoding for important biogeochemical processes (methane, iron, etc.) have been targeted (e.g., [77, 78]). However, research concerning questions about survival and evolution in the subseafloor has not yet emerged among the core foci in subseafloor biosphere studies, nor have research approaches that take a broader-scale view of the genetic content of microbes buried beneath the seaﬂoor. We envision Theme IV studies will embrace a compare-and-contrast approach across our C-DEBI field projects examining the total gene content of the deep subseafloor biosphere using metagenomics-based approaches (e.g., [79]). The term “metagenomics” includes a variety of whole-genome approaches such as shot-gun sequencing, i.e., [80], vector-based library tools [81], whole-genome amplifications [82] and other specialized methods.

Our first-glimpse at use of metagenomics in the deep subseafloor biosphere illustrates its potential power for evolutionary questions. As part of the initial “census” of life in subseaﬂoor sediments [1], it has emerged that globally, cell abundances decrease logarithmically with depth [83]. A consequence of this decrease is that with depth, microbes become increasingly isolated from each other, owing to the fact that chemical exchange in sediments is dictated by diffusion, which operates slowly over long length scales. Hence, we may hypothesize that an evolutionary consequence of this increasing isolation may be the loss of genes for functions such as chemotaxis and quorum sensing, which may not be needed as cells become isolated. Indeed, metagenomics surveys of sediments from the Peru Margin do show that genes for chemotaxis decrease with depth [75], hinting that further metagenomics surveys and cross-comparisons may yield exciting new insights on microbial evolution on Earth. Through project integration with C-DEBI, we will be able to integrate and compare these finding with metagenomics.
surveys at other sites, and in distinct biomes. For example, in the crust, where microbes exists in cracks, pores, and crevices through which seawater flows vigorously, there is less of the systematic isolationism with depth. Comparisons across the range of crust and sediments habitats may illuminate evolutionary trends that are a consequence of the increasing isolation of microbial cells. Are there systematic changes in gene content as a function of depth, distance from a spreading center? Do we see similar trends in the oligotrophic SP and NP sediments? Are there significant differences in the ability for viruses and predators to attack between oligotrophic (SPG & NP) and carbon-rich sediments (Guaymas)?

(d) C-DEBI Research Support Mechanisms. Each PI has budgeted support for research costs associated with major components of the three core research projects. Additionally, all senior research personnel laboratories are eligible through the C-DEBI Research Support program to apply for small grants in support of projects relating to C-DEBI research themes. Our C-DEBI program office will manage applications, which involves a two-page summary description of the project and time-frame (1-2 yrs of support). We anticipate supporting >700,000 / yr in research costs, and 300,000 / yr for instrumentation grants (postdoctoctoral, Student, and other C-DEBI support means are discussed below).


This STC Proposal articulates the rationale for the establishment of C-DEBI, which can be summarized as:

Timing: In the history of drilling for scientific research, there has only been one project drilled with deep subseafloor microbiology as the major objective [22]. However, three US-lead and one Japanese-lead project will be drilled before 2013; hence, we stand to fundamentally increase our knowledge and understanding of the deep subseafloor biosphere by at least four-fold in a science-as-usual mode of operation, where individuals and small groups each conduct their own specific science objectives at discrete sites. The alternative mode of operation is the development, in essence, of a collaboratory to accomplish a coordinated mission in deep subseafloor biosphere research, as represented by C-DEBI. C-DEBI will enable integration, coordination, and moreover, the development of international trust between researchers in this fledgling field, for transformative advances in our understanding of one of the largest biomes on Earth.

Maturity: Though our field is new, this community has been working towards center-like modes of operation for years. Other initiatives are on the rise on an international basis. For example, Dr. Bo Barker Jørgensen, the director of the Max-Planck-Institute for Marine Microbiology, is in the process of starting a new center at the University of Aarhus. In this case a physical center is being created, embodied by a moderate sized research faculty that will focus in part on the deep subseafloor biosphere. This and other examples of emerging focus groups for study of the deep biosphere are great assets to the development of our field. However, we present the case that the need for a virtual center, such as C-DEBI represents, is critical to coordinate this international community of researchers. C-DEBI presents the opportunity for the US to lead this international coordination effort, which is warranted at this time given the predominance of the US in leading deep subseafloor IODP proposals in the system today. The meeting we held at Catalina in Feb. 2008 evidences other indications of our readiness for center-level interactions—long prior to this present STC call we were in motion towards achieving this end goal. This is an active, motivated, self-assembling community of researchers, poised to produce high return on a center’s capital investment.

Opportunity: There is a stunning need to educate beyond traditional undergraduate and graduate levels about Earth and Ocean Sciences today. Capturing public attention concerning ocean sciences can be difficult—people are distracted and busy and ocean science is not often the focus in the popular press, even for its critical role in, for example, carbon cycling, climate change, ocean chemistry and energy production. Here we underscore that the “deep-hot biosphere”, even where it is cold, continues to capture imagination and excitement at a level that is rarely seen in ocean sciences—it is the current “wild west” in oceanography. It will not be so forever, if we are successful in our mission; the opportunity to seize this for public education in science and oceanography is NOW.
(D) Education and Human Resource Development Objectives

Overarching Goals.

Our highest priority goal is to create distinctive, targeted education programs at the K-12, undergraduate, graduate and postdoctoral levels in order to train and foster the next generation of deep subseaefloor biosphere researchers. This is first and foremost to ensure the robust continued development of this new field, and to arm the field with the brightest and most creative young minds that can take what has been built over the past decade and greatly expand it in this decade via C-DEBI.

We will create broad based educational opportunities that allow the Center’s newly generated knowledge to thrive, and we will design special programs to provide opportunities for all segments of our society. We are committed to making sure that future scientists are representative of the full diversity of our society. These students will become the next generation of deep subseaefloor biosphere researchers who fully integrate the Center’s tools and technology into their science. Additionally, we must translate knowledge in and of our field to the broader public, in part through our core education program (which will flow to public policy, administration, and other education fields in addition to academic fields)—but also via programs that promote broader dissemination of information and increased awareness to the public about the tremendous fraction of life on Earth that appears to be buried below the seafloor in sediment and rocks. The Research, Education, Knowledge Transfer and Diversity goals for the Center are closely inter-connected to ensure we meet these goals.

The Center’s education and diversity programs are designed not only to improve the educational pipeline (particularly for students from under-represented groups), but also to help form a community of young scholars. Given the Center’s location and contacts in Los Angeles, our K-12 programs place a special emphasis on the disadvantaged students of many different ethnicities and economic levels in the Los Angeles Unified School District and across the country.

K-12 Education.

Our primary goal for K-12 teachers and students is to introduce them to this emerging field of deep subseaefloor biosphere research and encourage them to incorporate this research into their classrooms. We will use the NSF Centers of Ocean Science Education Excellence (COSEE) framework to connect deep subseaefloor biosphere research and our community of scholars (PIs to undergrads) to K-12 science education. For the past seven years, USC has been the home to COSEE-West. One of the key programs in COSEE-West is the teacher-training (TeT) program. COSEE-West develops connections and interactions between cutting edge university research and TeT workshops and training programs through lecture series and in-person and on-line workshops that enhance the teachers’ instruction. We will develop (1) on-line teacher workshops, (2) a series of lectures, (3) on-site teacher training programs, (4) provide grants and “kits” for hands-on modules, and (5) collaborate with the Deep Earth Academy (DEA), which focuses on scientific deep sea drilling, providing numerous avenues for education and outreach (see below).

C-DEBI faculty will work with COSEE-West staff and K-12 teachers to create new lesson plans that explore the topics of our research and link it directly to State Science Standards and the principles of ocean literacy (http://www.collegeofexploration.org/oceanliteracy). C-DEBI will work with COSEE-West to develop and host annual on-line teacher workshops on the deep subseaefloor biosphere. Previous COSEE-West on-line workshops have reached between 100-600 teachers. C-DEBI faculty, postdoctorals, and students will work with COSEE-West staff to develop a series of taped lectures and presentations which will be uploaded to the The College of Exploration (TCOE) web site, home to the COSEE-West online lecture series (http://www.collegeofexploration.org.cosee_west). After the teachers view the presentations, the faculty and graduate students have set times available for the teachers to interact and ask questions on their topics of interest. Teachers may sign up though the Cal State system to receive 1 unit of credit for the workshop. Teacher’s interactions are tracked throughout the experience, so that we may evaluate their participation and follow their progress through pre- and post-workshop evaluations (section F). COSEE-West staff will follow-up with the teachers to evaluate use, and assist in integrating the new information and activities into their classrooms. Local C-DEBI graduate students will be
available to interact with the teachers in their respective regions and will provide additional connections into the teacher’s classroom as part of a College Mentors program where personal connections to students facilitate the likelihood that they will see college as a logical career choice. By knitting our activities into the COSEE-West framework, we will participate in their professional assessment process. Each COSEE center has a formal assessment activity that uses various approaches to document the extent to which the activities have a positive impact on the stated program goals and to guide further improvements.

Our educational programs require both the personal commitments of the PIs and a small investment in funds. The PIs will participate in the lecture process and lesson plan development each year, and we will disseminate this information and solicit input and contributions from our senior researchers and science TT’s. We will ensure that all C-DEBI supported graduate students and postdoctoral students commit to participation in this process, and will encourage broad participation among all graduate and postdoctoral scholars working in C-DEBI laboratories. Each of these lecture modules requires staff support and coordination by COSEE-West staff.

This community of teachers would then be encouraged and made aware of opportunities to participate in on-site teacher training programs at our partner institutions. For example, the University of Hawai‘i’s Astrobiology Laboratory Institute (ALI‘I) for Instructors is a week-long training course for grade 7-12 teachers. The deep subseafloor biosphere is an integral part of the ALI‘I workshop. One of the requirements for admission into this program is a commitment from the teacher to conduct workshops back in their home school district.

For further assistance with implementing lesson plans in their classrooms, we will provide small grants to select teachers who have attended our on-line workshops. Additionally, teachers may apply to receive deep biosphere “kits” that will be developed, including lesson plans and classroom supplies. Many of the technological-based modules require substantial materials, which school systems cannot afford, store or repair.

We will also partner with the Deep Earth Academy, DEA (http://www.deepearthacademy.org), a program of the Consortium for Ocean Leadership (COL) that facilitates and develops activities and materials based on authentic data from shipboard research expeditions to strengthen students’ mathematics, science, and analytical skills for a lifetime of learning. They work to equip K-12, university, and informal educators with materials to teach about the Earth using exploration of the world around us as a model to help students become better decision makers, problem solvers, science-literate citizens, and stewards of our planet. In so doing, DEA will be responsible for coordinating learning activities focused on the scientific processes and outcomes afforded by IODP’s United States drilling vessel and long-time geoscience workhorse, the JOIDES Resolution (JR). These include the new JR web portal (www.joidesresolution.org), live video broadcasting from the ship to school and informal audiences, teachers and educators at sea on every expedition, and the popular shipboard “School of Rock” professional development program for teachers, faculty, and museum educators (http://www.oceanleadership.org/learning/teachers/school_of_rock).

All expedition-based content is made available through the JR website, and much is published and distributed through outreach conducted by School of Rock participants. School of Rock 2009 will be taught in part by UC Santa Cruz C-DEBI Co-PI Andy Fisher and will include IODP deep biosphere themes that can begin to prepare C-DEBI for a long-term partnership. C-DEBI and DEA represent an ideal partnership for each of the C-DEBI IODP deep subseafloor biosphere expeditions. The DEA is poised to facilitate, support, and maximize the efforts of the scientists and educators involved. They are prepared to work with C-DEBI to plan expedition-based programs originating with the JR, including educators at sea, live ship-to-shore events, and School of Rock either aboard the JR or at a C-DEBI partner institution.

In addition to the JR-focused activities at sea that are supported by the DEA, many C-DEBI sea-going research efforts will be mounted in association with our three major projects. Though all site-survey work is now completed, we will use US ships for post-drilling work such as servicing our CORK observatories. In addition, our developmental projects are certain to have site-survey sea-going work in upcoming years. All PIs and many of our C-DEBI investigators actively engage in teacher-at-see
programs. C-DEBI will serve as a networking hub to link these various programs and the products of these activities in with the rest of our K-12 programs.

**Undergraduate Education.**

**Fellowships:** Our activities for undergraduates involve not only classroom education, but hands-on research as well. It is critical for young researchers to become part of the intellectual community of the C-DEBI laboratories and to get a certain amount of ownership of the research and discoveries. To this end, we propose the formation of the “C-DEBI “Deep Scholars” program, available at all levels of undergraduate study. During the Spring and Fall semesters, students will get hands-on experience in faculty laboratories under the mentorship of faculty and graduate students.

Several options will be available to students during the summer months. In addition to USC’s own Summer Undergraduate Fellowship Program (SURF), we will coordinate with several of our partner institutions that already have such programs in place, such as the ten-week summer programs at the University of Rhode Island (Summer Undergraduate Research Fellowships in Oceanography), and the Monterey Bay Aquarium Research Institute. We will digitally unite students across the country to share experiences via teleconferencing and through our Virtual Deep Biosphere Community.

**C-DEBI Inspired Courses:** Key Center faculty have already begun to bring deep subseafloor biosphere research into existing undergraduate courses, primarily through guest lectures. Some key personnel already teach undergraduate courses whose focus is shifting increasingly towards C-DEBI related topics—we estimate that we are currently reaching several hundred undergraduates each year.

At USC, we are creating a new undergraduate summer course in *Deep Marine Genomics and Evolution* (DMGE; linking to our science Theme 4). The course, taught by Drs. John Heidelberg and Eric Webb, will be targeted at underrepresented minority students (discussed further in the Diversity section), and geared towards upper level (junior/senior) undergraduates and Masters level students. This course will be developed based on the structural scaffold of a very successful NIH-funded Genomics Research Experiences for Undergraduates (GREU) program at USC, which has been running for several years. It will be open to 15 diversity students from any academic institution. We will recruit students from our partner institutions, as well as Historically Black Colleges and Universities (HBCU; http://www.ed.gov/about/units/list/whhbcu/edlite-list.html) and other Minority Serving Institutions (MSI’s; http://www.ed.gov/about/offices/list/ocr/edlite-minorityinst.html).

Students will receive an introduction to marine genomics and metagenomics with a special emphasis on their application to the deep subseafloor biosphere, training in the current web-based bioinformatics and genomics tools and an introduction to Perl programming. They will attend weekly seminars featuring presentations from researchers representing a wide range of disciplines in the biological sciences. This course will earn four units of transferable college credit.

This introductory course is designed to provide students with an exposure to basic concepts in microbial genomics and metagenomics as well as provide examples of the application of those concepts to deep-sea microbiology. The web-based bioinformatics and genomics are designed to familiarize the student with a wide variety of available tools for bioinformatics analysis. One of the goals of this section is to enable students to use these tools to their fullest with hands-on interpretation/discussion and experimentation, rather than just using the “default” lecturing settings.

The six-week class is divided between the main USC campus and the USC Wrigley Marine Science Center (WMSC) on Catalina Island. The time on Catalina is critical since it takes both the students and faculty out of the “typical” learning environment and places them in one where there is far more interaction between students, faculty and graduate teaching assistants—this is not only an important first initiation to the structure and atmosphere of graduate school, but a perfect way to build a tight, long-lasting community.

An interactive seminar series will encourage participation of the students to the fullest. The seminar includes reading a recent paper, chosen by the seminar speaker, to provide background to the discussion topic. Prior to the seminar, the students and instructors discuss the paper in a “Journal Club” format. This prepares the students for the seminar with the external speaker; by using this format it is our
hope the students will be empowered to participate in the more formal seminar, as well as giving the
students crucial experience in reading/interpreting scientific articles.

While USC is taking the lead on the formation of this new course, all core institutions are
committed to creating new curricular opportunities at their home institutions for their own students and to
recruiting minority students for the USC program. For example, Fisher plans to newly incorporate C-
DEBI themes into a ground water modeling class (Eart220) at UCSC.

**Graduate Education.**

*Training:* Within their own institutions, each of the PIs has support for training of graduate
students— in total 30 graduate years of support (six per year) are budgeted across the co-PI institutions.
Additionally, all senior personnel laboratories are eligible through the C-DEBI Graduate Fellow Program
to apply for graduate student funding. The application procedure involves a two-page summary
description of the project and time frame (1-2 yrs of support/fellow) and two letters from supporting
faculty, at least one of which must be a C-DEBI investigator. Applications will be reviewed by the
standing steering committee. We anticipate supporting approximately 20 graduates in total between PI
and Senior Investigator labs.

*Courses:* We will work with existing programs to integrate C-DEBI research into graduate
thematic focus courses in which our faculty are heavily engaged. USC C-DEBI faculty (Berelson and
Corsetti) are the co-Directors of the Agouron International GeoBiology course, and many C-DEBI faculty
have been involved as faculty for lectures and other teaching activities for this course. We have a history
of highlighting deep subseaefloor biosphere research via special symposia in this course and will integrate
emergent C-DEBI themes. C-DEBI faculty will work with the organizers of other graduate courses such
as the Hopkins Microbiology Course (lead by C-DEBI faculty Spormann), and the MBL Microbial
Diversity Course (many C-DEBI faculty have/do teach in this course) to incorporate emerging deep
subsurface biosphere research and technology.

As with our undergraduate programs, all key personnel will work to integrate C-DEBI research
into existing graduate courses such as USC’s GEOL 601, Topics in Geobiology.

*Small Grants:* Finally, we will award small research and travel grants (up to $5K) for graduate
students affiliated with the Center. These grants may be used to support research, travel for presenting C-
DEBI research at meetings, or travel exchanges to other partner institutions or institutions that have new
tools and techniques that can be applied to C-DEBI research.

**Postdoctoral Program.**

The C-DEBI Postdoctoral Scholar Program will be an internationally advertised program to bring
postdoctoral researchers into C-DEBI laboratories at US institutions. Our program will allow postdoctoral
scholars to apply to work within any C-DEBI senior investigator laboratory. Postdoctorals that work
between several laboratories will be encouraged to support synergy between laboratories. The application
procedure is identical to the graduate student application described above excepting the addition of a two
page CV for the applicant, and three letters of recommendation in total, one of which must be from the
applicant’s graduate advisor, and one other be the intended C-DEBI sponsor.

**Public Outreach.**

*Lectureship series:* A unique feature of the C-DEBI community is our spatial distribution across
the United States and beyond. While this presents challenges to this community—coordinating projects
and research, for example—it also provides opportunity for public dissemination of knowledge of the
field. We strive not only to reach those already involved in the field, but of equal importance, those who
are not familiar with the complexities and importance of the deep subseaefloor biosphere. We propose
to develop a lecture series that is modeled after the NSF RIDGE 2000 distinguished lecture series
(http://www.ridge2000.org/dls/). Small colleges and universities, particularly ones without existing
science programs, are the targets for these lectures, which are given by RIDGE scientists. Lecturers
prepare two separate presentations: one geared for a scientific audience, and one for the general public,
which is critical for attracting future students into the field. C-DEBI PI’s and scientists will work with
their local regional partners to provide lecture series to small colleges, aquaria and informal science
Museum and Aquaria Exhibitions: Through COSEE-West and the USC Wrigley Institute’s K-12 education programs, we have created excellent partnerships with the Los Angeles County Museum of Natural History, the California Science Center, the Cabrillo Aquarium, the Long Beach Aquarium of the Pacific and the Santa Monica Pier Aquarium. We will build on these connections to create public education opportunities that use the scientific discoveries from C-DEBI to educate the general public. This would come through C-DEBI scientists participating in public lecture series and collaborations on possible displays and educational materials for guests and teachers.

The USC Wrigley Institute has partnered with the USC Division of Animation and Digital Arts (within the School of Cinematic Arts) on a number of science communication projects in the past. We will work with faculty and graduate students to create short animations that will explain the complex subject of life in the deep subseafloor subsurface. These can be distributed over the web and can be incorporated into scientific presentations and displays in museums and aquaria. Similarly, partner institutions will work with their local educational centers. For example UH C-DEBI co-PI will work with education specialist from NASA Astrobiology Institute, the Center for Microbial Oceanography Research and Education, Waikiki Aquarium, and the Bishop Museum. In this way, the displays, animations and other education materials produced via COSEE-West and other C-DEBI member institutions will achieve greatly extended reach.

Science At-Sea Outreach: The deep subseafloor biosphere captures the interest and imagination of the general public in a significant way, exemplified by a recent New York Times blog on “The Intraterrestrials” (http://judson.blogs.nytimes.com/2008/06/10/meet-the-intraterrestrials/). The subsurface biosphere being the source of a NYT blog is notable in and of itself—but the public commentary, which can be viewed in posted responses, is simply amazing. “So, let’s see here... billions of bacteria per ounce of rock, not just surviving but thriving in every imaginable corner and crevice of the ocean floor... exploiting many, unexpected sources of metabolic activity.... and having multiple effects on the chemical and geological composition of the Earth, and even on its magnetic fields....”; and, “it is amazing to know how that “aliens” reach the energy from other sources”; as just a few examples.

C-DEBI seeks to capitalize on this current enthusiasm. USC’s communication director of research communications Carl Marziali will coordinate with communication liaisons at our partner institutions for further dissemination of expedition-based web-content to a broad variety of public scientific outlets, for example science blogs and general science articles featuring C-DEBI research. This will include the JR-expedition focused programs facilitated by the DEA, and other non-JR expeditions associated with C-DEBI research. For example, site-survey and CORK observatory cruises that use other research platforms within the US or abroad.

Edwards and Marziali, in collaboration with C-DEBI participants, recently tested this model of science based on a site survey expedition in the Atlantic for the C-DEBI NP project. This cruise was a German-American collaboration that utilized the German research vessel Maria. S. Merian. USC hosted a NP blog (http://northpondexpedition.usc.edu/) that was authored by Edwards with content and photos from the shipboard science party (including C-DEBI faculty Bach, Biddle, Ferdelman, Schippers, and Ziebis). Marziali worked with a number of other media outlets for additional dissemination of this blog, for example, Scientific American (http://www.sciam.com/blog/60-seconds-in-north-pond/), and the NSF’s new “Science 360” daily news site (http://news.science360.gov/archives/20090223.aspx) which rapidly spread throughout the science media world. Marziali also facilitated a “Behind the Scenes” feature, authored by Edwards, in LiveScience, an online science news wire that feeds MSNBC, Yahoo! and other outlets (http://www.livescience.com/environment/090424-bts-ocean-science.html). This was an unusually successful experiment, attracting significant attention to the deep subseafloor biosphere and the NP project. As with the NYT blog, response comments such as: “I was totally unaware of this aquifer under the ocean. That is something that should be studied for sure”; were common.
(E) Diversity Objectives

C-DEBI Core Diversity Goals.

The Diversity goals for the Center are to: (1) Increase the diversity of participants in all levels of C-DEBI from undergraduate, graduate and post-docs through to participating researchers and staff; (2) educate and work with 50 to 75 teachers each year about C-DEBI research; we will especially target teachers who specifically work within large populations of underrepresented minorities; (3) visit and provide lectures on C-DEBI research programs at 2-3 HBCU/MSI campuses each year; (4) provide a unique educational experience in the form of a special summer course for 15 undergraduates from underrepresented groups each year.

Table 2. Data for C-DEBI PI and Co-PI students completing MS or PhD April 2006 through April 2009.

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USC has a strong commitment to diversity at all levels of the academic community and throughout society. USC, as a private university, continues to promote affirmative action in student recruitment. When USC was named the 1999 Time Magazine College of the Year, it was attributed to USC’s efforts to improve the lives of inner-city youth and to promote diversity across the campus. Gender diversity has improved markedly in recent years, but significant improvements can still be made. USC’s Marine Environmental Biology doctoral Program currently has 39 graduate students, 24 women and 15 men with one African American, one Latino student and one Native American. USC’s Earth Science Program has 54 doctoral students with 24 women, 28 men and one Latino student. C-DEBI’s goals for advancement of women will also benefit from the existence of the USC Women in Science and Engineering program (WiSE). A primary goal of WiSE is to prepare the next generation of women tenure-track faculty in science and engineering disciplines, through a host of creative programs designed to address subtle biases and inequities that hinder women’s career advancement. Working with the math, science, and engineering departments across USC, WiSE matches and augments financial support to women graduate students, encouraging their research, enabling their travel to scientific conferences and meetings, and rewarding their achievements. WiSE will work in synergistic collaboration with C-DEBI to recruit and retain high-quality young women scientists as well as to provide them with versatile career paths.

Even in these times of great economic stress at public universities, UCSC recently created a Chief Diversity Officer position, a new position within the Chancellor's office for coordinating and managing diversity programs at the university. Example programs to foster diversity at UCSC include a program for Academic Excellence (ACE) for Science, Technology, Engineering, and Mathematics (STEM) education, which is designed to foster success among diverse undergraduate populations in large lecture classes. ACCESS is a academic bridge program to facilitate community college students transferring to UCSC. California Alliance for Minority Participation (CAMP) represents a program that puts undergrads in research labs and in the field. California State Summer School for Mathematics and Science (COSMOS) represents four-week summer residential program in education and research that is available to UCSC students. Other examples of programs in place and available to C-DEBI may be found at UCSC’s website (http://www2.ucsc.edu/eeo-aa/).

URI has a breadth of existing multi-pronged programs for enhancing, recruiting, and supporting diversity growth. A prominent example at the undergraduate level is the URI Talent Development Program, which supports students of color and disadvantaged students. URI also hosts a nationally competed URI Summer Undergraduate Research Fellowships in Oceanography (SURFO) Program, which engages students in cutting-edge research directly. On average, women comprise 65 % and

Table 2 presents a compilation of data concerning graduate degree completion from each of the PI and Co-PI institutions.
members of under-represented groups comprise 20 to 25% of the SURFO students. A faculty-initiative is also provided by the NSF-sponsored ADVANCE program, focused on increasing representation and advancement of women in academic science and engineering careers. To enhance the number and quality of minority students in its graduate programs, URI utilizes a wide variety of mechanisms, including dedicated minority student support programs, (New England Board of Higher Education & a Minority Doctoral Scholars Program). In addition, the URI Graduate School participates in New England regional activities to increase retention of minority students.

The UH brings a distinct multicultural learning environment to C-DEBI that is founded on its Hawaiian, Asian, and Pacific orientation and international leadership role. The UH motto is “Above all nations is humanity” and is reflected in the rich ethnic diversity of UH students: 22 percent Caucasian, 16 percent Japanese, 13 percent Filipino, 14 percent Hawaiian or part Hawaiian, five percent Chinese, 12 percent mixed ethnicity, and 18 percent other. The mission of the UH system is to provide quality education and training, to create knowledge through research and scholarship and to contribute to the cultural heritage of the community. UH encourages and fosters higher education for underrepresented groups through programs such as the Kua’ana Student Services, which facilitates entry of Native Hawaiians into UH (tutors, peer support, financial aid workshops). The Office of Multicultural Student Services provides employment, training and educational support to UH students who intend to tutor and advise minority-dominated public school students, and actively recruits ethnic minorities to apply for admission to UH. The Office of Student Equity, Excellence and Diversity also coordinates efforts to support students with disabilities, Native Hawaiians and ethnic groups, and women underrepresented in higher education. In further support of the educational goals of C-DEBI and is described in UH cost share support for a minority graduate student.

Given the many remote villages and towns in Alaska, many of which are located along the extensive coastline and support subsistence populations, in 1969 UAF developed a Rural Service Center, which is committed to responding to student needs by providing quality services to Native and rural students in the pursuit of higher education and its opportunities, and more recently UAF opened the Office of Multi-Cultural Affairs. UAF’s commitment to academic and vocational education and outreach that promote workforce preparation, economic development, life-long learning, and community development through Alaska, with an emphasis on Alaska Natives and underserved communities, is the focus of six satellite campuses that geographically serve nearly two-thirds of the state, representing more than 160 primarily Native Alaska communities, and state-or-the-art distant learning programs and technology. Other programs related to C-DEBI include the Alaska Native Science and Engineering Program, a STEM program, and the Alaska Experimental Program to Stimulate Competitive Research.

C-DEBI, its faculty, and all participating institutions are firmly committed to improving diversity at all levels of research and education and we are all committed to implementing innovative and effective programs so that C-DEBI is seen as a model for other Centers and institutions. The diversity objectives will be accomplished through an intensive effort to reach out to underrepresented minority groups through a variety of targeted activities outlined below.

K-12 Programs.

Our K-12 program is centered on reaching teachers and informal educators at aquaria and science centers through on-line workshops and lecture series. In past teacher workshops sponsored by COSEE-West, we have had up to 30% participation by minority teachers (COSEE-West NSF Annual Reports). Most of the local districts within the Los Angeles Unified School District (LAUSD) are minority-serving schools with a predominantly Latino/Hispanic majority (73.7% in 2007-2008), as well as significant populations of African Americans (10.9%). COSEE-West manages a list serve, Oceannlist, with 660 participants nationwide and uses Scuttlebutt from the National Marine Educators Association (NMEA) to announce activities and opportunities for teachers and informal educators to participate in. We will work closely with the recently established COSEE Diversity Working Group of the COSEE Council to develop mechanisms to effectively reach and engage minority teachers as well as those who teach in minority serving districts. The COSEE-West program will support three
Hispanic/Latino teachers to attend the National Marine Educator’s Association meeting in Monterey this summer, and C-DEBI will likewise support travel scholarships for minority teachers to attend annual meetings and present activities where appropriate. C-DEBI partner institutions will work to facilitate participation of teachers from minority-serving schools in local COSEE-West teacher workshops; for example, most Hawaii schools serve students of Native Hawaiian and other Pacific Island communities.

We will also promote C-DEBI research and programs at the Society for Advancement of Chicanos and Native Americans in Science (SACNAS) annual meetings through participation and presentations at the meeting by C-DEBI faculty, students and education and diversity staff (http://www.sacnas.org/). USC faculty representatives from earth science and marine biology, with a COSEE Council representative, have participated in this meeting for the last several years in order to engage the SACNAS community. SACNAS represents an excellent venue to recruit students, faculty, and teachers to the C-DEBI programs.

**Undergraduate.**

**Undergraduate Summer Program:** Dr. Steve Finkel (USC) has created an education program for traditionally underrepresented minorities in the fields of genetics, computational biology and molecular biology. As described in the Education Section, Drs. John Heidelberg and Eric Webb will be modeling their introduction to microbial genomics and evolution summer course, *Deep Marine Genomics and Evolution*, on this very successful program.

The six-week course will be composed of five diverse students from USC and ten diverse students from other institutions across the country. Recruitment for the course will be via a number of methods: (1) Through USC’s partnership with SACNAS, we will post announcements on their website and send announcements via email to their 20,000 members through their “e-nouncement” system. (2) Though a booth at the annual SANCAS conference, (3) through on-campus minority clubs, (4) by providing C-DEBI faculty with an advertising slide to add to presentations, and (5) by email distribution by C-DEBI faculty and minority serving institutions. Stipend support is included in this program.

Student participants will have a unique introduction to the C-DEBI community. Because half of the course is at the USC Wrigley Marine Science Center on Catalina Island, students will get to know their instructors (both the main instructors and visiting lecturers, many of whom will be diverse) in a different way than the standard classroom. By learning and living together, the students will be much more engaged in the Center’s activities, and with the participating graduate students and faculty. Those students enrolled at USC or partner institutions will be invited to participate in the C-DEBI Deep Scholars program for undergraduates so that they may continue their involvement throughout the school year.

To reach an even larger pool of underrepresented students, 3-4 instructors will be invited from California community colleges to evaluate how much of the Center approach and content can migrate into community college courses and to explore mechanisms for taking the excitement of our faculty and students and bringing it to these students. Under-represented minorities dominate community colleges in most of California and the science programs in these schools play key roles in determining if their students choose to continue in science at a 4-year institution.

**Graduate Students.**

To both recruit and retain minority students in our Ph.D. programs, we are offering two-year Student Research Assistantships each year. Our hope is that we can use these fellowships as recruiting tools particularly for underrepresented students – the fellowships will allow the students to focus on their own dissertation research early in their graduate studies. Our undergraduate programs will be used as active recruiting tools for underrepresented groups to C-DEBI institutions and research. USC, UCSC, URI, UH and UAF all offer University wide competitive graduate fellowships for incoming minority students each year – these will also be available for C-DEBI recruited students.

Recruitment of C-DEBI graduate students for these fellowships will be via a number of methods similar to those used to attract undergraduates: (1) Through partnership with SACNAS, we will post announcements on their website and send announcements via email to their 20,000 members through their “e-nouncement” system. (2) Though a booth at the annual SANCAS conference. (3) by providing C-DEBI faculty with an advertising slide to add to presentations, and (4) by wide email distribution by C-
DEBI faculty to minority serving institutions as well as visiting and presenting C-DEBI research at HBCU’s, MSI’s, and other minority serving institutions.

**Postdoctorals & Faculty Advancement: A C-DEBI Focus on Women in Science.**

Our fellowship program will take special measures to ensure advertisement and recruitment of underrepresented groups, through broadly disseminated canvassing and advertisement both through traditional media (e.g., advertisement in ASM’s Microbe magazine, postings on our websites) and some of the aforementioned avenues used for graduate recruitment where they apply. In addition, **C-DEBI will specifically emphasize career advancement for women in science, and recruitment of women into deep subseafloor research and ocean sciences generally.** The transitions from student to postdoctoral, and from postdoctoral to faculty/career scientist are well documented “attrition points” for young women, especially in the natural sciences and engineering. We will provide numerous opportunities at all levels for women to advance into leadership roles in our science committee’s. This commitment is evidenced in the leadership roles women are playing in this center: Edwards (Director), Biddle (Asst. Prof.; postdoctoral program committee), Ziebis (Asst. Prof; TT leader), Huber (Asst. Sci; SciCom member and meeting co-organizer), K. Heidelberg (Asst. Prof. and SciCom member), and Rogers (Asst. Prof.; meeting aid). Hence, C-DEBI features six women at different career stages in influential positions. Commitment by the PI’s, to advancing women in the sciences, and **C-DEBI wide commitment to this objective** is also evidenced by ongoing recruitment and mentoring in our laboratories (Fig. 2).

From the PI’s laboratory in recent years, three women postdoctorals and one female Ph.D. graduate have been placed in competitive faculty positions at Harvard Univ., Univ. of MN, Univ. of DE, and the Marine Biological Laboratory. Postdoctoral Orcutt will soon transition from Edwards’ lab to a competitive position in Jørgensen’s new Center at Aarhus (discussed above). Of these women, two (Chan and Toner) were recruited to deep-sea research from outside fields (terrestrial aquatic geomicrobiology and soil chemistry, respectively), and now in initiating their own laboratories have a major focus on deep sea/subseafloor biosphere research. **C-DEBI faculty include 10 women at the Assistant Professor (or equivalent) career stage and 17 total women across C-DEBI (35% of senior participants in the US).** With these levels of women participation across all career stages, C-DEBI will serve as a “career incubator”, supporting the career development of female postdoctorals and the current cadre of young women faculty through career advancement to senior faculty positions. The community building that will be fostered by creation of C-DEBI will help ensure advancement successes and increased diversity in the sciences and engineering.
(F) Knowledge Transfer Objectives

We have three knowledge transfer objectives: (1) training and fostering a diverse new community of deep subseafloor biosphere researchers with an emphasis on building an expertise base in young scientists; (2) communicating exciting results and new frontiers of research pertaining to the deep subseafloor biosphere to the broader public and education communities; and (3) information sharing concerning strategies to conduct C-DEBI-related research within national funding agencies and the IODP structures. Methods that will be used to achieve these objectives are described below (for (2), many of specific programs and methods for education and outreach are described in section D).

Research Exchanges: Promoting student-postdoctoral-faculty interactions and fostering collaborative intra- and inter-university research. C-DEBI will facilitate scientific coordination and collaborations by supporting student, postdoctoral, and faculty exchanges to build, educate and train the deep subseafloor biosphere research community. Exchanges will establish direct linkages among groups within individual institutions participating countries, which are intended to result in a well-connected community and the development of future deep subseafloor biosphere researchers and leaders. Exchanges will allow a C-DEBI researcher (student /postdoctoral /faculty) to spend 1-6 months at a participating C-DEBI host laboratory to carry out experiments, use analytical equipment, learn a new tool, and/or join a research cruise. C-DEBI participants have embraced the concept of hosting research exchanges (e.g., sample structure presented in Table 3). Exchanges may operate between any willing C-DEBI collaborating laboratories. Financial support for exchanges through C-DEBI will be ~50% of the total cost. Matching funds would be required, for example, a travel award from any program that supports student awards in this way (e.g., Geological Society of America, NASA Lewis and Clark fellowships), or by other means, such as matching support from the researcher’s institution or from a postdoctoral supervisor. We anticipate ~10 awards of $0.5K-5k will be granted annually. Applications will be managed by our C-DEBI program office, reviewed by the SciCom and ExCom, and awarded annually. A complete application will consists of: (1) a two-page research proposal, which outlines the intended objective and anticipated outcome of a research exchange; (2) a one-page budget outlining expected costs of the exchange as well as other sources of funds which will be used to support the exchange; (3) two letters of support (4) a one-page CV; and (5) a confirmation of financial commitment for the matching funds. Recipients of the exchange awards will be required to present their findings at the subsequent annual C-DEBI meeting. In addition, they will prepare a short summary of their exchange experience for display on the C-DEBI website. Acknowledgement of NSF and C-DEBI support is mandatory in all associated oral and poster presentations and publications.

Phone Conferencing: Phone conferencing will be a major mode of routine communication among C-DEBI groups. ExCom and SciCom will have regularly scheduled phone conferences, both independently and jointly. TT leaders and ExCom will phone conference ~ quarterly. The subjects of these conferences will vary from administrative to science planning. TT are the major mechanism of scientific exchange between the diverse C-DEBI communities and are anticipated to be our principal science incubator. TT’s will have monthly to bi-monthly phone conferences in order to discuss plans, progress, obstacles, other coordination and knowledge transfer issues. Additional TT ad-hoc groups will be formed for specific tasks (TAPs – see section B). Members

| Table 3. Examples of exchanges for this program – expertise and collaborations². |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| **Expertise**   | **Geochemistry** | **Geobiology**  | **Molecular Bio** | **Theory & models** | **Field Work**  |                  |
| **Technique**   |                 |                 |                  |                  |                 |                  |
| Lipids | Culturing | Sequencing | Energetics | CORKS |                 |                  |
| Isotopes | Activity rates | Metagenomics | Hydrogeology | Expenditions |                 |                  |
| Microsensors | Experiments | Quantification | Reactions | Equipment |                 |                  |
| OSMOs | Microscopy | FISH | Modeling | Site Surveys |                 |                  |
| C-DEBI members |                 |                 |                  |                  |                 |                  |
| K. Hinrichs | H. Cypionka | J. Huber | E. Shook | G. Wheat |                 |                  |
| O. Rouxel | W. Zicbis | J. Heidelberg | A. Fisher | A. Teske |                 |                  |
| T. Fereidman | M. Schrenk | F. Inagaki | W. Bach | S. D'Hontld |                 |                  |
| B. Occott | K. Edwards | A. Schippers | T. McCollem | J. Cohen |                 |                  |

² representative examples only; see information on our full C-DEBI community and projects/experience from our personnel listing and biosketches.
of the DEBI community (Bach, Becker, Cowen, Edwards, Fisher, Girguis, Glazer, Huber, Schrenk, Orcutt, Pettigrew, and Wheat) have demonstrated the successful utility of this mode of information transfer and decision making: For example, we have a standing CORK advisory group (TAP-like) group that has phone-conferences monthly (since Feb. 08, coordinated by Orcutt) to aid with development of CORKed observatories for the NP and JDF sites. Similar TAPs are envisioned to develop from the TT’s for other technical, logistical, or scientific needs. Teleconferences will be organized by a C-DEBI postdoctoral fellow using freely available online meeting planning and teleconferencing software—a model that has worked well for use for the CORK TAP. This allows the postdoctoral fellow to gain practical experience in organizing and managing conferences, and it also serves to foster collaboration, communication, and integration of young scientists into complex science projects.

**Videoconferencing.** Videoconferencing will be an integral component of C-DEBI’s objective to spread information amongst our geographically widespread participating institutions. We will host monthly virtual meetings/videoconferencing for science presentations from our TTs (rotating between themes), modeled after the successful NASA Astrobiology Institute Seminar Series concept, of which many of us have participated. Video seminars will focus on research results and activities of C-DEBI teams among the partner institutions. These seminars may also include invited talks, graduate student and summer student presentations and workshop plenaries to encourage interdisciplinary collaboration of those involved in deep subseafloor biosphere research. To engage the larger deep subseafloor biosphere community, the seminars and their closing question and discussion sessions will be recorded for public viewing on the website. Adobe Connect will be used for web conferencing and desktop sharing between meeting participants at their home institutions. USC manages an Adobe Acrobat server, which can be accessed with Adobe Flash via the internet (at http://breeze.usc.edu) for real-time visual and audio communication; image, text and video exchange; annotation; notes and more.

**C-DEBI Website, Cyber-infrastructure:** In collaboration with the USC Southern California Earthquake Center (SCEC) in Earth Sciences and TCOE liaisons, Tina Bishop and Peter Tuddenham, C-DEBI will develop and maintain a website for public access and data sharing among the C-DEBI research community. SCEC has been developing cyber-infrastructure for this center for well over a decade, and will serve as a model of website structure and function (http://www.scec.org/). TCOE will partner with C-DEBI in order to develop the architecture for our online communities for collaboration and learning for two principal objectives: 1) to support the connection among scientists and others in the C-DEBI project research community and 2) to foster the connections between C-DEBI scientists and educators through the online learning workshop program (section D). TCOE will provide an online project collaborative environment, a virtual C-DEBI Center, in which C-DEBI scientists, committee members, project leaders and others have the opportunity to dialogue in a private, password protected online space in an asynchronous format, with options for synchronous (real-time) exchange as desired. This will serve as an online meeting hub for collaboration, information and data exchange, planning, learning, and joint decision making for C-DEBI partners spread out across geographic distance. This would help the project meet its goal of supporting the C-DEBI collaborative framework for new and existing research projects.

In addition, cyber-infrastructure and databases are a well-established component of the IODP and its predecessor programs for facilitating coordination of complex logistical and technological aspects of deep subseafloor biosphere research. While the information and resources are pre-existing in many cases, navigating the IODP system is not always easy, particular for the unacquainted. The C-DEBI website can serve as a facilitating agent to the broader community, for example, by collating deep subseafloor biosphere proposals and communication among proponents and IODP committees on our C-DEBI website, and providing “tools” resources pages that are specific to deep subseafloor biosphere research.

**Meetings:** The field of deep subseafloor biosphere research is young; hence, in addition to phone and videoconferencing, direct interaction between our members is crucial for success. Five annual meetings are planned beginning in 2009 with funds from the DEBI RCN (discussed above). Meetings will be held at various locations, each organized by a local host and science team (with other local aids TBD), supervised by J. Amend (Table 4). Three-day meetings will have equal time for science
conferencing and a training workshop. Topics covered will span the range embodied within C-DEBI discussed in this proposal; year 5 we plan a joint marine-continental integration meeting. By 2013, we anticipate that then current needs for coordinating that science will dictate the future science themes and potential locations for meeting (2013- meeting topics TBD).

**Industry, National Lab, Drilling Partner & Liaison Coordination:** Wheat will lead efforts to ensure that our industry and drilling partner institutions are involved in C-DEBI activities and promote critical knowledge transfer among the organizations. This includes overseeing TAP development and facilitating the appropriate partner or liaisons involvement. For example, Industry Partner Pettigrew’s involvement in the CORK TAP conferencing is facilitated by Wheat. Some C-DEBI meeting topics are also appropriate for engaging partners and liaisons. IODP-MI liaison Greg Myers, in his capacity as engineering manager, will attend the Hawaii DEBI-RCN meeting (Table 4).

Edwards will serve as principal contact for our national laboratory partners at the ALS, with whom we have been developing methods for analysis of deep sea and subseafloor samples. Brandy Toner and Edwards are writing a proposal (June 2009) for long term “program” for the beamlines we use. This would result in a resident block of time at the ALS each year for us that we could in part be used to do “test” analysis for C-DEBI (users from any country can apply for instrument time).

**Education Evaluation Program.**

Formal evaluation of our program will help fine-tune the experiences for participants, maximize impact, and ensure knowledge transfer to our intended audiences. Follow-up contacts with participants will measure the impact of the program, months and in some cases, years later. Table 5 outlines the proposed evaluation plan for this multifaceted education program (to be conducted by B. Rabin; see section B).

<table>
<thead>
<tr>
<th>Component</th>
<th>Method</th>
<th>Evaluation Questions</th>
</tr>
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</table>
| K-12 Online Teacher Workshops | Pre/post online survey | - What have the participants learned?  
- How has the experience changed attitudes toward the content?  
- What were the most/least effective aspects of the training?  
- What are the main suggestions for improving the program? |
| K-12 Online Teacher Workshops | Online survey | - How have teachers used the material into their classrooms?  
- Are there differences in usage/satisfaction grade levels?  
- What are the main suggestions for improving the program? |
| C-DEBI Scholars | Online or paper survey at the end of the school year | - What aspects of the program worked best/least well?  
- In what ways do students think the program will impact them?  
- What suggestions do students have for improving the program? |
| C-DEBI Scholars | One-time retrospective online survey after 5 years | - What are participants doing now, career-wise?  
- In what ways did the program influence their career choices?  
- How do they see the program helping them in the future? |
| Deep Marine Genomics & Evolution | Paper survey at the end of the summer | - What aspects of the program worked best/least well?  
- In what ways do students think the program will impact them?  
- What suggestions do students have for improving the program, with specific attention paid to URM issues? |
| Deep Marine Genomics & Evolution | One-time retrospective online survey after 5 years | - What are participants doing now, career-wise?  
- In what ways did the program influence their career choices?  
- How do they see the program helping them in the future? |
| Graduate Student Funding | Paper or online survey of PI | - How has the student contributed to the field?  
- What presentations has the student given in the calendar year?  
- What papers has the student published in the calendar year?  
- What is the student’s next career move? |
| Postdoctoral Scholars | Paper or online survey of primary supervisor | - How has the postdoc contributed to the field?  
- What presentations has the postdoc given in the calendar year?  
- What papers has the postdoc published in the calendar year?  
- What is the postdoc’s next career move? |

All evaluation projects include questionnaire development in conjunction with the STC administrative and ExCom teams, data collection and online survey programming /monitoring where applicable, analysis of both qualitative and quantitative data, an executive summary of results, and complete data (for C-DEBI, NSF, and the EAC).


45. Teske, A., Microbial community composition in deep marine subsurface sediments of leg 201: Results from sequencing surveys and cultivations, in Leg 201 Scientific results. 2005, Ocean Drilling Program: College Station, TX.


Biosketch

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(a) Professional Preparation:
   i) The Ohio State University, Geology, B.S. (1994)
   ii) University of Wisconsin, Geochemistry, M.S. (1996)
   iii) University of Wisconsin, Geomicrobiology, Ph.D. (1999)

(b) Appointments:
   Associate Professor: Department of Earth Sciences (since May 2007), Univ. So. California
   Associate Professor: Department of Biological Sciences, Marine Environmental Biology Division, Univ. So. California (since July 2006)

(c) Publications (out of 50 published or in press):

   5 Papers most relevant to proposed work:


5 other significant publications:


(d) Synergistic Activities (5 example activities)

- I have given interactive presentations in elementary schools across the country (Massachusetts, Ohio, and California) to K-4th grade 11 times in the past 3 years.
- I taught one week of lectures as faculty in the Chilean “Austral Summer Institute” course in Benthic Geology and Microbiology, Dichato, Chile (Jan/Feb 2006)
- Faculty lecturer in the USC “Geobiology” course (annually since 2006) and the MBL “Microbial Diversity Course” (2000-2006)

(e) Collaborators and Other Affiliations (not at USC, and not part of this project)

B. Bailey (NASA Ames), D. Bazylinski (UNLV), K. Cassiotti (WHOI), M. Charette (WHOI), R. Egli (UNM), S. Fakra (ALS), C. German (WHOI), P. Girguis (Harvard), B. Glazer (UH), K. Hinrichs (Bremen), J. Huber (MBL), H. Jannasch (MBARI), M. Jetten (Netherlands), K. Kranunz (Harvard), K. Kroeger (USGS), W. Leavitt (Harvard), S. Manganini (WHOI), B. Moskowitz (UNM), C. Moyer (WWU), F., A. Sessions (CalTech), W. Shanks (USGS), E. Sholkovitz (WHOI), M. Sogin (MBL), H. Staudigel (Scripps), M. Strous (Netherlands) B. Tebo (OHSU), A. Templeton (UCB), H. Villinger (Bremen), R. Wirth (Potsdam)

(f) Graduate Advisors and Postdoctoral Sponsors:

Dr. John W. Valley University of Wisconsin) and Dr. Jillian F. Banfield (Univeristy of Wisconsin)

(g) Graduate student (total #:9) & Postdoctoral (total #: 11) supervision:

- **Current Postdoctorals**: B. Orcutt, 4/07-; J. Sylvan, 2/08-; N. Klab, 4/08-; S. Bennett, 4/09-
- **Former Postdoctorals**: C. Chan, 2/06 – 1/09 (Asst. Prof., U Del 1/09), B. Toner 6/05–12/07 (Asst. Prof., U Minn.); A. Dhillon (M. Sogin, prin. sponsor, Res. Assoc., Tuffs), 11/03–3/06; O. Rouxel, 12/03–4/05 (Asst. Sci., Marine Chem. & Geochem, WHOI); B. Van Mooy, 12/03–5/03 (Asst. Sci., WHOI, D. Repeta, prin. sponsor); A. Pearson, 7/00-8/01 (Assoc. Prof., Harvard); S. Petsch, 11/99-7/02 (Asst. Prof., U MA Amherst)
- **Current Ph.D. Students** A. Turner (1st yr., Earth Science [ES]), E. Singer (1st yr, ES), G. Horn (2nd year, Marine Environmental Biology [MEB]); R. Barco (1st year, MEB); **Former Students**: C. Santelli (Ph.D. May, 2007, MIT/WHOI); S. Simmons (Ph.D. May, 2006, MIT/WHOI), P. Canovas (M.S. March, 2006 (MIT/WHOI), D. Rogers (9/04-7/06 MIT/WHOI), E. Banning (9/04-7/06 MIT/WHOI)

(h) Experience relevant to this project:

- Co-Director of the NSF-sponsored DEBI RCN (Research Coordination Network).
- Lead Proponent on IODP proposal 677-Full “North Pond Atlantic Microbiology” Deep Biosphere Project
- Chief Scientist: R/V Melville 10-2006 Loihi seamount, HA. Collection of rocks, fluids, mats, and in-situ reaction materials.
- R/V Atlantis (11-2004) Collection of rocks, fluids, in-situ reaction materials at EPR 9°N.
Bio-sketch for James P. Cowen

JAMES P. COWEN
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(a) Professional Preparation
   i) University of California, Santa Barbara, Environmental Biology, B.A. (1973)
   ii) University of California, Santa Barbara, Biology, M.A. (1976)
   iii) University of California, Santa Cruz, Biology (Oceanography), Ph.D. (1983)

(b) Appointments:
   2007-2008    Associate Chair, Department of Oceanography
   2006-Present Division Head, Marine Geology and Geochemistry
   1998-Present Research Professor, Department of Oceanography
   1991-1998    Associate Research Professor, Department of Oceanography
   1990-1991    Associate Research Geochemist, Hawaii Institute of Geophysics, UH
   1986-1990    Assistant Research Geochemist, Hawaii Institute of Geophysics, UH
   1984-1985    National Research Council Research Associate, NOAA, PMEL, Seattle

(c) Publications (out of 73 published or in press)

   5 Papers most relevant to proposed work:

   1. Lam, T.Y.P., J.P. Cowen, B. Popp and R. Jones (2008) Microbial NH₃ oxidation and enhanced N-cycling in

      Pettigrew, T. L., Meldrum, R., Macdonald, R., Nielsen, M., Fisk, M., Cowen, J., Bach, W. and
      observatories for hydrogeologic and related experiments, IODP Expedition 301, eastern flank of Juan
      Station, TX (Integrated Ocean Drilling Program).*

      Microbiology* 155/7: 497-506


      (2003). Branched aliphatic alkanes with quaternary substituted carbon atoms in modern and ancient
      geologic samples. *Proceedings of the National Academy of Sciences* (PNAS) 100, no. 22, 12554-
      12558.

   5 other significant publications:

      Methane, manganese and methane isotopic composition in hydrothermal plumes following volcanic eruptions on
      the East Pacific Rise near 9°50’ N. *Geochem, Geophys, Geosyst* (G3) 9, 15 pages.


      *FEMS Microbiology and Ecology* 47, 191-206.


(d) Synergistic Activities (5 example activities; in addition to Grad and Undergrad. instruction)
- Organized an outreach-oriented Symposium on "Life in the extreme: The deep biosphere's influence on global processes"; AAAS 2009 Conf., Chicago, IL; February 12-16, 2009
- Organize "Teacher at Sea" outreach opportunities associated with NSF research projects
- Classroom (K-6th grade) talks and demonstrations, including 'Ship-to-Classroom' email/web/video-conf projects
- Serve as yearly Hawaiian Science and Engineering Fair Judge; Host/Moderator of high school Annual Student Symposium;
- Co-organize and lecture at Winter School for Astrobiology (international, graduate students)

(e) Collaborators and Other Affiliations (not at UH and not part of this project)
E.T. Baker (PMEL), K. Becker (RSMAS), K. Bruland (UCSC), B. Burd (DFO-CA), D. Butterfield (PMEL-UW), R. Dziak (OSU), C. Fisher (PSU), D. Fornari (WHOI), C. German (WHOI), S. Giovannoni (OSU), P. Girguis (Harvard), J. Huber (MBL), H.P. Johnson (UW), R. Jones (PSU), F. Kenig (UI-Chicago), J.W. Lavelle (PMEL), T. Shank (WHOI), R.E. Thomson (DFO-CA), C. Winn (HPU).

(f) Graduate Advisors and Postdoctoral Sponsors:
Thesis Advisor: Dr. Michael Neushal (UCSB)
Dissertation Advisor: Dr. Kenneth Bruland (UCSC)

(f) Graduate student and Postdoctoral supervision:
Postdoctorals: Brain Glazer, M. Bertram, Laura Pietra-Galvez
Current Grad Students: Huei-Ting Lin, M. Matzinger, S. Jungbluth, C. Daniels,

(g) Experience relevant to this project:
- Participated in over 40 research cruises (18 HOV/ROV cruises); Chief/Co-chief Scientist on 19
- US Advisory Committee for Scientific Ocean Drilling (IODP) (2006 to present)
- Deputy Director, UH-NASA Astrobiology Institute
- Proponent on the IODP proposals 545-Full (Tracer Transport Project)
- Lead PI on Microbial Observatory: Microbial Ecology of Ocean Basement Aquifers (JdFR CORKs)
- Co-PI on Tracer Transport (IODP-CORK) and North Pond Microbiology grants.
- Associate Editor, JGR—Biogeochemistry
STEVEN D’HONDT  
Professor  
Graduate School of Oceanography  
University of Rhode Island  
Narragansett, RI 02882

(a) Professional Preparation  
i) Stanford University, Geology, B.S. (1984)  

(b) Appointments  
Professor, University of Rhode Island (URI) (since June 2000), Graduate School of Oceanography (GSO)  
Associate Professor, URI, GSO (July 1995 - June 2000)  
Assistant Professor, URI, GSO (October 1989 - June 1995)

(c) Publications (ten of 60 peer-reviewed publications)  

(d) Recent Synergistic Activities (2005-present)  
• Teaching Service: Co-Coordinator of the 2008 URI Honors Colloquium, People and Planet: Global Environmental Change (http://www.uri.edu/hc). Developed and lead interdisciplinary courses on Biological Control of Ocean Chemistry (with R. Robinson and Spivack, 2006), Life in the Universe (with Spivack, 2005-2008), and Marine Stratigraphy (2005).

• Formal Community Service: (a) Co-Chair, Subsurface Life Task Force, Integrated Ocean Drilling Program (IODP) Management International (2007-present); (b) IODP Science Planning Committee (2002-2003, 2007-2008); (c) Co-Chair, Workshop on Exploring the Deep Biosphere with the IODP, sponsored by IODP and Joint Oceanographic Institutions; (d) Executive Council, NASA Astrobiology Institute (2001-2006); (e) Editorial Board, Astrobiology (2003-present).

(e) Collaborators and Other Affiliations (past 48 months, not at URI and not part of this project)
L.J. Abrams (UNC-Wilmington, M.A. Arthur (Penn State), H. Coxall (Cardiff U., U.K.) R. Harris (OSU), Jens Kallmeyer (U. Potsdam, Germany), L. Kump (Penn State), A. Riccardi (Penn State), M. Sogin (MBL), A. Teske (UNC-Chapel Hill), G. Wang (Xiamen U.), J.C. Zachos (UC-Santa Cruz).

(f) Graduate Advisors and Postdoctoral Sponsors:
• Thesis advisor: Gerta Keller (Princeton University)

(g) Graduate Students and Post-Doctoral (total 4) supervision:
• Current Graduate Students: Emily Walsh, M.S. candidate, Heather Schrum, Ph.D. candidate (co-advised with A.J. Spivack). Former Students: Carly Blair, M.S. 2007 (Ad sales; Subbacultcha); Guizhi Wang, Ph.D., 2007 (co-advised with A.J. Spivack) (Asst. Prof., Xiamen U.); Bonnie Epstein, Ph.D. 1999 (Programs & Exhibits, New England Aquarium); Scott Rutherford, Ph.D., 1999 (Asst. Prof., Roger Williams U.); Danielle Luttenberg, M.S., 1997 (Oceanographer, I.M. Systems Group); Dania Whitaker, M.S., 1996 (Lecturer, Bryant U.).


(h) Experience relevant to this project:
• Lead Proponent of IODP proposal 662-Full (Life beneath the seafloor of the South Pacific gyre). Ranked a Tier 1 project and ready to schedule for drilling.

• Lead Proponent of IODP Ancillary Program Letter 739 (Microbial respiration, biomass and community composition in subseafloor sediment of the very high-productivity Bering Sea). Scheduled for drilling in July-August, 2009.

• Chief Scientist, Oceanographic control and global distributions of subseafloor life and activity, RV Knorr (inaugural scientific voyage of WHOI deep piston-coring facility), Costa Rica-Hawaii, Jan-Feb 2009, sponsored by NSF-OCE (BIO).

• Chief Scientist, Knox-02RR, subsurface life survey expedition, South Pacific gyre, Dec 2006-Jan 2007, sponsored by NSF-ODP.

• Lead Proponent and Co-Chief Scientist of ODP Leg 201 (2002, the first and, so far, only ocean drilling expedition dedicated to study of subsurface life).

• Director of the URI Geobiology Laboratory (2004-present).

• Co-proponent of successful NSF LExEn proposal to develop and outfit the shipboard microbiology laboratory on the JOIDES Resolution (1999-2000).
Andrew T. Fisher

Earth and Planetary Sciences Department, A209  
University of California, Santa Cruz  
1156 High Street  
Santa Cruz, CA 95064  
(831) 459-5598 (direct)  
(831) 459-4089 (main office)  
(831) 459-3074 (fax)  
afisher@ucsc.edu

Education:
Stanford University  Geology    B.S  1984  
University of Miami  Marine Geology and Geophysics  Ph.D.  1989

Appointments:
2003- Professor  Department of Earth and Planetary Sciences, UCSC;  
(Iaffiliated with Depts. of Environmental Studies,  
Applied Math and Statistics, Ocean Sciences, and  
Environmental Toxicology)
1999-03 Associate Professor: Department of Earth Sciences, UCSC  
1995-99 Assistant Professor: Department of Earth Sciences, UCSC  
1994-95 Graduate Faculty: Department of Geological Sciences, Indiana University  
1993-95 Associate Scientist: Department of Geological Sciences and Indiana  
Geological Survey  
1993 Visiting Assistant Professor: Department of Geophysics  
Texas A & M University  
1989-93 Adjunct Assistant Professor: Department of Geophysics  
Texas A & M University  
1989-93 Staff Scientist: Ocean Drilling Program, Texas A & M University  

Five recent references related to proposed research (‘student or former student co-author):
Silver, E., Surprisingly-large heat and fluid fluxes driven through mid-plate outcrops on 21–23 Ma  

Fisher, A. T., Becker, K., Davis, E. E., Borehole-to-borehole hydrologic response across 2.4 km in the  
upper oceanic crust: implications for crustal scale properties, J. Geophys. Res., 113,  

A., "Bodzin, R., Villinger, H., Abrupt thermal transition reveals hydrothermal boundary and role of  

Hydrothermal circulation across 50 km on a young ridge flank: the role of seamounts in guiding recharge  

recharge and discharge guided by basement outcrops on 0.2-3.6 Ma seafloor east of the Juan de Fuca  
Ridge: observations and numerical models. Geochemistry, Geophysics, Geosystems, 7, Q07O02,  
Five other recent references (*student or former student co-author): 


Selected Synergistic Activities and Honors:
- Teaches courses in Hydrology, Groundwater, Geologic Principles, and Groundwater Modeling
- Member of technical advisory committees (volunteer) for Soquel Creek Water District, Pajaro Valley Water Management Agency, County of Santa Cruz Resource Conservation Service, Monterey County Water Resources Agency
- Supervised 30 undergraduate researchers during 2000-08, including seven REU scholars; UCSC Earth Sciences Department undergraduate faculty advisor, 1998-2001; graduate advisor: 2005-08
- Thirty-five invited presentations during 2000-07, including seven to non-scientific groups
- Seven oceanographic expeditions as chief or co-chief scientist, eight ocean drilling expeditions
- Fellow of the Geological Society of America; JOI-USSSSP Distinguished Lecturer; NSF-RIDGE Distinguished Lecturer

Collaborators in last 48 months:
Becker, K. (U Miami); Bekins, B. (USGS), Clark, J. (UCSB); Constantz, J. (USGS); Cowen, J. (U Hawaii); Deshon, H. (University of Memphis); Davis, E. E. (PGC); Gable, C.W. (LANL); Edwards, K. (USC); Harris, R.N. (OSU); Johnson, H. P., (UW), Los Huertos, M. (CSUMB); Pfender, M. (Federal Institute for Geosciences and Natural Resources); Ruppel, C. (USGS); Silver, E.A. (UCSC); Speiss, V. (University of Bremen); Stein, C. (University of Illinois Chicago); Villinger, H. (University of Bremen); Von Herzen, R.P. (WHOI); Wang, K. (Pacific Geoscience Center); Zuehlsdorff, L. (Norsar, Norway)

Graduate Advisor of co-PI:
Becker, K. (University of Miami)

Graduate Advisrees of co-PI (as primary advisor, total: 18):
Calla Schmidt, Andrew Racz, Tess Russo, Priya Ganguli, Christine Hatch (Ph. D., 2007; UNR), Mike Hutnak (Ph. D., 2007; USGS), Robert Sigler (M.S., 2007; CSUMB), Aaron Powers (M.S., 2007; Neilson Consulting), Greg Stemler (M.S., 2005, Geomatrix, Inc.), Chris Ruehl (M.S., 2004; UCSC), Patrice Friedmann (M.S., 2003: Marina Coast Water District), Glenn Spinelli (Ph.D., 2002; NMT), Emily Giambalvo (Ph.D., 2001; Sandia), Joshua Stein (Ph.D., 2000; Sandia), Danielle Widemann (M.S., 2000, Sonoma County School District), Jonathan Lear (M.S., 2000; Balance Hydrologics), Jon Erskine (M.S., 1998; Northgate Consultants)

Post-doctoral Researchers supervised by co-PI (total: 1):
Cherkaoui, A. (2000-02; Sodexho), Stauffer, P. (1999; LANL)
CHARLES GEOFFREY WHEAT
Research Professor
University of Alaska Fairbanks
Global Undersea Research Unit
School of Fisheries and Ocean Sciences
PO Box 475
Moss Landing, CA 95039

(a) Professional Preparation:
   ii) University of Washington, Oceanography, M.S. (1986)
       Thesis Advisor: Dr. Roy Carpenter
   iii) University of Washington, Oceanography, Ph.D. (1990)
       Thesis Advisor: Dr. Russ McDuff

(b) Appointments:
2004- Research Professor University of Alaska Fairbanks
1999- Adjunct Scientist Monterey Bay Aquarium Research Institute
1995- Affiliate Graduate Faculty University of Hawaii
1994- Regional Coordinator West Coast and Polar Regions Undersea
   Research Center (NURP)
1999-2004 Research Associate Professor University of Alaska Fairbanks
1999 Visiting Professor Université Paul Sabatier, Toulouse, France
1994-99 Research Assistant Professor University of Alaska Fairbanks
1993-95 Research Assistant Professor University of Hawaii
1993-95 Marine Coordinator (SOEST) University of Hawaii
1991-93 Post-Doctoral Fellow University of Hawaii

(c) Publications (out of 62 published or in press):

5 Papers most relevant to proposed work:


5 other significant publications:


(d) Synergistic Activities (5 example activities)
- I have given interactive hands-on presentations and technological activities to K-8th grade. These activities are being developed into web-based modules for broader distribution.
- We are developing new means for preserving microbial samples using continuous fluid samples (OsmoSamplers).
- We have developed a new fluid sampler for collecting hydrothermal fluids in a sterile container. The samplers were tested in 2008 and will be provided to the community in 2009 for collection of low temperature <150°C hydrothermal fluids from the Lau Back-arc Spreading Center.
- I have mentored students as part of NSF's Research Experience for Undergraduates (REU) Program, MATE's Intern Program, and MBARI's Summer Intern Program.
- Each of the past 5 years I have taken teachers (K-12) to sea. I also have taken NSF officials and writers to sea.

(e) Collaborators and Other Affiliations
K. Becker (U Miami), E. Davis (PGC, Canada ), K, Edwards (USC), P Girguis (Harvard), D. Kelley (U WA); J. Seewald (WHOI), M. Tivey (WHOI)

Graduate Advisor: Russell E. McDuff (U WA) Postdoc. Advisor: Michael J. Mottl (U HI)

(f) Graduate student (total: 3) & Postdoctoral supervision:
- Former Students: Becker (Ph.D.), Friedmann (M.S.), Gharib (Ph.D.), none of these are in academia.
- Current Students: Hulme (Ph. D.)

(g) Experience relevant to this project:
- I have participated on 59 cruises of which 36 included a submersible or ROV component.
- I have been Chief Scientist or Co-Chief Scientist on 22 sea-going expeditions.
- I have participated on 3 ODP-IODP drilling expeditions with a CORK component and have participated on a dozen CORK-related post-drilling expeditions.
- I have work on elucidating processes associated with low temperature hydrothermal systems for the past 20 years.
- I helped form and continue to help direct the RETINA program (http://retina.engr.scu.edu/), which is a program that bring scientists and engineers together to solve scientific questions through the development of technological solutions.
Biographical Sketch of Jeffrey C. Alt

Contact Information
Jeffrey C. Alt
Research Scientist
The University of Michigan
Department of Geological Sciences
1100 N. University
Ann Arbor MI 48109-1005
Tel: (734) 764-8380
Fax: 734-763-4690
Email: jalt@umich.edu

Professional Preparation
Undergraduate Education:
The University of Michigan Geology and Mineralogy B.S. 1975

Graduate Education:
The University of Miami, RSMAS Marine Geology and Geophysics M.S. 1981
The University of Miami, RSMAS Marine Geology and Geophysics PhD 1984

Postdoctoral Institutions:

Appointments
Research Scientist Dept. Geological Sciences, The University of Michigan, 1998-present
Visiting Professor Institut de Geologie, Universite Louis Pasteur, Strasbourg, France, 1996
Senior Research Scientist Washington University in St. Louis, 1987-1989
Research Scientist Washington University in St. Louis, 1985-1987

Publications
Selected Related Publications:

Selected Unrelated Publications:

Synergistic Activities
Utilize data from recent NSF-supported research on ODP Hole 1256D and the subsurface biosphere in oceanic basement in Marine Geology courses at Michigan, 2007-2009
Instructor for short course on low-grade metamorphism, Basel, Switzerland, 1999.
Invited speaker/participant JOI/ILP Hydrogeology conference, UC Santa Cruz, 1999.

Collaborators & Other Affiliations
Collaborators and Co-Editors (not affiliated with this project):
Wolfgang Bach (Bremen);
Rosalind Coggon (Imperial College, London);
Laura Crispini (Genoa);
Rod Ewing (Michigan);
Laura Gaggero (Genoa);
Carlos Garrido (Granada);
Sumio Miyashita (Niigata);
Shuhei Ono (Carnegie Inst.);
Olivier Rouxel (WHOI);
W.C. Shanks (USGS);
Paola Tartarotti (Milan);
Damon Teagle (NOC, Southampton);
Alexandra Turchyn (Cambridge);
Susumu Umino (Kanazawa);
Doug Wilson (UCSB).

Graduate and Postdoctoral Advisors:
Jose Honnorez: Departement de Geologie, Universite Louis Pasteur, Strasbourg, France (Retired)
Rodey Batiza: National Science Foundation, (Marine Geology and Geophysics), Arlington, VA

Thesis Advisor and Postgraduate-Scholar Sponsor:
Post Doctorals (4): Damon Teagle (NOC, Southampton); Anna Martini (Amherst); Rosalind Coggon (Imperial College, London); Alexandra Turchyn (U. Cambridge)
Graduate Students (1 as thesis advisor): Susan Alford (M.S.) (Committee member for 12 other students)
Biosketch

JAN P. AMEND
Associate Professor
Washington University
Department of Earth and Planetary Sciences
Environmental Studies Program
Division of Biology and Biomedical Sciences
McDonnell Center for the Space Sciences
St. Louis, MO 63130

(a) Professional Preparation
University of California, San Diego  Chemistry/Earth Science  B.A. 1987
University of California, Berkeley  Geology  Ph.D. 1995
University of Palermo, Italy (Postdoc)  Geochemistry  1995-1996
University of Washington (Postdoc)  Microbiology  1996-1997
Washington University (Postdoc)  Microbial Geochemistry  1997-1999

(b) Appointments
Associate Professor, Department of Earth and Planetary Sciences, Washington University, St. Louis (since July 1, 2005)
Director, Environmental Studies Program, Washington University, St. Louis (since July 1, 2005)
Assistant Professor, Department of Earth and Planetary Sciences, Washington University, St. Louis, (July 1, 1999 – June 30, 2005)
Member of the Division of Biology and Biomedical Sciences, Washington University (since 2001)
Faculty Fellow, McDonnell Center for the Space Sciences, Washington University (since 2003)

(c) Publications (out of 44 published or in press)
5 recent papers most relevant to the proposed project

5 other significant publications


(d) Synergistic Activities (5 example activities)

Member of the University City Science Advisory Committee (UCSAC), a group of local scientists committed to enhancing science education in the local, University City school district (K-12), which consists predominantly of low income families (since 2006).

Education Sub-committee Chair of Environmental Education and Research Working Group (EERWG), a Washington University (Chancellor’s Office) initiative to advance and improve all environmental issues on campus and in the local community (since 2005).

Member of the National Research Council Committees on the Origin and Evolution of Life (COEL) and NASA’s Astrobiology Strategy for the Exploration of Mars (since 2005). Panelist for Graduate School Information Forum, aimed at senior undergraduates at Washington University planning to attend graduate school, and Panelist for forum on ‘How to get a faculty/research job’, aimed at senior graduate students and post-docs at Washington University going on the job market (2005). Curriculum Committee member charged with designing the Environmental Studies Program (~100 majors), Washington University (2002-2003).

(e) Collaborators and other Affiliations (not at WUSTL, and not part of this project)


(f) Graduate student and Postdoctoral supervision:


(g) Experience relevant to this project (example activities)

- **Co-Director** (with Katrina Edwards, USC) of the NSF-sponsored DEBI RCN (Research Coordination Network)
- Project Leader of shallow-sea hydrothermal system research in the Aeolian Islands, Italy (ship-based and SCUBA-based field work in ’96, ’99, ’01, ’03, ’07, ’08)
- **Co-Investigator** of shallow-sea hydrothermal system research in Papua New Guinea (ship-based and SCUBA-based field work in ’03 and ’05)
- Participant of continental hot spring research in Yellowstone National Park (field work in ’97, ’99, ’00, ’01, ’04, ’06)
Biographical Sketch of Wolfgang Bach

Contact Information
Geoscience Department
University of Bremen
Klagenfurter Str., 28359 Bremen, Germany
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Fax: +49-421-218-65400
Email: wbach@uni-bremen.de

Professional Preparation
Undergraduate Education:
University of Giessen
Geology and Mineralogy
Diploma (~M.S.) 1991

Graduate Education:
University of Giessen
Geochemistry
Ph.D. 1996

Postdoctoral Institutions:
Woods Hole Oceanographic Inst.
Dept. of Geology and Geophysics
10/1996-05/1999

Appointments
Professor
University of Bremen (since 10/2005)
Associate Sci.
Woods Hole Oceanographic Inst. (05/2003-09/2005)
Assistant Sci.
Woods Hole Oceanographic Inst. (05/1999-05/2003)

Publications
Selected Related Publications:

Selected Unrelated Publications:
Synergistic Activities

- Co-convener of the ECORD Summer School “Geodynamics of Mid-Ocean Ridges”
- Co-chair of Steering Committee IODP New Ventures in Exploring Scientific Targets (2008-2009)
- Member of IODP Science Steering and Evaluation Panel (2003-2005)
- Presentations on Deep-Sea Hydrothermal Systems in elementary schools
- Lectures in ECORD, RIDGE and InterRidge short courses and summer schools

Collaborators & Other Affiliations

Collaborators and Co-Editors:
Jeff Alt (U Mich), Jaime Barnes (U New Mexico), Henry Dick (WHOI), Carlos Garrido (U Granada), Susan Humphris (WHOI), Benoit Ildefonse (U Montpellier), Adam Kent (Oregon State U), Hidenori Kumagai (JAMSTEC), Graham Layne (U St.John), Kentaro Nakamura (U Tokyo), Yaoling Niu (U Durham), Jörn Peckmann (U Bremen), Bernhard Peucker-Ehrenbrink (WHOI), Jeff Seewald (WHOI), Pat Shanks (USGS), Zach Sharp (U New Mexico), Damon Teagle (NOC Southhampton), Meg Tivey (WHOI), Heiner Villinger (U Bremen)

Graduate and Postdoctoral Advisors:
Graduate Advisor: Jörg Erzinger
Postdoctoral Advisor: Susan Humphris

Thesis Advisor (total: 10) and Postgraduate-Scholar Sponsor (total: 4):
Current Postdoctorals: Niels Jöns (10/2007-)
Former Postdoctorals: Neil Banerjee (U Edmonton), Martin Rosner (BAM)
Current PhD Students: Frieder Klein, Michael Hentscher, Dominik Niedermeier, Svenja Rausch, Liping Shu, Jörn Tonnius
Former Graduate Students: Cara Santelli (Ph.D. MIT/WHOI, 05/2007), Paul Craddock(Ph.D. MIT/WHOI, 09/2008), Peter Canovas (M.S., MIT/WHOI, 03/2006)
KEIR BECKER

Address: Division of Marine Geology & Geophysics, University of Miami, Miami, FL 33149

Professional Preparation:
Harvard College  Physical Sciences, cum laude,  A.B.,  1975
University of California, Scripps Institution of Oceanography, Oceanography,  Ph.D.,  1981

Appointments:
Professor, RSMAS - MGG, University of Miami, 1994-present
Associate Professor, RSMAS - MGG, University of Miami, 1987-1994
Assistant Professor, RSMAS - MGG, University of Miami, 1985-1987

Five Most Relevant Publications Since 2000


Five Other Significant Publications Since 2000

Synergistic Activities:

A. Scientific Expeditions since 1990 (* = Chief or Co-Chief Scientist):
(Prior to 1991: DSDP Legs 70, 78B, 83, 92; ODP Legs 102, 109, 111*, 118)
1991  ODP Legs 137 *, 139; Atlantis II 125-32
1993  ODP Leg 148; Atlantis II 129-5; Atlantis II 131-4 *
1994  Atlantis II 131-18; ODP Leg 158
1995  Atlantis II 132-10 *; ODPNAUT I *
1996  ODP Leg 168
1997  ODP Leg 174B *; Atlantis 3-8 *
1998  ODPNAUT II *
1999  Atlantis 3-39 *
2000  ODP Leg 190, Revelle Nalu01, Atlantis 3-55 *
2001  ODP Leg 196 *, Revelle Drift03 *
2002  JAMSTEC Kairei KR02-10, Atlantis 7-25 *
2003  JAMSTEC Kairei KR03-05
2004  JAMSTEC Yokosuka YK04-05, IODP Expedition 301
2005  Atlantis 11-32 *
2006  Atlantis 15-10 *
2007  Atlantis 15-23 *
2008  Atlantis 15-35

B. National/International Committee Service since 2000
NAS/NRC Committee on Seafloor Observatories, 1999-2000
Chairman, JOIDES Science Committee and Operations Committee, 2001-2003
NAS/NRC Committee on Future Needs in Deep Submergence Science, 2003
IODP Science Planning Committee (SPC), 2003-2007 (Vice-chair, 2004-2005)
Chairman, IODP Science Planning Committee, 2005-2007
IODP Science Advisory Structure Executive Committee (SASEC), 2006-2007, 2008-
ORION Science and Technology Advisory Committee (STAC), 2005-2007
WHOI/NSF Replacement HROV Oversight Committee (RHOC), 2005-2008
NSF-OCE Integrative Programs Section Committee of Visitors, 2008

C. Co-Convener/Steering Committee, CORK Workshops
Advanced CORK Workshop, two parts: San Diego Dec 1997/College St. Feb1998
CORK mini-workshop, DC, May 2004
NanTroSEIZE CORK mini-workshop, Yokosuka, October 2004
NanTroSEIZE Observatory Workshop, Tokyo, November 2007

Collaborators Within Last 48 Months: E.E. Davis (Geological Survey of Canada), A.T. Fisher
(UC Santa Cruz), H. Jannasch (MBARI), M. Kastner (Scripps Inst. Oceanography), M. Kinoshita
(JAMSTEC), C.G. Wheat (U. of Alaska).

Graduate Advisors: L. Dorman and V. Vacquier (UC, Scripps Institution of Oceanography)

Ph. D. Graduates: A. T. Fisher and G. Iturrino (total: 2)
Post-Doctoral Fellows Supervised: R. Harris (total: 1)
**William M. Berelson**
Professor
Department of Earth Sciences
University of Southern California
Los Angeles, CA  90089-0740
(213) 740-5828; berelson@usc.edu

(a) Professional Preparation:

i) University of Rochester,  Geology   B.A.   (1977)
ii) Duke University,  Geology   M.S.   (1979)
iii) U. Southern California,  Geochemistry   Ph.D.   (1985)

(b) Appointments:

Professor: Dept. Earth Sciences (Since Aug. 2008) University of Southern California
Associate Professor: Dept. Earth Sciences (2004-2008) U. of Southern California
Research Associate Professor: Dept. Earth Sciences (1996-2004) USC
Research Assistant Professor: Dept. Earth Sciences (1988-1995) USC
Post-doc: 1985-1987 University of Southern California

(c) Publications (out of 72):

5 Papers most relevant to proposed work:


Harrison, B. K., H. Zhang, W. Berelson and V. Orphan (2008) Variations in archaeal and bacterial diversity associated with the sulfate-methane transition zone in continental margin sediments (Santa Barbara Basin, CA) (Accepted: Applied and Environmental Microbiology)


5 other significant publications:


(d) Synergistic Activities (5 example activities)
- Co-Director/Instructor-International GeoBiology Summer course on Catalina Island; sponsored by Agouron Institute and USC Wrigley Institute for Environmental Studies. A 6-week class taught by various instructors with 20 students from an international pool of applicants. This intensive course involved lectures, labs, field trips and independent research for advanced graduate and post-doctoral students.
- I sponsored and presented a symposium on Geobiology at the last two SACNAS (Society for Advancement of Chicanos and Native American Scientists) conferences.
- I’ve taught ‘Crisis of a Planet’, an environmental geology course to 240 undergraduate students. This course included a weekly lab and a field trip in which a polluted lake was sampled for water chemistry and sediment properties.
- I also teach ‘Intro Oceanography’ to USC undergraduates and various graduate courses.
- I have worked as a volunteer for the Ocean Sciences Bowl, and event for high school students who compete to represent their school nationally by answering ocean-related questions and am sponsoring an intern program for local high school students.

(e) Collaborators and Other Affiliations (not at USC, and not part of this project):
M. Alperin (UNC), B. Balch (Bigelow), S. Dixit (LBNL), D. Feely (PMEL), D. Hammond (USC-PhD advisor), D. Herron (Duke, MS-advisor), J. McManus (OSU), V. Orphan (Caltech), R. Najjar (PSU), C. Sabine (PMEL), F. Sansone (U. Hawaii), D. Sigman (Princeton)

Graduate Advisors and Postdoctoral Supervisors:
- M.S. Thesis Advisor: Dr. Duncan Heron (Duke)
- Ph.D. Thesis Advisor: Dr. Douglas Hammond (USC)
- Post Doctoral Sponsor: Dr. Douglas Hammond (USC)

(f) Graduate student & Postdoctoral supervision:
- Current Postdoctorals: M. Prokopenko, 10/08-
14 PhD Graduate students advised, 3 MS students advised, 1 as major advisor
Biographical Sketch: JOAN M. BERNHARD

Department of Geology & Geophysics
Woods Hole Oceanographic Institution, MS 52
Woods Hole, MA 02543
Telephone: 508-289-3480
Fax: 508-457-2076
E-mail: jbernhard@whoi.edu

PROFESSIONAL PREPARATION:

<table>
<thead>
<tr>
<th>Institution</th>
<th>Major / Area</th>
<th>Degree, Year</th>
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<tbody>
<tr>
<td>Colgate University</td>
<td>Geology (High Honors)</td>
<td>B.A. cum laude, 1982</td>
</tr>
<tr>
<td>University of California, Davis</td>
<td>Geology</td>
<td>M.S., 1984</td>
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<td>Thesis advisor: Jere H. Lipps</td>
</tr>
<tr>
<td>University of California, San Diego</td>
<td>Oceanography</td>
<td>Ph.D., 1990</td>
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<td>Dissertation advisor: Robert R. Hessler</td>
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<tr>
<td>Wadsworth Center (NYSDOH)</td>
<td>Cell Biology</td>
<td>Postdoc; 1990-92; 1993-94</td>
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<td>Postdoctoral advisor: Samuel S. Bowser</td>
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<tr>
<td>University of Oslo</td>
<td>Benthic Ecology</td>
<td>Fulbright Scholar: 8/92-3/93</td>
</tr>
</tbody>
</table>

APPOINTMENTS:

2004-Present Tenured Associate Scientist, Woods Hole Oceanographic Institution
1996-1997 Research Scientist II, Wadsworth Center, New York State Dept. of Health
1994-1997 Assistant Prof., Dept. Biomedical Sci., University at Albany, State Univ. NY
1994-1996 Research Scientist I, Wadsworth Center, New York State Dept. of Health
1993-1994 Research Affiliate II, Wadsworth Center, New York State Dept. of Health
1992 Fulbright Fellow, University of Oslo
1990-1992 Research Affiliate I, Wadsworth Center, New York State Dept. of Health

RELEVANT PUBLICATIONS (5 of 57 total peer-reviewed publications):

OTHER SIGNIFICANT PUBLICATIONS (5):

SYNERGISTIC ACTIVITIES:
1) Development of meiofaunal/microbial life position method (FLEC), foraminiferal viability method using fluorogenic probes, and method to distinguish pre-experimental foraminiferal calcite from calcite formed during experiments.
2) Supervisor for 1-2 female and male undergraduates per year in independent (but supervised) research (including oceanographic cruise participation).
3) Current editorial service: Journal of Foraminiferal Research (Associate Editor, 2000 to present); Marine Micropaleontology (member, Editorial Board; 2004-present).
4) Board of Directors, Cushman Foundation for Foraminiferal Research, 2004-present; Vice President, Cushman Foundation for Foraminiferal Research, 2009.
5) In 2005-2006, Keynote/Plenary speaker at Geological Soc. of London (paleo-proxy meeting, 10/05), Forams 2006 International Conf. on Foraminifera (Natal, Brazil, 9/06)

COLLABORATORS (past 4 yr; excludes WHOI personnel): A Ammons (TAMU), J Baguley (UN Reno), JP Barry (MBARI), W Berelson (U So Cal), SS Bowser (Wadsworth), KR Buck (MBARI), GT Chandler (USC), J Deming (UW), R Douglas (U So Cal), K Edwards (U So Cal), E Escobar Briones, H Filipsson (U Lund), J Gieskes (SIO), ST Goldstein (UGA), A Graham (U Hawaii), A Habura (Wadsworth), R Haedrick (Memorial), P Hallock (USF), D Hammond (U So Cal), C Hintz (USC), S Jeon (Northeastern), J Kennett (UCSB), BS Leander (UBC), LA Levin (Scripps), J Martin (U Fl), J McManus (Or State), GF Mendoza (SIO), P Montagna (TAMU), C Nunnally (TAMU), M Prokopenko (Princeton), A Rathburn (Ind State), G Rowe (TAMU), F Sansone (U Hawaii), B Sen Gupta (LSU), TJ Shaw (USC), L Stott (U So Cal), R Summons (MIT), A Teske (UNC), P Visscher (U Conn), C Wei (TAMU), M Wicksten (TAMU), N Yubuki (UBC)
Current Postdoctorals: A. McIntyre-Wressnig, 5/08-, M. First, 9/08. Former Postdoctorals: H. Filipsson (Asst Prof (equivalent), Univ Lund), C. Hintz (Asst. Prof, Savannah State Univ, TJ Shaw, prin. sponsor)
Current Ph.D. Students: S. Lincoln (MIT, Committee Member), J. Lessaigne (LSU, Committee Member) Undergraduates: USC Honor’s Thesis advisor (E Kaneff, C Robinson, P Murphy); WHOI SSF: D Williams, E Mollo-Christensen, N Eisenkolb; MS Students: D Volz (USC), J Blanks (USC); PhD Students: M Williams (Wadsworth), CJ Hintz (USC), M First (U Georgia)
4 Post Doctorals advised, participated on committees of 5 PhD students

Experience relevant to this project:
• Proponent on IODP proposal 677-Full “North Pond Atlantic Microbiology” Deep Biosphere Project
• Co-PI with Edwards on funded NSF grant to develop CARD-FISH-FLEC
• Co-PI on pending NSF proposal to study deep-biosphere eukaryotes (with A Teske and V Edgcomb)
• Chief Scientist on 15 research cruises and participant on 29 other research cruises, including four DSRV Alvin dives to date; two cruises using ROV Tiburon (MBARI), ROV Jason cruise 7/07, ROV Hyperdolphin (JAMSTEC) 6/08.
Jennifer F. Biddle

College of Marine and Earth Sciences
University of Delaware
700 Pilottown Road
Lewes, DE 19958

Tel: (314)-360-4899
Fax: (302)-645-4028
Email: jfbiddle@udel.edu

Professional Preparation
i) Rutgers University, New Brunswick, NJ, Biotechnology, B.S. 1999
ii) Pennsylvania State University, University Park, PA, Biochemistry and Molecular Biology, PhD, 2006.

Appointments
Adjunct Professor (since Sept. 2009) University of Delaware, College of Marine and Earth Sciences, Lewes, DE
Postdoctoral Fellow (since Apr. 2009) University of North Carolina at Chapel Hill, Department of Marine Science, Chapel Hill, NC
NASA Postdoctoral Fellow (2007-2009) University of North Carolina at Chapel Hill, Department of Marine Science, Chapel Hill, NC
Postdoctoral Fellow (2006-2007) Pennsylvania State University, Department of Geosciences, University Park, PA

Five publications relevant to proposed work


Other publications


Synergistic Activities
- Reviewer for Lewis and Clark Fund for Field Research in Astrobiology (2009)
- Reviewer for ISME Journal, Environmental Microbiology and Geobiology
- Speaker for AbSciCon (2007)
- Co-Author of licensed curriculum "Life on other planets: the search for ET" (2007)
- Facilitated workshops for K-4 and 5-8 students, PSGC (2004)
• Astrobiology Educator Workshop Facilitator, PSGC (2002-2004)
• Shorebased scientific party, ODP Leg 201 (2002)
• Research cruises: 2007 R/V Cape Hatteras, Gulf of Mexico, 2008 R/V Atlantis (with Alvin), Guaymas Basin, 2009 R/V MSM Merian

Collaborators
Marc Alperin (University of North Carolina at Chapel Hill)
Carol Arnosti (University of North Carolina at Chapel Hill)
Antje Boetius (Max Planck Institute for Marine Microbiology)
Virginia Edgcomb (Woods Hole Oceanographic Institution)
Kai-Uwe Hinrichs (University of Bremen)
Christopher House (Penn State University)
Sue Huse (Marine Biological Laboratory)
Katrin Knittel (Max Planck Institute for Marine Microbiology)
Mitch Sogin (Marine Biological Laboratory)
Ramunas Stepanauskas (Bigelow Marine Laboratory)

Graduate and Postdoctoral Advisors:
Jean Brenchley, Department of Biochemistry and Molecular Biology, Pennsylvania State University
Christopher House, Department of Geosciences, Pennsylvania State University
Andreas Teske, Department of Marine Science, University of North Carolina at Chapel Hill

Students co-advised within the past two years:
Zena Cardman, Sara Underwood, Vincent Klokman, Charles Martin (UNC undergraduates); Luke McKay (UNC grad student); Mandi Martino (Penn State grad student); Moshe Rhodes (Penn State grad student); Thomas Roberts (Penn State undergraduate)

Other Affiliations
Center for Environmental Genomics, University of Delaware
Biographical Sketch:  RUTH ELAINE BLAKE

Mail:  Yale University, Department of Geology and Geophysics, P.O. Box 208109
       New Haven, CT 06520-8109
E-mail: ruth.blake@yale.edu  Tel:  (203) 432-3191   Fax:  (203) 432-3134

A.  Professional Preparation
Wayne State University  Geology  B.S., Magna Cum Laude  1987
University of Texas  Geology  M.S.  1992
University of Michigan  Geology  Ph.D.  1997
Marine Biological Laboratory, Woods Hole, MA, Microbial Diversity Course  2000

B.  Academic & Professional Appointments
2009-Present:  Professor of Geology & Geophysics, Yale University, New Haven, CT, Associate Professor of Geology & Geophysics, Chemical Engineering and Forestry and Environmental Studies, Yale University, New Haven, CT, 2006-2009
7/1/2000-5/06:  Assistant Professor of Geology & Geophysics Yale University, New Haven, CT
9/98-7/2000:  NSF Postdoctoral Research Fellow, Yale University, New Haven, CT
5/98- 98:  Bateman Postdoctoral Research Fellow, Yale University, New Haven, CT
1/98-4/98:  Postdoctoral Research Scientist, University of Michigan, Ann Arbor, MI
9/92-10/97:  Graduate Research Assistant, University of Michigan, Ann Arbor, MI
6/92-9/92:  Summer Intern Geochemist, Chevron Petroleum Technology Co., La Habra, CA,
6/89 - 9/92:  Geochemistry Laboratory Assistant, Southwest Research Institute - San Antonio, TX
5/84 - 4/87:  Reservoir Engineering Co-op Geologist, ANR Pipeline Company, Detroit, MI

C.  5 Publications Most Relevant to this Proposal:  * student  † postdoc
Stout, L.M†., Blake, R.E., Greenwood, J.P†., Martini, A.M. and Rose, E.C.*. (2008—accepted w/ revisions, FEMSEC-08-11-0465) Microbial Diversity and Geochemistry at Volcanic Sulphur Springs, St. Lucia W.I., FEMS Microbiology Co-op Geologist, ANR Pipeline Company, Detroit, MI

5 Additional Publications:  * student  † postdoc

5
Collaborators
Michael Böttcher (Ctr. for Baltic Sea Res.)
Albert Colman (U. of Chicago)
David Emerson (ATCC/George Mason U.)
Marilyn Fogel (Geophysical Laboratory)
Bør Barker Jorgensen (Max Planck –Bremen)
David Karl (U. of Hawaii)
Aivo Lepland (Geol. Surv. Norway)
Timothy Lyons (U. Missouri)
William Metcalf (University of Illinois)
Craig Moyer (W. Washington Univ)
James R. O’Neil (U. of Mich.—Emeritus)
Douglas Rumble (Geophysical Laboratory)
Bernhard Schink (Universitat Konstanz)
Karl K. Turekian (Yale University)

D. Synergistic Activities
• Associate Editor, American Journal of Science; ODP and R/V Atlantis/DSV ALVIN cruises GEOTRACES;
• Yale College Executive Committee; IODP Deep Biosphere Workshop participant< 10/2006;
• Space Studies Board Committees on the Origin and Evolution of Life; Planetary Protection of Venus; and Astrobiology Strategy for Mars (2003-07);
• Faculty mentor /advisor for undergraduates at Yale Univ, Amherst College, and STARS and Mellon-Bouchet undergraduate research fellows programs at Yale;
• Educational Outreach with Amistad Freedom Schooner.

E. Thesis Advisors

F. Advisees (total#: 7) and Postdoctoral Associates (total #: 6) (at Yale unless stated otherwise)
SaeJung Chang (Postdoc, Yale Univ. 2005-08)
Albert Colman (PhD, ’02) Jeanine Mohammed (BS, ’04)
Scott Coomber (Postdoc.2001-2002) Abiola Pollard (BS ’03)
Sitindra Dirghangi (graduate, 2nd yr) Matthew Shirley (BS, ’03)
Elizabeth Donald (Stanford Univ. 5th yr. PhD) Lisa Stout (Postdoc, 2006-)
Alexis Dekerchove (graduate—Engineering) Alexandre Surkov (Postdoc, 2002-2005.)
James Greenwood (Postdoc, 2000-2003) John Vandenbrooks (PhD, ’06)
Deb Jaisi (Postdoc, Yale Univ. 2007-) Sharon Walker (Engineering, PhD ’05)
Yuhong Liang (PhD, ’05) 

Honors & Awards
Blaustein Visiting Faculty Fellowship—Stanford University, Spring 2009
Ocean Drilling Program Distinguished Lecturer (2003-2004)
Woodrow Wilson National Faculty Fellowship (2003-2004)
Hellman Foundation Fellowship—Yale University (2001)
NSF Postdoctoral Fellowship—Yale (1998)
Bateman Postdoctoral Fellowship—Yale (1998)
J.A. Dorr Student of the Year Award in Geoscience— U. of Michigan (1998)
Rackham Res. Partnership—U.of Mich (95)
Geol. Soc. of Amer. Research Grant (1995)
Rackham Merit Fellowship—U. of Mich. (91)
Phi Beta Kappa (1987)
Society of Petroleum Engineers Scholarship (1987)
Amer. Geol. Inst. MPP Scholarship (85, 87)
Golden Key National Honor Society (1985)
ANR Pipeline Co. Co-op Scholar (5/84-4/87)
Suzanne Marie Carbotte
Lamont-Doherty Earth Observatory
Box 1000, Palisades NY 10964

(a) Professional Preparation:

University of Toronto, Toronto, Ont.    Geology and Physics,    H.B.Sc.    1982
Queen's University, Kingston, Ont.    Marine Geophysics,    M.Sc.    1986
University of California Santa Barbara    Marine Geophysics,    Ph.D.    1992

(b) Appointments:

Jan 2007    Heezen Senior Research Scientist, Lamont-Doherty Earth Observatory
Oct. 2003    Doherty Research Scientist, Lamont-Doherty Earth Observatory, Palisades, NY.
1996-2003    Associate Research Scientist, LDEO, Palisades, NY.
1993-1996    Post-Doctoral Research Fellow/Scientist LDEO, Palisades, NY
1986-92    Research Assistant and Teaching Assistant, Department of Geological Sciences, University of California, Santa Barbara, CA.

(c) Publications:

5 most relevant to proposed work
5 other significant publications:

(d) Synergistic Activities (5 example activities):
Memberships on Boards, Committees:
2004–2006 IODP SSP Panel
Programs
2008 co-Chief Scientist for multichannel seismic study of the East Pacific Rise (MGL0812).
2002 Chief Scientist for multichannel seismic study of the Juan de Fuca Ridge (EW0207).
2000/2001 Fletcher Side-scan sonar and CHIRP subbottom study of Hudson River.

(e) Collaborators within last 48 months (not part of this project):
J. Babcock (SIO), R. Bell (LDEO), P. Canales (WHOI), J. Cochran (LDEO), R. Detrick (WHOI), J. Diebold (LDEO), V. Ferrini (WHOI), D. Fornari (WHOI), C. Fox (NGDC), A. Harding (SIO), R. Haymon (UCSB), J. Helly (SDSC), G. Kent (SIO), K. Lehnert (LDEO), L. Mayer (UNH), S. Miller (SIO), M. Nedimovic (Dalhousie), W.B.F. Ryan (LDEO), T. Shank (WHOI), T. Shipley (UTIG), S. White (USC).

Graduate Advisors and Postdoctoral Sponsors
Thesis Advisor: Dr. Edward Farrar. Queens University, Cananda, M.Sc.
Thesis Advisor: Dr. Ken Macdonald, UC Santa Barbara, CA, PhD
Post-Doctoral Advisor: Dr. John Mutter, Columbia U, NY

(f) Graduate student & Postdoctoral supervision
Post-Doctoral Scientist Sponsor (total 3): Mladen Nedimovic, Vicki Ferrini, Helene Carton
DAVID A. CARON  
Professor, Dept. of Biological Sciences  Phone: (213) 740-0203  
University of Southern California  Fax: (213) 740-6720  
3616 Trousdale Pkwy., AHF 301  Email: dcaron@usc.edu  
Los Angeles, CA 90089-0371

Professional Preparation:  
University of Rhode Island, Microbiology  B.S.  1975  
University of Rhode Island, Oceanography  M.S.  1977  
Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, Biological Oceanography  Ph.D.  1984

Appointments and Professional Experience  
1975 - present  Participation on >30 major research cruises. Field research at field stations in Bermuda (BBSR), Jamaica (DBRS), Barbados (BRI), Catalina Island (USC marine station), Caribbean Marine Research Center (LSI, Bahamas).  
1999 - present  Professor, University of Southern California  
2003 - 2006  Professor, Department Chair, University of Southern California  
1999 - 2003  Professor, Section Head, University of Southern California  
1997 - 1999  Senior Scientist, WHOI.  
1996 - 1998  Visiting Lecturer, University of Massachusetts, Dartmouth.  
1993 - 1997  Associate Scientist with tenure, WHOI.  
1986 - 1999  Visiting Lecturer, Bridgewater State College, Bridgewater, MA.  

Recent Awards and Honors  
Mary Sears Chair for Excellence in Biological Oceanography (1999)  
Seymour Hutner Award (Society of Protozoologists; 2002)  
Fellow, American Academy of Microbiology (2007)

Publications (out of 154 published & in press articles and chapters)  
5 Papers most relevant to proposed work  
5 other significant publications  


Synergistic Activities

1. Short-courses offered on Marine Microbial Ecology and Microbial Food Webs, conducted for Instituto Oceanográfico, Universidade de São Paulo, Brazil, and the University of Rostock, Rostock, Germany.

2. Past and present editorialship duties (8 journals) and reviewership duties (>25 journals).

3. Participation in Centers for Ocean Science Education Excellence, working with K-12 teachers in LA school district to improve curricula. Facilitation high school biology course offered on USC campus to local inner city school (32nd Street School).

4. Lectures for local middle schools, high school on careers in science and engineering. Seminars for science library guilds, state and county water boards and toxicological societies.

5. Panelist on NSF panels (Biological Oceanography, Polar Programs, LExEn-Life in Extreme Environments), NOAA panels (EcoHAB), NASA panels.

Collaborators and other Affiliations

Collaborators and other Cols: C.R. Benitez-Nelson (U.So.Carolina), M. Brzezinski (UCSB), M. Carter (UCSD), R.M. Cerrato(Stony Brook), M.R. Dennett (WHOI), J Dolan (Villefranche-sur-Mer), D. Estrin (UCLA), R.J. Gast (WHOI), C.J. Gobler (Stony Brook), D. Hambright (OU), G. Langlois (CDPH), D.L. Lonsdale (Stony Brook), J. McGowan (UCSD), P. Miller (SCCWRP), R.W. Sanders (Temple), B. Sherr (OSU), E. Sherr (OSU), R. Shipe (UCLA), D. Siegel (UCSB), D. Valout (CNRS), A.Z. Worden (MBARI).

Advisors: L.P. Madin (Woods Hole Oceanographic Inst.); John McN. Sieburth (deceased)

Current Students and Postdocs: Adriane Jones (Ph.D. candidate); Beth Stauffer (Ph.D. candidate); Diane Kim (Ph.D. candidate); Erica Seubert (Ph.D. candidate); Peter Countway (Postdoc investigator); Marie-Eve Garneau (Postdoc investigator); Meredith Howard (Postdoc investigator).

Former Students and Postdocs: A. Arenovski (Questa Engineering Corp.); Michael Atkins (Woods Hole Oceanographic Inst.); Ulrike Berninger (Univ. of Kiel); Per Carlsson (Kalmar University); A.J. Lewitus (BMFL/ U.S.Carolina); Ee Lin Lim (Temple University); J. Shimeta (Franklin & Marshall); L.A. Amaral Zettler (Marine Biol. Lab.); K. Cellineri (Berwick Academy), R.J. Gast (Woods Hole Oceanographic Inst.p); S. Moorthi (University of Cologne), Julie Rose (NOAA), Xuemei Bai (Solana, Inc.).

Total PhD students advised: 10
Total PostDocs Sponsored: 14
ANN RUBIN CLOSE

Address: USC Wrigley Institute for Environmental Studies
Los Angeles, CA 90089-0371
Phone: (213) 740-6705
Fax: (213) 740-6720
E-Mail: close@usc.edu

(a) Professional Preparation:
University of California Santa Cruz   Biology    BA, 1987
University of California Santa Cruz   Marine Science    MS, 1989

(b) Appointments:
1997-present   Associate Director, University of Southern California Wrigley Institute for Environmental Studies
1994-1998   Executive Director, Risk Prediction Initiative, Bermuda Biological Station for Research, Inc.
1990-1995   Head Technician/Lab Manager, Bermuda Atlantic Time Series Study, Bermuda Biological Station for Research, Inc.

(c) Publications


(d) Synergistic Activities (5 example activities)

Ms. Close directs the diverse marine and environmental science education and outreach programs at the Wrigley Institute, ranging from K-12 education through undergraduate and graduate courses. She created and has served as director of the USC Wrigley Institute Family Science Program since it’s creation eight years ago. Participants range from age 5-90, and spend a week learning about marine and environmental sciences at a working marine lab. She also runs the USC Catalina Semester, a program for undergraduate students run at the Wrigley Marine Science Center on Catalina. The semester, which accepts up to twenty students each semester, focuses on the Microbial Earth in the Fall and on Marine Population Dynamics in the Spring.

International GeoBiology Summer course for Graduate Students: Ann has served as the course coordinator for the Agouron Institute/NSF summer International GeoBiology course since the program began in 2003. The course offers intensive interactions between the fields of biology and earth sciences on an advanced level. Over a period of five weeks, participants are exposed to an in-depth treatment of how biology interacts with the environment and how these interactions have shaped the evolution of the earth. Participants get hands-on experience on modern research methods in geobiology and participate in small research groups solving current questions relevant to the field.

Director, Los Angeles County Ocean Sciences Bowl and Diversity Initiative. Since 2000, the USC Wrigley Institute, in conjunction with the Jet Propulsion Laboratory, has been host to the Consortium for Ocean Leadership-sponsored Annual National Ocean Sciences Bowl. The aim of this timed academic competition is to raise high school students’ awareness of the oceans, ocean research and the critical role the sea plays in global climate, world economy, history and culture. For the past four years, we have also been part of an Ocean Leadership program to increase the diversity of participants in the competition. We work closely with schools with students in traditionally under-represented groups throughout the year to increase their enthusiasm, excitement and learning in the marine and environmental sciences.

Executive Director, Risk Prediction Initiative. Founded in 1993 by Anthony Michaels and Anthony Knap, this was a unique partnership between 13 insurance and reinsurance companies and a group of climate and atmospheric scientists. The goal of the program was to understand the role of climate in creating variability in the probability of hurricane landfall. This program lead to the creation of new risk management approaches and financial instruments (like catastrophe bonds) that more effectively handle the rare, large losses. The companies made annual contributions of $100,000 each to fund the public science. The executive director managed the relationships with the companies, managed a peer-review process for evaluating science proposals, administered the grants to the scientists and ran a series of meetings to create effective communication between the science and business leaders.

(e) Collaborators and Other Affiliations (not at USC, and not part of this project)

Susan Cook (Consortium of Ocean Leadership), Kurt Hanselmann (University of Zurich), Kimberly Lievense, (Jet Propulsion Laboratory), John Spear (Colorado School of Mines).
Biographical Sketch of Frederick S. Colwell

Contact Information
College of Oceanic and Atmospheric Sciences
104 COAS Admin Bldg
Oregon State University
Corvallis, OR 97331
Tel: 541-737-5220
Fax: 541-737-2064
Email: rcolwell@coas.oregonstate.edu

Professional Preparation
Undergraduate Education:
Whitman College
Biology
BA
1977

Graduate Education:
Northern Arizona University
Microbiology
MS
1982
Virginia Tech
Microbiology
PhD
1986

Postdoctoral Institutions:
Idaho National Laboratory (INL)
Biotechnology Department
1986-1988

Appointments
Professor
College of Oceanic and Atmospheric Sciences (since June 2006), Oregon State Univ.; adjunct in the OSU Department of Microbiology

Affiliate faculty
Dept. Bacteriology and Biochem., University of Idaho (since 1993)

Consulting Scientist
Biotechnology Department, INL (1998-2006)

Advisory Scientist
Biotechnology Department, INL (1994-1998)

Scientific Specialist
Biotechnology Department, INL (1992-1994)

Senior Scientist
Biotechnology Department, INL (1990-1992)

Scientist
Biotechnology Department, INL (1988-1990)

Adjunct and graduate faculty
Dept. of Biology, Idaho State Univ. (1990-2008)

Publications
Selected Related Publications:


5 Other Significant Publications:


Synergistic Activities (5 examples)
- Current president of the International Society for Subsurface Microbiology; co-organizer of the 6th International Symposium on Subsurface Microbiology (ISSM) (Aug 2005); Member of International Steering Committee for the 7th ISSM (Nov 2008)
- Scientific Technology Panel member for the Integrated Ocean Drilling Prog. (2006-09)
- Expert panel member (2007-08) and co-author of the report Energy from Gas Hydrates: Assessing the Opportunities and Challenges for Canada published by the Council of Canadian Academies
- Consultant and Scientist-in-Residence for San Francisco Exploratorium in the design of Winogradsky columns and demonstration of the Volta apparatus (July 2001)
- Distinguished Lecturer for the Ocean Leadership’s, U.S. Science Support Program (affiliated with the Integrated Ocean Drilling Program) during 2009-10 academic year

Collaborators & Other Affiliations
Collaborators and Co-Editors (not part of this proposal):

Graduate and Postdoctoral Advisors:
- MS: Harold Speidel (Northern Arizona Univ; Tennessee Valley Auth.)
- PhD: Don Cherry (Virginia Tech) and Sally Hornor (Virginia Tech)
- Postdoc: Paul Wichlacz (INL)

Thesis Advisor and Postgraduate-Scholar Sponsor:
Postdoctoral scholars (total: 5): D. Cummings (Point Loma Univ.), H. Lee (INL)
D. Newby (INL), D. Reed (INL), Y. Fujita (INL)

Graduate students:
- MS: S. Boyd, M Elam (OSU, current student), H. Poppen (OSU, current student)
FRANK ALDEMARO CORSETTI, Ph.D.
Department of Earth Sciences, University of Southern California, Los Angeles, CA 90089-0740
fcorsett@usc.edu

(a) Professional preparation
University of California Davis        Geology        B. S. 1989 (High Honors)
University of California Santa Barbara Geological Sciences        Ph.D. 1998

(b) Appointments
Associate Professor, Earth Sciences, USC, 2006-present
Assistant Professor, Earth Sciences, USC, 2000-2006
Postdoctoral Researcher (UC President’s Postdoctoral Scholar) UCSB, 1999-2000
Lecturer, UCSB, spring 1999

(c) Publications
Five publications relevant to current proposal

Five other publications

(d) Synergistic Activities
Vice Chair, Geomicrobiology Division, Geological Society of America
Associate Editor: Geobiology (Blackwell), current
Associate Editor, Palaios (SEPM), past
President-Elect, Pacific Section SEPM (Society for Sedimentary Geology)
Co-director, USC-Agouron-Wrigley Institute International Summer course in Geobiology.

(e) Collaborators & Other Affiliations
• **Collaborators and Co-Editors:** Stanley M. Awramik, UCSB; Corine Bakermans, Michigan State University; Aymon Baud, Geologic Museum, Lausanne; Will Beaumont, UC Irvine; Will Berelson, USC; Tanja Bosak, MIT; David Bottjer, USC; Woody Fischer, Caltech; John Grotzinger, Caltech; James (Whitey) Hagadorn, Amherst College; Doug Hammond, USC; Samantha Joye, University of Georgia; Alan J. Kaufman, University of Maryland, College Park; Dave Kidder, Ohio University; Matthew Kirby, Cal State Fullerton; Paul K. Link, Idaho State University, Pocatello; Steve Lund, USC; Ken Nealson, USC; Dianne Newman, MIT; Victoria Orphan, Caltech; David Pierce, UCSB; Alex Sessions, Caltech; Russell Shapiro, Cal State Chico; John Spear, Colorado School of Mines; John H. Stewart, USGS Menlo Park; Adam Woods, Cal State Fullerton.

• **Graduate Advisors and Postdoctoral Sponsors:** Stanley M. Awramik, (UCSB; graduate advisor-chair of committee), James Boles, (UCSB; graduate advisor), Bruce Tiffney, (UCSB; graduate advisor), John Crowell, (UCSB; postdoctoral mentor)

• **Thesis Advisor and Postgraduate-Scholar Sponsor (16 current; 35 total)**
  Current Students (primary advisor): Sean Loyd (Ph.D.); Victoria Petryshyn (Ph.D.); Current Students (secondary advisor): Laurie Barge (Ph.D.); Alyssa Bell (Ph.D.); Max Berkelhammer (Ph.D.); Kirk Domke (Ph.D.); Carie Frantz (Ph.D.); Sarah Greene (Ph.D.); Catherine Jamet (Ph.D.); Orion Johnson (Ph.D.); Adriane Jones (Ph.D.); Deborah Khider (Ph.D.); Rowan Martindale (Ph.D.), Scott Mata (Ph.D.); Jingmai O’Conner (Ph.D.); Shiqing Xu (Ph.D.).
  Past Students and current location (* denotes primary advisor): Jake Bailey (Ph.D.)*, Postdoc, Caltech/Assistant Professor, U of Minn. (2010), Nicole Bonuso (Ph.D.), Assistant Professor, Cal State Fullerton; Matthew Clapham (Ph.D.), Assistant Professor, UC Santa Cruz; Steve Dornbos (Ph.D.), Assistant Professor, University of Wisconsin; Margaret Frasier (Ph.D.), Assistant Professor, University of Wisconsin; David Ginsburg (Ph.D.); Oscar Gonzalez-Yajimovich (Ph.D.), Professor, Universidad Autónoma de Baja California; Gerald Grellet-Tinner (Ph.D.), Assistant Professor, South Dakota School of Mines; Tran Huynh (M.S.); Nate Lorentz (Ph.D.)*; Katherine Marenco (Ph.D.), Postdoc UC Riverside; Pedro Marenco (Ph.D.)*, Postdoc, UC Riverside/Assistant professor, Bryn Mawr (fall 2009); Alison Olcott (Ph.D.)*, Assistant Professor, University of Kansas; Sara Pruss (M.S., Ph.D.), Assistant Professor, Smith College; Jamal Ramadan (Ph.D.); Everett Salas (Ph.D.), Postdoc, Rice University; Stan Teerman (Ph.D.), Chevron-Texaco; Kiri Wagstaff (M.S.)*, JPL.
**Biosketch for Heribert Cypionka**, full Professor of Paleomicrobiology

Institute for Chemistry and Biology of the Marine Environment (ICBM)
University of Oldenburg, Germany
Carl-von-Ossietzky-Str. 9-11, D-26123 Oldenburg, Germany

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Fax: +49 441 798 3404
E-mail: cypionka@icbm.de

**Professional Preparation:**

Institute for Microbiology in Göttingen, Germany, Microbiology Diploma in Biology 1979
Institute for Microbiology in Göttingen, Germany, Ph.D. (Dr. rer. nat.) 1982
The Free University, Amsterdam, Netherlands, Postdoctoral Feb. 1983 - May 1983

**Appointments:**

October 1992 - Current: Full Professor in Oldenburg
1999 – 2001: Director of the ICBM
Nov. 1989: *Venia legendi* for "Microbiology" and "Microbial Ecology" at Habilitation
April 1987 - Sept. 1992: Assistant Professor (Hochschulassistent)
June 1983 - March 1987: Research associate at the Faculty of Biology at Konstanz (Prof. Dr. N. Pfennig, advisor)

**Publications:**


*5 other significant publications:*

5 Synergistic Activities

4. PICOLAY, a freeware program allowing three-dimensional projections of microscopic image stacks (www.picolay.de)

Collaborators & Other Affiliations:

- Collaborators and Co-Editors: (names and current organizational affiliation during the past 48 months)
  Prof. F. Inagaki JAMSTEC, Kochi, Japan
  Prof. J. Kostka Florida State University, Tallahassee, USA
  Prof. J. Parkes University of Cardiff, Wales, UK
  Prof. D. Stahl University of Washington, Seattle, USA
  Prof. A. Teske University of North Carolina, Chapel Hill, USA

- Graduate Advisors and Postdoctoral Sponsors:
  Prof. Dr. H.G. Schlegel, University of Göttingen, Germany
  Prof. Dr. A.H. Stouthamer, Free University of Amsterdam, The Netherlands

- Thesis Advisor (total students: 9) and Postgraduate-Scholar Sponsor (None):

  Currently there are 4 PhD students working in my group.

Committees:

  Oceanographic commission of the German Science Foundation 1992-1998
  Editorial Board of FEMS Microbiology Ecology since 2000
  Editorial Board of Environmental Microbiology since 2001
  Member of the Review Board 'Microbial Ecology and Applied Microbiology' at the German Science Foundation (DFG) since 2004

Research interests

- Biogeochemistry of sediments, marine deep biosphere
- Physiology and bioenergetics of bacteria
- Cultivation of bacteria from natural environments
- Microscopy and digital imaging
Biographical Sketch:

LINDA E. DUGUAY

University of Southern California
WIES/USC Sea Grant Program (SGP), AHF 254F
Los Angeles, CA 90089-0373
Phone: (213) 821-1335  Fax: (213) 740-5936  Email:duguay@usc.edu

(a) Professional Preparation
University of Rhode Island  Biology   A.B.  1968
University of Miami, RSMAS  Biol. Oce.   M.S.  1973
University of Miami, RSMAS  Biol. Oce.   Ph.D.  1979

(b) Appointments
2000-Present               Research Associate Professor of Marine Environ. Biology at USC
1999-Present  Deputy Director of the Wrigley Institute for Environmental Studies (WIES)
             at USC and Director, USC Sea Grant Program (SGP)
2000-2008     Executive Dir., USC Tyler Prize for Environmental Achievement
2000-2002     Director of Environmental Studies Program at USC
1998-1999     Program Manager for Arctic Natural Sciences, Arctic Science Section,
             Office of Polar Programs NSF, Arlington, VA
1996-1998     Program Manager for Science Planning, Advanced Projects, and
             International Coordination, Office of Polar Programs, NSF, Arlington, VA
1994-1995     Antarctic Science Section, Special Programs Manager, on detail, Office
             of Polar Programs, NSF, Arlington, VA
1990-1996     Associate Program Director, Biological Oceanography Program,
             Geosciences Directorate, NSF, Arlington, VA.
1989-1999     Research Assistant Professor, University of Maryland, Chesapeake
             Biological Laboratory, Solomons, MD
1987–1989     Senior Research Associate, University of Maryland, CBL
1987–1988     Visiting lecturer, St. Mary’s College of Maryland, St. Mary’s City
1982-1983     Assistant Professor, Natural Science Department, Southampton College,
             Southampton, NY
1980-1987     Research Assistant Professor, Marine Sciences Research Center,
             SUNY, Stony Brook, NY.

(c) PUBLICATIONS:
Knap, A., Dewailly E., Furgal, E., Galvin, J., Baden, D., Bowen, R. E., Depledge, M., Duguay, L.,
Health and Human Health: Developing a Research and Monitoring Framework. Environmental
Health Perspectives (EHS). 110 (9):839-845.

protein of nitrogenases in natural populations of Trichodesmium thiebautii. Appl. Environ. Micro:
669-676.


Monteleone, D.M. and L.E. Duguay. 1988. Laboratory studies of predation by the ctenophore
10:359-372.

Duguay, L., D. M. Monteleone and C. E. Quaglietta. 1989. Abundance and distribution of
zooplankton and ichthyoplankton in Great South Bay, New York, during the Brown Tide outbreaks
Bloom-Causes and Impacts of Recurrent Brown Tides, ed. by E.M. Cosper.

(d) Synergistic Activities
Dr. Duguay has been involved in integrating research and education and increasing the educational opportunities for students at all levels (informal, K-12, undergraduate, graduate) throughout her career.

- She taught undergraduate students at Southampton College and St. Mary’s College. She taught an environmental science course for K-12 teachers in the continuing education program at SUNY Stony Brook. She was a substitute science teacher (7-12) in Stony Brook and Port Jefferson School Districts in NY.
- She was a participant in NSF’s public outreach programs through the Office of Legislative and Public Affairs (OLPA). At NSF, she was involved with the REU, CAREER, and POWRE programs, as well as the Teachers experiencing the Arctic and Antarctic Program (TEA). She ran OCE’s REU site competition in 95/96 and OPP’s Antarctic TEA program in 97.
- The Wrigley Institute and the USC Sea Grant Program have strong outreach/extension and education components. Wrigley/Sea Grant hosts two special one-week camps at the WMSC on Catalina for middle school and high school girls and Dr. Duguay has been involved as a mentor and role model.
- Dr. Duguay has served on the meetings and educational committee of the American Society of Limnology (ASLO).
- She is the current COSEE-West representative to the COSEE Council and Chair Elect for the COSEE Council (2010 – 2011). At the 2005 Aquatic Sciences meetings she co-chaired a session on COSEE and the broader impacts of Ocean Science Research.

(e) Collaborators and Other Affiliations:

Collaborators and Co-Editors. Capone, D. G. (USC), Fong, P. (UCLA) Hamner, W. and Hamner P. (UCLA), Michaels, A. M.. (USC);

Graduate Advisors and Postdoctoral Sponsors:
M.S.  Dr. Michael Reeve, University of Miami, now retired
Ph.D. Dr. Dennis Taylor University of Miami, Virginia Institute Marine Science
No post-doctoral advisor appointed to the SUNY Stony Brook Research Faculty

Thesis Advisor for students: 3 total
SUNY SB Ph.D. Dr. Doreen Monteleone, with NY State, EPA
SUNY SB M.S. Ms. Claire Quaglietta, high school science teacher
U. Maryland M.S. Mr. Mike Brittsan, Smithsonian in DC
Biographical Sketch: VIRGINIA P. EDGCOMB

Woods Hole Oceanographic Institution
Department of Geology and Geophysics MS#52
Woods Hole, MA 02543
Phone: 508-289-3734 /FAX 508 457-2076  email: vedgcomb@whoi.edu

PROFESSIONAL PREPARATION:
University of Virginia   Envir. Sci./Finance  BS  1978
University of Delaware  Microbiology/Ecology PhD  1997
Marine Biological Laboratory Evolution Postdoc     1997-1999
Woods Hole Oceanographic Microbiology/Ecology Postdoc     1999-2005

APPOINTMENTS:
2005-present  Research Associate III, Woods Hole Oceanographic
2003-2005 Visiting Investigator, Woods Hole Oceanographic
1999-2003 NRC/NASA Astrobiology Fellow, Woods Hole Oceanographic
1999 –2000 Staff Scientist, Marine Biological Laboratory
1997-1999 Postdoctoral Scholar, Marine Biological Laboratory

PUBLICATIONS (5 of 32 peer reviewed publications):
(i)– five papers relevant to the research proposed


Teske, A., K.-U. Hinrichs, V. Edgcomb, A. d.V. Gomez, D. Kysela, M.L. Sogin, and H.W.
Jannasch 2002. Archaeal and bacterial population structure of hydrothermal sediments
at the Guaymas Basin vent sites: evidence for anaerobic methanotrophy. Applied and

Santelli, C., Edgcomb, V., Bach, W., and Edwards, K. 2009. The diversity and abundance of
bacteria inhabiting seafloor lavas positively correlate with rock alteration. In press, Env.

Growth and Survival of the hyperthermophilic chemolithoautotrophic archaea
Methanocaldococcus jannaschii and Archaeoglobus profundus under high temperature,

Edgcomb, V., Orsi, W., Leslin, C., Epstein, S.S., Bunge, J., Jeon, S., Yakimov, M.M., Behnke, A.,
and Stoeck, T. 2009. Protistan community patterns within the brine and halocline of deep
hypersaline anoxic basins (DHABs) in the eastern Mediterranean Sea. Extremophiles

(ii) – five significant papers in other areas

Edgcomb, V.P., A.G.B. Simpson, L. Amaral Zettler, T.A. Nerad, D.J. Patterson, and M.L. Sogin
2002. Pelobionts are degenerate protists: Insights from molecules and morphology.
Molecular Biology and Evolution 19:978-982.

Edgcomb, V.P., J.M. Bernhard, and S. Jeon. 2007. Deep-sea microbial eukaryotes in anoxic,
microoxic, and sulfidic environments, In: J. Seckbach (ed.) Algae and Cyanobacteria in

subsurface microbial communities in Nankai Trough sediments (ODP Leg 190, Site
1176), FEMS Microbiol. Let. 45(2);115-125.

2007. Survival and growth of two heterotrophic hydrothermal vent archaea, Pyrococcus
strain GB-D and Thermococcus fumicola, under hydrothermal vent and subsurface

SYNERGISTIC ACTIVITIES:
--Lecturer in annual MBL-sponsored workshops for secondary science teachers and teaching assistant in Workshop on Molecular Evolution, MBL.
--Supervisor for undergraduate and graduate students in independent research, PhD committee member for 5 graduate students.

COLLABORATORS/CO-AUTHORS (past 5 years; excludes WHOI personnel):
Anke Behnke (U of Kaiserslautern), John Bunge (Cornell U), Richard Christen (U Nice, France), Katrina Edwards (USC), Slava Epstein (Northeastern U), Sunok Jeon (Northeastern U), Brian Leander (University of British Columbia), Chesley Leslin (Northeastern U), Karen Lloyd (UNC-Chapel Hill), Barbara MacGregor (UNC Chapel Hill), William Orsi, (Northeastern U), Cara Santelli (Harvard), Thorsten Stoeck (U of Kaiserslautern), Paula Suarez (U Simon Bolivar, VZ), Roger Summon (MIT), Gordon Taylor (Stony Brook), Andreas Teske (UNC/Chapel Hill and WHOI), Pieter Visscher (U. Conn), Michail Yakimov, IAMC-CNR, Naoji Yubuki (University of British Columbia).

Graduate Advisors: David W. Smith and John McDonald (University of Delaware) Postdoctoral Advisors: Mitchell L. Sogin (MBL), Andreas Teske (Woods Hole Oceanographic Institution-NRC Astrobiology Postdoctoral Fellowship)

RESEARCH CRUISES AND FIELD EXPERIENCE:
**BIOGRAPHICAL SKETCH**

<table>
<thead>
<tr>
<th>NAME</th>
<th>POSITION TITLE</th>
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<tbody>
<tr>
<td>Sirine C. Fakra</td>
<td><strong>Senior Associate Beamline Scientist, Advanced</strong></td>
</tr>
<tr>
<td></td>
<td><strong>Light Source 10.3.2, Lawrence Berkeley National</strong></td>
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<td></td>
<td><strong>Laboratory</strong></td>
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**eRA COMMONS USER NAME** (credential, e.g., agency login)

<table>
<thead>
<tr>
<th>Professional Preparation:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Université Pierre and Marie Curie (Paris VI), Paris, France</td>
</tr>
<tr>
<td>Physics</td>
</tr>
<tr>
<td>B.S. 1995</td>
</tr>
<tr>
<td>Université Pierre and Marie Curie (Paris VI), Paris, France</td>
</tr>
<tr>
<td>Physics</td>
</tr>
<tr>
<td>M.S. 1996</td>
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<tr>
<th>Appointments:</th>
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<tbody>
<tr>
<td>2000-Present Associate Beamlne Scientist at the Advanced Light Source, Lawrence Berkeley National Lab</td>
</tr>
<tr>
<td>1999 Engineer (Physicist) jointly at Smartec SA.; Swiss Federal Institute of Technology (EPFL), Lausanne and CERN – LHC, Geneva, Switzerland.</td>
</tr>
<tr>
<td>1997-1998 Associate Researcher (Physicist), Institute of Experimental Physics, Swiss Federal Institute of Technology (EPFL), Lausanne, Switzerland.</td>
</tr>
</tbody>
</table>

**B. 5 papers most relevant to proposed work**


**C. 5 other significant papers**

D. Synergistic activities

- As associate beamline scientist at ALS beamline 10.3.2, I guide users with their synchrotron based experiments and participate in the analysis of many types of material and environmental sciences samples at both the microprobe beamline 10.3.2 and the ALS Scanning Transmission X-ray Microscopes.
- Developed an Fe K-edge X-ray Absorption Near Edge Structure database of standard Fe bearing minerals, posted on the web, to be freely used by researchers.
- Tour of the ALS facility for students and visitors.

E. Collaborators over the past 48 months

Alivisatos, A. P. (LBNL); Ackley A. R. (Colorado State University); Aruguete, D. M., (Virginia Tech); Banfield J. F (UC Berkeley); Bernardis M. (Leibniz-Institut fur Pflanzenbiochemie); Brownlee D.E. (University of Washington, WA); Burchell, M. J. (University of Kent, UK); Butterworth, A.L. (Space Sciences Lab, UC Berkeley); Cervini-Silva J. (Universidad Nacional Autónoma de México); Chan, C. S., (U. Delaware); Chan, E. M., (LBNL); Chen, B. (LBNL); Chrysochoou M. (University of Connecticut, Storrs CT); Clemens S. (U. Joseph Fourier, Grenoble); Courtin-Nomade A., (U. of Limoges); Dermatas D. (Stevens Institute of Technology, Hoboken, NJ); Dunphy-Guzman K.A. (Sandia National Lab); Edwards D.C. (was at Princeton), Edwards, K. J. (USC); El Naggar, M., (was at UCB); Emerson D. (Bigelow Oceanography Lab.); Freeman, J.L., (CSU); Freidlich (LLNL); Galli, G. A. (UC Davis); Garfullina (Colorado State University); Geoffroy, N., (U. Joseph Fourier, Grenoble); German, C. R., (WHOI); Gilles B. (LBNL), Glasauer, S.M (U. of Guelf, Canada); Guo Q. Z. (Brookhaven National Lab); Gygi F. (U.C. Davis); Harada, E. (Leibniz-Institut fur Pflanzenbiochemie); Hu J.Z. (Brookhaven National Lab); Hudelson S. (MIT); Inoue E. (RIKEN Plant Science Center, Japan); Ionescu, M. (ANSTO); Isaure, M. P., (U. Joseph Fourier, Grenoble); Ishiyama (RIKEN Plant Science Center, Japan); Johnson-Maynard J.L. (U. of Idaho); Kearsley, A., (Natural History Museum, London); Keller, L. P. (NASA Johnson Space Center); Kruger M. B. (U. Missouri); Kunz M. (LBNL); Larson, B., (U. Joseph Fourier, Grenoble); Li, L.S., (was at UCB); Lindblom, S. D., (was at Colorado State U.); MacDonald (LBNL); Mathies, R.A. (UC Berkeley); Moffett, J. W., (UCSC); Moller, G., (U. of Idaho); Muthu D.V. S. (U. of Missouri); Ogliore, R. C., (Space Sciences Lab, UC Berkeley); Oram, L., (U. of Idaho); Pairis (U. Joseph Fourier, Grenoble); Pilon-Smits, E. A. H., (Colorado State University); Poulin M. (LBNL); Powell M. (University of Idaho); Rouxel O. (WHOI), Santelli C.M. (was at WHOI); Serret G. (U. Joseph Fourier, Grenoble); Shuh D.K. (LBNL), Snead, C. J., (Space Sciences Lab, UC Berkeley); Soublard-Colin, M. (U. of Limoges); Spagnoli (UC Berkeley); Sposito G. (UC Berkeley); Strawn, D. G., (U. of Idaho); Takahashi (RIKEN Plant Science Center, Japan); Tamura, N., (LBNL); Toner, B. (U. Minnesota); Tyliszczak (LBNL), Van Hoewyk (was at Colorado State University); Westphal, A.J. (Space Sciences Lab, UC Berkeley); T. Warwick (LBNL), Williamson, A. (was at LLNL), Yang P. (U.C. Berkeley); Yuhas B. (UC Berkeley), H.Z. Zhang (UC Berkeley), L. H. Zhang (Colorado State U.); M.E. Zolensky (NASA Johnson Space Center).


Awards:

Biographical Sketch

Timothy G. Ferdelman
Staff Research Scientist
Group Leader, Biogeochemistry Research Group
Max-Planck-Institute for Marine Microbiology
Celsiusstr. 1
D-28359 Bremen
GERMANY

Email: tferdelm@mpi-bremen.de

Biographical Sketch

Timothy G. Ferdelman
Staff Research Scientist
Group Leader, Biogeochemistry Research Group
Max-Planck-Institute for Marine Microbiology
Celsiusstr. 1       Email: tferdelm@mpi-bremen.de
D-28359 Bremen      Phone: +49(0)421-2028-632
GERMANY       Fax: +49(0)421-2028-69

(a) Professional Preparation:
i) Miami University (Oxford, Ohio), Interdisciplinary Studies, B.Phil. (1983)
ii) University of Delaware (Newark, Delaware), Marine Studies, M.S. (1998)
iii) University of Delaware (Newark, Delaware), Oceanography, Ph.D. (1994)

(b) Appointments:
Research Group Leader (W2): Biogeochemistry Research Group, Department of Biogeochemistry (since July 2007), Max-Planck-Institute for Marine Microbiology
Research Scientist (equiv. BAT IIa and Ib): Biogeochemistry Research Group, Department of Biogeochemistry (since Sept. 1994) Max-Planck-Institute for Marine Microbiology,
Research Fellow: Department of Biogeochemistry (since Sept. 1992- August 1994) Max-Planck-Institute for Marine Microbiology, Bremen

(c) Publications (out of 45 published or in press):
5 Papers most relevant to proposed work:

5 other significant publications:
dynamics on sulfide oxidation and other major biogeochemical processes in the chemocline of
Mariager Fjord (Denmark). Marine Chem., 74, 29-51
10. Fossing H, Ferdelman TG, and Berg P. 2000. Sulfate reduction and methane oxidation in
continental margin sediments influenced by irrigation (South-East Atlantic off Namibia). Geochim.
Cosmochim. Acta, 64, 897-910.

(d) Synergistic Activities
- Max-Planck-Research School (MarMic) Faculty – Courses in Biogeochemistry
- MPI Ombudsmann since 2002
- Member of the IODP Deep Sub-seafloor Life Task Force

(e) Collaborators and Other Affiliations (not at MPI-Bremen and not part of this project)
Collaborations: V. Brüchert (U. Stockholm); B.A. Cragg (U. Cardiff, Wales); H. Cypionka, (U. Oldenburg);
S. D’Hondt, (U. Rhode Island); B. Engelen, (U. Oldenburg); H. Fossing (NERI, Denmark); K. Hinrichs (U.
Bremen); S. Kasten (AWI, Bremerhaven); T. Lyons (U. Cal., Riverside); J. McKenzie (ETH, Zürich); H.
Mills (TAMU); R.J. Parkes, (U. Cardiff, Wales); R. Pockalny (U. Rhode Island); A. Schippers (BGR, Hannover);
B. Schnetger (U. Oldenburg); S. Severmann (Rutgers); D. Smith, (U. Rhode Island); A.
Spivack, (U. Rhode Island); C. Vasconcelas (ETH, Zürich); M. Zabel, (U. Bremen).

Active member of the German National Research Center MARUM (U. Bremen) since its founding in 2005;
Adjunct status to the Centre for Geomicrobiology, University of Aarhus, Denmark (B.B. Jørgensen and
colleagues).

(f) Graduate Advisors and Postdoctoral Sponsors
MS.: Prof. Thomas M. Church, (College of Marine Studies, U. Delaware)
Ph.D.: Prof. Thomas M. Church, (College of Marine Studies, U. Delaware)
Post-doctoral: Prof. B.B. Jørgensen (MPI&CfG, Aarhus) and Dr. H. Fossing (NERI, Silkeborg, Denmark)

(g) Graduate student & Postdoctoral supervision:
Present lead of the Biogeochemistry Research Group comprising 3 scientists, 7 post-docs, 7 PhD.
students, and 4 technical staff. Current direct graduate and post-doctoral supervision includes:
Postdoctorals: A. Kamyshny (MPI & U. Maryland) 11/06-; P. Meister, 09/07-; G.L. Arnold, 10/07, and A.

(h) Experience relevant to this project:
Over 20 major oceanographic expeditions including: IODP Site Survey expeditions MSM11-1 (North
Pond, 2009) and R/V Revelle Knox2RR (South Pacific 2006-07/ proponent on IODP proposal 662);
Co-chief Scientist on Meteor Expedition 76-1 (MeBo Seafloor Drilling, Benguela Upwelling, May 2008);
Co-chief Scientist IODP Expedition 307 Porcupine Carbonate Mounds; Shipboard participant on ODP
Leg 201 (Peru Biosphere)
Biosketch

STEVEN E. FINKEL
Associate Professor
University of Southern California

Department of Biological Sciences
Molecular & Computational Biology Section
Los Angeles, CA 90089-0371

Email: sfinkel@usc.edu
Phone: (213) 821-1498
Fax: (213) 740-8631

(a) Professional Preparation:
  i) University of California, Berkeley, Molecular Biology, B.A. (1987)
  ii) University of California, Los Angeles, Biological Chemistry, Ph.D. (1994)
  iii) Harvard Medical School, Microbiology & Molecular Genetics, Postdoc. (1994-1999)

(b) Appointments:
  Associate Professor: Department of Biological Sciences, Molecular & Computational Biology Section, University of Southern California (Aug. 2007-present)
  Assistant Professor: Department of Biological Sciences, Molecular & Computational Biology Section, University of Southern California (Jan. 2000-Jul. 2007)
  Member, USC/Norris Comprehensive Cancer Center (Jan. 2000-present)
  Co-Director, Undergraduate & Minority Programs, USC Center for Excellence in Genomic Science (2004-present)

(c) Publications (out of 34 published or in press)

  5 Papers most relevant to proposed work:

  5 other significant publications:

(d) Synergistic Activities (5 example activities)
3. Guest lecturer in the USC “Geobiology” course (annually since 2006)
5. Graduate Program Faculty: Molecular & Computational Biology; Program in Biological & Biomedical Sciences; Geobiology Graduate Program; Integrative & Evolutionary Biology; Genetics, Molecular & Cellular Biology; Graduate Program in Microbes & Microbial Systems

(e) Collaborators and Other Affiliations (not at USC)
J.C. Biffinger (NRL); J. Cohen (Rockefeller); G. Johnson (AFRL); R. Kolter (Harvard); A. Minsky (Israel); B.R. Ringeisen (NRL); M.H.H. Stevens (Ohio U.); H. Tissenbaum (U. Mass. Worcester); P. Webster (HEI).

(f) Graduate Advisors and Postdoctoral Sponsors
Dr. Richard Calendar, University of California, Berkeley
Dr. Reid. C. Johnson, University of California, Los Angeles
Dr. Roberto Kolter, Harvard Medical School

(g) Graduate student (Total 6) & Postdoctoral (Total 1) supervision:

*Former Postdoctorals*; M.J. Farrell, 1/01-5/05 (President, Genentext LLC, Winetka, CA.)
*Former Graduate Students*: S. Nair, 8/01-5/05 (Postdoc, Dana-Farber Cancer Institute); V. Palchevskiy, 8/01-5/07 (Postdoc, UCLA School of Medicine); E.D. Pepper, 8/01-8/07 (Assistant Professor, Santa Monica College)

*Current Students* A. Kraigsley (5th yr., MCB), C. Corzett (4rd yr. MCB/PIBBS), M. Ribbens (4rd yr., MCB), K. Chavan (3rd yr., MCB)
Bio-Sketch – S Geiger

Sebastian Geiger-Boschung
Institute of Petroleum Engineering
Heriot-Watt University and Honorary Fellow
School of Geosciences
University of Edinburgh
Sebastian.Geiger@pet.hw.ac.uk

Professional Preparation:
University of Freiburg, Germany Geology and Mineralogy Vordiplom 1997 Oregon
State University, USA Hydrogeology MSc 2000
ETH Zurich, Switzerland Computational Geology Ph.D. 2004
ETH Zurich, Switzerland Department of Earth Science Post Doc 2004 - 2005

Full-time researcher on modelling multiphase fluid flow in hydrothermal systems, mentor of PhD student Dim Coumou

Appointments:
2006-present Lecturer, Institute of Petroleum Engineering, Heriot-Watt University and Honorary Fellow, School of Geosciences, University of Edinburgh

Publications:
5 Publications most closely related to the project:


5 Other Significant Publications:


5 Synergistic Activities:
(1) I am a member of the Edinburgh Collaborative of Subsurface Science and Engineering (ECOSSE - http://www.erp.ac.uk/ecosse/). ECOSSE is the U.K.'s largest research team in geosciences and was founded by the School of Geosciences, University of Edinburgh, Institute of Petroleum Engineering, Heriot-Watt University, British Geological Survey, and the Scottish Universities Environmental Research Centre. ECOSSE researchers are working on such diverse areas as CO2 storage, reservoir simulation, reservoir geophysics/imaging, carbonate reservoirs, etc. ECOSSE was established with funding from the Scottish government.

(2) Within ECOSSE I am leading the reservoir simulation/predictability and uncertainty theme. Here we are closely collaborating with the Maxwell Institute of Mathematical Sciences to develop new, fast, and robust algorithms to improve the simulation and predictability of complex and non-linear subsurface flow processes. The Maxwell Institute is another joint research institute in Edinburgh, founded by the University of Edinburgh and Heriot-Watt University.

(3) I am leading computational hydrodynamics group at the Institute of Petroleum Engineering (consisting of 5 PhD students and 2 affiliated PhD students). Our central mission is to improve the basic understanding and predictability of non-linear multi-phase flow processes in structurally complex porous media. We do this by combining high-resolution (space-time-physics) simulations with high-performance computing, mathematical algorithm development, and laboratory work. We use apply our work to the following areas: production of oil and gas from complex hydrocarbon reservoirs, predicting subsurface storage of CO2, and exploiting geothermal energy. Funding comes from private sector companies (e.g., ExxonMobil) and UK research councils.

(4) I am a member of the Scottish Centre for Carbon Storage (http://www.geos.ed.ac.uk/scss), the U.K.'s largest group of researchers working on CCS. We cover the complete, highly interdisciplinary, chain of CCS, from capture, transport, and storage to monitoring, and also expanded our research to public awareness and policy making. The Centre is funded by the private sector and UK research councils. The head of the Centre, Prof. Stuart Haszeldine, advises the UK government on CCS.

(5) I am actively involved in various other interdisciplinary projects. For example, I am part of the organising committee of a professional workshop, hosted by the Society of Petroleum Engineers, on upscaling fractured carbonate reservoirs. Here we are aiming to bring together researchers from academia and industry to establish and define the state of the art in geology, mathematics, geophysics, and simulation for upscaling structurally complex and lithologically heterogeneous reservoirs. I am also working as a consultant for various oil companies, giving specialist lectures on reservoir simulation. I have given invited talks to the new Centre of Excellence in Geothermal Research in Italy or the Institute d Physique de Globe in Paris, discussing how techniques in petroleum engineering can actually benefit the fundamental research in hydrothermal and geothermal systems.

Collaborators and Co-Editors:
Dr Susan Agar, ExxonMobil Upstream Research Company; Dr Mandefro Belayneh, Dept of Earth Sciences and Engineering, Imperial College, London; Dr Jens Birkholzer, Lawrence Berkeley National Laboratory; Prof Martin Blunt, Dept of Earth Sciences and Engineering, Imperial College, London; Dr Ian Butler, School of Geoscience, University of Edinburgh; Dr Andrea Cortis, Lawrence Berkeley National Laboratory; Dr Dim Coumou, Potsdam Institute of Climate Impact Research; Dr Thomas Driensker, Dept of Earth Science, ETH Zurich; Dr Steve Elphick, School of Geoscience, University of Edinburgh; Dr Simon Emmanuel, Dept of Geology and Geophysics, Yale University; Prof Colin Graham, School of Geoscience, University of Edinburgh; Prof Reiner Helmig, Institute of Hydraulic Engineering, University of Stuttgart; Dr Randi Holm, Centre for Integrated Petroleum Research, University of Bergen; Prof Gabriel Lord, Dept of Mathematics, Heriot-Watt University; Prof Stephan Matthai, School of Reservoir Engineering, Montan University, Leoben; Dr Jennifer Niessner, Institute of Hydraulic Engineering, University of Stuttgart; Dr Ingo Pecher, GNS Science Ltd, New Zealand; Prof Sonja Philipp, Centre for Geosciences, University of Goettingen; Dr Fiona Reid, Edinburgh Parallel Computing Centre

Graduate Advisors and Postdoctoral Sponsors:
PhD: Prof Christoph Heinrich and Dr Thomas Driesner
Institute of Isotope Geochemistry and Mineral Resources, Switzerland

MSc: Prof Roy Haggerty and Prof John Dilles, Oregon State University

Thesis Advisor and Postgraduate-Scholar Sponsor
M. Lupi, A. Tambue, G. Nicoll, K. Schmid, Y. Zaretskiy, C. Fricke, R. Annewandter, all current PhD students (total: 7)
Biographical Sketch

James B. Gill
Distinguished Professor, Earth and Planetary Sciences
University of California, Santa Cruz, California 95064

Professional Preparation:
Wheaton College (Ill.) (Geology) B.S. 1966
Franklin and Marshall College (Pa.) (Geology) M.S. 1968
Australian National University (Geochemistry) Ph.D. 1972

Appointments:
Distinguished Professor: 2005-current
Professor, UCSC, 1984-2005
Vice Chancellor for Research, 1994-00
Chair, Monterey Bay Crescent Ocean Research Consortium, 1998-00
Director, Monterey Bay Education Science and Technology Center, 1993-1996
Dean, Division of Graduate Studies and Research, 1990-91, 1999
Chair, Earth Sciences, 1986-89
Assistant and Associate Professor, UCSC, 1972-84
Visiting Professor:
University of Canterbury Erskine Fellow, 1998
Université Blaise Pascal (Clermont Ferrand), 1991-92.
Tohoku and Tokyo Universities, 1985-86
Université Paris VII, 1980-81
University of Auckland, 1976-77

Ten representative publications


**Synergistic Activities:** For six years I was a research vice chancellor as well as scientist and gave Congressional testimony about science in public policy. Currently I serve on the MARGINS Steering Committee.

**Collaborators during the last four years (other than former grad students):**
D. Clague (MBARI); K. Hoernle (Geomar); D. Kelley (UW); P. Michaels (Tulsa); Y. Tamura and J. Kimura (IFREE/JAMSTEC); S. Turner (Macquarie).

**THESIS ADVISORS:** S.R. Taylor and W. Compston (ANU)


**POST-DOCTORAL ASSOCIATES (total: 8):** P. Jezek (retired); R. Williams (LLNL); K. Hoernle (Geomar); S-W Wee (Korean National); F. Tepley (OSU), F. Ramos (NMSU); C. Harris; B. Dreyer.
**BIOGRAPHICAL SKETCH, Peter R. Girguis**

**Education**
University of California, Santa Barbara,
Ecology, Evolution and Marine Biology  PhD  2000
University of California, Los Angeles
Physiology and Marine Biology  B.Sc., with Honors  1994

**Appointments**
2005-present Harvard University
   Assistant professor, Organismic and Evolutionary Biology
2005-present Monterey Bay Aquarium Research Institute
   Adjunct Research Scientist
2001-2004 Monterey Bay Aquarium Research Institute
   Packard-MBARI Postdoctoral Fellow

**10 Relevant Publications**


**Synergistic Activities**

- NSF-Ridge 2000 Distinguished Lecturer for Education and Outreach;
- Founder of the Cambridge-Rindge Latin School-Harvard University “Students on the sea” program;
- Led the development of an Internet-based science question and answer program ([www.scienceline.ucsb.edu](http://www.scienceline.ucsb.edu));
- Promotion of outreach opportunities through participation in the REVEL program ([http://www.ocean.washington.edu/outreach/revel/](http://www.ocean.washington.edu/outreach/revel/));
- Vice-president of OceansWide, an experience-based educational program to introduce ocean sciences to K-12 in New England ([http://www.oceanswide.org](http://www.oceanswide.org))

**Collaborators and Co-Editors**

Dr. Virginia Armburst (University of Washington); Dr. John Baross (University of Washington); Dr. James J. Childress (University of California Santa Barbara); Dr. John Delaney (University of Washington); Dr. Edward DeLong (MIT); Dr. Charles Fisher (Penn State University); Dr. Deborah Kelley (University of Washington); Dr. Raymond Lee (Washington State University); Dr. George Luther (Univ. Delaware); Dr. Ann Pearson (Harvard University); Dr. Clare Reimers; Dr. Geoff Wheat (University of Alaska)

**Postdoctoral Supervisor:** Dr. Ed DeLong, MBARI
**Graduate Advisors:** Dr. James Childress, UC Santa Barbara
Dr. Robert Trench, UC Santa Barbara
Dr. Raul Suarez, UC Santa Barbara
Biosketch

BRIAN T. GLAZER
University of Hawaii (UH) (808) 956-6658 phone
Department of Oceanography (808) 956-9225 fax
205 Marine Science Building glazer@hawaii.edu
Honolulu, HI 96822

EDUCATION
Pennsylvania State University Biology B.S. (1997)
University of Delaware Marine Studies M.S. (2000)

APPOINTMENTS
UH Department of Oceanography, Assistant Professor 2006-present
UH Department of Ocean and Resources Engineering, Cooperating Graduate Faculty 2007-present
UH NASA Astrobiology Institute, Postdoctoral Fellow 2004-2006

PUBLICATIONS (out of 22 published, 5 currently submitted)

Five publications most relevant to proposed work:

Five other significant publications:
SYNERGISTIC ACTIVITIES (5 example activities)

Deep submergence fieldwork: Participated in 13 UNOLS research cruises, 11 DSV *Alvin* dives, 3 DSV *Jason* cruises, since 2000.


University education: instructor for graduate Chemical Oceanography, and Aquatic Geomicrobiology, undergraduate Global Biogeochemistry; guest lectures for graduate UH Computational Astrobiology Course, UH Astrobiology Seminar Series; coordinator for Oceanography Department Biogeochemistry Brown Bag series; chair of UH Oceanography Marine Geology & Geochemistry Division Curriculum Committee; invited seminar, University of Hawaii Ocean and Resources Engineering Department, “Technology development for marine biogeochemistry and geomicrobiology”, Member, cooperating graduate faculty, University of Hawaii Department of Ocean and Resources Engineering, 2007-present; invited lecture, Oregon Health and Science University, “In situ investigations of geomicrobial synergy within oxic-anoxic transition zones”


COLLABORATORS (not at UH and not affiliated with this proposal)

S. Craig Cary (UD); Greg Druschel (UVM); Dave Emerson (Bigelow); George W. Luther, III (UD); Craig Moyer (WWU); Donald Nuzzio (AIS, Inc.); Hubert Staudigel (UCSD); Martial Taillefert (GaTech); Brad M. Tebo (OHSU)

Graduate Advisors and Postdoctoral Sponsors:

James P. Cowen (UH-NASA Astrobiology, postdoc); George W. Luther, III (University of Delaware, Ph.D.); Kent S. Price (retired, University of Delaware, M.S.)

Thesis Advisor and Postgraduate-Scholar Sponsor: (graduate thesis advisor total: 3):

2009-present – Ph.D. advisory committee chair, Jennifer Murphy, UH-Oceanography;
2008-present – M.S. advisory committee chair, Michael Matzinger, UH-Oceanography;
2008-present – M.S. advisory committee member, Sean Jungbluth, UH-Oceanography;
2008-present – Ph.D. advisory committee member, Huei-Ting Lin, UH-Oceanography;
2008-present – M.S. advisory committee member, Brian Jaress UH-Information and Computer Sciences;
2006-present - M.S. advisory committee chair, In Chieh Chen, UH-Ocean and Resources Engineering;
2006-present - Ph.D. advisory committee member, Rebecca Briggs, UH-Oceanography;
2001-2004 - supervised summer research efforts of visiting undergraduates enrolled in the NSF Research Experience for Undergraduates program at UD
John Francis Heidelberg

**Professional Preparation.**
Maryville College, Maryville, TN. Biology. B.A. 1987
University of Maryland, College Park, MD, Marine-Estuarine-Environmental Sciences. Ph.D. 1997

**Professional Experience.**
2006 – Present Associate Professor, University of Southern California (USC)
2006 – Present Adjunct Researcher, The J. Craig Venter Institute (JCVI)
2006 – 2007 Present Adjunct Associate Investigator, The Institute for Genomic Research
2004 – 2006 Associate Investigator, The Institute for Genomic Research (TIGR)
1999 – 2004 Assistant Investigator, The Institute for Genomic Research (TIGR)
1999-99 Collaborative Investigator, The Institute for Genomic Research (TIGR)
1997-99 Post-Doctoral Fellow, The Institute for Genomic Research (TIGR)
1996-96 Graduate Teaching Assistant, Department of Microbiology, UMD
1992 –94 Faculty Research Assistant, Center for Agricultural Biotech., UMD
1991-92 Graduate Teaching Assistant, Marine-Estuarine Environmental Sci, UMD
1990- 91 Graduate Research Assistant, Department of Microbiology, UMD
1987-89 Animal Program Coordinator, Brukner Nature Center, Troy Ohio

**Five publications most relevant to the proposed research.**

**Additional Significant Publications.**
Synergistic activities.
1) Involved in the reorganization and automation of genome closure process, including serving as new faculty mentor at TIGR.
2) Is an invited speaker for talks on both specific genomes (i.e., *Vibrio cholerae*) and to speak on general environmental genomics. Heidelberg makes special efforts to speak at small colleges and from multi-disciplinary graduate programs to environmental genomics to a broader audience.
3) Instructor in the BBSR Environmental Genomics course.
4) As volunteered for the TIGR-Mentor for high school and undergraduate students in the Maryland/DC area.

Current collaborators.
Aravind, L. (NCBI); Bhaya, Devaki (The Carnegie Institution); Cohan, F. M. (Wesleyan University); Colwell, R.R. (UMD); Daly, M. J. (USUSH); DeLong, E. (MIT); Dougherty, B. A. (Bristol-Myers Squibb); Duncan, M. (Forsyth Dental Center); Eisen, J. A. (UC-Davis); Fleischmann, R. D. (TIGR); Fraser, C. M. (TIGR); Grossman, A.R. (The Carnegie Institution); Haft, D. H. (TIGR); Heizen, R.A. (University of Wyoming); Jeffries, A. C. (Chiron); Leung, K. (Department of the Army); Lindner, L (WRAIR); Masignani, V. (Chiron); McClarly, G. (University of Manitoba); Mekalanos, J. J. (Harvard Medical School); Moxen, E. R. (Chiron); Nelson, K. E. (TIGR); Nelson, W. C. (TIGR); Nierman, W.C. (TIGR); Paulsen, I. (TIGR); Peterson, J. D. (TIGR); Pizza, M. (Chiron); Porgulske-Fox, A. (University of Florida); Qin, H. (LTI); Rappuoli, R. (Chiron); Salzberg, S. L. (UMD); Samuel, J.A. (Texas A&M); Smith, H. O. (VI); Sutton, G. G. (VI); Tettelin, H. (TIGR); Venter, J. C. (VI); Voordouw, G. (University of Calgary); Walker, C (University of Florida); Wall, J.D. (University of Missouri-Columbia); Ward, D.M. (Montana State University); White, O. (TIGR); Zinder, S. (Cornell University).

Graduate Advisor: Rita R. Colwell (University of Maryland, College Park, MD)
Postdoctoral Advisor: Owen White, TIGR; Rebecca Clayton, TIGR

Thesis Advisor (0) and Postgraduate-Scholar Sponsor (0)
Grim, Christopher. UMBI, Graduate Committee Member
KARLA B. HEIDELBERG

Department of Biology, AHF 231 Phone: (310) 510-4038
University of Southern California Fax: (310) 510-1364
Los Angeles, CA 90089 Email: Kheidelb@usc.edu

(A) PROFESSIONAL PREPARATION:
- Maryville College, TN (Individualized major in Biology) B.A. (Honors) 1988
- University of Maryland, College Park, MD and UMCES Horn Point Laboratory Marine-Estuarine Environmental Sciences, (Biological Oceanography) PhD 1999
- Univ. Maryland, College Park, Department of Biology,
  Effects of hydrodynamics and prey behavior on Coral Heterotrophic Feeding.
  Postdoctoral Fellowship 1999-2001

(B) APPOINTMENTS:
2006-Present Assistant Professor, University of Southern California, Department of Biological Sciences and Wrigley Institute of Marine Science.
2006-2008 Adjunct Research Scientist. J. Craig Venter Institute, Rockville, MD
2003-2006 Environmental Genomics Global Program Coordinator/Scientist. J. Craig Venter Institute, Rockville, MD
2001-2004 Adjunct Research Faculty. Dept. of Biology, Univ. Maryland, College Park
2002-2003 Adjunct Teaching Faculty. Hood College. Frederick, MD

(C) 5 PUBLICATIONS MOST CLOSELY RELATED TO THIS PROJECT:


Shibu Y, G Sutton, DB Rusch, AL Halperrn, S Williamson, K Remington, JA Eisen, KB Heidelberg, G Manning, W Li, L Jaroszewski, P Cieplak, CS Miller, H Li, ST Mashiyama, MP Joachimiak, C van Belle, JM Chandonia, DA Soergel, Y Zhai, K

OTHER PUBLICATIONS:

(D) SYNERGISTIC ACTIVITIES:
(2007/08) Hydrothermal vents and Antarctica expeditions http://www.expeditions.udel.edu/
(2006) Scientific Advisor; Discovery Documentary Cracking the Ocean Code

(E) COLLABORATORS/OTHER AFFILIATIONS (not at USC or from this proposal):

(F) GRADUATE STUDENT SUPERVISION (total 4)
As Major Graduate Advisor: Amy Koid, 2007-present. (PhD); Nadine Eisenkolb, (PhD)
Graduate Student Committee Service: Sharon Longford (External PhD Dissertation reviewer, UNSW, AUS); Adrianne Jones (USC PhD candidate); Rowan C. Martindale (USC PhD candidate); Diane Kim (USC PhD student); Beth Staufford (USC PhD student); Tonja Slota (MS, 2003, U. MD).

(G) EXPERIENCE RELEVANT TO THIS PROJECT
Kai-Uwe Hinrichs
Organic Geochemistry Group, Head
Department of Geosciences & MARUM Center for Marine Environmental Sciences
University of Bremen, PO Box 330 440
D-28334 Bremen, Germany

Tel: 0421-218-65700
Fax: 0421-218-65715
Email: khinrichs@uni-bremen.de
Web: http://www.marum.de/English/Kai-Uwe_Hinrichs.html

EDUCATION:
University of Oldenburg (ICBM), Germany, Chemistry, Diploma (equiv. to M. Sc.) 2/1994
University of Oldenburg (ICBM), Germany, Organic Geochemistry, Ph.D. 5/1997

APPOINTMENTS:
5/2004 – present Full Professor (W3 with tenure), Dept. of Geosciences, University of Bremen
3/2004 – present Adjunct Scientist, Dept. of Geology & Geophysics, WHOI
10/2002 -4/2004 Associate Professor (C3, tenured), Dept. of Geosciences, University of Bremen
7/2000 – 12/2002 Assistant Professor, tenure-track, Dept. of Geosciences, University of Bremen

5 SELECTED PUBLICATIONS RELEVANT TO THIS PROPOSAL (OUT OF 44 PUBLISHED OR IN PRESS)


5 OTHER PUBLICATIONS


SELECTED PROFESSIONAL ACTIVITIES RELEVANT TO THIS PROPOSAL:

■ Participation in seagoing expeditions: ODP Leg 155 (1994) Amazon Fan, ODP Leg 201 (2002, as co-proponent) Continental margin off Peru & Equatorial Pacific; Meteor Exp. 67/2b with ROV Quest, Gulf of Mexico (2006); RV Point Lobos with ROV Ventana, Eel River Basin (1999)


■ Conference chairman, 24th International Meeting on Organic Geochemistry, Bremen, 2009

■ Member, Editorial board, Geology (2004-2006)

■ Associate Editor, Organic Geochemistry (2006 – )


■ Co-Chair of MARUM Research Area Seepage of fluid and gas (jointly with G. Bohrmann; 2004-2006) and Biogeochemical Processes (jointly with M. Zabel; 2007 – present), both areas to be succeeded by new area Geosphere-Biosphere Interactions (Hinrichs, Zabel, Bohrmann, Boetius, 7/2009 ff.).

■ Member, MARUM board of directors since 2004.

COLLABORATORS AND OTHER AFFILIATIONS (NOT AT U BREMEN, AND NOT PART OF THIS PROJECT)

Antje Boetius (MPI Bremen), Tim Ferdelman (MPI Bremen), John M. Hayes (WHOI), Christopher House (Penn State U), Samantha Joye (U Georgia), Victoria Orphan (CalTech), John Pohlman (USGS Woods Hole), Stefan Sievert (WHOI), Roger E. Summons (MIT), Stuart Wakeham (Skidaway Institute of Oceanography)

Graduate Advisors and Postdoctoral Sponsors:

Prof. Jürgen Rullkötter (University of Oldenburg (ICBM), Germany)
Prof. John M. Hayes (Woods Hole Oceanographic Institution (WHOI))

GRADUATE STUDENT AND POSTDOCTORAL SUPERVISION (AS PRIMARY ADVISOR, ONLY)


Biographical Sketch of Julie A. Huber

Contact Information
Assistant Scientist
Josephine Bay Paul Center
Marine Biological Laboratory
7 MBL Street
Woods Hole, MA 02543
Tel: (508) 289-7291
Fax: (508) 457-4727
Email: jhuber@mbl.edu

Professional Preparation
Undergraduate Education:
Eckerd College
Marine Science, Biology
B.S. 1998

Graduate Education:
Univ. of Washington
Biological Oceanography
M.S. 2000
Univ. of Washington
Biological Oceanography
Ph.D. 2004
Univ. of Washington
Astrobiology
Cert. 2004

Postdoctoral Institutions:
Marine Biological Laboratory
NRC/NASA Postdoctoral Fellow 2005-2006

Appointments
2008- Assistant Professor (MBL), Department of Ecology and Evolutionary Biology, Brown
2007- Assistant Scientist, Marine Biological Laboratory
2005-2006 NRC/NASA Postdoctoral Fellow, Marine Biological Laboratory
1998-2000 Research Assistant, University of Washington, Oceanography
1996-1998 Research Assistant, Eckerd College, Marine Science

Publications
Selected Related Publications:

Selected Unrelated Publications:
nitrogenase genes in the deep NE Pacific Ocean. *Environ. Microbiol.* 7:1525-1534


**Synergistic Activities**

- Lecturer, Living in the Microbial World, Marine Biological Laboratory (2006-)
- Totem Award (Puget Sound Chapter of the Public Relations Society of America) and Communicator of Excellence Award (Washington Press Association) for *Life Deep Down: Scientists explore undersea volcanic vents on ABCNews.com* (1999)
- Deep-sea vent research cruise participant on 10 NSF and NOAA cruises (1998)

**Collaborators & Other Affiliations (not at the MBL or part of this proposal)**

*Collaborators and Co-Editors:*

*Graduate and Postdoctoral Advisors:*
Baross, J.A. (U. Washington) and Sogin, M.L. (Marine Biological Laboratory).

*Thesis Advisor and Postgraduate-Scholar Sponsor:*
None
FUMIO INAGAKI
Group Leader, Principal Scientist
Geomicrobiology Group, Kochi Institute for Core Sample Research,
Japan Agency for Marine-Earth Science & Technology (JAMSTEC),
Monobe B200, Nankoku 783-8502, Kochi, Japan
Phone: +81-88-878-2204; Fax: +81-88-878-2192; E-mail: inagaki@jamstec.go.jp

Professional Preparations
- Kyushu University, Fukuoka, Japan, Faculty of Agriculture, (Microbiology) B.S. 1995
- Kyushu University, Microbial Genetics Division, Institute of Genetic Resources, Faculty of Agriculture, (Molecular Genetics) M. Sc. (Diploma student) 1997
- Kyushu University, Microbial Genetics Division, Institute of Genetic Resources, Faculty of Agriculture, (Microbial Ecology) Ph. D. 2000
- Dissertation: Effects of the extremely thermophilic bacteria on the formation of siliceous deposits in geothermal environments

Appointments
- April 2007-, Group Leader and Principal Scientist of the Geomicrobiology Group, Kochi Institute for Core Sample Research, JAMSTEC
- April 2006 -2007, Research Scientist of the Kochi Institute for Core Materials, JAMSTEC
- April 2005 -2009, Sub-Leader, Extremobi osphere Research Center, JAMSTEC
- April 2005 – March 2006, Guest Scientist of the Biogeochemistry Group, Max-Planck-Institute for Marine Microbiology, Bremen, Germany
- April 2000 – March 2005, Research Scientist, JAMSTEC

5 publications that are most closely related to the proposal (out of 60 published or in press)

5 Other Significant Publications

**Synergistic Activities**

- Co-chair of the IODP Workshop “Exploration of Subseafloor Life with the Integrated Ocean Drilling Program”, Vancouver, Canada, 2006
- Committee member of IODP-Science Steering and Evaluation Panel (SSEP) (2008-)
- Chair of the session “Subseafloor life and biosphere”, ISSM 2008, Shizuoka, Japan (2008)

**Collaborators (not at JAMSTEC)**

Antje Boetius (MPI-Bremen), Frederick S. Colwell (OSU), Taiki Futagami (Kyushu Univ., Japan), Kai-Uwe Hinrichs (Univ. Bremen), Anna Kaksonen (Tampere Univ. Tech, Finland), Kengo Kubota (Tohoku Univ., Japan), Mark A. Lever (Aarhus Univ., Denmark), Julius Lipp (Univ. Bremen), Satoshi Nakagawa (Hokkaido Univ., Japan), Ko-ichi Nakamura (AIST, Japan), Kenneth H. Nealson (USC), Yohey Suzuki (AIST, Japan), Hitoshi Tomaru (Univ. Tokyo).

**Graduate Advisors and Postdoctoral Sponsors:**

Prof. Seiya Ogata (Kyushu University, Japan)

**Experience Relevant to this project**

- ODP Leg 201, shipboard scientist, the Eastern Equatorial Pacific and Peru Margin (2002)
- IODP Expedition 301, shipboard scientist, the Juan de Fuca Ridge Flank (2004)
- PI of CK06-06 Chikyu Shakedown Cruise, gas-hydrates off Japan (2006)
- IODP Expedition 316, shipboard scientist, the Nankai Trough seismogenic zone (2007-2008)
- Chief scientist of CK09-01 Chikyu training cruise Leg 1, the Kumano mud-volcano (2009)

**Educational work (international)**

2007 NSF-JSPS Summer Program Research Fellow (Mark A. Lever, UNC)
2008 NSF-JSPS Summer Program Research Fellow (Brandon Brigss, OSU)
2008 ECORD Summer School Lecturer, Bremen

**Awards**

- Japan Society for the Promotion of Science Research Fellow (1999) (c/o Prof. Seiya Ogata)
- Alexander von Humboldt Foundation Research Fellow (2005-2006) (c/o Prof. Bo Barker Jørgensen)

**Expertise**

Geomicrobiology, Molecular Ecology, Microbiology, Biogeochemistry
Biographical Sketch of

BO BARKER JØRGENSEN
Professor, Director
Center for Geomicrobiology, Dept. of Biological Sciences
University of Aarhus, Denmark
& Max Planck Institute for Marine Microbiology
28359 Bremen, Germany

Tel: +45 89 42 33 14
Fax: +45 89 42 27 22
Email: bo.barker@biology.au.dk

(a) Professional Preparation
i) University of Aarhus, Denmark, Biology, M.S. 1973
ii) University of Aarhus, Denmark, Biology, Ph.D. 1977

(b) Appointments
Head of Center for Geomicrobiology, University of Aarhus, Denmark (since October 2007)
Professor, Dept. of Geology, University of Bremen, Germany (since 1993)
Adjunct Professor, Dept. of Biological Sciences, University of Aarhus (since 1993)
Director, Max Planck Institute for Marine Microbiology, Bremen, Germany (since 1992)
Research Professor of the Danish Natural Science Research Council, Univ. of Aarhus (1987-1992)
Senior Lecturer, Dept. of Ecology and Genetics, University of Aarhus (1977-1987)

(c) Publications
(>250 peer-reviewed publications, incl. 22 publ. in Science and Nature, ISI Highly Cited Scientist)

Selected Related Publications:

Selected Unrelated Publications:
(d) Synergistic Activities (5 examples)

- Lectures on the Deep Biosphere to the general public for 1700 people, March 2009
- DRILLS (Distinguished Researcher & International Leadership Lecture Series) lecturer of the IODP on the deep sub-seafloor biosphere at six universities in the USA, March 2008
- Faculty of the “Austral Summer Institute” course in Benthic Geology and Microbiology, Dichato, Chile (Jan/Feb 2006)
- Two programs, based on my research, on the Danish State Television (30 min, 2005) and Danish State Radio (45 min, 2007) on Methane in the Seabed and on The Deep Biosphere. The TV program won an international award for science programs.

(e) Collaborators & Other Affiliations

Rudolf Amann (MPI-Bremen, D), Carol Arnosti (UNC), Peter Berg (Univ. Virginia), Antje Boetius (MPI-Bremen, D), Bernie P. Boudreau (Dalhousie Univ., CN), Donald E. Canfield (Univ. Southern Denmark), Philippe van Cappellen (Georgia Tech.), Andrew W. Dale (IfM-GEOMAR, Kiel), Steven D’Hondt (URI), Timothy Feredman (MPI-Bremen, D), Kai Finster (Univ. Aarhus, DK), Kai-Uwe Hinrichs (Univ. Bremen, D), Tori M. Hoehler (NASA-ARC, Moffett Field), Markus Hüttel (FSU), Fumio Inagaki (JAMSTEC, JP), J. Gijs Kuenen (Univ. Delft, NL), Marcel Kuypers (MPI-Bremen, D), Richard Pancost (Bristol Univ., GB), R. John Parkes (Univ. Cardiff, GB), Gregor Rehder (IOW, D), Axel Schippers (BGR; Hannover, D), Volkhard Spies (Bremen Univ., D), Andreas Teske (UNC), Michael Wagner (Univ. Vienna, A)

(f) Graduate Advisors and Postdoctoral Sponsors

Thesis Advisor: Prof. Tom Fenchel (University of Aarhus, Denmark)

(g) Graduate student & Postdoctoral supervision

- Current Postdoctorals: H. Røy, 10/07-; B. Gribsholt, 10/07-; K. U. Kjeldsen, 3/08-; M. Lever, 1/09-
- Former Postdoctorals: ca 20

- Current Ph.D. students: R, Dunker, A. Vossmeyer, Julia Rosa de Rezende, Irene H. Tarpgaard
- Former Ph.D. students: ca 40

(h) Experience relevant to this project

- R/V Atlantis with submersible ALVIN, Guaymas Basin (2008)
- Chief scientist, R/V Poseidon with submersible JAGO, Black Sea (2004)
- Chief scientist, R/V Meteor, Black Sea (2001)
- Chief scientist, R/V Poseidon, Benguela upwelling system off Namibia (1999)
- Chief scientist, R/V Petr Kottsov, Black Sea (1997)
- Coordinator of EU project BALTIC GAS, 12 international partners (2009-2011)
- Coordinator of EU project METROL, 10 international partners (2002-2005)
- Scientific Steering Committee, EU Integrated Project HERMES (42 international partners)
Biographical Sketch of Jens Kallmeyer

Contact Information:
University of Potsdam,
Department of Geosciences,
Geomicrobiology Group
Karl-Liebknecht Str. 24, Haus 27
D-14476 Potsdam

Tel: *49-331-977-5694
Fax: *49-331-977-5700
Email: kallm@geo.uni-potsdam.de

Professional Preparation:
University of hannover (Germany)                      Geology                      Vordiplom (B.S. equivalent)                  1995
University of Bremen (germany)                       Geology                      Diplom (M.Sc> equivalent)                   1998
University of North Carolina at Chapel Hill          Marine Sciens, Rotary Ambassadorial Scholar 1999
Max Planck Institute for MarineMicrobiology         Microbiology                  PhD                                        2003
GeoforschuhgsZentrum Postdam, Dept Organic Geochemistry PostDoctoral 2003 -2004
Astrobiology Institute, Graduate School of Oceanography, University of RI      PostDoc 2005 -2006
Geoforschungszentrum Potsdam, Dept Organic Geochemistry PostDoctoral 2007 -2008

Appointments:
11/2008 – Present    Head of the Geomicrobiology Research Group, University of Postdam
                      Equivalent to Assistant Professor

Publications:
Selected Related Publications:

Selected Unrelated Publications:


**Synergistic Activities:**
1) International Continental Drilling Program (ICDP) Observer to the Subsurface Life Task Force of the Integrated Ocean Drilling Program (IODP) to foster the cooperation between the different programs.
2) Responsible for the construction and implementation of the mobile Geomicrobiology Research Laboratory “BugLab” at GFZ Potsdam.

**Collaborators & Other Affiliations**

**Collaborators and Co-Editors**
1) Prof. Charles Cockell, Open University, Milton Keynes, UK
2) Prof. Akper Feyzullaev, National Academy of Sciences, Baku, Azerbaijan
3) Dr. Britta Gribsholt, Dr. Hans Røy, Center for Geobiology, Aarhus University, Denmark
4) Dr. Axel Schippers, German Federal Institute of Geosciences and Natural Resources (BGR), Hannover
5) Prof. Tina Treude, IFM/Geomar, University of Kiel, Germany

**Graduate Advisors and Postdoctoral Sponsors:**
PhD supervisor: Prof. Bo Barker Jørgensen, Dr. Tim Ferdelman (both MPI Bremen)
Postdoctoral supervisors: Prof. Brian Horsfield (GFZ Potsdam); Steven D'Hondt, David Smith (both GSO-URI)

**Thesis Advisor (total: 2) and Postgraduate-Scholar Sponsor:**
Rishi Ram Adhikari, PhD student since 11/08
Patrick Sauer, PhD student since 11/08
Biographical Sketch - Fabien KENIG, UIC

(a) Education:
Université d’Orsay, France  Geology    Maitrise  1985
Université d’Orsay, France  Sedimentology, Geophysics D.E.A.   1986
Université d’Orléans, France  Organic Geochemistry  Doctorate 1991

(b) Postdoctoral Experience:
Indiana University, Bloomington, Biogeochemical Laboratories  1990-1992
Netherlands Institute for Sea Research (NIOZ) Division of Marine Biogeochemistry 1993-1994
University of Hawaii (SOEST) Dept. of Geology and Geophysics  1994-1995

(c) Appointments
Professor, University of Illinois at Chicago,  2008-pres.
Associate Professor, University of Illinois at Chicago,  2002-2008
Assistant Professor, University of Illinois at Chicago  1996-2002

(d) Five publications relevant to the proposed research

(e) Five other significant publications


(f) Synergistic activities

- Since Fall-96, my laboratory trained 23 undergraduate students, including 5 female minority students (Asian and Hispanics). Most of them helped in the advancement of externally funded research projects. Most of the students trained in organic geochemical experimental procedures continued to work in my laboratory for independent research projects.
- Panel member for two NASA programs during 2005-2006.
- K12: Taught Introduction to Planetary Geology to 4th grader.
- Campus Director, Illinois Space Grant Consortium, 2007

(g) Collaborators

Collaborator to the McMurdo LTER; Ken Anderson (SIU); Yosi Bar-Cohen (NASA JPL); Andre Bekker (University of Manitoba); Simon Brassell (Indiana University); Jim Cowen (University of Hawaii); David Crich (UIUC, Chemistry Dept.); David DesMarais (NASA-Ames); Peter Doran (UIUC); Steve Forman (UIUC); Chris H. Fritsen (DRI, Reno); Glenn Frysinger (Coast Guard Academy); Richard Gaines (Coast Guard Academy); John D. Hudson (Univ. of Leicester, UK); W. Berry Lyon (Byrd Polar Res. Center); Jennie McElwain (FMNH); Chris P. McKay (NASA Ames); Alison Murray (DRI, Reno); John C. Priscu (Montana State); Christopher Reddy (WHOI); Summons Roger E. (MIT); Brad Sageman (NWU); Philippe Schaeffer (CNRS, Strasbourg, Fr); Martina Schmeling (Loyola University); Claudia Schroeder-Adams (Carleton University, CA); Juergen Shieber (Indiana University); Jaap S. Sinninghe Damsté (NIOZ, NL); Neil Sturchio, (UIUC)

Graduate and Post-Doctoral Advisors

Alain Y. Huc (IFP, France),
Jean Trichet (Université d’Orléans, France),
John M. Hayes (WHOI),
Jan W. de Leeuw (NIOZ, NL),
Brian N. Popp (University of Hawaii)

Thesis advisor for
Graded:
Difrancesco Gregory (MS, 2000),
Simons Dirk-Jan (Ph.D. 2001),
Brown Todd (MS 2003),
Lawson Jennifer (Ph.D. 2005),
Mygurskiy Anton (MS, 2005),
Ventura Todd (Ph.D., 2006)
Jaraula Caroline (Ph.D. 2008)

4 PhD Students advised, 0 Post Docs sponsored
Biographical Sketch

ROSALYNN Y. LEE
Program Manager
University of Southern California
Department of Biological Sciences
Marine Environmental Biology Division
Los Angeles, CA 90089-0371 Email: rosalyyl@usc.edu

(a) Professional Preparation:
   i) Undergraduate Education:
      University of Virginia, Department of Environmental Sciences, B.A. (1998)
   ii) Graduate Education:
      University of Georgia, Department of Marine Sciences, Ph.D. (2006)
   iii) Postdoctoral Institutions:
      Rutgers University, Institute of Marine and Coastal Sciences (2005-2008)

(b) Appointments:
Program Manager of NSF-sponsored DEBI RCN (Research Coordination Network):
Department of Biological Sciences, Marine Environmental Biology Division, University of
Southern California (since March 2009)

(c) Publications (published or in press):
5 publications not related to proposed work:

(d) Synergistic Activities
• Training of Scientists and Managers. Instructed participants from developing countries and countries with economies in transition in the use of spatially explicit, global GIS models of nutrient transport by rivers to coastal systems as part of a UNESCO-Intergovernmental Oceanographic Commission project (two week series in January and September 2006).
• Coordination of Scientific Interaction. Managed the NSF Research Coordination Network project on denitrification to bring together scientists studying denitrification from a wide array of disciplines through networking, annual workshops, and online training (2005-2008).
• Teaching of Undergraduate Students. Instructed lectures and laboratories for Physical Oceanography (Fall 1998), Biological Oceanography (Spring 1999), The Marine
Environment (Fall 2004), and Biology of the Marine Environment (Spring 2005) at the University of Georgia.

- Outreach to the Public. Mentored high school science teachers in the field and laboratory, and communicated with elementary school students in the classroom and the general public at the Sandy Creek Nature Center (Athens, Georgia, 2000-2004).

(e) Collaborators and Co-Editors
S. Seitzinger (IGBP, Rutgers University), E. Davidson (WHRC), R. Zepp (EPA), G. Shank (UTMSI), S. Joye (UGA), C. Meile (UGA)

(f) Graduate Advisors and Postdoctoral Sponsors:
Dr. Samantha B. Joye (University of Georgia)
Dr. Sybil P. Seitzinger (Rutgers University, Institute of Marine and Coastal Sciences)

(g) Undergraduate Student Supervision:
- 2007 Summer REU: Chava Weitman (Rutgers University)
- 2001 Summer REU: Ellen Fragaszy (University of Georgia)
Biographical Sketch of Steve P. Lund

Contact Information
College of Letters, Arts and Sciences Tel: (213) 740-5835
Fax: Email: slund@usc.edu

Professional Preparation
Undergraduate Education:
University of North Dakota Department of Geology BS 1972

Graduate Education:
University of Minnesota Department of Geology and Geophysics MS 1976
University of Minnesota Department of Geology and Geophysics PhD 1981

Postdoctoral Institutions:
University of Southern California Department of Earth Sciences 1980-1982

Appointments
Prof Department of Earth Sciences, University of Southern California 2000-present
Assoc Prof Department of Earth Sciences, University of Southern California 1991-2000
Asst Prof Department of Earth Sciences, University of Southern California 1988-1991
Asst Res Prof Department of Earth Sciences, University of Southern California 1982-1988

Publications
Selected Related Publications:

Selected Unrelated Publications:
5. S. P. Lund. A comparison of the Late Quaternary statistical secular variation that is recorded in

**Synergistic Activities**

- Shipboard Scientist ODP Leg 172, ODP Leg 202, IODP Expedition 310
- Science Party ODP Leg 167, IODP Expedition 310
- LacCore National Lake Sediment Core Repository/Analysis Center – External Advisory Panel, 2005-present, Chairman 2009-present.

**Collaborators & Other Affiliations**

*Collaborators and Co-Editors: (primary only, not at USC)*

- Larry Benson (USGS-Boulder), Gilbert Camoin (CENERGE – France), Tom Johnson (U Minnesota-Duluth), Lloyd Keigwin (WHOI), Matthew Kirby (Cal State- Fullerton), Scott Mensing (U Nevada – Reno), Joe Stoner (Oregon State), Nicolas Thouveny (CENERGE – France).

*Graduate and Postdoctoral Advisors:*

- Subir Banerjee (U of Minnesota) PhD advisor
- Tom Henyey (University of Southern California) Post-doc advisor
**BIOGRAPHICAL SKETCH**

**NAME**

Matthew A. Marcus

**POSITION TITLE**

Beamline scientist, Advanced Light Source 10.3.2, Lawrence Berkeley National Laboratory

**Professional Preparation:**

City College of New York  Physics   B.S.  1972
Harvard University    Physics   Ph.D.  1978

**Appointments:**

2001-Present  Beamline Scientist at Advanced Light Source
1998-2001  Systems Engineer (Physicist) at KLA-Tencor
1978-1998  Member of Technical Staff at Bell Labs (Lucent)

**B. 5 papers most relevant to proposed work**


**C. 5 other significant papers**


4. Quantitative Speciation of Heavy Metals in Soils and Sediments by Synchrotron X-ray Techniques, Manceau, A., M.A. Marcus, and N. Tamura, in Applications of Synchrotron Radiation in Low-Temperature Geochemistry and
5. Curti E., Dähn R., Farges F., Vespa M., “Na, Mg, Ni and Cs distribution and speciation after long-term alteration of a simulated nuclear waste glass: A micro-XAS/XRF/XRD and wet chemical study” Geochimica et Cosmochimica 73, 2283-2298

D. Synergistic activities

As beamline scientist at ALS beamline 10.3.2, I participate in the analysis of many different types of samples, including altered minerals.

E. Collaborators and Co-Editors

Alivisatos, A. P., (LBNL); Arai, Y., (Clemson); Aruguete, D. M., (Virginia Tech); Bach, W. (WHOI) Bargar, J. R., (Stanford); Buenassisi, T., (MIT); Burchell, M. J. (University of Kent, Canterbury, Kent CT2 7NH, UK); Butterworth, A. L., (Space Sciences Lab, UC Berkeley); Cabot, A., (was at UC Berkeley); Cai, Z., (APS); Chan, C. S., (U. Delaware); Chan, E. M., (LBNL); Courtin-Nomade, (U. of Limoges); Edwards, K. J. (USC); El Naggar, M., (was at UCB); Fakra, S. C., (ALS); Freeman, J. L., (CSU); Gainsforth, Z., (Space Sciences Lab, UC Berkeley); Galli, G. A., (was at LLNL); Geoffroy, N., (U. Joseph Fourier); German, C. R., (WHOI); Glans, P. A., (BU); Grafe, M., (CSIRO-Minerals); Granina, L., (Limnological Institute, Russian Academy of Science); Guo, J.-H., (ALS); Harada, E., (Environmental chemistry group, LGIT, U. of Grenoble); Heald, S. M., (APS); Heuer, M. (Berlin Solar GmbH); Hopp, L., (University of Bayreuth); Hughes, S. M., (UCB); Ionescu, M., (ANSTO); Isare, M. P., (Environmental chemistry group, LGIT, U. of Grenoble); Istratov, A. A., (Siltronic Corporation); Jacquot, O., (Institute of Biogeochemistry and Pollutant Dynamics, Department of Environmental Sciences, ETH Zurich); Jacquet, T., (Environmental chemistry group, LGIT, U. of Grenoble); Kearsley, A., (Natural History Museum, London); Keller, L. P., (NASA Johnson Space Center); Kersten, M., (Geosciences Institute, Johannes Gutenberg-University); Kirpichtchikova, T., (Phytoresotre—Site et Concept, Hôtel Vigée Le Brun, 8 rue du Sentier, 75002 Paris, France); Kretzschmar, R., (Institute of Biogeochemistry and Pollutant Dynamics, Department of Environmental Sciences, ETH Zurich); Lai, B., (APS); Lanson, B., (Environmental chemistry group, LGIT, U. of Grenoble); Lanson, M., (Environmental chemistry group, LGIT, U. of Grenoble); Li, L.S., (was at UCB); Lindblom, S. D., (was at U. Colorado); Manueau, A., (Environmental chemistry group, LGIT, U. of Grenoble); Manganini, S. J., (WHOI); Mathies, R., (UCB); Mattesini, M., (Uppsala U.); McCollum, T., (U. Colorado Boulder); Minor, A. M., (LBNL); Moffett, J. W., (USC); Moller, G., (U. of Idaho); Myneni, S. C. B., (Princeton); Nagy, K., (Environmental chemistry group, LGIT, U. of Grenoble); Nico, P. S., (LBNL); Ogliore, R. C., (Space Sciences Lab, UC Berkeley); Oram, L. (U. of Idaho); Panfilni, F., (was at Environmental chemistry group, LGIT, U. of Grenoble); Peiffer, S., (University of Bayreuth); Pickert, M. D., (HP Labs); Pilon-Smits, E. A. H., (U. Colorado); Puntes, V. F., (Institut Catala` d’Estudis i Recerca Avancat & Institut Catala’ de Nanotecnologia); Quinn, C. F., (U. Colorado); Rouxel, O. (WHOI); Santelli, C. M., (WHOI); Sarret, G., (Environmental chemistry group, LGIT, U. of Grenoble); Sharma, P., (Department of Materials Science, Royal Institute of Technology, SE-100 44 Stockholm, Sweden); Shevchenko, E., (was at LBNL); Smith, K. E., (BU); Snead, C. J., (Space Sciences Lab, UC Berkeley); Soubran-Colin, A., (U. of Limoges); Sparks, D. L., (U. Delaware); Strawin, D. G., (U. of Idaho); Takahashi, T. (U. of Hiroshima); Tamura, N., (ALS); Tapper, R. V., (U. Delaware); Toner, B., (U. Minnesota); Villard, A., (Institute of Geology, University of Neuchâtel); Voegelin, A., (Institute of Biogeochemistry and Pollutant Dynamics, Department of Environmental Sciences, ETH Zurich); Webb, S. M., (SSRL); Weber, E. R., (Fraunhofer Institute for Solar Energy Systems); Westphal, A. J., (Space Sciences Lab, UC Berkeley); Williamson, A., (was at LLNL); Wirth, R., (GeoForschungsZentrum Potsdam, Potsdam, Germany); Yin, Y., (UC Riverside); Zachara, J. M., (Pacific Northwest Laboratory).

F. Graduate Advisors:

Turnbull (Deceased)
SUMMARY CURRICULUM VITAE

Matthew D. McCarthy
Associate Professor
University of California at Santa Cruz
Ocean Sciences Department
1156 High Street , Santa Cruz CA. 95064
Tel: (831) 459-4718 / -1533  Fax (831) 459-4882
mccarthy@pmc.ucsc.edu

Professional Preparation

University of California, San Diego Chemistry/Biochemistry               BS 1987
Carnegie Institution of Washington Geophysical Laboratory , Postdoctoral Fellow 1999-2000

Appointments

Present:   Associate Professor, Ocean Sciences, University of California, Santa Cruz
2001-2007 Assistant Professor, Ocean Sciences, University of California, Santa Cruz
1999-2001 University of Hawaii, Research Faculty, State of Hawaii , SOEST Young Investigator
Marine Analytical Chemist.

Publications:
(Papers denoted by † are first-authored by McCarthy graduate student)

5 Publications most closely related to the proposal:

• Johnson, H.P., and others ( 2003). Probing for Life in the Ocean Crust with the LEXEN Program. Eos, 84, 109-116

5 Other significant publications:


Synergistic Activities:
The McCarthy lab does broad research in topics of organic geochemistry/chemical oceanography. A main focus has been developing compound-specific stable isotope measurements (15N and 13C), coupled with radiocarbon (14C), of specific organic molecules or compound classes to understand source and transformation of dissolved and particulate organic matter in the sea in a broad range of environments. Particular recent focus has been molecular level and isotopic tracers for bacterial/archaeal carbon and nitrogen. Some examples of cross-cutting applications of such work are 1) the composition and sources of DOM in crustal fluids, especially as related to testing ideas about a crustal biosphere 2) potential influence of mid-water microbial chemosynthetic production on the oceanic DOM pool, 3) new tools to understand carbon flow within food chains, 4) paleoceanographic tools for tracing paleo-nitrogen sources and processing, as recorded in deep sea corals and sediments.

Honors and Awards
1999 Carnegie Institution of Washington Fellow
1999 State of Hawaii, 1999 Young Investigator Award. (School of Ocean and Earth Science and Technology)
1998 Chateaubriand Fellow, Department of State, France.

Collaborators and Co-Editors:
Dr. Ron Benner, University of South Carolina; Dr. Ellen Druffel, UC Irvine; Dr. Tom Guilderson, Lawrence Livermore National Labs, Center for Accelerator Mass-Spectrometry, Dr. Paul Koch, U.C. Santa Cruz, Earth Science Dept., Dr. Cindy Lee, SUNY, Stony brook, Dr. Greg Rau, NASA-AMES Research Center, Dr. Christina Ravelo, UCSC; Dr. Carsten Schubert, EAWAG Switzerland.

Graduate Advisor and Postdoctoral Sponsors
PhD Graduate Advisor: Dr. John Hedges (deceased)
PostDoc at Ecole national Superieur Chimie, Paris advisor: Dr. Claude Largeau (Retired)
PostDoc at Carnegie Institution of Washington: Advisor Dr. Marilyn Fogel (Carnegie Geophysical Lab)

Graduate Students (5) and Postdoctoral Fellows (3) Advised
Thesis Advisor for:
Dr. Petra Dekens (Assistant Professor, CSU-SF) co-advised with Prof. Christina Ravelo, UCSC
Ms. Leslie Roland (PhD Candidate, UCSC)
Mr. Brett Walker (PhD Candidate, UCSC)
Ms. Jennifer Lehman (MS student, UCSC)
Mr. Fabian Batista (PhD student, UCSC) co-advised with Prof. Christina Ravelo, UCSC

Postgraduate-Scholar Sponsor
Dr. Maria Calleja (UCSC)
Dr. Thomas Larsen (UCSC)
Dr. Ian Voparil (Shell Global Solutions)
Biosketch

Thomas M. McCollom  
Research Associate III  
University of Colorado  
Laboratory for Atmospheric and Space Physics  
Email: mccollom@lasp.colorado.edu  
CB392  
Phone: (303) 735-3072  
Boulder CO  80309  
Fax: (303) 492-6946

(a) Professional Preparation:
University of Colorado at Boulder  Biology  B.S.  1983.  
University of Colorado at Boulder  Geology  B.S.  1990.  
Washington University, St. Louis  Earth Sciences  Ph.D.  1996.  

(b) Appointments:
April 2002 to present: Research Associate, University of Colorado, Boulder,

(c) Publications:
5 Papers most relevant to proposed work:


5 other significant publications:


**(d) Synergistic Activities (5 example activities)**

- Hosted visiting graduate students from Arizona State University, SUNY Stony Brook, and UCLA to perform experiments in my lab (2004-2006).
- Developed thermodynamic databases for computer program EQ3/6 for use by scientists and students at University of New Hampshire, University of Colorado, Arizona State University, and Woods Hole Oceanographic Institution.
- Taught graduate level courses at University of Colorado: “Astrobiology” (Spring, 2003, 2009); “Mars” (Spring 2006).
- Associate Editor, *Geochimica et Cosmochima Acta* (since Oct., 2008)

**(e) Collaborators not included in reference list**

Brian Hynek (U. Colorado), Bruce Jakosky (U. Colorado), Barbara Sherwood Lollar (U. Toronto), Mike Mottl (U. Hawaii), Karyn Rogers (U. Missouri), Mitch Schulte (U. Missouri), Alexis Templeton (U. Colorado), Dawn Cardace (NASA Ames), Tori Hoehler (NASA Ames), Chris German (Woods Hole Oceanographic).

**Graduate Advisor:** Dr. Everett Shock (Arizona State U.)

**Post-doctoral Advisors:** Dr. Berndt Simoneit (Oregon State), Dr. Jeff Seewald (WHOI).

**(f) Undergraduate Research Assistants supervised (since 2002, total #: 6):**


**(g) Experience relevant to this project:**

- Participant in five research cruises to deep-sea hydrothermal systems including the East Pacific Rise, Juan de Fuca Ridge, and Mid-Atlantic Ridge.
Biosketch

ELLIS MENG
Assistant Professor
University of Southern California
Viterbi School of Engineering
Departments of Biomedical and Electrical Engineering
Email: ellis.meng@usc.edu
Phone: (213) 740-6952
Fax: (213) 821-3897

(a) Professional Preparation:
       Thesis Advisor: Dr. Yu-Chong Tai

(b) Appointments:
  Assistant Professor: Ming Hsieh Department of Electrical Engineering - Electrophysics, Univ. So. California (since May 2008)
  Assistant Professor: Department of Biomedical Engineering, Univ. So. California (since July 2004)
  Visiting Associate: Dept. Electrical Engineering, Caltech (Oct 2003 – Apr 2008)
  Assistant Professor: Dept. Mechanical and Aeronautical Eng., UC Davis (Oct 2003– June 2004)

(c) Publications:

      5 Papers most relevant to proposed work:


      5 other significant publications:


(d) Synergistic Activities (5 example activities)
- MEMS Research: Dr. Meng directs the Biomedical Microsystems Lab at USC which focuses on advancing biocompatible polymer micromachining, sensors and actuators, microfluidics, and implantable MEMS and bioMEMS. She is a thrust leader for Interface Technology in the Biomimetic MicroElectronic Systems Engineering Research Center (BMES-ERC) at USC.
- Teaching Innovations: Dr. Meng has developed BME 451: Fundamentals of Biomedical Microdevices to expose undergraduate engineers to advanced research topics in bioMEMS and teaches an innovative introductory course for engineering freshman (ENGR 102) at USC. She has also developed a graduate course in bioinstrumentation (BME 650) at USC.
- Education: Dr. Meng was the Associate Director of Education and Student Diversity (BMES-ERC) and promotes undergraduate research and student diversity. She mentored 5 Bravo Medical Magnet High School students in the USC STAR program. Students placed 1st, 2nd, and 3rd in their school science fair; received 1st place and honorable mention at the Los Angeles County Science Fair; and received honorable mention at the California State Fair. Dr. Meng also mentored over 38 undergraduate researchers from various programs.
- Dr. Meng developed interdisciplinary collaborations with microbiologists in marine biology and earth sciences through a Geobiological Interface Imaging and Microfluidics program. She also presented a talk on microfluidics at the USC Microbiology Program Retreat.

(e) Collaborators and Other Affiliations (not at USC, and not part of this project)
Axel Scherer (Caltech); Yu-Chong Tai (Caltech); Xin Zhang (Boston Univ.); Chris Zorman (Case Western)

(f) Graduate & Postdoctoral Advisors:
Yu-Chong Tai (Caltech); Jerome Pine (Caltech)

(g) Graduate student & Postdoctoral Supervision:
- **Current Ph.D. Students**  H. Gensler (1st yr., Biomedical Engineering), C. Gutierrez (3rd yr., Biomedical Engineering), J. Kuo (1st yr, Biomedical Engineering), PY Li (5th yr, Electrical Engineering), R. Lo (5th year, Biomedical Engineering), M. Nguyen (1st yr, Biomedical Engineering), G. Sundar (1st yr, Biomedical Engineering)
Urbashi Mitra

PROFESSIONAL PREPARATION:
University of California, Berkeley, Electrical Engineering & Computer Science B.A. 1987
University of California, Berkeley, Electrical Engineering & Computer Science M.S. 1989
Princeton University, Electrical Engineering, Ph.D. 1994

APPOINTMENTS:
2005 – present The University of Southern California Professor
2001 – 2005 The University of Southern California Associate Professor
2004 – present The University of Southern California Co-Director, Communication Sciences Institute
Fall 2003 Stanford University Visiting Scholar
Fall 2002 Rice University Texas Instruments Visiting Associate Professor
1994-2000 The Ohio State University Assistant Professor, Associate Professor
Summer 1995 Eurecom Institute, Sophia Antipolis, France Visiting Scholar,
1990-1994 Princeton University Research Assistant
1989-1990 Bellcore, Red Bank, New Jersey Member of Technical Sta®,
1987-1989 University of California, Berkeley Research Assistant,
Summer 1987 Tampere University of Technology, Finland Research Assistant

PUBLICATIONS:

PROFESSIONAL ACTIVITIES:
Networks 2005), IEEE JSAC (Multiuser Detection Q2 2008), IEEE JSAC (Underwater Acoustic Communications and Networks Q4 2008)

Associate Editor: (IEEE Transactions on Information Theory)(2007-present), (IEEE Journal on Oceanic Engineering)(2006-present)

Co-Chair, Workshop on Underwater Networks (with Mobicom 2006)

Tutorials Chair (IEEE Information Theory Symposium 2007)

Finance Chair (IEEE International Conference on Acoustics, Speech and Signal Processing, 2008)


Associate Editor (IEEE Transactions on Communications) (1996-2001)

Membership Chair for the IEEE Information Theory Society (1996-2000)

NSF Workshop participant: Cross-Layer Design (Reston, VA September 2007), Future Research Directions in Communications (Dallas, TX July 2000) and Sensor Networks (Evanston, IL December 2002).

COLLABORATORS AND OTHER AFFILIATIONS:
Recent Collaborators
Giuseppe Caire (USC), Michael Fitz (University of California, Los Angeles), Andrea Goldsmith (Stanford), Babak Hassibi (CalTech), Scott Jordan (University of California, Irvine), C. C. Kuo (USC), Shri Narayanan (USC), Mike Neely (USC), Robert Nowak (University of Wisconsin), Antonio Ortega (USC), James Preisig (WHOI), Ashutosh Sabharwal (Rice University), Bob Scholtz (USC), Milica Stojanovic (MIT), Gaurav Sukhatme (USC), Dana Porrat (Hebrew University of Jerusalem), Haris Vikalo (CalTech).

ADVISORS:
H. Vincent Poor (Ph.D.,Princeton University), Edwin Lewis (M.S.,University of California, Berkeley).

PAST AND CURRENT ADVISEES:
Emre Aktas, Ph.D. 6/02 (Assistant Professor, Hacettepe University, Ankara, Turkey), Jiangxin Chen, M.S. 6/97 (Qualcomm), Shuzhen Chen, M.S. 10/96 (Compression Labs Inc.), Wanshi Chen, Ph.D. 12/06 (Qualcomm), Li-Chung Chu, Ph.D. 6/99 (Ericsson), Stefan Franz, Ph.D. 8/06 (Rhode-Schwartz), Jifeng Geng, Ph.D. 6/04 (Qualcomm), Keerthi Govind, M.S. 6/96 (Qualcomm), Chatchai Meesookhoo, Ph.D. 5/07, Zhoyue Pi, M.S. 8/00 (Nokia), Adolfo Recio, M.S. 12/98 (ImpSat), Nick Richard, Ph.D. expected 5/09, Abhay Sharma, M.S. 10/00 (Analog Devices Inc.), Siwaruk Siwamogsatham, M.S. 6/97, Radha Srinivasan, M.S. 9/98 (LinCom), Gautam Thatte, Ph.D. expected 5/08, Madhavan Vajapeyam, Ph.D. 1/07 (Qualcomm), Satish Vedantam, Ph.D. expected 5/08, Sau-Hsuan Wu, Ph.D. 9/03 (Assistant Professor, National Tsing Hua University, Hsinchu, Taiwan).


RESEARCH AREAS: sensor networks, acoustic communications, collaborative communication, information theory, cross-layer design, ultra-wideband communications, multimedia over wireless, adaptive & blind equalization techniques, hando® algorithms, code-division multiple-access communications for personal wireless and mobile applications, and space-time coding for DS-CDMA.
BIOGRAPHICAL SKETCH – Craig L. Moyer

Biology Department                      Phone (360) 650-7935
Western Washington University          Fax (360) 650-3148
Biology Building MS#9160                cmoyer@hydro.biol.wwu.edu
Bellingham, WA 98225

Education:
Oregon State University  (Biology)  B.S.    1986
Oregon State University  (Microbiology)  M.S.    1988
University of Hawaii   (Oceanography)  Ph.D.   1995

Professional Experience:
  2008-  Professor    Western Washington University
  2002-08 Associate Professor   Western Washington University
  1997-02 Assistant Professor  Western Washington University
  1995-97 Post-Doctoral Research Associate  Michigan State University
  1990-95 Graduate Research Assistant  University of Hawaii
  1986-90 Graduate Research Assistant  Oregon State University

Five Most Closely Related Publications:
Five Other Significant Publications:


Synergistic Activities:

Participated in over 50 oceanographic expeditions and acted as scientific observer on over 250 dives using DSVs Alvin, SeaCliff and Pisces V and ROVs Hyperdolphin, ROPOS and Jason II.

Participation in the educational outreach for the iron microbial observatory or FeMO program. I have participated in the development of science curriculum, pedagogy and website design. In addition, I have facilitated multiple real-time video link-ups with high school classrooms where students can Q&A with scientists at sea. These research activities have afforded extraordinary educational opportunities, many of which can be accessed online (http://earthref.org/FEMO/main.htm and most recently at http://earthref.org/FEMO/cruises/2008/main.htm).

Supervised over 50 undergraduate research projects, 21 in last five years, with 4 currently underway. Students are engaged in a wide array of research projects relating to molecular phylogeny and microbial diversity from both aquatic and terrestrial habitats. These include several REU summer internships.

Supervised 13 undergraduate professional work experience internships, 7 in last five years. Students enter collaborative agreements between local biotechnical businesses, governmental agencies, environmental testing agencies, or professional research laboratories and WWU to conduct research and training projects over the summer.

Panelist, Integrated Ocean Drilling Program, Microbiological Working Group. 2003/04. Examined issues related to microbiological sampling issues with regard to deep ocean drilling such as the prevention of contamination, sample storage procedures, importance of patent rights, recommendations for standardized microbial protocols, etc.

Recent Collaborators:

John Baross (Univ. of WA), Katrina Edwards (USC), Robert Embley (NOAA-Vents), David Emerson (Bigelow Labs), Patricia Fryer, (Univ. of HI), Mike Mottl (Univ. of HI), Fumio Inagaki (JAMSTEC), Frank Sansone (Univ. of HI), Hubert Staudigel (SIO), Ken Takai, (JAMSTEC), Brad Tebo (OHSU), Geoffrey Wheat (Univ. of AK).

Graduate & Postgraduate Advisors:

James M. Tiedje (MI State Univ.), David M. Karl (Univ. of HI), Richard Y. Morita (OR State Univ.).

Thesis Advisor for Master’s Students in Biology Dept at WWU (8):

Biographical Sketch

(a) Professional Preparation
University of Chicago    Biochemistry    B.S.    1965
University of Chicago    Microbiology    Ph.D.    1969

(b) Appointments
J.C. Venter Institute  Professor 2007 – present
Univ. S. California  Professor 2001 – present
Cal Tech/JPL   Professor 1997 – 2001
Scripps Oceanographic/UCSD Professor 1973 – 1985

(c) Publications

(d) Synergistic Activities
1. Chair of the NAS Committee on the Origin and Evolution of Life (COEL) 2005-2008
2. Member of the Space Studies Board for the NAS (SSB) 2004 – 2007
3. Member of the Editorial Board of the International Society for Microbial Ecology (current activity)
4. Member of the Editorial Board of Environmental Microbiology (current activity)
(e) Collaborators & Other Affiliations

- Collaborators and Co-Editors:
  Gardner, T. (Boston U.); Goodman, S. (USC); Gorby, Y. (JCVI); Gorlenko, V. (IMM); Hagadorn, J.W. (Amherst College); Hall, J. (Exxon Mobil); Halpern, A. (JCVI); Hastings, J. (Harvard, U.); Heidelberg, J. (JCVI); Heidelberg, K. (USC); Hirayama, M. (JAMSTEC); Hoffman, J. (JCVI); Horikoshi, K. (JAMSTEC); Howard, C. (JCVI); Hsu, L. (USC); Hug, W. (Photonics Inc.); Inagaki, F. (JAMSTEC); Ishii, S. (JCVI); Joergensen, B. (MPI); Johnson, G. (NRL); Karl, D. (JCVI); Kastner, M. (UCSD/SIO); Keller, J. (U. Ghent); Kim, B. (KIST); Klappenbach, J. (MSU); Koijima, S. (JAMSTEC); Kravitz, S. (JCVI); Kus, E. (USC); LaDuc, M. (JPL); Lane, A.L. (JPL); Lanoli, B. (U. Alberta); Lever, M. (MPI); Li, J. (PNNL); Li, K. (JCVI); Logan, B. (Penn State U.); Lüttge, A. (Rice U.); Mansfeld, F. (USC); McDonald, G. (U. Texas); McLean, J. (JCVI); Miyazaki, M. (JAMSTEC); Moyer, C. (JAMSTEC); Nadeau, L. (NRL); Nishi, S. (JAMSTEC); Nogu, Y. (JAMSTEC); Nunoura, T. (MSU); Obraztsova, A. (USC); Oida, H. (JAMSTEC); Okada, H. (JAMSTEC); Osterman, A. (Burnham Inst.); Pietron, J. (NRL); Pinchuk, G. (PNNL); Platt, T. (JCVI); Popa, R. (Portland State Univ.); Rabaey, K. (U. Sydney); Reardon, C. (PNNL); Reed, S. (PNNL); Remington, K. (NIH); Ribbens, M. (USC); Ringeisen, B. (NRL); Rodionov, D. (Burnham Inst.); Rodriguez, J. (U. Ghent); Rogers, Y-H. (JCVI); Romine, M. (PNNL); Rosso, K. (PNNL); Rusch, D. (JCVI); Saffarini, D. (U. Wisc.-Milwaukee); Salas, E. (Rice U.); Sathyendranath, S. (JCVI); Schelble, R. (Exxon Mobil); Serres, M. (MBL); Shimamura, M. (JAMSTEC); Sijapati, K. (JPL); Smith, H. (JCVI); Sorokin, D. (Tech. U. Delft); Souza, V. (JCVI); Spormann, A. (Stanford U.); Stadnichuk, I. (IMM); Stanek, D. (MSU); Steele, A. (Carnegie Inst. Washington); Stewart, C. (JCVI); Sturm, C. (Rice U.); Sutton, G. (JCVI); Suzuki, M. (JAMSTEC); Takai, K. (JAMSTEC – Japanese Marine Sci. Tech. Center); Takami, H. (JAMSTEC); Tamayo-Castillo, G. (MBL); Teske, A. (Max Planck Inst., Bremen – MPI); Thorpe, J. (JCVI); Tiedje, J. (Michigan State U.); Tourova, T. (IMM); Tran, B. (JCVI); Udvardia, F. (USC); Urakawa, H. (JAMSTEC); Utterback, T. (JCVI); Venter, J.C. (J.Craig Venter Inst.[JCVI]); Verstraete, W. (U. Ghent); Watanabe, H. (JAMSTEC); Waters, M. (USC); Weber, P. (LLNL); Williams, C. (NRL); Williamson, S. (JCVI); Wright, M. (JPL); Wu, D. (JCVI); Wu, L. (MSU); Yamato, Y. (JAMSTEC); Yang, X. (Burnham Inst.); Yooseph, S. (JCVI); Zhang, L. (USC); Zhou, J. (U. Oklahoma); Zhulin, I. (PNNL);

- Graduate Advisors and Postdoctoral Sponsors.
  Dr. Alvin Markovitz – Ph.D. advisor (U. Chicago – emeritus)
  Dr. J. W. Hastings – Postdoc advisor (Harvard U. – emeritus)

- Thesis Advisor and Postgraduate-Scholar Sponsor.
  Totals: 28 Graduate Students Achieved Ph.D.s; 30 Postdoctoral Scholars

  Graduate Students: (previous 5 years)
  Scott, James – 2003 – Dartmouth Univ., Asst. Professor;
  Salas, Everett – 2008 – Rice University, Postdoc
  Bretschger, Orianna – 2008 – J.C. Venter Institute, Research Scientist,
  McCrow, John – 2008 – J.C. Venter Institute, Research Scientist
  Waters, Michael – May, 2009 – Postdoc – NIST

  Postdoctoral Scholars: (Previous 5 years)
  Corien Bakermans 2002-2004 – Asst. Prof, Penn State Univ. - Altoona
  Mohammed El-Naggar – 2007-2008 – Asst. Prof, USC;
  Jason He – 2008 - present
  Jinjun Kan – 2007 – present
  Li Zhang – 2008 - present
Biographical Sketch

Willam Cheesman Nelson

Professional Preparation.
Bucknell University, Lewisburg, PA. Biology/Chemistry. B.A./B.A. 1990
University of North Carolina, Chapel Hill, NC. Biology. Ph.D. 1996
Laboratory of Viral Disease, NIAID, NIH, Bethesda, MD. Viral DNA replication. 1996-1998

Appointments.
2007-Present Research Assistant Professor, University of Southern California (USC)
2004-2007 Bioinformatics Analyst Manager, The Institute for Genomic Research (TIGR)
1998-2004 Bioinformatics Analyst, TIGR

Most Relevant Publications.


Other Significant Publications.


Synergistic activities.

- Refined data management processes for high-throughput genome analysis (TIGR)
- Engineered genome annotation tools (TIGR)
- Developed multiple-genome comparison and annotation tools (TIGR)
- Served as a mentor for high school students doing independent study projects (Thomas Jefferson High School for Science and Technology, VA)
- Developed the Monterey Bay Microbial Observatory website, one of the first web sites designed to display metagenome data

Current collaborators.

Bhaya, Devaki (The Carnegie Institution); Bryant, DA (Penn State). Caron, David (USC); DeLong, E. (MIT); Eisen, J. A. (UC-Davis); Fleischmann, R. D. (JCVI); Forsberg, CW(Guelph); Fraser, C. M. (UMD); Grossman, A.R. (The Carnegie Institution); Gwinn-Giglio, M (UMD); Haft, D. H. (JCVI); Heidelberg, J. (USC); Heidelberg, Karla (USC); Mekalanos, J.J. (Harvard Medical School); Methe, BA (JCVI); Morrison, M (OSU); Myers GS (UMD); Nealon, K (USC); Nelson, K. E. (JCVI); Nierman, W.C. (JCVI); Paulsen, I. (McQuarrie); Ravel, J (UMD); Rusch, D (JCVI); Salzberg, S. L. (UMD); Selengut, J (JCVI); Seshadri, R (JCVI); Smith, H. O. (JCVI); Tettelin, H. (UMD); Venter, J. C. (JCVI); Ward, D.M. (Montana State University); Webb, Eric (USC); White, O. (UMD).

Graduate Advisor: Steven W. Matson (UNC-CH)

Postdoctoral Advisor: Mark D. Challberg (NIAID)
BETH ORCUTT
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University of Southern California
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Marine Environmental Biology Division & Department of Earth Sciences
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(a) Professional Preparation:
i) The University of Georgia, Interdisciplinary Studies (Marine Geochemistry emphasis), B.S. Summa Cum Laude (2002)
ii) The University of Georgia, Marine Sciences, Ph.D. (2007), Thesis Advisor: Dr. Samantha B. Joye

Appointments:
i) Postdoctoral Research Associate: Department of Biological Sciences, Marine Environmental Biology Division, University Southern California (since April 2007)
ii) Research Scientist: Center for Geomicrobiology, University of Aarhus, Denmark (to begin 09/2009)

(b) Publications (out of 12 published or in press):

5 Papers most relevant to proposed work:

5 other significant publications:
2) Moran, M.A., Belas, R., Schell, M.A., Gonzalez, J.M., Sun, F., Sun, S., Binder, B.J., Edmonds, J., Ye, W., Orcutt, B., Howard, E., Meile, C., Palefsky, W., Goesmann, A., Ren, Q., Paulsen, I.,


(c) Synergistic Activities:

- Starred in short educational video explaining ‘geomicrobiology’ and current scientific projects conducted on the Juan De Fuca Ridge flank for middle- and high-school audiences, as part of the Joint Oceanographic Institute Learning Program (filmed by Leslie Peart, Sept. 2007). [http://www.youtube.com/watch?v=MEnfhD95SrQ](http://www.youtube.com/watch?v=MEnfhD95SrQ)
- I have given a presentation about “Geomicrobiology in the Oceans” at a local community college
- Symposium Co-organizer: 5th Annual Southern California Geobiology Symposium, April 2008
- Session Co-organizer: American Geophysical Union Fall 2008 conference, San Francisco, CA; “Life in the Deep Biosphere: A Decade of Peeking at the Unseen Majority”

(d) Collaborators and Other Affiliations (not at USC, and not part of this project)

A. Boetius (MPI, Bremen, Germany); B. Bailey (NASA Ames), K.-U. Hinrichs (Uni Bremen, Germany), H. Jannasch (MBARI), B. B. Jørgensen (Uni Aarhus, Denmark), S. B. Joye (UGA), K. Knittel (MPI, Bremen, Germany), C. Meile (UGA), C. Moyer (WWU), A. Ramette (MPI, Bremen, Germany), F., H. Staudigel (Scripps), B. Tebo (OHSU), B. Toner (UMinnesota), T. Treude (IFM-GEOMAR, Kiel, Germany), S. Vance (JPL)

(e) Experience relevant to this project:

- Proponent on the NSF-sponsored Dark Energy Biosphere Institute Research Coordination Network (RCN)
- Lead designer of subsurface *in situ* microbial observatories with machine shop engineers at USC
- Cruise to Loihi Seamount with R/V *Thompson* (10/2008) to collect and deploy seafloor microbial incubation chambers
- Cruise to Juan de Fuca ridge flank CORKed boreholes on R/V *Atlantis* with HOV *Alvin* (09/2007 & 08/2008) to recover and deploy borehole microbial incubation experiments
- Participant in many other multi-week oceanographic cruises to Gulf of Mexico, North Sea, Monterey Canyon, Endeavor Ridge

B. Orcutt, Biosketch
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Geological and Planetary Sciences, MC100-23
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Office: 626.395.1786
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PROFESSIONAL PREPARATION

UNIVERSITY OF CALIFORNIA, SANTA BARBARA
Aquatic Biology B.A. 1994

UNIVERSITY OF CALIFORNIA, SANTA BARBARA, Ecology, Evolution, & Marine Biology PhD 2001

EXPERIENCE

APPOINTMENTS:

CALIFORNIA INSTITUTE OF TECHNOLOGY, PASADENA, CA
Assistant Professor of Geobiology, Division of Geological and Planetary Sciences 2004-present

NASA AMES RESEARCH CENTER, MOFFETT FIELD, CA
National Research Council Associate 2002-2004

MONTEREY BAY AQUARIUM RESEARCH INSTITUTE, MOSS LANDING, CA
Research Assistant / Graduate Student 1999-2002

UNIVERSITY OF CALIFORNIA, SANTA BARBARA, CA
Research Assistant / Graduate Student 1995-1998

SFSU TIBURON CENTER FOR ENVIRONMENTAL STUDIES
Research Technician 1994-1995

PUBLICATIONS:

5 PUBLICATIONS MOST CLOSELY RELATED TO THE PROPOSAL PROJECT


5 OTHER SIGNIFICANT PUBLICATIONS:


SYNERGISTIC ACTIVITIES

• Editorial board member, Environmental Microbiology and Geobiology Journal, 2009.
• American Academy of Microbiology Colloquium ‘Microbes in the rare biosphere’, San Francisco, CA 2009
• Adjunct Scientist, Monterey Bay Aquarium Research Institute, 2008-present.
• TASK Force scientific advisory panel: International Ocean Drilling Program. 2007-present.

Collaborators and Co-Editors:
Christopher House, Penn State University
David Des Marais, Linda Jahnke, and Tori Hoehler, Niko Finke, NASA Ames Research Center
Alex Sessions, Shana Goffredi, John Grotzinger, Caltech
Samantha Joye, University of Georgia, GA
Bob Vrijenhoek, Chris Scholin, Christina Preston, Bill Ussler, MBARI
Will Berelson, University of Southern California
Wiebke Ziebis, University of Southern California
Mary Lidstrom, University of Washington
Tim Lyons, University of California Riverside
Lisa Levin, Greg Rouse, Scripps Institute of Oceanography
Tony Rathburn, University of Indiana
Kevin McKeegan, University of California, Los Angeles

GRADUATE ADVISORS AND POSTDOCTORAL SPONSORS:
Dr. Edward F. DeLong (MIT) graduate advisor
Dr. David DesMarais (NASA Ames Research Center) postdoc advisor

THESIS ADVISOR (TOTAL #) AND POSTGRADUATE SCHOLAR SPONSOR (total #)
Rachel Poretsky, Postdoctoral Fellow, 2009-present
Olivia Mason, Postdoctoral Fellow, 2009-present
Jake Bailey, Postdoctoral Fellow, 2009-present
Abigail Green, Graduate student, 2007-present.
Anne Dekas, Graduate student, 2006-present.
Ben Harrison, Graduate student, 2004-present.
Annelie Pernthaler, Postdoctoral Fellow 2005-2007, current: group leader Leipzig, Germany
Kendra Turk, master’s student 2004-2006, current: NASA Ames Research Center
BIOGRAPHICAL SKETCH

Adina Paytan  Institute of Marine Science, UC Santa Cruz, Santa Cruz, CA

Education

Hebrew University, Jerusalem, Israel (Geology and Biology)  B.S.  1985
Weizmann Institute of Science, Rehovot, Israel. (Science Education)  M.S.  1987
Hebrew University, Jerusalem, Israel (Earth Sciences - Oceanography)  M.S.  1989
Scripps Institution of Oceanography, (UCSD, Oceanography)  Ph.D.  1996

Professional Experience

2007-present  Associate Research Scientist, Institute of Marine Sciences, UCSC
2007-present  Adjunct Scientist, Monterey Bay Aquarium Research Institute
1999-2007  Assistant Professor, Department of GES, Stanford University
2003-2007  Mentoring Co-Chair American Women in Science Association
1996-1999:  Post Graduate Researcher, SIO, UCSD
1993:  Teaching Assistant, Introduction to Geochemistry, UCSD
1989-1995:  Science Research Assistant, SIO, UCSD
1987-1989:  Teaching Assistant, Hebrew University

Five Recent Publications


Five Additional Publications


**Synergistic Activities:**
2006-present  Associate Editor – Limnology and Oceanography Methods  
2003-present  Associate Editor - Marine Chemistry  
2004-2006  Associate Editor - Geology  
COSEE CA Advisory Board,  
Founder – GeoKids Program,  
AWIS Palo Alto Chapter Mentoring co-Chair  
Hass Center Faculty Advisory Board  
Institute for Research on Women and Gender Faculty Committee,  
Kids Science Challenge, NPR

**Collaborators and Co-Editors:**
M. Altabet (UB), T. Bralower (Pan State), T. Bullen (USGS), G.Cutter (ODU), S. Dyhrman (WHOI), L. Hadly (Stanford), K. Johnson (MBARI), C. Kendal (USGS), W. Moore (USC), S. Monismith (Stanford), A. Post (MBL), J. Ryan (MBARI), C. Revello (UCSC).

**Graduate Advisors:**
Miriam Kastner (SIO, UCSD)  
Mark Theimens (UCSD)

**Thesis Advisor (Total #: 22) and Postgraduate-Scholar Sponsor (Total #: 8)**

**Former Graduate Students:**
Sarah Mearon (GeoMetrix), Meagan Eagle (WHOI), Kristen Averyt (NCAR), Karen McLaughlin (SCWRP), Greg Shellenbarger (USGS), Gaurav Misra (?), David Nicholson (UW), Ashley Ivy (teacher in Texas), Nick Handler (?), Megan Young (USGS), Scott Wankel (Harvard), Tzvetie Erohina (Shell), Ellen Gray (UCSC), Katy Esbury (GeoMatrix), Jessica Luo (Park Service), Elizabeth Griffith (UCSC).

**Former Post Doctoral Fellows:** Kristina Faul (Mills), Kathrine Hoppe (UW), Ying Chen (Fodong China), Bob Feranec (Natural History Museum NY), John Breier (WHOI).

**Current Graduate Student Advisees:** Karen Knee, Andear Erenhard, Joseph Street, Kate Mackey, Nadine Krupinski, Elizabeth Derse

**Current Undergraduate Advisees:** Chris Denford, Spenser Craven, Tim Lambert, Colin Lee, Devon Orme, Denise Wong, Tatiana Klass, Christopher Taylor, Spencer Davis

**Post Doctoral Fellows:** Cecile Mioni, Clifton Buck, Elizabeth Griffith
THOMAS L. PETTIGREW, P.E.

Professional Preparation:

University of Texas at Arlington, Mechanical Engineering, B.S., 1976
University of Texas at Arlington, 30 hours graduate work in Materials Science

Employment History:

April 2004 – Present: Staff Consultant, Mohr Engineering, Div. of Stress Engineering Services, Inc.,
December 1986 – February 2004: Staff Engineer, Chief Engineer, Supervisor of Engineering, Assistant Supervisor of Engineering, Sr. Development Engineer, Ocean Drilling Program, Texas A&M University,
November 1977 – July 1980: Design Engineer, Rector Wellhead Equipment Company,

Publications

4. T. Pettigrew, “Design and Operation of a Wireline Pressure Core Sampler”, Ocean Drilling Program Technical Note #17, 19992

Synergistic Activities:

• Engineering Design and Analyses
Mr. Pettigrew has extensive experience in the design of instrumented subsea wellheads (CORK, ACORK, and Borehole Instrument Hanger) for deep ocean scientific research and has personally supervised 6 each CORK installations - 3 off western Canada in 2400 m water depth, 1 off Oregon in 800 m water depth, and 2 in the Barbados Trench in 5000 m water depth; 2 each ACORK installations off Japan in 4800 m water depth; and 2 each borehole instrument hanger installations off Japan in 4800 m water depth from the D/V JOIDES Resolution. Assisted in numerous recoveries of long term fluid samplers, thermistor strings, and data loggers from existing instrumented borehole installations via the submersible Alvin and ROV Jason on board the R/V Atlantis, the ROV Kaiko on board the R/V Kairei, and the D/V JOIDES Resolution.

While at the Ocean Drilling Program Mr. Pettigrew worked on developing many different specialized drilling and coring tools such as core catchers, a rotary drill-in casing system, a 10,000 psi wireline pressure core sampler, a water powered hammer drill-in casing system, a 4-1/2” custom liner hanger and liner, a 10,000 psi test chamber, an inflatable straddle packer system, a 4” air jet oil saver, a 4” ID drilling jar, a formation fluid sampler, and stuck wireline logging tool recovery tools.

Mr. Pettigrew has provided down hole tool technical expertise, designed and deployed special application down hole tools, designed mechanical, hydraulic and wireline set packers both retrievable and permanent types, as well as, other types of down hole service and production tools, researched and developed hostile environment seals and packing elements for down hole tools, designed down hole tools for tubing conveyed perforating, and designed a wireline deployable, tubing resetable, packer, for the oil and gas industry.

- **Specialized Professional Competence**
  Mechanical design of instrumented (thermistor strings, borehole fluid sampling, seismometers, strain meters, tilt meters, borehole pressure meters, etc.) deep sea borehole equipment (CORK, ACORK, Borehole Instrument Hanger) including seafloor wellheads, hangers, associated subsurface equipment, deployment and recovery tools, as well as, development of deployment and recovery procedures for said equipment. Design of specialized drilling, workover, production, and coring down hole tools for the oil and gas industry, as well as, deep ocean research.

- **Research**
  Mr. Pettigrew has been involved in research to develop hostile environment down hole tool seals for the oil and gas industry.

- **Registrations and Professional Societies**
  Registered Professional Engineer, Texas No. 50882
  American Society of Mechanical Engineers
  American Society for Metals

- **Patents**
**Biosketch**

**ELLEN S. PLATZMAN**  
Associate Research Professor  
Department of Earth Sciences  
University Southern California  
3651 Trousdale Parkway, Los Angeles, California, 90089, USA  
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e-mail: platzman@usc.edu

**Professional Preparation:**  
- Cornell University Biology BA 1983  
- Cornell University Geology BA Cum Laude 1983  
- University of California Santa Barbara Geology MA 1985  
- Swiss Federal Institute of Technology (ETH) Geophysics PhD 1990

**Appointments:**  
- 2004 Associate Research Professor: University of Southern California,  
- 1995-2004 Lecturer/ Director of Paleomagnetism Laboratory: Univ. College London.  

**5 Relevant Publications:**

Steve P. Lund¹, Martha Schwartz¹, Will Berelson¹, **Ellen Platzman¹**, Rebecca Poulson², and Gary Acton *(submitted)* Environmental Factors Controlling the Distribution of Magnetic-Mineral-Forming Bacteria in Deep Sea Sediments  

**Other Publications**

**Platzman,** E., 2002, Magnetic constraints on the thermal evolution of a collapsing orogen,
Geophysical Journal International, 149, 776-786.

Synergistic Activities

- Editorial Board Member: Journal of the Geological Society [2003-present]
- Participant in, Women in Science (WISE) Program.

Collaborators and Other Affiliations (not at USC, and not part of this project)
S. Bogue (Occidental College); C. Ebinger (U. of Rochester); M. Fuller, (U. of Hawaii); T. Kidane (Addis Abeba); N. Linford (English Heritage); M. Maslin, (University College London, UK); P. Meredith, (University College London, UK); K. Pickering (University College London, UK); T. Raub (Caltech); M. Wong (Colgate).

Graduate Advisors and Postdoctoral Sponsors:
William Lowrie: retired ETH
John Ramsey: retired ETH
John Dewey: emeritus UC Davis
Philip England: Oxford University

Graduate Student Supervision (total: 7)
Lena Taylor (PhD UCL, current); Francis Cooper (PhD USC, 2008); Maria Papanikolaou (PhD, Cambridge University, 2008); Philip Benson (PhD, 2004); Neil Linford (PhD, 2003); Emma Durham (PhD, 2000); Andrew Mayfield (PhD, 1999).

Experience relevant to this project:
- (EPSRC) UK Nanomagnetism Network: Founding Member [2000 - 2004]
- Visiting Fellow Institute for Rock Magnetism, University of Minnesota (1995)
- R/V Melville (10-1985) EPR, staff scientist, deep tow, collection of rocks
Biographical Sketch:

BETH E. RABIN
2407 Tesla Terrace
Los Angeles, CA 90039
Phone: (323)663-1617 Email:bethrabin@sbcglobal.net

(a) Professional Preparation
University of California, Berkeley Psychology   B.A. 1987
University of California, Los Angeles Educational Psychology  M.A. 1990
University of California, Los Angeles Educational Psychology  Ph.D. 1994

(b) Appointments
2002-Present               Educational Research Consultant for Higher Education, Los Angeles, CA
2001-Present  Children's Television Educational Consultant, Los Angeles, CA
1995-2001 Vice President, Research Communications, Ltd., Boston, MA
1994-1995 Director of Research and Analysis, Research Communications, Ltd., Boston, MA
1992-1994 Technology Specialist, Educational Technology Unit, UCLA, Los Angeles, CA

(c) Publications:


(d) Synergistic Activities
Dr. Rabin has over fifteen years of experience in educational evaluation and research, including many beyond-the-traditional-classroom educational experiences. Her expertise ranges from evaluation of children’s science television series for public and cable television to university-level educational programs.

- Dr. Rabin has been the evaluator for five years for the USC’s Center for Excellence in Genome Science’s minority programs, and for Dartmouth Medical School’s Summer Research Undergraduate Fellowship program. This includes an annual end-of-experience evaluations as well as five-year retrospective studies examining program impact and tracking of participants.
- She served as evaluation consultant to the Keck Foundation for a retrospective evaluation of their biomedical fellowship grants.
- Her evaluation work extends beyond the hard sciences to include programs at USC’s Annenberg School for Communication: The USC Annenberg/Getty Arts Journalism Fellowship (end-of-experience evaluation and five-year retrospective) and USC Annenberg Health Journalism Fellowships.
- Dr. Rabin’s work goes outside the university setting to include informal educational environments. She has conducted formative and summative research for many children’s science television series including Cro (Sesame Workshop), Magic School Bus (Scholastic), Bill Nye the Science Guy (PBS), Bear in the Big Blue House (Disney Channel), My Friends Tigger and Pooh (Disney Channel) and Sid the Science Kid (Henson/PBS).
Biographical Sketch
Michael S. Rappe

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(a) Professional Preparation
• Washington State University, Biology and University Honors Program, B.S., 1991.
• Oregon State University, Genetics Program and Department of Microbiology, Ph.D., 1997.
• Centre National de la Recherche Scientifique, Station Biologique de Roscoff, France, Postdoctoral Research Associate, 1997-99.
• Oregon State University, College of Veterinary Medicine, Postdoctoral Research Associate, 1999-2000.
• Oregon State University, Department of Microbiology, Postdoctoral Research Associate, 2000-2003.

(b) Appointments
Research
• Assistant Research Professor, Hawaii Institute of Marine Biology, SOEST, University of Hawaii. 7/03-present
• Postdoctoral Research Associate, High Throughput Culturing Facility, Department of Microbiology, Oregon State University. Advisor: Dr. Stephen Giovannoni. 3/99-6/03
• Postdoctoral Research Associate, Anaerobic Microbiology Group, College of Veterinary Medicine, Oregon State University. Advisor: Dr. A. Morrie Craig. 3/99-7/00
• Postdoctoral Research Associate, Phytoplankton Group, Centre National de la Recherche Scientifique, Station Biologique de Roscoff, France. Advisor: Dr. Daniel Vaulot. 6/97-3/99

Teaching
• Co-Instructor, Agouron Summer Course in Microbial Oceanography, Agouron Institute and the University of Hawaii. Summers, 2006-present
• Co-Instructor, Coral Molecular Biology Techniques Workshop, Hawaii Institute of Marine Biology, University of Hawaii. Summers, 2003-present

(c) Publications
Five Publications Related to the Proposed Research
Five Other Publications

(d) Synergistic Activities
2. Ongoing contributions to hands-on research training and education of K-12 and undergraduate students of native Pacific Islanders in Hawaii
3. Ongoing technical contributions in microbial ecology including novel cultivation methods, high throughput microbe screening, fluorescence in situ hybridization, and non-culture-based detection and characterization of microbial diversity
5. Scientific advisory panel for joint Oregon/Hawaii SeaGrant program to bring marine biotechnology to K-12 teaching curriculum

(e) Collaborators and Other Affiliations
(i) Collaborators and Co-Editors Not at the University of Hawaii

(ii) Graduate and Postdoctoral Advisors
Graduate and postdoctoral advisor: Stephen Giovannoni (OSU); postdoctoral advisors: A. Morrie Craig (OSU), Daniel Vaulot (Station Biologique de Roscoff, France)

(iii) Thesis Advisor (2) and Postgraduate-Scholar Sponsor (2)
Thesis advisor: Marina Brandon (UH, 2006); Sara Yeo, (UH, 2008)
Postgrad Sponsor: Alex Eiler (UH, 2009); Megan Huggett (UH, 2009)
Karyn L. Rogers

BIOGRAPHICAL SKETCH

Department of Geological Sciences
101 Geology Building
University of Missouri
Columbia, MO 65211

phone: (573) 884-8480
fax: (573) 882-5458
e-mail: RogersKL@missouri.edu

a) Professional preparation

Harvard University  Earth & Planetary Sciences  A.B., 1996
Stanford University  Geological & Environmental Sciences  M.S., 2001
Washington University  Earth & Planetary Sciences  Ph.D., 2006

b) Appointments

Assistant Professor, University of Missouri, January 2008 to present
Guest Investigator, Woods Hole Oceanographic Institution, 2008-2009
Postdoctoral Scholar, Woods Hole Oceanographic Institution, 2006-2007

c) Publications

i) Most relevant to proposed research

ii) Other publications
d) Synergistic activities

Reviewer, Pearson Publications, Primary Education Science textbooks, 2008-present.
UMBC ADVANCE, Faculty Horizons Workshop for Aspiring STEM Faculty, MD, 2008.
On the Cutting Edge, Early Career Geoscience Faculty Workshop, VA, 2008.
Earth Science Literacy Initiative Online Workshop, 2008.
Dark Energy Biosphere Institute, Workshop, Catalina Island, California, 2008.
15th Annual Goldschmidt Conference, Symposium Chair, Geochemical Controls on Microbial Processes, 2005.

e) Collaborators and other affiliations (last 48 months)

i) Collaborators
M. Alperin (Univ. of N. Carolina), J. Amend (Washington University), W. Bach (Univ. Bremen), D. Bird (Stanford Univ.), G. Druschel (Univ. of Vermont), J. Cowen (Univ. Hawaii), K. Edwards (USC), A. Fisher (Univ. Calif. – Santa Cruz), C. Gammon (CalTech), S. Gurrieri (INGV, Palermo, Sicily, Italy), T. Hoehler (NASA Ames), J. Holden (Univ. Mass. - Amherst), J. Huber, MBL), B. Hynek (Univ. of Colorado), S. Ingullaggiato (INGV, Palermo, Sicily, Italy), T. McCollom (Univ. of Colorado), D. Meyer-Dombard (Univ. of Illinios - Chicago), P. Neuhoff (Univ. of Florida), B. Orcutt, USC), A. Pedersen (Geological Museum, Copenhagen), D. Rizzo (Univ. of Vermont), M. Schulte (Univ. of Missouri), J. Seewald (Woods Hole Oceanographic Institution), E. Shock (Arizona State University), S. Sievert (Woods Hole Oceanographic Institution), A. Skoog (Univ. of Connecticut), L. Stannius (Geological Museum, Copenhagen), A. Teske (Univ. N. Carolina), P. Vlahos (Univ. of Connecticut).

ii) Graduate advisor and postdoctoral sponsors
Graduate advisors: Jan Amend (Washington University), Dennis Bird (Stanford University), Everett Shock (Arizona State University)
Postdoctoral advisors: Jeffrey Seewald and Stefan Sievert (Woods Hole Oceanographic Institution),

iii) Graduate Students and postdocs
Ariel Bennet (Univ. Missouri [MU]), Sarah Stephenson (MU, starting summer 2008); Rachel Barker (MU, starting summer 2008).
Total students advised: 3
Total Postdoctoral scholars: 0
OLIVIER ROUXEL
Assistant Scientist
Woods Hole Oceanographic Institution
Marine Chemistry & Geochemistry Dept., MS#25
Woods Hole, MA 02543

Office: (508) 289-3655
Fax: (508) 457-2013
e-mail: orouxel@whoi.edu

EDUCATION:
Ecole National Superieure de Geologie de Nancy, France, Engineering, Diploma (B.S. equiv), 1998
Institut National Polytechnique de Lorraine, France, Earth Sciences, M.S., 1998
Institut National Polytechnique de Lorraine, France, Geochemistry, Ph.D., 2002

APPOINTMENTS:
5/05 - present: Assistant Scientist, Department of Marine Chemistry and Geochemistry, Woods Hole
Oceanographic Institution.
12/03 - 5/05: Deep Ocean Exploration Institute Postdoctoral Scholar, Department of Marine
Chemistry and Geochemistry, Woods Hole Oceanographic Institution.
11/02 - 11/03: Research associate, Department of Earth Sciences, University of Cambridge, UK
9/98-11/02: Research Assistant at the Centre de Recherches Pétrographiques et Géochimiques (CRPG-CNRS)
France.

5 PUBLICATIONS MOST CLOSELY RELATED TO THE PROPOSED PROJECT:
ecosystems thrived in late Paleoproterozoic redox-stratified oceans. Earth Planet. Sci. Lett (in
revision)
Toner B.M., Fakra S.C., Manganini S.J., Santelli C.M., Marcus M.A., Moffett J.W., Rouxel O.,
Sulfate Reduction in Altered Oceanic Basalts at ODP Site 801. Earth Planet. Sci. Lett., 268, 110-
123.

5 OTHER SIGNIFICANT PUBLICATIONS:
35: 717-746.
Rouxel O., Galy A. and Elderfield H. The geochemistry of Germanium Isotopes in Igneous Rocks
Spectrometry Reviews, 25, 515-550 (DOI 10.1002/mas.20078)
Proterozoic Ocean Redox State. Science, 307, 1088-1091
Collaborators within the past 48 months: J. Alt (U. Michigan); A. Anbar (U. Arizona); W. Bach (U. Bremen, Germany); A. Bekker (Canada); R. Blake (Yale); E. Boyle (MIT); C. Cloquet (CNRS, France); M. Conte (MBL); N. Dauphas (U. Chicago); O. Donard (CNRS, France); K. Edwards (USC); D. Emerson (Bigelow); P. Fralick (Lawrence, WI); A. Galy (U. Cambridge, UK); B. Glazer (U. Hawai); T. Grenne (Norway); J.L. Hannah (Colorado State U); L.R. Kump (PSU); T.W. Lyons (Riverside); C. Moyer (WWU); S. Ono (MIT); N. Planavsky (Riverside); O. Pokrovski (CNRS, France); L. Reisberg (CNRS, France); D. Rumble (Carnegie Inst.); C. Scott (Riverside); P. Shanks (USGS); J. Slack (USGS); H. Staudigel (UCSD); H.J. Stein (Colorado State U.); B. Tebo (OHSU); B. Toner (UMN); C. Wheat (U. Alaska); Y. Yaomin (Qingdao, China).

Thesis Advisors: J. Ludden (CNRS, now British Geological Survey), Y. Fouquet (IFREMER)  
Postdoctoral advisors: H. Elderfield (Univ. of Cambridge), K. Edwards (WHOI, now USC)  

Synergistic Activities
Ad-hoc reviewer of book chapters published by the Mineralogical Society of America, Elsevier Science.  
Ad-hoc reviewer of proposals submitted to National Science Foundation, European Science Foundation, Petroleum Research Fund, INSU France.

Experience Relevant to this Project:
10/07: Geochemist, Cruise KM0719 (R/V Kilo Moana)  
07/06: Geochemist, Cruise MGLN10MV (R/V Melville)  
07/06: Geochemist, Cruise MGLN06 (R/V Melville)  
11/04: Geochemist, Cruise AT11-20 (R/V Atlantis)  
05/01: Petrologist, Cruise IRIS (R/V Atalante)  
04/99: Petrologist, Ocean Drilling Program, Leg 185

Research Interests
Chemical cycling and isotopic fractionation of metals (Fe, Cu) and metalloids (S, Se, Ge, Sb) during alteration of the oceanic crust and in seafloor hydrothermal systems. Iron, sulfur, germanium and selenium isotope systematics in marine sediments and paleoceanographic implications. Developments of sulfur, iron and selenium isotopes as biogeochemical tracers of the deep biosphere. Processes controlling the isotopic fractionation of metals and metalloids between continental run-off and the oceans.
AXEL SCHIPPERS
Privatdozent
Section Geomicrobiology
Federal Institute for Geosciences
and Natural Resources (BGR)
Stillleweg 2, 30655 Hannover
Germany
Email: axel.schippers@bgr.de
Phone: +49 511 643 3103
Fax: +49 511 643 2304

(a) Professional Preparation:
   i) University of Hamburg, Germany, Biology, diploma (1994)
   ii) University of Hamburg, Germany, Geomicrobiology, Ph.D. (1998)
   iii) University of Hannover, Germany, Geomicrobiology, Habilitation, Privatdozent (2006)
   iv) University of Hamburg; Post-Doc, 1998-1999:
       German-Romanian project about abatement of acid rock drainage formation in sulfidic mine waste
   v) Max Planck Institute for Marine Microbiology, Bremen; Post-Doc, 1999-2001:
       Anaerobic oxidation of metal sulfides in marine sediments

(b) Appointments:
   2007- Present: Head of BGR Section Geomicrobiology
   2001-2007: Permanent scientist and deputy head of Section Geomicrobiology, Federal Institute for Geosciences and Natural Resources (BGR), Hannover

(c) Publications (out of more than 80 published):
   5 Papers most relevant to proposed work:

5 other significant publications:


(d) Synergistic Activities (5 example activities)
- Permanent lecturer at the Leibniz University of Hannover, Germany, regular teaching for undergraduate students: lectures and laboratory courses on basic microbiology, excursions
- Lecturer for “Biomining Course”, University of Concepcion, Chile 2008.

(e) Collaborators and Other Affiliations (not at BGR, and not part of this project)
S. Bottrell (Leeds, UK), M. Böttcher (Warnemünde, Germany), B. Dold (Concepcion, Chile), R.B. Herbert Jr. (Uppsala, Sweden), R.J. Parkes (Cardiff, UK), W. Sand (Duisburg-Essen, Germany), M. Staubwasser (Köln, Germany), H. Villinger (Bremen, Germany), F. von Blanckenburg (Potsdam, Germany)

(f) Graduate Advisor and Postdoctoral Sponsor:
Prof. Dr. Wolfgang Sand (University of Hamburg)
Prof. Dr. Bo Barker Jørgensen (Biogeochemistry Department, Max Planck Institute for Marine Microbiology, Bremen)

(g) Graduate student (total 7) & Postdoctoral supervision (total 3):
- **Current Postdoctorals**: A. Blazejak, 1/06-, D. Kock, 8/08-
- **Former Postdoctorals**: L.N. Neretin, 9/02 – 9/05 (UNEP, Washington DC, scientific advisor)
- **Current Ph.D. Students**: A. Breuker (1st yr.), F. Gründger (1st yr.), J. Frerichs (1st yr.), H. Korehi (2nd yr.), G. Köweker (3rd yr.), M. Siegert (3rd yr.)
- **Former Students**: D. Kock (Ph.D. July, 2008, Leibniz University Hannover, Germany

(h) Experience relevant to this project:
- Lead proponent on four successful proposals for deep biosphere research (3 years each) within the priority programs IODP (3) and ICDP (1) of the German Science Foundation (DFG)
- Co-Proponent on IODP proposals 677-Full “North Pond Atlantic Microbiology” Deep Biosphere Project, and 549-Full6 “Monsoonal Variability and Oxygen Minimum Intensity in the Northern Arabian Sea”
- Co-Proponent on proposals for ship time of the German vessels R/V Maria S. Merian MSM11/1 (2009 North Pond) and R/V Meteor M72/5 (2007 Black Sea)
- Shipboard participant of ODP Leg 201 Peru Biosphere (2002)
MATTHEW O. SCHRENK
Assistant Professor
East Carolina University
Department of Biology
Howell Science Complex, S301B
Greenville, NC 27858

Email: schrenkm@ecu.edu
Phone: (252) 328-5276
Fax: (262) 328-4178

(a) Professional Preparation:
   ii) University of Washington, Oceanography, M.S. (2001)

(b) Appointments:
   Assistant Professor: Department of Biology (since August 2008), East Carolina Univ.
   Postdoctoral Associate, Carnegie Institution of Washington, Geophysical Laboratory and
   Department of Terrestrial Magnetism (2007-2008)
   NASA Astrobiology Institute, Postdoctoral Fellow (2005 – 2007)

(c) Publications:

   5 Papers most relevant to proposed work:

      metabolizing microbial communities dominate in the Lost City Hydrothermal Field
      Schrenk, E. Olson, G. Proskurowski, M. Jakuba, A. Bradley, B. Larson, K. Ludwig, D.
      Glickson, K. Buckman, A.S. Bradley, W. Brazelton, K. Roe, M. Elend, A. Delacour, S.
      linked to subseaﬂoor geochemical processes at the Lost City Field, Mid Atlantic Ridge.
      Environ. Microbiol. 6(10):1086-1095.
      microorganisms within the walls of an active black smoker hydrothermal chimney. Appl.
      Distribution of Thiobacillus ferrooxidans and Leptospirillum ferrooxidans: implications for

   5 other significant publications:

      Sulfide Deposits. In Magma to Microbe at Mid Ocean Ridges. AGU Monograph. R. Lowell,
      A. Metaxas (Eds.).
      Elsewhere. In Planets and Life: The Emerging Science of Astrobiology. J.A. Baross and
      Olson, M.O. Schrenk, K.R. Roe, G. LeBon, P. Rivizzigno, and AT3-60 Shipboard Scientific


(d) Synergistic Activities (example activities)

- Ad hoc reviewer of manuscripts (FEMS Microbiology Ecology, Astrobiology, Microbial Ecology, JGR-Biogeosciences) and research proposals (NSF, NASA, NOAA)
- Participant. Dark Energy Biosphere Institute Workshop, Catalina Island, CA (Feb 2008)
- Participant. Pale Blue Dot III workshop. Chicago, IL (Sept. 17-20, 2006)
- Convener and Organizer, “Biofilms in the Environment” session at fall American Geophysical Union Meeting, San Francisco, CA (Dec. 2006)
- Convener and Organizer, “Extremophiles” and “Molecular Biological Approaches in Geobiology” sessions at Astrobiology Science Conference, Washington, D.C. (2006)

(e) Collaborators and Other Affiliations

J. Amend (Wash U), J. Banfield (UC-Berkeley), J. Baross (UW), G. Cody (CIW), J. Delaney (UW), K. Edwards (USC), J. Holden (UMass), J. Huber (MBL), D. Kelley (UW), D. Meyer-Dombard (UIC), S. Seager (MIT)

(f) Graduate Advisors and Postdoctoral Sponsors:

Graduate Advisor: Dr. John A. Baross (University of Washington)
Postdoctoral Sponsors: Dr. George D. Cody (CIW), and Dr. Sara Seager (MIT)

(g) Graduate Student Supervision (total 2):

- Current Graduate Students
  - A. Lozano-Diaz (1st yr., Biology [M.Sc.]), Q. Woodruff (1st yr, Biology [M.Sc.])

(h) Experience relevant to this project:

- Collection of hydrothermal sediment samples and deployment of in situ experiments Aeolian Islands, Italy, NASA postdoctoral research (2006-2007)
- Coordination of geo-microbiological analyses from high pH hydrothermal chimneys from the Lost City Field, Mid Atlantic Ridge (2001, 2003)
- Deployment and recovery of high temperature sulfide microbial incubators, Juan de Fuca Ridge, R/V Thompson, KECK-ROPOS (2003)
- Collection of hydrothermal vent chimneys and coordination with geological and geochemical sampling. Tidal Perturbations Cruise Juan de Fuca Ridge, R/V Atlantis (2000)
Biographical Sketch of Mitchell Schulte

Contact Information
University of Missouri
Department of Geological Sciences
101 Geology Building
Columbia, MO 65211
Tel: (573) 884-5712
Fax: (573) 882-5458
Email: schultemd@missouri.edu

Professional Preparation

Undergraduate Education:
Washington University, St. Louis Earth and Planetary Sciences A.B. 1987

Graduate Education:
University of North Dakota Geology & Geological Engineering M.S. ABD
Washington University, St. Louis Earth and Planetary Sciences Ph.D. 1997

Postdoctoral Institutions:

Additional Training:
New England Biolabs Workshop in Molecular Biology & PCR Smith College Summer ’03

Appointments
09/05-present Assistant Professor, Dept. of Geological Sciences, University of Missouri
06/07-present Guest Investigator, Woods Hole Oceanographic Institution
07/00-06/06 Staff Research Scientist, Exobiology Branch, NASA Ames Research Center

Publications

Selected Related Publications:

Selected Unrelated Publications:


**Synergistic Activities**

- I have served as a mentor for two students in the MS-PHDs Program (for underrepresented minorities in the sciences) at meetings of the Science Steering and Evaluation Panel of the Integrated Ocean Drilling Program.
- I am the faculty advisor for the MU Geology Club.
- Editorial Board Member for the journal *Astrobiology*.
- Invited lecturer, Saturday Morning Science Lecture Series. This lecture series is designed to provide school-aged children and the general public with access to research activities of scientists at the University of Missouri and across the country. I have also arranged lectures for outside speakers.
- Steering committee, CHART On-Line Workshop. This workshop is being run by the Consortium for Ocean Leadership to define the U.S. contribution to the INVEST workshop for the Integrated Ocean Drilling Program for renewal in 2013.

**Collaborators & Other Affiliations**

**Collaborators and Co-Editors:**

Jan Amend (Washington University), Wolfgang Bach (Univ. Bremen), William Berelson (USC), Janice Bishop (SETI Institute), David Blake (NASA Ames), Jim Cowen (Univ. Hawaii), Ken Cullings (NASA Ames), David DesMarais (NASA Ames), Steve D'Hondt (Univ. Rhode Island), Katrina Edwards (USC), Andy Fisher (UC Santa Cruz), Brian Glazer (Univ. Hawaii), Karla Heidelberg (USC), Tori Hoehler (NASA Ames), Julie Huber (MBL), Deborah Kelley (University of Washington), Marvin Lilley (University of Washington), Tom McCollom (Univ. Colorado), Beth Orcutt (USC), Karyn Rogers (Univ. Missouri), Olivier Rouxel (WHOI), Matt Schrenk (East Carolina Univ.), Jeffrey Seewald (WHOI), Jeffrey Seitz (Cal. State Univ. East Bay), Everett Shock (Arizona State Univ.), Andreas Teske (Univ. North Carolina), Geoff Wheat (Univ. Alaska-Fairbanks), Wiebke Ziebis (USC)

**Graduate and Postdoctoral Advisors:**

Everett Shock (Ph.D. thesis advisor), Arizona State University
Sherwood Chang (postdoctoral advisor, retired), NASA Ames Research Center
Cindy Lerner (postdoctoral advisor, retired), NASA Ames Research Center
George Cooper (postdoctoral advisor), NASA Ames Research Center

**Thesis Advisor and Postgraduate-Scholar Sponsor:**

Steven Pagan (M.S. student), University of Missouri, Spring 2009 graduation
Ariel Bennett (Ph.D. student), University of Missouri, current

Total students advised as thesis advisor: 2
Total students advised as committee member: 7
Postdocs advised: 0

_Schulte CV - 2_
Wei-Min Shen  
USC Information Sciences Institute  
4676 Admiralty Way, Marina del Rey, CA 90292  
phone: 310-448-8710, fax: 310-822-0751  
Email: shen@isi.usc.edu, web: http://www.isi.edu/robots

Education  
Jiao-Tong University, Beijing, China, Computer Engineering, B. S., 1982  
Institution of Automation, Academy of Science, Beijing, China, Artificial Intelligence, M.S., 1983  
Carnegie Mellon University, Computer Science, Masters, 1986  
Carnegie Mellon University, Computer Science, Ph.D., 1989

Professional Appointments  
2004-  Research Associate Professor, Computer Science Department, USC  
2002-  Director, Polymorphic Robotics Laboratory, Information Sciences Institute, USC  
2002-  Associate Director, Center for Robotics and Embedded Systems, USC  
1999-  Project Leader, Information Science Institute, USC  
1995-2004 Research Assistant Professor, Computer Science Department, USC  
1994-1999 Senior Research Scientist, Information Science Institute, USC  
1993-1994 Senior Member of the Technical Staff, MCC, Austin, TX  
1989-1993 Member of the Technical Staff, MCC, Austin, TX

Publications and Patent  
Over 150 publications, including one book and three US patents (two pending)

Publications most related to the project  

Publications of other significance  

Synergistic Activities  
1. More than 21 years of research experience. His current research interests include self-reconfigurable and metamorphic systems, autonomous robots, Machine Learning, Artificial Intelligence, and Life Science. He is the PI for the SuperBot project for developing a modular, multifunctional and self-reconfigurable robotic system for space application, a co-inventor of
CONRO, and the inventor of hormone-inspired distributed and decentralized control for self-reconfigurable systems. He has designed and built several generations of autonomous self-reconfigurable robots for land, water, and space (simulated zero-gravity environment).


4. Graduate Course Development for Computer Science Department at the University of California: Autonomous Learning and Discovering Agents.


Collaborators and Other Affiliations
a) Collaborators: Jafar Adibi, University of Southern California; George Bekey, University of Southern California; Cheng-Ming Chuong, University of Southern California; Berok Khoshnevis, University of Southern California; Jay Modi, University of Southern California; Mark Moll, University of Southern California; Behnam Salemi, University of Southern California; Milind Tambe, University of Southern California; Jeff Taylor, University of Hawaii; Peter Will, University of Southern California; P Mark Yim, University of Pennsylvania, Wayne Zhang, University of Washington.

b) Graduate advisors: Herbert A. Simon, Carnegie Mellon University.

c) Thesis Advisor and Post-Graduate-Scholar Sponsor:

Total number of graduate students advised: Dr. Jafar Adibi, Research Manager, PricewaterhouseCoopers (PWC), Dr. Jay Modi, Assistant Professor, Drexel University, Dr. Behnam Salemi, USC, ICT, Dr. Kasper Stoy, University of Southern Denmark. Current PhD students: Mike Rubenstein, Jacob Everist, Chi Ho Chiu, Feili Hou, Nadeesha Ranasinghe. (PhD: 8 students total, Postdoctoral: 2 total)

Honors and Awards
2008 Best Paper Award in autonomous/unmanned systems, 26th Army Science Conference
2008 Championship at the first planetary contingency robotic competition, ICRA
2007 Invited demonstration at the WIRED NextFest, LA Convention Center
2007 Invited speaker at Institution of Automation, Academy of Sciences, Beijing, China
2006 Invited speaker at Barcelona Science Museum, Celebration of 50th Anniversary of AI
2004 Invited plenary speaker at the International Conference on Complex Systems, Boston, USA
2003 Phi Kappa Phi Faculty Recognition Award, University of Southern California
2002 Best Paper Award, International Conference on Simulation of Adaptive Behaviors
2001 Invited plenary speaker at ITT Vaguard Convention, Los Angeles, USA
1997 World Champion Award at Robotic-Soccer RoboCup, Nagoya, Japan
1997 Meritorious Service Award, Information Sciences Institute, University of Southern California
1996 Second Place Award in AAAI Robotics Competition, Portland, Oregon
1983 National Scholarship Award for Education Abroad, The Chinese Ministry of Education
1983 First Place Student Award in national entrance examination, Chinese Academy of Sciences
1982 University Outstanding Graduate Award (top 2%), Jiao-Tong University, Beijing, China
Biographical Sketch for Everett L. Shock
School of Earth & Space Exploration,
and Dept. of Chemistry & Biochemistry
Arizona State University, Tempe, AZ, 85287

Professional Preparation
Undergraduate: Univ. of California, Santa Cruz  Earth Sciences  B.S. 1978
Graduate: Univ. of California, Berkeley  Geology  Ph.D. 1987

Appointments
Professor, School of Earth & Space Exploration and Department of Chemistry & Biochemistry, Arizona State University (since July 2002).
Director, W.M. Keck Foundation Laboratory for Environmental Biogeochemistry, Arizona State University (since July 2002).
Director, Environmental Studies Program, Washington University, St. Louis, MO, USA (1993-2001).
Professor, Associate Professor, and Assistant Professor, Department of Earth and Planetary Sciences, Washington University, St. Louis, MO, USA: (1987-2002).
Research Assistant, U.C. Berkeley: theoretical research in high-pressure/temperature inorganic and organic aqueous solution chemistry, chemical interaction of minerals and organic compounds with aqueous solutions in geochemical processes (six years).
Teaching Assistant, U.C. Berkeley: structural geology, introductory geology, theoretical geochemistry (one year).

Honors
Fellow, Geochemical Society and European Association for Geochemistry, 2009
Steinbach Visiting Scholar, Woods Hole Oceanographic Institution, 2007
Fellow, American Geophysical Union, 2005
Hooker Distinguished Visiting Professor, McMaster University, 2004
Visiting Scholar, Western Michigan University, 2003
Outstanding Faculty Mentor Award, Graduate Student Senate, Washington University, 2000

Five Recent Publications Most Closely Related

Five Additional Publications of Relevance to this Proposal


**Synergistic Activities**

- Development of thermodynamic databases for aqueous organic and inorganic species that are freely distributed over the internet, and used around the world.
- Application of High-Resolution Inductively-Coupled Plasma Mass Spectrometry (HR-ICP-MS) to trace element studies of natural and human-impacted water resources, hydrothermal fluids, petroleum, and soils.
- Director of field research at Yellowstone National Park on hydrothermal ecosystems involving scientists from Arizona State University, Washington University, University of New Mexico, Yale, Stanford, MIT, University of Colorado, Carleton College, University of Waikato, McMaster University, Lawrence Livermore National Lab, Woods Hole Oceanographic Institution, University of North Carolina, University of Nevada-Las Vegas, NASA-Ames, and University of Illinois-Chicago.
- Collection Editor, AGU’s *Biogeoscience Editor’s Choice* journal (2002-2005).

**Collaborators & Other Affiliations**

Jan Amend (Wash. U.), Ariel Anbar (ASU), James Elser (ASU), Tobias Fischer (U. New Mexico), Ferran Garcia-Pichel (ASU), Ian Gould (ASU), Nancy Grimm (ASU), Hilaire Hartnett (ASU), Melanie Holland (Geotek), John Holloway (ASU), Vladimir Majer (U. Blaise Pascal), D’Arcy Meyer-Dombard (U. Ill. Chicago), Julie Morris (NSF), Robert Pappalardo (NASA), Andrey Plyasunov, Nataliya Plyasunova (CrystalTech), Panjai Prapaipong (ASU), Jason Raymond (UC Merced), Anna-Louise Reysenbach (Portland State), Roger Summons (MIT), Lynda Williams (ASU), Mikhail Zolotov (ASU), Natalya Zolotova (ASU).

**PhD Advisor:** Harold C. Helgeson (UC Berkeley; deceased)  **Postdoctoral Advisor:** none

**Graduate Advisees:** David Sassani (PhD, 1992, Golder Associates); Marc Willis (MS, 1993, Fullerton College); Tom McColloM (PhD, 1996, U. Colorado); Laura Wetzel (PhD, 1997, Eckerd College); Mitch Schulte (PhD, 1997, U. Missouri); Laura Griffith (PhD, 1998, US Navy); Panjai Prapaipong (PhD, 2001, ASU); Samantha Fernandes (MS, 2002; consulting); D’Arcy Meyer-Dombard (PhD, 2004, U. Ill. Chicago); Jennifer Smith (MS, 2006, Dugway Data Services Team); Brandon McLean (MS, 2007, HydroSystems, Inc.); Todd Windman (PhD, current, C&B); Jeff Havig (PhD, current, SESE); Audrey Stewart (MS, current, C&B); Xiaoding Zhuo (PhD, current, C&B); Chris Glein (PhD, current, SESE); Tracy Lund (MS, current, SESE); Peter Canovas (PhD, current, C&B); Ziming Yang (PhD, current, C&B).

**Post-doctoral Advisees (last 5 years):** Jenny Cox 2004-2005 (self employed); Florian Schwandner 2004-2006 (Colorado State University).

**Totals:** Masters: 6; PhD: 13; Post-docs: 9.
David C. Smith
Graduate School of Oceanography dcsmth@gso.uri.edu
University of Rhode Island (401) 874-6172
Narragansett, RI 02882-1197 www.gso.uri.edu/~dcsmith

Professional Preparation:
California State University, Long Beach Marine Biology BS 1984
Univ. California, San Diego (Scripps) Marine Biology PhD 1994
Univ. California, San Diego (Scripps) Post-Doctoral 1994-1996

Appointments: (Graduate School of Oceanography, University of Rhode Island)
2008 – present, Professor
2006 – present, Associate Dean
2003 – 2008, Associate Professor
1997 – 2003, Assistant Professor

5 Relevant Publications:


Dickens, GR, M Koelling, DC Smith, L Schnieders, and IODP Expedition 302 Scientists. 2007. Rhizon sampling of pore waters on scientific drilling expeditions: An example from IODP Expedition 302, Arctic Coring Expedition (ACEX). Scientific Drilling Journal. 4: 22-25


5 Other Publications


Smith DC and D’Hondt S. 2006. Exploration for life in deeply buried subseafloor sediments.


Synergistic Activities:
1. Editorial service:
   a. Associate Editor, Estuaries, 2002 – 2008

2. Service to the scientific drilling community:
   a. Member, ODP Science Measurements Panel 2000 – 2003


4. Outreach efforts in K-12
   a. Development of a microbial ecology laboratory exercise with Mr. John Labriola, science teacher, Chariho Middle School.
   c. Mentor, elementary teachers – Water Kit (GEMS-Net)
   e. JASON Project - middle school videoconference (2006)
   f. Mentor, Metcalf Institute for Environmental Reporting (2004 - present)

Collaborators (not in publications)
B. Bekins (USGS), R. Blake (Yale), H. Brinkhuis (Utrecht), B. Cragg (Cardiff), H. Cypionka (Oldenburg), E. DeLong (MIT), J. Dickens (Rice), T. Ferdelman (MPI-Bremen), C. House (Penn State), K-U Hinrichs (U. Bremen), F. Inagaki (JAMSTEC), B.B. Jørgensen (MPI-Bremen), D. Karl (Hawaii), D. Miller (TAMU), R. Parkes (Cardiff), S. Rutherford (Roger Williams), P. Sobecky (Georgia Tech), A. Shippers, K. Takai (JAMSTEC), J. Wiegel (U. Georgia),

Graduate/Postdoctoral Advisor, F. Azam (UCSD, Scripps Institution of Oceanography)

Graduate Advisees (total 5): E. Keane (M.S., 2000), A. Staroscik (PhD, 2003), Marek Kirs (PhD 2005), Heather Saffet, (PhD 2007), Annie Cox (present)
Postdoctoral Associates (total 2): Bruno Soffientino, Jens Kallmeyer
S. ADAM SOULE
Assistant Scientist, Woods Hole Oceanographic Institution
Clark S. 272C, MS #24, Woods Hole, MA 02543
508.289.3213 • ssoule@whoi.edu • www.whoi.edu/people/~ssoule

EDUCATION

<table>
<thead>
<tr>
<th>Institution</th>
<th>Degree</th>
<th>Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carleton College, Northfield, MN.</td>
<td>Geology B.A.</td>
<td>1997</td>
</tr>
<tr>
<td>University of Oregon, Eugene, OR.</td>
<td>Geological Sciences Ph.D.</td>
<td>2003</td>
</tr>
</tbody>
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APPOINTMENTS

<table>
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<tr>
<th>Year</th>
<th>Position</th>
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<tbody>
<tr>
<td>2005-present</td>
<td>Assistant Scientist, Woods Hole Oceanographic Institution.</td>
</tr>
<tr>
<td>2000</td>
<td>Volunteer at the Hawaiian Volcanoes Observatory, Geophysics Group.</td>
</tr>
</tbody>
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FIVE MOST RELEVANT PUBLICATIONS

<table>
<thead>
<tr>
<th>Author(s)</th>
<th>Title</th>
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FIVE ADDITIONAL PUBLICATIONS

<table>
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<tr>
<th>Author(s)</th>
<th>Title</th>
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SYNERGISTIC ACTIVITIES

Professional Organization Memberships: AGU, GSA, IAVCEI


Reviewer of Proposals for: National Science Foundation: Ocean Sciences and Earth Sciences.

Educational activities: Co-taught Marine Geology & Geophysics II, WHOI (2009); Led field course in geophysical methods (2007, U of O), field trips to Hawai`i (WHOI, 2004; UofO, 2001), and was an instructor at the U of O field camp (2002). I have delivered invited lectures in Geology Dept. seminar series at Syracuse, Johns Hopkins, and IPGP U Paris in the past year.

Graduate students advised: Dorene Nakata, WHOI/MIT JP PhD; Allison Fundis, U. Florida Masters (co-advisor); Abigail Fusaro, WHOI/MIT JP PhD 2006 (co-advisor); Chris Waters^, WHOI/MIT JP PhD (co-advisor).

COLLABORATORS (Not including WHOI)

E. Baker (PMEL) D. Geist (U Idaho) M. Reed (U Oregon)
A. Bezos (Nantes) B. Glazer (U. Hawaii) I. Ridley (USGS)
D. Bohnenstiehl (NC State) K. Harpp (Colgate) K. Rubin (U Hawai`i)
J. Cann (Leeds) R. Holmes (LDEO) V. Schindwein (Alfred Vegner Inst.)
S. Carbotte (LDEO) M. Jakobsson (Stockholm U.) M. Tolstoy (LDEO)
K. Cashman (U Oregon) J. Kauahikaua (USGS) F. Waldhauser (LDEO)
H. Edmonds (UT Austin) B. Love (U. Washington) B. Weiss (MIT)
J. Escartín (IPGP) A. Maloof (Princeton) S. White (U. S.Carolina)
V. Ferrini (LDEO) K. Nakamura (AIST) L. Whitcomb (Johns Hopkins)
D. Forsyth (Brown) M. Perfit (U. Florida)

PhD advisor: Kathy Cashman (U. Oregon); Post-doc advisor: Dan Fornari (WHOI)

FIELD EXPERIENCE

2007-2008 Field program in Antarctica (Dry Valleys) using ground-based LiDAR to image patterned ground and constrain rates of cryoturbation in volcanic and glacial landscapes.

2007 Cruise AT15-17 to EPR: Deep-towed sidescan and bathymetry survey and ROV operations over the site of the 2005-06 eruption at 9°N and the overlapping spreading center at 9°03'N.

2006 Cruise GRAVILUCK to the Lucky Strike segment of the MAR (N/O Atalante): Examining recent volcanic and tectonic processes in a slow spreading MOR.

2006 Cruise AT15-7 to the East Pacific Rise: Rapid response to the 2006 eruption, sampling and mapping the newly emplaced lava flow.

2006 Field study of Deccan Flood basalts, Maharashtra, India.

2006 Cruise OR-217 to offshore Taiwan: Surveys of methane hydrates with deep-towed camera system.

2005 Cruise AT11-27 to the Eastern Galapagos Spreading Center: Sampling and observation of recent volcanics and associated hydrothermal vent communities.

2004 Cruise AT11-7 to the East Pacific Rise, 9°N: Sampling and observation of channelized lava flows and crustal accretion in young MOR volcanics.

1999-2003 Field studies of active and historic lava flows on Kilauea Volcano.
Biographical Sketch of Arthur J. Spivack
Graduate School of Oceanography
University of Rhode Island
Narragansett, RI 02882

Professional preparation
Massachusetts Institute of Technology, Chemistry, SB, 1980
Massachusetts Institute of Technology and Woods Hole Oceanographic Institution, Oceanography, Ph.D.1986

Professional Experience
7/02-present  Professor, University of Rhode Island, Graduate School of Oceanography
7/00-6/02  Associate Professor, URI, Graduate School of Oceanography
7/97-7/00  Professor, Department of Earth Sciences, University of North Carolina at Wilmington.
1/94-7/97  Associate Professor, Department of Earth Sciences UNCW
1/88-12/93  Assistant Professor, Scripps Institution of Oceanography, University of California

Publications


Prokopenko M. G., Hammond D. E., Spivack, A.J. and Stott L.,”Impact of diagenesis on δ¹⁵N of organic matter in marine sediments; ODP Sites 1227 and 1230” Scientific Results ODP
Leg 201


Patents- Method and System of Preventing Corrosion of Conductive Structures, Numbers 6551491 & 6325915.

Synergistic Activities.

1990- 1993 Director of the Scripps Undergraduate Research Fellowship and Research Careers for Minority Scholars programs.
1999 Participation in the development and execution of an interactive tele-video oceanography course for in service junior and senior high school teachers.
2001 Faculty mentor of a NSF sponsored, K-12 Graduate Teaching Fellow.
2003-2007 Science mentor in the Guiding Education in Math & Science Network (GEMS-NET) project a NSF funded program that trains teachers in exploration-based science teaching.
2004-2006 Co-developed and taught undergraduate honors astrobiology course titled, “Life in the Universe”. This course satisfies the university’s natural science requirement.
2008 Co-ordinator of URI’s largest academic outreach program, Global Environmental Change, a colloquium which attracted approximately 1,000 people to eleven seperate events.

Recent Collaborators (last four years)
Bekins, B., USGS; Collett, T, USGS; D’Hondt, S., URI; Davis, E., Geolog. Survey Canada; Hayes, J., WHOI; Hinrichs, K-W., Univ. of Bremen; Holm, N. G., Stockholm U.; Kastner, M., UCSD; Lemarchand, D., U.Paris; Mayer, L, UNH; McNeil, C., URI; Pagani, M., Yale; Prokopenko, M. G., Princeton; Soffientino, B., URI; Stewart, M., U. Illinois; Torres, M., OSU.; Wei, W., UCSD.

Graduate and Post-doctoral Advisors
John M. Edmond- MIT- deceased
Gerald Wasserburg- California Institute of Technology

Thesis Advisor and Postgraduate-Scholar Sponsor

Previous five years
Heather Groundwater (MS-GSO), Peiru Zheng (MS-GSO), Guizhi Wang (Ph.D. GSO), Heather Schrum (PhD-GSO), Bruno Soffientino (co-supervisor-post-Doc), Jens Kallmeyer (co-supervisor-post-Doc)

Thirteen graduate students supervised and four post-doctoral scholars supervised.
Biosketch

ALFRED M. SPORMANN
Professor
Stanford University
Department of Civil & Environmental Engineering, and Chemical Engineering, and (by courtesy) of Biological Sciences, and of Geological & Environmental Sciences
Clark E253, MC5429 Email: spormann@stanford.edu
318 Campus Drive Phone: (650) 723-3668
Stanford, CA 94305 Fax: (650) 724-4927

(a) Professional Preparation:
   i) Philipps-University, Marburg, FRG, M.S. (1985)
   ii) Philipps-University, Marburg, FRG, M.S. (1989)
      Thesis Advisor: Rolf Thauer

(b) Appointments:
   Professor: Dept. Civil & Environ. Eng. and, Dept. of Chemical Engineering, Stanford University (2007 – present)

(c) Publications (out of 44 published or in press):
   5 recent papers most relevant to proposed work:

   other significant publications:

A. Spormann, Biosketch


**(d) Synergistic Activities (5 example activities)**

- Course director: Microbial Diversity Course, MBL, Woods Hole (2000-2004)
- Course director: Hopkins Microbiology Summer Course (International 4 week 24/7 intensive course in microbial biology), Pacific Grove, CA (2006-present)
- Director Biofilm Research Center, Stanford University, 2000-2005
- Editor, *Applied and Environmental Microbiology*, 2006-present
- Co-organizer of annual “West Coast Bacterial Physiology Meeting”, Asilomar, CA 2000-present
- Co-organizer of annual NSF-supported Science teacher workshop “Mercury in the environment”, Stanford University, 2004-present

**(e) Collaborators and Other Affiliations (not at SU, and not part of this project)**

B. Bebout (NASA Ames), J. Haagensen (DTU, Denmark), J. Pett-Ridge (LLNL); P. Weber (LLNL); L. Semprini (Oregon State University), Soeren Molin (DTU, Denmark), Paul Rainey (Massey University, NZ), Phillip Schmitt-Kopplin (Helmholz-Zentrum, Muenchen).

**(f) Graduate student & Postdoctoral supervision:**

- **Current Postdoctorals**: L. Burow, 06/08-, L. Chao, 08/08-, D. Woebken, 08/08-, R. Saville, 01/09-, S. Lohner, 03/09-
- **Former Postdoctorals**: S. Behrens, – 12/08 (Professor Univ. of Tuebingen, Germany), P. Entcheva-Dimitrov 6/05–12/07 (Scientist, Abbott Vascular); J. Gescher, 11/03–3/06 (Professor, Albert-Ludwigs-University Freiburg, Germany); G. Meshulam, 12/03–4/05 (Scientist, Codexis), K. Thormann, 12/03–5/03 (Professor, MPI Marburg, Germany); Dale Pelletier (ORNL)

**(g) Experience relevant to this project:**

- Research expertise in microbial physiology, energetics, and microbial evolution.
- Research expertise in biology of slow growing microorganism
- Research expertise in biogeochemistry
GAURAV SUHAS SUKHATME
Computer Science Dept., University of Southern California (USC), Los Angeles, CA 90089

gaurav@usc.edu  http://robotics.usc.edu/~gaurav

A. Professional Preparation
Indian Institute of Technology, Bombay Computer Science and Engineering  B.Tech.  1991
University of Southern California Computer Science  M.S.  1993
University of Southern California Computer Science  Ph.D.  1997
University of Southern California Computer Science  Postdoc  1998

B. Appointments
2005-present  Associate Professor, Computer Science Department, USC
2000 – 2005  Assistant Professor, Computer Science Department, USC
1998 - 2000  Research Assistant Professor, Computer Science Department, USC

C. Publications (from 120+ published/in press, available at http://robotics.usc.edu/~gaurav)
5 publications most relevant to the proposed work:

5 other significant publications

D. Synergistic Activities
4. Conference Chair: General Chair RSS 2006, Program Chair ICRA 2008, RSS 2005
5. Conference Program Committees: SenSys, DCROSS, WAFT, ICRA, FSR, AAAI, Agents, IAS, WIRE, DARS, CIRA, IROS, also Proposal reviewing for NSF (CISE) and NASA (IS)

E. Collaborators and Other Affiliations
USC: Murali Annnavaram, David Caron, Leana Golubchik, Ramesh Govindan, Erik Johnson, Burt Jones, David Kempe, Bhaskar Krishnamachari, Sami Masri, Maja Matarić, Nenad Medvidovic, Urbashi Mitra, Shrikanth Narayanan, Stefan Schaal, Donna Spruitz-Metz; UCLA: Deborah Estrin, Mark Hansen, Bill Kaiser, Greg Pottie; MIT: Cynthia Breazeal, Daniela Rus; UPenn: Vijay Kumar; Dartmouth: Richard Granger, Laura Ray; Caltech/JPL: Yi Chao, Larry Matthies, James Montgomery, Issa Nesnas

F. Graduate Student (total: 22) and Postdoctoral Supervision (total: 7)
1. Graduate Advisor and Postdoctoral Sponsor: George Bekey, USC
3. Current postdocs: R. Smith, S. Poduri
4. Former PhD Advisees: M. Batalin (Postdoc, CENS), S. Hrabar (Senior Researcher, CSIRO, Australia), K. Harbick (Independent Consultant), M. Kobilarov (Postdoc, Caltech), D. Latimer (US Airforce), B. Jung (Navcomm Inc.), D. Naffin (Navcomm Inc.), S. Poduri (Postdoc, USC), M. Rahimi (Nokia Research), S. Saripalli (Assistant Professor, Arizona State University), G. Sibley (Postdoc, Oxford, University), D. Wolf (Assistant Professor, University of Sao Paolo), B. Zhang (Microsoft)
5. Former Predoctoral Advisees: S. Lee (PhD student, KAIST), E. Ostergaard (Assistant Professor, University of Southern Denmark), K. Stoy (Associate Professor, University of Southern Denmark), J. Wawerla (PhD student, Simon Fraser University)
6. Former Postdoctoral Advisees: T. Dahl (Assistant Professor, University of Newport), A. Panangadan (Postdoc, Childrens Hospital), A. Howard (JPL), A. Tews (Senior Researcher, CSIRO, Australia), R. Vaughan (Assistant Professor, Simon Fraser University)

G. Experience Relevant to this Project
Gaurav Sukhatme has been the technical and administrative lead on several successful NSF and DoD projects serving as PI or Co-PI on 30 grants and contracts totaling approximately $22M. Federal grant sources include NSF, DARPA, ONR, NASA and NOAA. Sukhatme was PI on Tactical Mobile Robotics (DARPA, 1998-2000), Mobile Autonomous Robot Software (DARPA, 1999-2002), Software for Distributed Robotics (DARPA 2000-2002) and MARS 2020 (DARPA, 2002-2004). He is currently a Co-PI on the ONR MURI Modular Social Intelligence for Teaming and Coalition Adaptation of Heterogeneous Autonomous Cooperative Agents (ACAs) (ONR, 2008-2011). He is a Co-PI on the NSF Science and Technology Center for Embedded Networked Sensing in which he focuses on the applications of robotics to sensing and sampling the aquatic environment.
Ken Takai

Geomicrobiologist
Subground Animalcule Retrieval (SUGAR) Program,
Japan Agency for Marine-Earth Science & Technology (JAMSTEC),
2-15 Nastushima-cho,
Yokosuka 237-0061, Japan
Phone: +81-468-67-9677; Fax: +81-468-67-9715; E-mail: kent@jamstec.go.jp

Professional Preparation:
Kyoto University, Department of Agriculture,         B. S.                     1992
University of Washington, School of Oceanography,   Visiting scientist,          1994-1995
Kyoto University, Division of Applied Biosciences, Graduate School of Agriculture, Ph.D., 1997

Appointments:
2008- Laboratory Leader, Precambrian Ecosystem Lab, JAMSTEC
2005- Program Director, SUGAR Program, JAMSTEC
2002-2005 Group Leader, SUGAR Program, JAMSTEC
1999-2002 Research scientist, SUGAR Project, JAMSTEC
1998-1999 Postdoctoral fellow, Department of Environmental Microbiology, Pacific Northwest National Laboratory (PNNL)
1997-1998 Post-doctoral fellow, DEEPSTAR group,
1997-1997 Post-doctoral fellow, Division of Applied Bioscience, Kyoto University
JAMSTEC

C-DEBI-related peer-reviewed publication:


Selected Synergistic Activity:
• Teaching courses in Geomicrobiology in Nippon University, Tohoku University, Tokyo Institute of Technology, Kyusyu University and Shizuoka University
• 30 oceanographic expeditions during 1999-2009 and 12 as a chief scientist
• Onshore microbiological investigations related with ODP Leg#195, #201, #204 and IODP Leg#301 and #306

Collaborators and Co-Editors:
David Butterfield (NOAA-PMEL), Cornel deRonde (GNS, New Zealand), Toshitaka Gamo (Ocean research Institute, Univ. of Tokyo), Fumio Inagaki (JAMSTEC Kochi), Junichiro Ishibashi (Kyusyu Univ.), John Lupton (NOAA-PMEL), Tomoaki Morishita (Kanazawa Univ.), Craig Moyer (Western Washington Univ.), Kyoko Okino (Ocean research Institute, Univ. of Tokyo), Jeffery Seewald (WHOI), Mathew Stott (GNS, New Zealand), Michinari Sunamura (Univ. Tokyo), Tomohiro Toki (Ryukyu Univ.), Urumu Tsunogai (Hokkaido University), Yuichio Ueno (Tokyo Institute Technology), Geoff Wheat (Univ. Alaska, Fairbanks), William Whitman (Univ. Georgia)

Graduate Advisors and Postdoctoral Sponsors:
Masahiro Yamamoto, Junichi Miyazaki, Tomoro Watsuj i, Hiroko Makita, Sanae Sakai, Yukari Yoshida, Shinsuke Kawagucci, Takazo Shibuya (JAMSTEC, past & present postdoctoral in JAMSTEC), Satoshi Nakagawa (Hokkaido University, past graduate student in JAMSTEC), Elizabeth Swanner (Univ. Colorado, past summer school student in JAMSTEC)
Biographical Sketch of ANDREAS P. TESKE

Present address: University of North Carolina, Dept. of Marine Sciences
351 Chapman Hall, CB 3300, Chapel Hill, NC 27599
Phone: 919-843-2463 / Fax: 919-962-1254 / email: teske@email.unc.edu

Professional Preparation:
- Fellow of the German National Scholarship Foundation 1988 – 1991
- Univ. of Illinois, Champaign-Urbana, Fulbright Fellowship, July 1991 - July 1992
- Hannover University, Germany, Biochemistry, Diploma (Masters), 1991
- Max-Planck-Institute for Marine Microbiology, Bremen, Germany, Microbial Ecology, Ph.D., 1995

Appointments:
Professor, Dept of Marine Sciences, UNC Chapel Hill (July 2007 - )
Associate Professor, Dept of Marine Sciences, UNC Chapel Hill (July 2002-2007)
Assistant Scientist at the Woods Hole Oceanographic Institution,
Adjunct Scientist, WHOI (February 2003-2006) and MBL (since July 2002)
Research Fellow at Hanse Institute for Advanced Study, Germany (2007-2008)

Five relevant publications for this proposal:

Five other publications:

Synergistic activities:
1) Division and Session chair at conferences, including ASM Division N Chair (Microbial Ecology) July
Co-Chair (with J. Kostka) of Session “The Shallow Subsurface Biosphere” at ASM General Meeting, Boston, June 1-5, 2008; Co-chair (with T. Ferdelman) of Session “The Subsurface Biosphere” (No. 33) at Goldschmidt Conference, Davos, Switzerland, August 18-23, 2002.

2) Research cruises, most recently to the Eastern Equatorial Pacific and the Peru Margin (on JOIDES Resolution in 2000 and 2002), to Svalbard (2003), Chile (2006) and Guaymas Basin (Chief scientist Dec. 2008), and work on behalf of cruise infrastructure (obtaining NSF funding and setting up the current microbiology laboratory on JOIDES Resolution as a community resource for seagoing microbiologists since May 2000)

3) Journals: Advisory editorial board of Geobiology (since 2003); Editorial Board member for FEMS Microbiology Ecology, Applied and Environmental Microbiology, and the ISME Journal (all since 2007); frequent reviewer for these and other journals

4) Service on committees and in targeted research initiatives: Work with ICOMM (International Census of Marine Microbes) on microbial diversity of the deep subsurface; participant and discussion leader as ICOMM workshops (MBARI, Nov. 2003 and Amsterdam, May 2008); providing raw data and metadata for ICOMM database; Member of Ridge 2000 Steering Committee (February 2004 – December 2006)

5) Outreach and teaching: Diverse invited talks at workshops and conferences; Joint Oceanographic Institutions Distinguished Speaker 2007-2008; Speaker at MBL Microbial Diversity course 2004-2006.

Collaborators during the last 48 months: Daniel B. Albert, (UNC Chapel Hill); Jan Amend (Washington University, St. Louis); Carol Amost (UNC Chapel Hill); Antje Boetius, (MPI for Marine Microbiology, Bremen, Germany); Heribert Cypionka (Oldenburg University, Germany); Steven D’Hondt (University of Rhode Island); Virginia Edgcomb (Woods Hole Oceanographic Institution). Katrina Edwards (USC); Manabu Fukui (Tokyo Metropolitan University, Tokyo, Japan); Kai-Uwe Hinrichs (Bremen University, Bremen, Germany); Christopher House (Penn State University); Fumio Inagaki (JAMSTEC, Yokosuka, Japan); Bo B. Jørgensen, (MPI for Marine Microbiology, Bremen, Germany); Samantha Joye (Univ. of Georgia); Katrin Knittel (MPI for Marine Microbiology, Bremen, Germany); Barbara MacGregor, (UNC Chapel Hill); Christopher Martens (UNC Chapel Hill); Jim McManus (Oregon State University); David C. Smith (University of Rhode Island); Mitchell L. Sogin (MBL).

Ph.D. advisor: Bo B. Jørgensen, Max-Planck-Institute for Marine Microbiology, Bremen, Germany, and Center for Geomicrobiology at Aarhus University, Aarhus, Denmark

Postdoctoral advisor: Holger W. Jannasch (WHOI) deceased

Graduate Students (Total # as thesis advisor: 5):

Postdoctorals sponsored (total # 8): Virginia Edgcomb (WHOI/MBL), Michael S. Atkins (WHOI/MBL), Stefan Sievert (WHOI), Konstantinos A. Kormas (WHOI), Antje Lauer (UNC), Ketil Sørensen (UNC), Dina Leech (UNC), Jennifer Biddle (UNC; current)

Research interests: molecular microbial ecology; microbiology of the marine sulfur and methane cycle, hydrothermal vent and deep subsurface microbiology.
Biographical Sketch

BRANDY M. TONER

Assistant Professor
Department of Soil, Water, and Climate
University of Minnesota – Twin Cities
St. Paul, MN 55108

Email: toner@umn.edu
Phone: (612) 624-1362
Fax: (612) 625-2208

(a) Professional Preparation

Bemidji State University, Environmental Studies, B.S. (1997)
University of California Berkeley, Civil & Environmental Engineering, M.S. (1999)

(b) Appointments

Assistant Professor, Dept. of Soil, Water & Climate, University of Minnesota - Twin Cities
1/2008 – present
Graduate Faculty, Water Resources Science, UMN, 7/2008 - present
Graduate Faculty, Environmental Engineering, UMN, 5/2008 – present
Graduate Faculty, Geology and Geophysics, UMN, 11/2008 – present

(c) Publications – 5 most relevant


(d) Synergistic Activities – Examples

- Co-I on MN Office of Higher Education STEM grant for Nanotechnology Education to train high school teachers in nano-science
- Gave interviews leading to non-technical articles on my research: (1) Earth Magazine; http://www.earthmagazine.org/; May 2009 issue; and (2) CCAC North Campus Student Newspaper, Community College of Allegheny County of Pittsburgh, PA; http://www.ncvoiceonews.net/.
- Developing/teaching a new Ph.D. course in Environmental Surface Chemistry (UMN SOIL8110) that focuses on analysis of real iron speciation data from East Pacific Rise hydrothermal plumes.
- Participated in a COSEE Instructor Training for Communicating Ocean Sciences, WHOI, 10/19/2007

(e) Collaborators (not listed as co-authors above)

Calvin Alexander (UMN); John Bargar (SSRL); Craig Benson (UW–Seattle); Paul Bloom (UMN); John A. Brier (WHOI); Brent Dalzell (UMN); Gregory Dick (UM–Ann Arbor); Daniel Engstrom (SMM); Melinda Erickson (USGS); Brian Glazer (UH–Honolulu); Jeffrey Gralnick (UMN); Timothy Griffis (UMN); Randall Kolka (MEF); Dylan Millet (UMN); Edward Nater (UMN); John Parise (SUNY Stony Brook); Lee Penn (UMN); James Schauer (UW-Madison); William Seyfried (UMN); Martin Shafer (UW–Madison); Bradley Tebo (OGI School of Science & Engr); Sheri White (WHOI).

(f) Graduate Advisors and Post Doctoral Sponsor:

PhD Advisor and present affiliation: Garrison Sposito (UC Berkeley)
Post Doctoral Sponsor and present affiliation: Katrina Edwards and James Moffett (USC)

(g) Graduate Students and Postdoctoral Supervision

Ph.D. Advisees (total as thesis advisor: 1) Sarah Nicholas (UMN); Amanda Turner (USC, K. Edwards prin. advisor); Jill Coleman-Wasik (UMN, D. Engstrom prin. advisor); Mikella Rough (UMN, W.E. Seyfried prin. advisor); Gregory Fransen (UMN, K. Brooks prin. advisor)

Postdoctoral Advisees (Total as sponsor: 1) Shahida Quazi (current)

(h) Seagoing Experience, relevant to this project:

R/V Thompson (10/2008 Loihi Seamount), ROV JASON, Chief Scientist C. Moyer
HONGMEI WANG
Professor
China University of Geosciences
School of Environmental Studies          email: wanghmei04@163.com
Department of Biological Science and Technology   Tel: 086-27-67883158
Wuhan, 430074, Hubei, P R China              Fax: 086-27-8743

(a) Professional Preparation:
i) China University of Geosciences, Paleaonotology, B.S. (1992)
iii) China University of Geosciences, Geomicrobiology, Ph.D. (2001)

(b) Appointments:
Professor: School of Environmental Studies (Since Jan 2008), China Univ. of Geosci.
Associate Professor: School of Environmental Studies (Since Aug 2003-Dec 2007), China Univ. of Geosci.
Assistant Professor: Faculty of Earth Science, China Univ. of Geosci. (Sep 1999-July 2003)

(c) Publications (5 out of 30 published or in press):

5 significant publications:
5、Raúl Hita, Hongmei Wang, Jerry M. Bigham, José Torrent , Olli H. Tuovinen , Bioleaching of a pyritic sludge from the Aznalcóllar (Spain) mine spillage at ambient and elevated temperatures, 2008, Hydrometallurgy, 93:76-79.

(d) Synergistic Activities
I have given interactive lectures on geomicrobiology and geobiology hold in Beijing and Wuhan respectively (Oct 2008).

(e) Collaborators and Other Affiliations (not at CUG, and not part of this project)
Jerry M Bigham (Ohio State Univ); Tiping Ding (Institute ofMineral Resources, Chinese
Academy of Geological Sciences); Zhang Lin (State Key Laboratory of Structural Chemistry, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences); Anhuai Lu (Peiking Univ); Xiancai Lu (Nanjing Univ); Olli H Tuovinen (Ohio State Univ).

(f) Graduate Advisors and Postdoctoral Sponsors:
   Dr. Wenhuai Zhang (China University of Geosciences)
   Thesis Advisor: Dr. Fengqing Yang (China University of Geosciences)

(g) Graduate student (total: 7) & Postdoctoral supervision (total: 0)
   Current Ph.D. Students: Deng Liu (2nd yr, Earth Science [ES])
   Current graduate Students: Xiaofen Yang (3rd yr, Environmental Science), Qianying Liu (2nd yr, Molecular biology and biochemistry [MBB]); Linfeng Gong (1st yr, MBB), Xuan Qiu (1st yr, MBB), Hima Hissane (Environmental Engineering)
   Former graduate Students: Xiaoling Zhao (Ecological Geology)
Eric A. Webb
Biographical sketch

Eric A. Webb                        Date of Birth 3/27/70
Department of Biological Sciences
Marine and Environmental Biology Section
University of Southern California, AHF 331
3616 Trousdale Parkway
Los Angeles, CA 90089-0371

a. Professional preparation

<table>
<thead>
<tr>
<th>Institution</th>
<th>Major</th>
<th>Degree, Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>The Ohio State University</td>
<td>Microbiology</td>
<td>B.Sc., 1994</td>
</tr>
<tr>
<td>The University of Wisconsin-Madison</td>
<td>Bacteriology</td>
<td>Ph.D., 1999</td>
</tr>
<tr>
<td>The Woods Hole Oceanographic Institution (WHOI)</td>
<td>Postdoctoral</td>
<td>1999-2001</td>
</tr>
</tbody>
</table>

Awards
- WHOI Post-Doctoral Scholarship Award (1999)
- Herman Symthe Award for outstanding research by a doctoral candidate (1998)
- Department of Bacteriology Travel Award (1998)
- ASM Travel Grant (1996)

b. Appointments
- Assistant Professor, University of Southern California, Biology Depart., MEB Section (7/06 – present)
- Associate Scientist without tenure, Biology Department WHOI (2006)
- Assistant Scientist, Biology Department WHOI (2001 to 2005)
- Post-Doctoral Scholar Woods Hole Oceanographic Institution (1999-2001)

c. Selected Ten Publications


d. Synergistic Activities

**Education**

*Postdoctoral/Graduate level:* I am committed to education. I am the advisor for two MIT-WHOI Joint program students (Dreux Chappell (co-advised with Jim Moffett) and Adam Rivers (co-advised with Penny Chisholm) and am still a member of numerous student committees. At USC I am the primary advisor of Dr. Jill Sohm and Maria Intermaggio, co-advice Emily Smail (with Sanudo-Wilhelmy), and I serve on graduate committees both at USC and WHOI (and one at UCSC).

*Undergraduate level:* One of the primary mechanisms for undergraduates to perform research at WHOI was through the WHOI Summer Student Fellow (SSF) Research Experience program. I have mentored two SSFs, Ian Ehrenreich and Sara Selgrade. Ian Ehrenreich presented his work at a national meeting (American Society for Microbiology) in Washington D.C., and has published his finding in Appl. Environ. Microbiol. In addition to SSFs, I have also supported numerous REU students with private and federal support, including: Frances Carpenter (University of Dundee, U.K.), Ian Ehrenreich (Stanford University – a year after his SSF appointment), and Tyler Hickman (University of Virginia). Since moving to USC I have mentored three REU students: Meghann Niesen (University of Georgia) – 2007, Megha Prasad (USC) – 2007, and Bethanie Edwards (Hendrix College) – 2008. Bethanie contributed significantly and recently presented her work at an international meeting (ASLO 2009 Nice, France) and is co-author on a manuscript submitted to Limnology and Oceanography.

*High School level:* Since it is important to introduce students who are not familiar with science as a career to research in their youth, I have advised Falmouth Academy student science projects and served as a judge in the Falmouth Academy science fair and Falmouth High School science fair. I will also be a judge at the Los Angeles Science fair in the Spring of 2009.

**Community Service**

Member of annotation teams for the genomes of *Synechococcus* and *Prochlorococcus*

High School Science fair Judge (2000, 2009)


e. Collaborators and Other Affiliations

1. **Collaborators.**

   Alison, Butler (UCSB), Sallie W Chisholm (MIT), Sonya Dyhrman (WHOI), Katrina Edwards (USC), James Moffett (USC), Christopher Reddy (WHOI), Gabrielle Rocap (UW), Andrew Rose (UW-Madison), Mak Saito (WHOI), Ben Van Mooy (WHOI), David Waite (UNSW), John Waterbury (WHOI), Jonathan Zehr (UCSC).

2. **Graduate and Post Doctoral Advisors**

   Downs, Diana The University of Wisconsin-Madison (Ph.D.)
   Moffett, James University of Southern California (Postdoctoral)
   Waterbury, John Woods Hole Oceanographic Institution (Postdoctoral)
Biosketch

SHUCHENG XIE
Professor
State Key Laboratory of Geological Processes and Mineral Resources
Faculty of Earth Science
China University of Geosciences
Wuhan, 430074, Hubei, P R China
email: xiecug@163.com
Tel: 086-27-67883001
Fax: 086-27-67885096

(a) Professional Preparation:
   ii) China University of Geosciences, Paleontology, M.S. (1992)
   iii) China University of Geosciences, Organic Geochemistry, Ph.D. (1996)

(b) Appointments:
   Professor: Faculty of Earth Science (Since Dec 2000), China Univ. of Geosci.
   Associate Professor: Faculty of Earth Science (Since Oct 1997), China Univ. of Geosci.
   Assistant Professor: Faculty of Earth Science, China Univ. of Geosci. (Sep 1995)

(c) Publications (5 out of 130 published):

5 significant publications


(d) Synergistic Activities
   I have given interactive lectures related to geobiology hold in China (Oct 2008), and AGU fall meeting (Dec, 2005).

(e) Collaborators and Other Affiliations (not at CUG, and not part of this project)
Hailiang Dong (Miami University)
Richard Evershed (University of Bristol, UK)
Richard Pancost (University of Bristol)

(f) Graduate advisors and Postdoctoral Sponsors

Dr. Hongfu YIN (China University of Geosciences)

(g) Graduate student (total # 10) & Postdoctoral sponsors (total # 1)

Postdoctor: Hongxia Peng

Current Ph.D. Students: Xianyu Huang (3rd yr, organic geochemistry [OG]), Xiaoyan Ruan (3rd, OG), Xiangru Ma (3rd, OG), Rencheng Li (2nd, micropaleontology), Yangmin Qin (2nd, micropaleontology), Zongmin Zhu (2nd, geophysics), Yuhui Liu (2nd, Earth Science), Genming Luo (1st, OG), Jianhua Liu (1st, OG), Lin Chen (1st, OG)

Current graduate Students: Huan Yang (3rd yr, OG), Chenglin Jia (3rd yr, OG); Wenjun Wu (1st yr, OG)

(h) Scientific Research Projects

PI, Microbial geolipids in peatland in response to Quaternary climate change in Central China, Natural Science Foundation of China, 2006-2009
PI, Geobiological processes during the formation of marine hydrocarbon source rocks in South China, Sinopec project, 2006-2011
PI, Biogeology and environmental geology, Ministry of Education of China, 2008-2012
PI, Biomarkers in Devonian and Triassic calcimicrobialite in South China, Ministry of Education of China, 2004-2006
PI, Microbial lipids in stalagmite in response to Holocene climate change in Central China, Ministry of Education of China, 2003-2005
PI, Geolipids from loess-paleosol sequence in North China, Natural Science Foundation of China, 2002-2005
PI, Biometallogenesis of Qixiashan polymetallic deposit in East China, Natural Science Foundation of China, 1998-2000
PI, Biometallogenesis of mineral deposits in Yangtze region, Ministry of Land and Resources of China, 2000-2001
Wiebke Ziebis

Address
Dr. Wiebke Ziebis
Assistant Professor of Marine Environmental Biology
University of Southern California
Dept. of Biological Sciences
Marine Environmental Biology/ Geobiology Program
3616 Trousdale Pkwy, AHF 335
Los Angeles, CA 90089-0371
Phone: 213-821-1198
FAX: 213-740 - 8123
E-mail: wziebis@ucs.edu

a. Professional Preparation

<table>
<thead>
<tr>
<th>Institution</th>
<th>Major / Area</th>
<th>Degree, Year</th>
</tr>
</thead>
<tbody>
<tr>
<td>- University Kiel, Germany</td>
<td>Biology / Marine Zoology</td>
<td>B.S., 1990</td>
</tr>
<tr>
<td>- University Kiel, Institute for Marine Research</td>
<td>Biology / Benthic ecology</td>
<td>M.S. 1992</td>
</tr>
<tr>
<td>- University Bremen, Dept. of Geosciences and Max Planck Institute for Marine Microbiology</td>
<td>Biogeochemistry</td>
<td>Dr. rer. nat. 1997 (summa cum laude - with highest honors)</td>
</tr>
</tbody>
</table>

a. Appointments

Oct.  2003 - Present  Assistant Professor for Marine Environmental Biology, Department of Biological Sciences, Geobiology Program, University of Southern California, Los Angeles

Jan. 2001 - 2003 Research Fellow, Scripps Institution of Oceanography, La Jolla, CA, Marine Life Research Group and Marine Research Division
Research Fellowship awarded by the DFG (German Research Foundation)

Jan. 1999 – Dec. 2000 Research Scientist, Max Planck Institute for Marine Microbiology, Department of Biogeochemistry

Jan. 1996 – Dec. 1998 Postdoctoral fellow, Max Planck Institute for Marine Microbiology, Department of Biogeochemistry – Fellowship awarded by the EU (MAST, Marine Science and Technology) for a 3-year project on shallow-water hydrothermal vents

Honors and Awards

2001- 2002 Two- year Research Fellowship awarded by the DFG (German Research Foundation)
1996-1999 Three-year Post-doctoral fellowship awarded by the European Union in the MAST III Program (Marine Science and Technology)

b. Selected Publications

5 most relevant to the project


5 other publications


(iv) SYNERGISTIC ACTIVITIES:
- Serving as an active member on the Deep Submergence Science Committee (DESSC) appointed 5/08,
- (2) Development of in-situ methods and instrumentations for studying geochemical gradients and microbial processes in extreme environments (Hydrothermal vents, hydrocarbon seeps),
- (3) Integration of graduate and undergraduate students in fieldwork, laboratory research and research cruises
- (4) Participating in the NSF sponsored USC-Geobiology REU Program each year (2004-2008)
- (5) serving on the advising committee for 11 graduate students ( Dept. Earth Sciences and Dept. Biol. Sciences
- (6) USC Lecturer in Environmental Microbiology (BISC 419) and Biogeochemical Cycles (BISC 536), development of a new course (BISC 417) Benthic Microbial Ecology for the Catalina Fall Semester,
- (7) Reviewer for several journals and funding agencies (Mar. Chem., Geology, Limnol. and Oceanogr., G3, FEMS Microbial Ecology, Marine Env. Research, JEMBE, MEPS and ACS, NSF, NOAA, EU.

(v) COLLABORATORS AND OTHER AFFILIATIONS:

Collaborators and Co-Editors.

<table>
<thead>
<tr>
<th>Last Name</th>
<th>First Name</th>
<th>Institution</th>
<th>Last Name</th>
<th>First Name</th>
<th>Institution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baco-Taylor</td>
<td>Amy</td>
<td>FSU</td>
<td>Martin</td>
<td>Jonathan</td>
<td>FSU</td>
</tr>
<tr>
<td>Bernhard</td>
<td>Joan</td>
<td>WHOI</td>
<td>Orphan</td>
<td>Victoria</td>
<td>CalTech</td>
</tr>
<tr>
<td>Busse</td>
<td>Lilian</td>
<td>UCSD/SIO</td>
<td>Rathburn</td>
<td>Anthony</td>
<td>ISU</td>
</tr>
<tr>
<td>Carney</td>
<td>Robert</td>
<td>PSU</td>
<td>Reysenbach</td>
<td>Anna-Louise</td>
<td>PSU</td>
</tr>
<tr>
<td>Pike</td>
<td>David</td>
<td>Caltech</td>
<td>Shank</td>
<td>Tim</td>
<td>WHOI</td>
</tr>
<tr>
<td>Gieskes</td>
<td>Joris</td>
<td>UCSD/SIO</td>
<td>Sievert</td>
<td>Stefan</td>
<td>WHOI</td>
</tr>
<tr>
<td>Goffredi</td>
<td>Shana</td>
<td>CalTech</td>
<td>Smith</td>
<td>Craig</td>
<td>Univ Hawaii</td>
</tr>
<tr>
<td>Haese</td>
<td>Ralf</td>
<td>Geoscience/Australia</td>
<td>Treude</td>
<td>Tina</td>
<td>IFM/GEOMAR</td>
</tr>
<tr>
<td>Halanych</td>
<td>Kenneth</td>
<td>Auburn University</td>
<td>Thruber</td>
<td>Andrew</td>
<td>UCSD/SIO</td>
</tr>
<tr>
<td>Kasten</td>
<td>Sabine</td>
<td>AWI Bremerhaven</td>
<td>Tryon</td>
<td>Michael</td>
<td>UCSD/SIO</td>
</tr>
<tr>
<td>Lee</td>
<td>Ray</td>
<td>USU</td>
<td>Valentine</td>
<td>David</td>
<td>UCSB</td>
</tr>
<tr>
<td>Levin</td>
<td>Lisa</td>
<td>UCSD/ SIO</td>
<td>Vrijenhoek</td>
<td>Robert</td>
<td>MBARI</td>
</tr>
</tbody>
</table>

Graduate and Postdoctoral Advisors.
- M.S. (Marine Biology) Advisor: Prof. Dr. G. Graf, Marine Biology Department, University Rostock
- Ph.D. (Marine Biogeochemistry) Advisor: Prof. Dr. B.B. Jørgensen, Director MPI Bremen
- Post-doctoral research (Marine Biogeochemistry) Advisor : Prof. Dr. B.B. Jørgensen, MPI Bremen
<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>PROPOSAL NO.</th>
<th>DURATION (months)</th>
</tr>
</thead>
<tbody>
<tr>
<td>University of Southern California</td>
<td>Proposed</td>
<td>Grant</td>
</tr>
</tbody>
</table>

**PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR**

Katrina J Edwards

**A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates**

<table>
<thead>
<tr>
<th>Name</th>
<th>PI/PD</th>
<th>Co-PI</th>
<th>Faculty</th>
<th>Other Senior Associates</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katrina J Edwards</td>
<td>Director</td>
<td>1.00</td>
<td>0.00</td>
<td>2.00</td>
</tr>
<tr>
<td>Ann Close</td>
<td>Managing Director</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Linda Duguay</td>
<td>Research Coordinator</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>John Heidelberg</td>
<td>Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
</tr>
<tr>
<td>Rosalynn Lee</td>
<td>Associate Managing Director</td>
<td>6.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Others</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>12,965</td>
</tr>
</tbody>
</table>

**B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Number</th>
<th>Rate</th>
<th>Base</th>
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</thead>
<tbody>
<tr>
<td>Post Doctoral Scholars</td>
<td>48.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Other Professionals (Technician, Programmer, etc.)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>Graduate Students</td>
<td>160,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Undergraduate Students</td>
<td>40,000</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secretarial - Clerical (if charged directly)</td>
<td>0</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Other</td>
<td>90,000</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)**

| Total Salaries and Wages (A + B) | 603,498 |

**D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)**

<table>
<thead>
<tr>
<th>Item</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Laser Dissection System</td>
<td>280,000</td>
</tr>
<tr>
<td>Permanent Equipment - See Justification</td>
<td>100,000</td>
</tr>
<tr>
<td>TOTAL EQUIPMENT</td>
<td>380,000</td>
</tr>
</tbody>
</table>

**E. TRAVEL**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic (incl. Canada, Mexico and U.S. possessions)</td>
<td>45,000</td>
</tr>
<tr>
<td>Foreign</td>
<td>20,000</td>
</tr>
</tbody>
</table>

**F. PARTICIPANT SUPPORT COSTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stipends</td>
<td>688,000</td>
</tr>
<tr>
<td>Travel</td>
<td>150,000</td>
</tr>
<tr>
<td>Subsistence</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>165,000</td>
</tr>
</tbody>
</table>

**G. OTHER DIRECT COSTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Materials and Supplies</td>
<td>17,000</td>
</tr>
<tr>
<td>Publication Costs/Documentation/Dissemination</td>
<td>10,000</td>
</tr>
<tr>
<td>Consultant Services</td>
<td>0</td>
</tr>
<tr>
<td>Computer Services</td>
<td>50,000</td>
</tr>
<tr>
<td>Subawards</td>
<td>1,542,537</td>
</tr>
<tr>
<td>Other</td>
<td>280,900</td>
</tr>
</tbody>
</table>

**H. TOTAL DIRECT COSTS (A THROUGH G)**

| Amount | 1,900,437 |

**I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)**

**F&A (Rate: 62.0000, Base: 1533047)**

| Amount | 950,489 |

**J. TOTAL DIRECT AND INDIRECT COSTS (H + I)**

| Amount | 5,023,473 |

**K. RESIDUAL FUNDS**

| Amount | 0 |

**L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)**

| Amount | 5,023,473 |

**M. COST SHARING PROPOSED LEVEL $**

| Amount | 0 |

---

*Electronic Signatures Required for Revised Budget*
<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Cal</th>
<th>Acad</th>
<th>Sumr</th>
<th>Funds Requested</th>
</tr>
</thead>
<tbody>
<tr>
<td>Webb, Eric</td>
<td>Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>12965</td>
</tr>
</tbody>
</table>
**SUMMARY PROPOSAL BUDGET**

**ORGANIZATION**
**University of Southern California**

**PROPOSAL NO.**

**DURATION (months)**

**AWARD NO.**

**PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR**

**Katrina J Edwards**

**Funds Requested By**

**Funds granted by NSF (if different)**

<table>
<thead>
<tr>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
</tr>
</thead>
</table>

| Org. Rep. Name* | Jean Chan |

---

**A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates**

(List each separately with title, A.7. show number in brackets)

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SuMR</th>
<th>Requested by</th>
<th>Proposed</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katrina J Edwards - Director</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>32,280</td>
<td></td>
</tr>
<tr>
<td>Ann Close - Managing Director</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>10,708</td>
<td></td>
</tr>
<tr>
<td>Linda Duguay - Research Coordinator</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>13,799</td>
<td></td>
</tr>
<tr>
<td>John Heidelberg - Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>12,823</td>
<td></td>
</tr>
<tr>
<td>Rosalynn Lee - Associate Managing Director</td>
<td>6.00</td>
<td>0.00</td>
<td>0.00</td>
<td>29,744</td>
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</tr>
<tr>
<td>Others (List individually on Budget Justification Page)</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>13,484</td>
<td></td>
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<tr>
<td>Total Senior Personnel (1 - 6)</td>
<td>8.00</td>
<td>0.00</td>
<td>4.00</td>
<td>112,838</td>
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**B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)**

<table>
<thead>
<tr>
<th>Role</th>
<th>Number</th>
<th>Rate</th>
<th>Proposal</th>
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</thead>
<tbody>
<tr>
<td>Post Doctoral Scholars</td>
<td>4</td>
<td>48.00</td>
<td>213,200</td>
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<tr>
<td>Other Professionals (Technician, Programmer, etc.)</td>
<td>0</td>
<td>0.00</td>
<td>0</td>
</tr>
<tr>
<td>Graduate Students</td>
<td>6</td>
<td>48.00</td>
<td>213,200</td>
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<td>Undergraduate Students</td>
<td>8</td>
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<td>213,200</td>
</tr>
<tr>
<td>Secretarial - Clerical (if charged directly)</td>
<td>0</td>
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<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>2</td>
<td>8.00</td>
<td>166,400</td>
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<tr>
<td>Total Salaries and Wages (A + B)</td>
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<td></td>
<td>527,638</td>
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**C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)**

<table>
<thead>
<tr>
<th>Fringe Benefits</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Total Salaries, Wages and Fringe Benefits (A + B + C)</td>
<td>753,529</td>
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</table>

**D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)**

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Permanent Equipment - See Justification</td>
<td>$104,000</td>
</tr>
<tr>
<td>Total Equipment</td>
<td>$104,000</td>
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**E. TRAVEL**

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount</th>
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<tbody>
<tr>
<td>Domestic (incl. Canada, Mexico and U.S. Possessions)</td>
<td>46,800</td>
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<td>Foreign</td>
<td>20,800</td>
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**F. PARTICIPANT SUPPORT COSTS**

<table>
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<th>Type</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Stipends</td>
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<tr>
<td>Travel</td>
<td>150,000</td>
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<tr>
<td>Subsistence</td>
<td>0</td>
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<tr>
<td>Other</td>
<td>171,600</td>
</tr>
<tr>
<td>Total Number of Participants</td>
<td>(40)</td>
</tr>
<tr>
<td>Total Participant Costs</td>
<td>1,037,120</td>
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</table>

**G. OTHER DIRECT COSTS**

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>Materials and Supplies</td>
<td>17,510</td>
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<tr>
<td>Publication Costs/Documentation/Dissemination</td>
<td>10,500</td>
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<td>Consultant Services</td>
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<td>Computer Services</td>
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<tr>
<td>Subawards</td>
<td>1,698,377</td>
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<tr>
<td>Other</td>
<td>286,936</td>
</tr>
<tr>
<td>Total Other Direct Costs</td>
<td>2,013,323</td>
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<tr>
<td>Total Direct Costs (A through G)</td>
<td>3,975,572</td>
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**I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)**

<table>
<thead>
<tr>
<th>Type</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>F&amp;A (Rate: 62.0000, Base: 1421099)</td>
<td></td>
</tr>
<tr>
<td>Total Indirect Costs (F&amp;A)</td>
<td>881,081</td>
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<tr>
<td>Total Direct and Indirect Costs (H + I)</td>
<td>4,856,653</td>
</tr>
<tr>
<td>Residual Funds</td>
<td>0</td>
</tr>
</tbody>
</table>

**L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)**

| Amount | 4,856,653 |

**M. COST SHARING PROPOSED LEVEL $**

| Proposed Level $ | 0 |

**FOR NSF USE ONLY**

**PI/PD NAME**

**Katrina J Edwards**

**INDIRECT COST RATE VERIFICATION**

**FOR NSF USE ONLY**

**ORG. REP. NAME**

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET*
<table>
<thead>
<tr>
<th>Name - Title</th>
<th>Cal</th>
<th>Acad</th>
<th>Sum</th>
<th>Funds Requested</th>
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<tbody>
<tr>
<td>Webb, Eric - Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>13484</td>
</tr>
</tbody>
</table>
## Summary Proposal Budget

**Organization:** University of Southern California  
**Proposal No.:** Proposed  
**Duration (months):** 3

### Principal Investigator / Project Director
**Katrina J Edwards**

#### senior Personnel: PI/PD, Co-PIs, Faculty and Other Senior Associates
(List each separately with title, A.7. show number in brackets)

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Funds Requested By proposer</th>
<th>Funds granted by NSF (if different)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katrina J Edwards - Director</td>
<td>0.00</td>
<td>0.00</td>
<td>2.00</td>
<td>33,571</td>
<td></td>
</tr>
<tr>
<td>Ann Close - Managing Director</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>11,136</td>
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<tr>
<td>Linda Duguay - Research Coordinator</td>
<td>1.00</td>
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<tr>
<td>John Heidelberg - Minority Course Instructor</td>
<td>0.00</td>
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#### total Senior Personnel (1 - 6)

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#### Other Personnel (Show Numbers in Brackets)

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#### total Salaries and Wages (A + B)

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#### Fringe Benefits (if charged as direct costs)

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<th>Funds granted by NSF (if different)</th>
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<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
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#### Equipment (list item and dollar amount for each item exceeding $5,000.)

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<td>Permanent Equipment - See Justification</td>
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#### Total Equipment

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#### Travel

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#### Participant Support Costs

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<td>744,141</td>
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<td>TRAVEL</td>
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<td>SUBSISTENCE</td>
<td>178,464</td>
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#### Total Number of Participants (40)

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#### Other Direct Costs

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<th>Funds Requested By proposer</th>
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<td>COMPUTER SERVICES</td>
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#### Total Other Direct Costs

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<tr>
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<td>1,997,954</td>
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#### Total Direct Costs (A Through G)

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<th>SUMR</th>
<th>Funds Requested By proposer</th>
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<tr>
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#### Indirect Costs (F&A) (Specify Rate and Base)

<table>
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<tr>
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#### Total Indirect Costs (F&A)

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<th>Name</th>
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<tr>
<td>TOTAL INDIRECT COSTS</td>
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#### Total Direct and Indirect Costs (H + I)

<table>
<thead>
<tr>
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<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Funds Requested By proposer</th>
<th>Funds granted by NSF (if different)</th>
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<tbody>
<tr>
<td>TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
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#### Residual Funds

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<tr>
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<th>ACAD</th>
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#### Amount of This Request (J) or (J minus K)

<table>
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<tr>
<th>Name</th>
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<th>ACAD</th>
<th>SUMR</th>
<th>Funds Requested By proposer</th>
<th>Funds granted by NSF (if different)</th>
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<tbody>
<tr>
<td>AMOUNT OF THIS REQUEST</td>
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#### Cost Sharing Proposed Level

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<tr>
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<th>ACAD</th>
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<th>Funds granted by NSF (if different)</th>
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<tr>
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#### Agreed Level If Different

<table>
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<tr>
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<th>ACAD</th>
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<th>Funds Requested By proposer</th>
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<tbody>
<tr>
<td>AGREED LEVEL IF DIFFERENT</td>
<td>0</td>
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**For NSF Use Only**

**PI/PD Name:** Katrina J Edwards  
**Organization Rep. Name:** Jean Chan  
**Date Checked:**  
**Date Of Rate Sheet:**  
**Initials - ORG:**

---

*Electronic Signatures Required for Revised Budget*
### SUMMARY PROPOSAL BUDGET COMMENTS - Year 3

<table>
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<th>Other Senior Personnel</th>
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<tr>
<td>A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates</td>
<td>Katrina J Edwards - Director</td>
<td>0.00</td>
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</tr>
<tr>
<td></td>
<td>Ann Close - Managing Director</td>
<td>1.00</td>
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</tr>
<tr>
<td></td>
<td>Linda Duguay - Research Coordinator</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>John Heidelberg - Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td></td>
<td>Rosalynn Lee - Associate Managing Director</td>
<td>6.00</td>
<td>0.00</td>
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<td>OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
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<td>OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
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<td></td>
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**PI/PD NAME:** Katrina J Edwards

**FOR NSF USE ONLY:**

**INDIRECT COST RATE VERIFICATION:**

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<th>Value</th>
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<td>J J J Edwards - Director</td>
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<tr>
<td>DATES</td>
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<tr>
<td>PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR</td>
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**FOR NSF USE ONLY:**

*Electronic Signatures Required for Revised Budget*
### SUMMARY PROPOSAL BUDGET COMMENTS - Year 4

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<td>Minority Course Instructor</td>
<td>0.00</td>
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<td>Funds Requested by proposer</td>
<td>Funds granted by NSF (if different)</td>
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<tr>
<td>B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)</td>
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<tr>
<td>1. ( 3 ) POST DOCTORAL SCHOLARS</td>
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<tr>
<td>3. ( 2 ) GRADUATE STUDENTS</td>
<td></td>
<td></td>
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<tr>
<td>4. ( 8 ) UNDERGRADUATE STUDENTS</td>
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<td>5. ( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)</td>
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<td>6. ( 2 ) OTHER</td>
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<td>TOTAL SALARIES AND WAGES (A + B)</td>
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<td>C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)</td>
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<td>122,308</td>
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<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
<td></td>
<td></td>
<td>637,628</td>
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<tr>
<td>D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)</td>
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<td></td>
<td></td>
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<tr>
<td>Permanent Equipment - See Justification</td>
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<td></td>
<td>$116,986</td>
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<tr>
<td>TOTAL EQUIPMENT</td>
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<td></td>
<td>116,986</td>
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<tr>
<td>E. TRAVEL</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
<td></td>
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<td>2. FOREIGN</td>
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<td>23,397</td>
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<td>F. PARTICIPANT SUPPORT COSTS</td>
<td></td>
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<tr>
<td>1. STIPENDS</td>
<td>$804,863</td>
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<td>2. TRAVEL</td>
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</tr>
<tr>
<td>3. SUBSISTENCE</td>
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<td>4. OTHER</td>
<td>193,027</td>
<td></td>
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</tr>
</tbody>
</table>
| TOTAL NUMBER OF PARTICIPANTS ( 40 ) | | | TOTAL PARTICIPANT COSTS ($1,147,890)
| G. OTHER DIRECT COSTS | | | |
| 1. MATERIALS AND SUPPLIES | | | 19,134 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | | | 12,155 |
| 3. CONSULTANT SERVICES | | | 0 |
| 4. COMPUTER SERVICES | | | 0 |
| 5. SUBAWARDS | | | 1,711,817 |
| 6. OTHER | | | 308,918 |
| TOTAL OTHER DIRECT COSTS | | | 2,052,024 |
| H. TOTAL DIRECT COSTS (A THROUGH G) | | | 4,030,569 |
| I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE) | | | |
| F&A (Rate: 62.0000, Base: 1353876) | | | |
| TOTAL INDIRECT COSTS (F&A) | | | 839,403 |
| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | | | 4,869,972 |
| K. RESIDUAL FUNDS | | | 4,869,972 |
| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | | | 4,869,972 |
| M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $ 0 | | |
### Other Senior Personnel

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Cal</th>
<th>Acad</th>
<th>Sumr</th>
<th>Funds Requested</th>
</tr>
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<tbody>
<tr>
<td>Webb, Eric</td>
<td>Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
<td>1.00</td>
<td>15168</td>
</tr>
<tr>
<td>A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)</td>
<td>NSF Funded Person-months</td>
<td>Funds Requested by proposer</td>
<td>Funds granted by NSF (if different)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Katrina J Edwards - Director</td>
<td>0.00</td>
<td>0.00</td>
<td>10.00</td>
<td>168,113</td>
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<tr>
<td>Ann Close - Managing Director</td>
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<td>0.00</td>
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</tr>
<tr>
<td>Linda Duguay - Research Coordinator</td>
<td>5.00</td>
<td>0.00</td>
<td>0.00</td>
<td>71,866</td>
<td></td>
</tr>
<tr>
<td>John Heidelberg - Minority Course Instructor</td>
<td>0.00</td>
<td>0.00</td>
<td>5.00</td>
<td>66,782</td>
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<tr>
<td>Rosalynn Lee - Associate Managing Director</td>
<td>30.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
<td>0.00</td>
<td>0.00</td>
<td>5.00</td>
<td>70,224</td>
<td></td>
</tr>
<tr>
<td>TOTAL SENIOR PERSONNEL (1 - 6)</td>
<td>40.00</td>
<td>0.00</td>
<td>20.00</td>
<td>587,659</td>
<td></td>
</tr>
</tbody>
</table>

B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)

| 1. (19) POST DOCTORAL SCHOLARS | 228.00 | 0.00 | 0.00 | 1,046,004 |
| 2. (0) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 0.00 | 0.00 | 0.00 | 0 |
| 3. (26) GRADUATE STUDENTS | 740,267 |
| 4. (40) UNDERGRADUATE STUDENTS | 216,653 |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | 0 |
| 6. (10) OTHER | 487,469 |
| TOTAL SALARIES AND WAGES (A + B) | 3,078,052 |

C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)

| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | 3,714,391 |

D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

| TOTAL EQUIPMENT | 821,632 |

E. TRAVEL

| 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS) | 243,735 |
| 2. FOREIGN | 108,326 |

F. PARTICIPANT SUPPORT COSTS

| TOTAL NUMBER OF PARTICIPANTS | 200 |
| TOTAL PARTICIPANT COSTS | 5,370,124 |

G. OTHER DIRECT COSTS

| 1. MATERIALS AND SUPPLIES | 90,258 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | 55,256 |
| 3. CONSULTANT SERVICES | 0 |
| 4. COMPUTER SERVICES | 50,000 |
| 5. SUBAWARDS | 8,409,445 |
| 6. OTHER | 1,490,517 |
| TOTAL OTHER DIRECT COSTS | 10,095,476 |

H. TOTAL DIRECT COSTS (A THROUGH G)

| 20,353,684 |

I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)

| TOTAL INDIRECT COSTS (F&A) | 4,520,628 |

J. TOTAL DIRECT AND INDIRECT COSTS (H + I)

| 24,874,312 |

K. RESIDUAL FUNDS

| 0 |

L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)

| 24,874,312 |

M. COST SHARING PROPOSED LEVEL $ 0 | AGREED LEVEL IF DIFFERENT $ 0 |

PI/PD NAME

| Katrina J Edwards |

FOR NSF USE ONLY

| INDIRECT COST RATE VERIFICATION |

ORG. REP. NAME*

| Jean Chan |

DATE CHECKED | DATE OF RATE SHEET | INITIALS - ORG |

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
C-DEBI: Budget Justification

A. Senior personnel

Two months of salary support/yr are requested for Katrina Edwards in support of director responsibilities. Edwards will also be relieved of \( \frac{1}{2} \) of her teaching load by the college, and hence commits \( \frac{3}{4} \) of her time total towards directorship responsibilities.

One month of salary support/year are requested for Ann Close and Linda Duguay in support of their described roles within C-DEBI. 6-mo of salary support is requested for Rosalynn Lee. Support for two administrative assistants are requested, to be hired for support of the C-DEBI education programs and diversity programs. One month of salary is requested in support of John Heidelberg and Eric Webb for teaching our described summer diversity course.

B. Other personnel

Support for four-postdoctorals/yr is requested at USC. One per year is allocated for Edwards’ North Pond research program objectives. The remainder are part of the USC postdoctoral fellowship program and; applicants may apply to work with any of the USC C-DEBI senior personnel and have access to these funds.

Support for 6 graduate students in total years is budgeted at USC within the College and Engineering. One per year is allocated for Edwards’ North Pond research program objectives, and the remainders are part of the USC graduate student fellow program, which will be administered by application.

Support for eight undergraduate researchers is requested at USC. Any C-DEBI faculty may request this support, which will be administered at the discretion of the director.

C. Fringe Benefits

Fringe Benefits are calculated on salaries at current USC rates and are only charged to faculty and staff salaries

D. Permanent Equipment

Permanent equipment costs at the level of 100K/yr are requested for USC. These can be accessed by application to the director by any C-DEBI faculty, and are intended for major infrastructure that will benefit many groups. For example:

- Seafloor instrumentation development
- borehole experimental devices
- CORK accessories

USC also requests funds for acquisition of a laser dissection system for use in our C-DEBI user-facilities (280K)

E. Travel

Travel costs are estimated for C-DEBI administration and for attendance at meetings (science and coordination meetings). USC senior investigators will be supported whenever possible through this fund or through the research support programs discussed below.

F. Participant Costs
The participant costs cover five broad categories:

1. **Meetings and Travel costs** – $150K/yr is budgeted for other travel costs associated with C-DEBI activities – for example, **Faculty-Postdoc-Student Exchanges**, travel associate sea-going research, or to attendance at a meeting.

2. **Postdoctoral fellowships** – We have budgeted for ~10 fellowships per year for postdocs to be funded outside USC (but otherwise similar to the USC program; above); budgeted funds include a modest research discretionary fund (see below for description).

3. **Student fellowships** – We have budgeted for ~10 fellowships per year for students to be funded outside USC (but otherwise similar to the USC program; above); budgeted funds include a modest research discretionary fund (see below for description).

4. **Undergrad minority summer course** – We have budgeted 80K/yr for stipend ($400/week), travel, meals, and accommodations (dorm and island) costs for 15 students to spend three weeks on campus and three weeks on Catalina island for the described summer course.

5. **Online Teacher Workshop**. Approximately 60K/yr is budgeted for participant costs associated with our COSEE-programs, including teacher workshops and education/outreach activities.

6. **Undergraduate support**. Approximately 25K/yr is budgeted for undergraduate support – this will be available to the entire C-DEBI community.

**G. Other Direct Costs**

1. **Materials and Supplies**

Materials and supplies are budgeted for Edwards’ group research-related activities. Other USC senior personnel activities are supported by the faculty project support category below.

2. **Publication Costs**

Publication costs are budgeted for USC C-DEBI wide publications and includes modest support for graphics development for C-DEBI.

3. **Computer Services**

Funds are allocated in year one for the development of a website and the cyber-infrastructure required for C-DEBI. C-DEBI will use in-house support within the Earth Sciences Department and the SCEC program.

4. **Subcontracts**

Principal categories of support for each Co-PI institution are included below. Funds are intended to support “core research” associated with the North Pond, Juan de Fuca, and South Pacific projects. These costs are calculated and described in co-PI budget justifications.

Two other major categories of research support for outside-USC C-DEBI senior personnel are budgeted.
1. **Research Grants** – small research grants (50 to 200K) are budgeted for C-DEBI senior personnel. These will be administered on an application-basis by the research coordinator and reviewed by the steering committee with oversight from the executive committee.

2. **Major equipment** – funds for major equipment (up to 200K) are budgeted for C-DEBI senior personnel. These will be administered on an application-basis by the research coordinator and reviewed by the steering committee with oversight from the executive committee.

**Rebate from USC on Overhead Charges:**

USC is unable to waive indirect cost charges for the establishment of the research and major equipment sub-grants. However, the College dean has agreed to provide hard dollar funds equivalent to the indirect costs recovered from these sub grant agreements. The funds will be made available to the PI for use on this project at her discretion.

5. **Other**
   i. **Transport of Equipment**

Funds for Edwards’ group for cruise related shipping are requested. Other USC senior personnel activities are supported by the faculty project support category below.

   ii. **Grad Student Research fund**

1000/yr is allocated for each Grad student Fellow as a discretionary fund for research or travel.

   iii. **Postdoctoral Research Fund**

2500/yr is allocated for each Postdoc Fellow as a discretionary fund for research or travel.

   iv. **Engineering Tuition**

Funds to cover the tuition associated with the support of an engineering student at USC are budgeted.

   v. **Faculty project support**

200K/yr is budgeted to support USC C-DEBI research activities as part of the broader C-DEBI small grants program (described above for outside USC support, but implemented similarly here).

**H. Indirect Costs**

Indirect Costs are budgeted at 62% on modified direct costs (excluding >25K for subcontracts, participant costs, major instrumentation).

An incremental increase of 4% is included in future project periods.

**USC Contribution**

1. College Dean's Match equivalent to 20% of total indirect cost recovery
2. College Dean's Match equivalent to indirect cost recovery on research and major equipment subgrants
3. College providing tuition for grad students.
**SUMMARY PROPOSAL BUDGET**

**University of Alaska Fairbanks Campus**

**PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR**

**C. Geoffrey J Wheat**

<table>
<thead>
<tr>
<th>A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)</th>
<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF (if different)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. C. Geoffrey Wheat - Professor</td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>7. (1) TOTAL SENIOR PERSONNEL (1 - 6)</td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
</tbody>
</table>

| B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS) | | | |
|---|---|---|
| 1. (0) POST DOCTORAL SCHOLARS | 0.00 | 0.00 | 0.00 | 0 |
| 2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.) | 9.00 | 0.00 | 0.00 | 30,236 |
| 3. (0) GRADUATE STUDENTS | | | 0 |
| 4. (1) UNDERGRADUATE STUDENTS | | | 9,880 |
| 5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY) | | | 0 |
| 6. (0) OTHER | | | 0 |

| C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS) | 72,732 |
| TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C) | 102,190 |

| D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.) | | |
|---|---|
| Fabricate/buy equipment, see justification | $ 10,000 |
| TOTAL EQUIPMENT | 10,000 |

| E. TRAVEL | | |
|---|---|
| 1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS) | 1,665 |
| 2. FOREIGN | 0 |

| F. PARTICIPANT SUPPORT COSTS | | |
|---|---|
| 1. STIPENDS | $0 |
| 2. TRAVEL | 0 |
| 3. SUBSISTENCE | 0 |
| 4. OTHER | 0 |
| TOTAL NUMBER OF PARTICIPANTS | 0 |
| TOTAL PARTICIPANT COSTS | 0 |

| G. OTHER DIRECT COSTS | | |
|---|---|
| 1. MATERIALS AND SUPPLIES | 5,000 |
| 2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION | 1,000 |
| 3. CONSULTANT SERVICES | 25,000 |
| 4. COMPUTER SERVICES | 0 |
| 5. SUBAWARDS | 0 |
| 6. OTHER | 5,400 |
| TOTAL OTHER DIRECT COSTS | 36,400 |
| H. TOTAL DIRECT COSTS (A THROUGH G) | 150,255 |

| I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE) | | |
|---|---|
| MTDC U Alaska rate (Rate: 26.0000, Base: 140255) | 36,466 |
| TOTAL INDIRECT COSTS (F&A) | 36,466 |

| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | 186,721 |
| K. RESIDUAL FUNDS | 0 |

| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | 186,721 |

| M. COST SHARING PROPOSED LEVEL $ | 0 |
| AGREED LEVEL IF DIFFERENT $ |

**PI/PD NAME**

**C. Geoffrey J Wheat**

**FOR NSF USE ONLY**

<table>
<thead>
<tr>
<th>ORG. REP. NAME*</th>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
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<tr>
<td>Jean Chan</td>
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*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET*
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<thead>
<tr>
<th>Organization</th>
<th>University of Alaska Fairbanks Campus</th>
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</thead>
<tbody>
<tr>
<td>Principal Investigator / Project Director</td>
<td>C. Geoffrey J Wheat</td>
</tr>
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</table>

**A. Senior Personnel: PI/PD, Co-PI’s, Faculty and Other Senior Associates**
(List each separately with title, A.7. show number in brackets)

<table>
<thead>
<tr>
<th>Name</th>
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<th>SUMR</th>
<th>Total Funds</th>
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**B. Other Personnel (Show Numbers in Brackets)**

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<th>Category</th>
<th>Amount (in Brackets)</th>
<th>Total</th>
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<tr>
<td>2. Other Professionals (Technician, Programmer, etc.)</td>
<td>13.50</td>
<td>51,168</td>
</tr>
<tr>
<td>3. Graduate Students</td>
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</tr>
<tr>
<td>4. Undergraduate Students</td>
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<td>0</td>
</tr>
<tr>
<td>5. Secretarial - Clerical (If Charged Directly)</td>
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<td>0</td>
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<tr>
<td>6. Other</td>
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**D. Equipment (List Item and Dollar Amount for Each Item Exceeding $5,000.)**
- purchase or fabricate equip., see budget just. $10,000

**E. Travel**

<table>
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<th>Category</th>
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<td>1. Domestic (incl. Canada, Mexico and U.S. possessions)</td>
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<tr>
<td>2. Foreign</td>
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**F. Participant Support Costs**

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</thead>
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<td>1. Stipends</td>
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</tr>
<tr>
<td>2. Travel</td>
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</tr>
<tr>
<td>3. Subsistence</td>
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</tr>
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<td>4. Other</td>
<td>0</td>
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**G. Other Direct Costs**

<table>
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<td>3. Consultant Services</td>
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<td>4. Computer Services</td>
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**H. Total Direct Costs (A Through G)**

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**I. Indirect Costs (F&A) (Specify Rate and Base)**

<table>
<thead>
<tr>
<th>Description</th>
<th>Amount</th>
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</thead>
<tbody>
<tr>
<td>MTDC U Alaska rate (Rate: 26.0000, Base: 176610)</td>
<td>45,919</td>
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</table>

**J. Total Direct and Indirect Costs (H + I)**

<table>
<thead>
<tr>
<th>Amount</th>
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<tbody>
<tr>
<td>232,529</td>
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</table>

**K. Residual Funds**

<table>
<thead>
<tr>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

**L. Amount of This Request (J) or (J Minus K)**

<table>
<thead>
<tr>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>232,529</td>
</tr>
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</table>

**M. Cost Sharing Proposed Level $**

<table>
<thead>
<tr>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
</tr>
</tbody>
</table>

**FOR NSF USE ONLY**

<table>
<thead>
<tr>
<th>PI/PD Name</th>
<th>C. Geoffrey J Wheat</th>
</tr>
</thead>
<tbody>
<tr>
<td>ORG. REP. NAME*</td>
<td>Jean Chan</td>
</tr>
</tbody>
</table>

*Electronic Signatures Required for Revised Budget
<table>
<thead>
<tr>
<th>ORGANIZATION</th>
<th>PROPOSAL NO.</th>
<th>DURATION (months)</th>
<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF (if different)</th>
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</thead>
<tbody>
<tr>
<td>University of Alaska Fairbanks Campus</td>
<td>Proposed</td>
<td>3</td>
<td>CAL</td>
<td>ACAD</td>
<td>SUMR</td>
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</tbody>
</table>

**PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR**

**C. Geoffrey J Wheat**

A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates

(List each separately with title, A.7. show number in brackets)

<table>
<thead>
<tr>
<th>A.7.</th>
<th>C. Geoffrey Wheat - Professor</th>
<th>3.00</th>
<th>0.00</th>
<th>0.00</th>
<th>35,612</th>
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</table>

6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)

<table>
<thead>
<tr>
<th>6.</th>
<th>OTHERS</th>
<th>0.00</th>
<th>0.00</th>
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7. (1) TOTAL SENIOR PERSONNEL (1 - 6)

<table>
<thead>
<tr>
<th>7.</th>
<th>TOTAL SENIOR PERSONNEL (1 - 6)</th>
<th>3.00</th>
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<th>0.00</th>
<th>35,612</th>
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</table>

B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)

<table>
<thead>
<tr>
<th>1.</th>
<th>POST DOCTORAL SCHOLARS</th>
<th>0.00</th>
<th>0.00</th>
<th>0.00</th>
<th>0</th>
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</table>

2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)

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<thead>
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<th>OTHER PROFESSIONALS</th>
<th>13.50</th>
<th>0.00</th>
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<th>52,703</th>
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3. (0) GRADUATE STUDENTS

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<th>GRADUATE STUDENTS</th>
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<th>0.00</th>
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4. (1) UNDERGRADUATE STUDENTS

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<tr>
<th>4.</th>
<th>UNDERGRADUATE STUDENTS</th>
<th>9,880</th>
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5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)

<table>
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<tr>
<th>5.</th>
<th>SECRETARIAL - CLERICAL</th>
<th>0.00</th>
<th>0.00</th>
<th>0.00</th>
<th>0</th>
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6. (0) OTHER

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TOTAL SALARIES AND WAGES (A + B)

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<thead>
<tr>
<th>TOTAL SALARIES AND WAGES</th>
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C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)

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TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)

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<thead>
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<th>TOTAL SALARIES, WAGES AND FRINGE BENEFITS</th>
<th>142,723</th>
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D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

Buy/fabricate equipment, see justification

<table>
<thead>
<tr>
<th>Buy/fabricate equipment</th>
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TOTAL EQUIPMENT

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E. TRAVEL

<table>
<thead>
<tr>
<th>TRAVEL</th>
<th>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</th>
<th>$1,833</th>
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F. PARTICIPANT SUPPORT COSTS

<table>
<thead>
<tr>
<th>PARTICIPANT SUPPORT COSTS</th>
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1. STIPENDS

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<thead>
<tr>
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2. TRAVEL

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<tr>
<th>TRAVEL</th>
<th>$0</th>
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3. SUBSISTENCE

<table>
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<tr>
<th>SUBSISTENCE</th>
<th>$0</th>
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</table>

4. OTHER

<table>
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<tr>
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</table>

TOTAL NUMBER OF PARTICIPANTS

<table>
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<tr>
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G. OTHER DIRECT COSTS

<table>
<thead>
<tr>
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<th>36,945</th>
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1. MATERIALS AND SUPPLIES

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<tr>
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2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION

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3. CONSULTANT SERVICES

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<tr>
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4. COMPUTER SERVICES

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<th>COMPUTER SERVICES</th>
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</table>

5. SUBAWARDS

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<tr>
<th>SUBAWARDS</th>
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6. OTHER

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<thead>
<tr>
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TOTAL OTHER DIRECT COSTS

<table>
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<tr>
<th>TOTAL OTHER DIRECT COSTS</th>
<th>36,945</th>
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H. TOTAL DIRECT COSTS (A THROUGH G)

<table>
<thead>
<tr>
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I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)

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<thead>
<tr>
<th>MTDC U Alaska rate (Rate: 26.0000, Base: 181501)</th>
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<tbody>
<tr>
<td>TOTAL INDIRECT COSTS (F&amp;A)</td>
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<tr>
<td>TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
</tr>
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</table>

K. RESIDUAL FUNDS

<table>
<thead>
<tr>
<th>RESIDUAL FUNDS</th>
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L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)

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M. COST SHARING PROPOSED LEVEL

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AGREED LEVEL IF DIFFERENT

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<thead>
<tr>
<th>AGREED LEVEL IF DIFFERENT</th>
<th>$0</th>
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</thead>
</table>

PI/PD NAME

<table>
<thead>
<tr>
<th>PI/PD NAME</th>
<th>C. Geoffrey J Wheat</th>
</tr>
</thead>
</table>

FOR NSF USE ONLY

<table>
<thead>
<tr>
<th>FOR NSF USE ONLY</th>
<th>INDIRECT COST RATE VERIFICATION</th>
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ORG. REP. NAME

<table>
<thead>
<tr>
<th>ORG. REP. NAME</th>
<th>Jean Chan</th>
</tr>
</thead>
</table>

Date Checked | Date Of Rate Sheet | Initials - ORG

3 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
<table>
<thead>
<tr>
<th>A.  SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates</th>
</tr>
</thead>
<tbody>
<tr>
<td>(List each separately with title, A.7. show number in brackets)</td>
</tr>
<tr>
<td></td>
</tr>
<tr>
<td>----------------------------</td>
</tr>
<tr>
<td>1. C. Geoffrey Wheat - Professor</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
</tr>
<tr>
<td>6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
</tr>
<tr>
<td>7. (1) TOTAL SENIOR PERSONNEL (1 - 6)</td>
</tr>
<tr>
<td>B.  OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)</td>
</tr>
<tr>
<td>1. (1) POST DOCTORAL SCHOLARS</td>
</tr>
<tr>
<td>2. (2) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
</tr>
<tr>
<td>3. (0) GRADUATE STUDENTS</td>
</tr>
<tr>
<td>4. (0) UNDERGRADUATE STUDENTS</td>
</tr>
<tr>
<td>5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)</td>
</tr>
<tr>
<td>6. (0) OTHER</td>
</tr>
<tr>
<td>TOTAL SALARIES AND WAGES (A + B)</td>
</tr>
<tr>
<td>C.  FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)</td>
</tr>
<tr>
<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
</tr>
<tr>
<td>D.  EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)</td>
</tr>
<tr>
<td><strong>Buy/fabricate equipment, see justification</strong></td>
</tr>
<tr>
<td>TOTAL EQUIPMENT</td>
</tr>
<tr>
<td>E.  TRAVEL</td>
</tr>
<tr>
<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
</tr>
<tr>
<td>2. FOREIGN</td>
</tr>
<tr>
<td>F.  PARTICIPANT SUPPORT COSTS</td>
</tr>
<tr>
<td>1. STIPENDS</td>
</tr>
<tr>
<td>2. TRAVEL</td>
</tr>
<tr>
<td>3. SUBSISTENCE</td>
</tr>
<tr>
<td>4. OTHER</td>
</tr>
<tr>
<td>TOTAL NUMBER OF PARTICIPANTS (0)</td>
</tr>
<tr>
<td>TOTAL PARTICIPANT COSTS</td>
</tr>
<tr>
<td>G.  OTHER DIRECT COSTS</td>
</tr>
<tr>
<td>1. MATERIALS AND SUPPLIES</td>
</tr>
<tr>
<td>2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION</td>
</tr>
<tr>
<td>3. CONSULTANT SERVICES</td>
</tr>
<tr>
<td>4. COMPUTER SERVICES</td>
</tr>
<tr>
<td>5. SUBAWARDS</td>
</tr>
<tr>
<td>6. OTHER</td>
</tr>
<tr>
<td>TOTAL OTHER DIRECT COSTS</td>
</tr>
<tr>
<td>H.  TOTAL DIRECT COSTS (A THROUGH G)</td>
</tr>
<tr>
<td>I.  INDIRECT COSTS (F&amp;A) (SPECIFY RATE AND BASE)</td>
</tr>
<tr>
<td><strong>MTDC U Alaska rate (Rate: 26.0000, Base: 244329)</strong></td>
</tr>
<tr>
<td>TOTAL INDIRECT COSTS (F&amp;A)</td>
</tr>
<tr>
<td>J.  TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
</tr>
<tr>
<td>K.  RESIDUAL FUNDS</td>
</tr>
<tr>
<td>L.  AMOUNT OF THIS REQUEST (J) (OR J MINUS K)</td>
</tr>
<tr>
<td>M.  COST SHARING PROPOSED LEVEL $</td>
</tr>
<tr>
<td>AGREED LEVEL IF DIFFERENT $</td>
</tr>
</tbody>
</table>

**PI/PD NAME**

C. Geoffrey J Wheat

**FOR NSF USE ONLY**

INDIRECT COST RATE VERIFICATION

Jean Chan

Date Checked: Date Of Rate Sheet: Initials - ORG

4 *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
### University of Alaska Fairbanks Campus

#### PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR

**C. Geoffrey J Wheat**

#### A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates

(List each separately with title, A.7. show number in brackets)

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Funds Requested by Proposer</th>
<th>Funds granted by NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>C. Geoffrey Wheat</strong></td>
<td>3.00</td>
<td>0.00</td>
<td>0.00</td>
<td>38,889</td>
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</tr>
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<td></td>
</tr>
</tbody>
</table>

**Funds Requested by Proposer:**

- **C. Geoffrey Wheat** - Professor

**Funds granted by NSF:**

- **C. Geoffrey Wheat** - Professor

#### B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)

<table>
<thead>
<tr>
<th>Post-doctoral Scholars</th>
<th>9.00</th>
</tr>
</thead>
<tbody>
<tr>
<td>Other Professionals</td>
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</tr>
<tr>
<td>Undergraduate Students</td>
<td>0</td>
</tr>
<tr>
<td>Secretarial - Clerical</td>
<td>0</td>
</tr>
<tr>
<td>Other</td>
<td>0</td>
</tr>
</tbody>
</table>

**TOTAL SALARIES AND WAGES (A + B):** 47,387

#### C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)

**TOTAL FRINGE BENEFITS:** 62,807

#### D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

**TOTAL EQUIPMENT:** 0

#### E. TRAVEL

<table>
<thead>
<tr>
<th>Domestic (Incl. Canada, Mexico and U.S. Possessions)</th>
<th>2,036</th>
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</thead>
<tbody>
<tr>
<td>Foreign</td>
<td>0</td>
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#### F. PARTICIPANT SUPPORT COSTS

**TOTAL NUMBER OF PARTICIPANTS:**

<table>
<thead>
<tr>
<th>Stipends</th>
<th>0</th>
</tr>
</thead>
</table>

**TOTAL PARTICIPANT COSTS:** 0

#### G. OTHER DIRECT COSTS

- **MATERIALS AND SUPPLIES:** 6,079
- **PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION:** 1,000
- **CONSULTANT SERVICES:** 15,000
- **COMPUTER SERVICES:** 0
- **SUBAWARDS:** 0
- **OTHER:** 5,465

**TOTAL OTHER DIRECT COSTS:** 27,544

#### H. TOTAL DIRECT COSTS (A THROUGH G)

**TOTAL DIRECT COSTS:** 244,456

#### I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)

**MTDC U Alaska rate (Rate: 26.0000, Base: 244456)**

**TOTAL INDIRECT COSTS (F&A):** 63,559

#### J. TOTAL DIRECT AND INDIRECT COSTS (H + I)

**TOTAL DIRECT AND INDIRECT COSTS:** 308,015

#### K. RESIDUAL FUNDS

**RESIDUAL FUNDS:** 0

#### L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)

**AMOUNT OF THIS REQUEST:** 308,015

**AMOUNT OF THIS REQUEST (J) OR (J MINUS K):** 308,015

#### M. COST SHARING

**PROPOSED LEVEL ($) AGREE LEVEL IF DIFFERENT$:** 0

---

**FOR NSF USE ONLY**

**PI/PD NAME:** C. Geoffrey J Wheat

**ORG. REP. NAME:** Jean Chan

**Date Checked**

**Date of Rate Sheet**

**Initials - ORG**

---

5 **ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**
<table>
<thead>
<tr>
<th>A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates</th>
<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF (if different)</th>
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<td>2.</td>
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<tr>
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<td>0.00</td>
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<tr>
<td>4.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>5.</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
</tr>
<tr>
<td>6. ( ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>7. ( 1 ) TOTAL SENIOR PERSONNEL (1 - 6)</td>
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<table>
<thead>
<tr>
<th>B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. ( 2 ) POST DOCTORAL SCHOLARS</td>
</tr>
<tr>
<td>2. ( 9 ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
</tr>
<tr>
<td>3. ( 0 ) GRADUATE STUDENTS</td>
</tr>
<tr>
<td>4. ( 5 ) UNDERGRADUATE STUDENTS</td>
</tr>
<tr>
<td>5. ( 0 ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)</td>
</tr>
<tr>
<td>6. ( 0 ) OTHER</td>
</tr>
<tr>
<td>TOTAL SALARIES AND WAGES (A + B)</td>
</tr>
<tr>
<td>C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)</td>
</tr>
<tr>
<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
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<table>
<thead>
<tr>
<th>D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)</th>
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<tbody>
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<td>TOTAL EQUIPMENT</td>
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</tbody>
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<table>
<thead>
<tr>
<th>E. TRAVEL</th>
</tr>
</thead>
<tbody>
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<tbody>
<tr>
<td>1. STIPENDS</td>
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<td>3. CONSULTANT SERVICES</td>
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<td>4. COMPUTER SERVICES</td>
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<tr>
<td>H. TOTAL DIRECT COSTS (A THROUGH G)</td>
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<tr>
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<td>J. TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
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<td>K. RESIDUAL FUNDS</td>
</tr>
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<td>L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)</td>
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| M. COST SHARING PROPOSED LEVEL $ | 0 |
| AGREED LEVEL IF DIFFERENT $ | 0 |

<table>
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<td>C. Geoffrey J Wheat</td>
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<th>ORG. REP. NAME*</th>
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<td>Jean Chan</td>
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*C ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
University of Alaska Fairbanks  
Statement of Work and Budget Justification

The University of Alaska Fairbanks (UAF) requests monies from the National Science Foundation (NSF) for a portion of the geochemical component of this program. As stated in the text of the proposal, Wheat’s primary responsibilities on the executive committee will be to oversee the technological transfer of information and the development of CORKs and the instruments that are placed in and on them. Wheat will also play a primary role in geochemical and hydrologic studies at the Juan de Fuca CORKs and the proposed North Pond CORKs. Wheat also will develop the science plan for the study of Dorado Outcrop with Fisher and other deep-biosphere targets including but not limited to existing CORKs and boreholes and planned deep sea drilling operations. In general, Wheat will help direct the C-DEBI program, oversee student (postdoctoral fellows and graduate and undergraduate students) involvement and education, interpret geochemical data, and work with our collaborators to develop and publish scientific and general public manuscripts.Outlined below is the justification for each of the categories listed on the NSF budget pages.

Salaries: UAF requests a 3 months of salary per year for the 5-year duration of the grant for Wheat. Only part of Wheat’s salary is paid by the West Coast and Polar Regions Undersea Research Center (WC&PRURC). The remainder comes from outside funding agencies via proposals such as this one. Even though Wheat is an employee of the University of Alaska Fairbanks, he will conduct his portion of the project from his office in Moss Landing, CA at the Monterey Bay Aquarium Research Institute (MBARI) facilities. This arrangement is possible because Wheat is the Regional Coordinator in charge of the California Branch of the WC&PRURC and is an Adjunct Scientist at MBARI.

As noted above, Wheat’s primary responsibilities as a member of the executive committee will be to oversee the technological transfer of information and the development of CORKs and the instruments that are placed in and on them. A major portion of the developmental work will be in consultation with engineers and deep-sea operators (i.e., submersibles and remotely operated vehicles) at Stress and Mohr Engineering, the Monterey Bay Aquarium Research Institute, Santa Clara University, and Woods Hole Oceanographic Institute. Consultant fees are included in another portion of the budget to work with individuals to advance scientific return through technological development. To help with the development, fabrication and testing of these new technologies, Wheat will oversee a technician (7 months per year). This technician will oversee general laboratory procedures, maintain QA/QC, and focus on the testing, reliability, and robustness of the new technologies as well as maintain all operational equipment to deploy and recover seafloor and sub-seafloor instruments, samplers, and experiments. This technician will help Wheat mentor and oversee the two part-time undergraduate students (10 hrs per week for 12 months per year). These students will likely be engineering students at Santa Clara University. Wheat, Kitts, and Kirkwood have developed the RETINA program; a component of which is the involvement in undergraduate engineering students in real-world problems and applications. For the past 3 years Wheat has hired one or two students, some for summer internships and others through out the year. This relationship provides opportunities for the student and working, reliable, and timely instruments and samplers for Wheat. Another possible source for undergraduate labor is one of the local junior colleges. Wheat’s wife works at Hartnell Community College and at Cabrillo Community College. She has acted as an agent for students to get involved in Wheat’s oceanographic and subsurface research.

In addition to these roles as part of the executive committee, Wheat will also play a primary role in geochemical and hydrologic studies at the Juan de Fuca CORKs and the proposed North Pond CORKs. Wheat also will develop the science plan for the study of Dorado Outcrop with Fisher and other deep-biosphere targets including but not limited to existing CORKs and boreholes and planned deep sea drilling operations. As mentioned above, the laboratory technician, in addition to the duties listed above, will help oversee laboratory QA/QC procedures.

Also, we requested 9 months per year for Years 4 and 5 for a Postdoctoral Fellow. This Fellow will fall under the general mentoring program outlined in the proposal text. This Fellow will work on data collected during the early portion of the proposal with the idea that a major focus will be to integrate and synthesis data from various deployments and laboratories from a variety of geological settings, but with a geochemical or hydrology focus.
UAF also requests funds for one graduate student per year for Years 2-5 (This position is listed as a laboratory assistant in the budget pages because Wheat is not at UAF and has made arrangements with local academic institutions.). It is anticipated that the one person will be hired for Years 2 and 3 and another for Years 4 and 5. These students will work part time (e.g., 20 hours per week; the remainder will come from other activities (e.g., TA). Wheat has access to graduate students at Moss Landing Marine Laboratories (MLML), UC Santa Cruz (UCSC), and CSU Monterey Bay who have the background to conduct analytical measurements, fabricate instruments and sensors, and test sensors. Students that are supported by this grant will use a portion of the data associated with DEBI operations for their master’s thesis. Other arrangements are typically made to cover tuition costs. These students will help prepare for sea, conduct the many and varied chemical analyses, and prepare manuscripts for publication.

**Permanent Equipment**  UAF requests $10K per year for Years 1-4 to purchase or fabricate equipment (instruments, sensors, or samplers) to be modified for deep sea or sub-seafloor operations. A variety of tools are in development or need to be developed, including but not limited to a flow meter for borehole applications, a subsurface borehole oxygen probe, contamination-free fluid samplers, borehole televiewer and sampler deployed from an ROV or submersible, in situ pore water extractor for use with deep-sea drilling operations (modification of the Fissler tool for the new HPC coring shoes with a focus on minimizing contamination), and making a GC for borehole operations.

**Travel**  UAF requests travel funds for each year for Wheat, the Postdoctoral Fellow or graduate student to attend a national meeting, including costs for registration and abstract fees.

**Material and Supplies**  Materials and supplies are required for each of the five years of the proposed program. Monies are required to analyze fluids from laboratory experiments and tool/sampler/sensor/instrument development efforts. Such analyses include but are not limited to dissolved Mn and Fe at low levels (nmol/kg) ammonium, nitrate, and phosphate using colorimetric methods, Cl, pH, alkalinity and F using potentiometric methods, ICP-AES, ICP-MS, AA, IC, and isotopic methods. Chemicals and supplies for these analyses are requested including disposable test-tubes for sample dilution before the sample is injected into a particular instrument and cones, nebulizers, torches, and columns that are consumed with use. Isotopic analyses also may be conducted in cooperation with other laboratories if necessary.

**Other**  Several items are included in this category such as communications/computer services/software, publications, shipping samples, samplers, and sensors, analytical costs, registration for meetings, and CORK/engineering consultants. Wheat has access to several laboratories for conducting chemical analyses: MBARI (autoanalyzer for measuring concentrations of dissolved nutrients; FIA and standard chemical analyses [F]), MBARI/Wheat (IC for measuring concentrations of anions in seawater [sulfate, Br]), Soil Control Laboratories (Watsonville, CA) (ICP-AES for measuring a variety of elements [Fe, Mn, Si, Sr, B, S, Na, Ca, Mg, K, Ba, Li]), and Moss Landing Marine Laboratories (ICP-MS for measuring trace elements including the rare earth elements). Stable isotopic analyses can be conducted at a variety of university laboratories depending on the need for a particular isotopic result (e.g., O and H [UC Berkeley], C and N [UH], S [UC Davis], Sr [MLML], Li and B [You, Taiwan], and 14C [WHOI]). Wheat works in Moss Landing, CA where there are no UAF facilities. UAF leases laboratory space from MBARI for Wheat to conduct his research.

**Indirect Costs**  Facilities and Administrative (F&A) Costs are negotiated with the Office of Naval Research and for research are calculated at 26% of the Modified Total Direct Costs (MTDC). Nominally all UAF grants charge 47.5% overhead; however, because this work is being conducted off campus in a leased facility, the overhead is lowered. MTDC includes Total Direct Costs minus tuition, stipends, scholarships, sub-awards amounts over $25,000, participant support costs, and equipment. A copy of the agreement is available at: [http://www.alaska.edu/controller/cost-analysis/negotiated_agreements.html](http://www.alaska.edu/controller/cost-analysis/negotiated_agreements.html).
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### SUMMARY PROPOSAL BUDGET

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<td>Andrew J Fisher</td>
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<td>AWARD NO.</td>
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**A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates**

- **Andrew T Fisher** - Professor
  - CAL: 1.50
  - ACAD: 0.00
  - SUMR: 0.00
  - Grants: 20,016

**B. OTHER PERSONNEL**

- Post Doctoral Scholars: 12.00, Grants: 74,000
- Other Professionals: 0.00, Grants: 0
- Graduate Students: 20,010
- Undergraduate Students: 6,775
- Secretarial - Clerical: 0
- Other: 0

**C. FRINGE BENEFITS**

- Total Salaries, Wages, and Fringe Benefits: 120,801

**D. EQUIPMENT**

- Total Equipment: 13,750

**E. TRAVEL**

- Domestic (Incl. Canada, Mexico and U.S. Possessions): 7,400
- Foreign: 3,900

**F. PARTICIPANT SUPPORT COSTS**

- Stipends: 0
- Travel: 0
- Subsistence: 0
- Other: 0

**G. OTHER DIRECT COSTS**

- Materials and Supplies: 13,750
- Publication Costs/Documentation/Dissemination: 2,200
- Consultant Services: 1,800
- Computer Services: 0
- Subawards: 0
- Other: 11,826

**H. TOTAL DIRECT COSTS (A THROUGH G)**

- 185,071

**I. INDIRECT COSTS (F&A)**

- MTDC (TDC-GSR fees, tuition, permanent equip (Rate: 51.5000, Base: 176445)
  - Total Indirect Costs (F&A): 90,869

**J. TOTAL DIRECT AND INDIRECT COSTS (H + I)**

- 275,940

**K. RESIDUAL FUNDS**

- 0

**L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)**

- 275,940

**M. COST SHARING PROPOSED LEVEL**

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**FOR NSF USE ONLY**

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<th>Andrew J Fisher</th>
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<tbody>
<tr>
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<td>Jean Chan</td>
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*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
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<th>Funds Granted by NSF</th>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
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<td>AGREED LEVEL IF DIFFERENT $</td>
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**FOR NSF USE ONLY**

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<thead>
<tr>
<th>PI/PD NAME</th>
<th>INDIRECT COST RATE VERIFICATION</th>
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<tbody>
<tr>
<td>Andrew J Fisher</td>
<td>Date Checked</td>
</tr>
<tr>
<td>Jean Chan</td>
<td></td>
</tr>
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---

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET*
### SUMMARY PROPOSAL BUDGET

**Year**: 4

**Organization**: University of California - Santa Cruz

**Principal Investigator / Project Director**: Andrew J Fisher

#### A. Senior Personnel: PI/PD, Co-PI's, Faculty and Other Senior Associates

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Person-months</th>
<th>NSF Funded</th>
<th>Requested By</th>
<th>Funds granted by NSF</th>
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</thead>
<tbody>
<tr>
<td>Andrew T Fisher</td>
<td>Professor</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>14,717</td>
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<td>Other (list individually on budget justification page)</td>
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<td>0.00</td>
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<td>14,717</td>
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#### B. Other Personnel

- Post Doctoral Scholars: 12.00
- Other Professionals (Technician, Programmer, etc.): 0.00
- Graduate Students: 21.229
- Undergraduate Students: 7.187
- Secretarial - Clerical (if charged directly): 0
- Other: 0

**Total Salaries and Wages (A + B)**: 121,639

#### C. Fringe Benefits (If charged as direct costs)

**Total Salaries, Wages and Fringe Benefits (A + B + C)**: 145,579

#### D. Equipment (List item and dollar amount for each item exceeding $5,000.)

**Total Equipment**: 0

#### E. Travel

- Domestic (incl. Canada, Mexico and U.S. Possessions): 3,155
- Foreign: 0

#### F. Participant Support Costs

- Stipends: 0
- Travel: 0
- Subsistence: 0
- Other: 0

**Total Number of Participants**: 0

**Total Participant Costs**: 0

#### G. Other Direct Costs

- Materials and Supplies: 9,200
- Publication Costs/Documentation/Dissemination: 2,500
- Consultant Services: 0
- Computer Services: 1,800
- Subawards: 0
- Other: 12,538

**Total Other Direct Costs**: 26,038

#### H. Total Direct Costs (A Through G)

**Total Direct Costs**: 174,772

#### I. Indirect Costs (F&A)(Specify Rate and Base)

**MTDC (TDC-GSR fees, tuition, permanent equip (Rate: 51.5000, Base: 164334)**

**Total Indirect Costs (F&A)**: 84,632

#### J. Total Direct and Indirect Costs (H + I)

**Total Direct and Indirect Costs**: 260,404

#### K. Residual Funds

**Residual Funds**: 0

#### L. Amount of This Request (J) or (J Minus K)

**Amount of This Request**: 259,404

#### M. Cost Sharing Proposed Level $ 0

**Agreed Level if Different**: 0

**PI/PD Name**: Andrew J Fisher

**Indirect Cost Rate Verification**

**Org. Rep. Name**: Jean Chan

---

**FOR NSF USE ONLY**

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<th>Date of Rate Sheet</th>
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*Electronic Signatures Required for Revised Budget*
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<th>University of California-Santa Cruz</th>
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<tbody>
<tr>
<td>PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR</td>
<td>Andrew J Fisher</td>
</tr>
</tbody>
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### PROPOSAL BUDGET

#### A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates

- **Andrew T Fisher - Professor**: 1.50 Person-months, $22,738

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Person-months</th>
<th>Funds Requested By NSF</th>
<th>Funds Granted by NSF</th>
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<tr>
<td>Andrew T Fisher</td>
<td>1.50</td>
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<td>1.50</td>
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#### B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)

- **Post Doctoral Scholars**: 0 Person-months, 0
- **Other Professionals**: 0 Person-months, 0
- **Graduate Students**: 1 Person-month, $21,866
- **Undergraduate Students**: 1 Person-month, $7,403
- **Secretarial - Clerical (if charged directly)**: 0
- **Other**: 0

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Person-months</th>
<th>Funds Requested By NSF</th>
<th>Funds Granted by NSF</th>
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<td>0</td>
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<td>0</td>
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<tr>
<td>Other Professionals</td>
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<td>0.00</td>
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<td>0</td>
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#### C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)

- **Total Salaries, Wages and Fringe Benefits (A + B + C)**: $55,855

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<th>Name</th>
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<th>Person-months</th>
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<td>Total Salaries, Wages and Fringe Benefits (A + B + C)</td>
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#### D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

- **Total Equipment**: $2,650

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<th>Person-months</th>
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#### E. TRAVEL

- **Domestic (Incl. Canada, Mexico and U.S. Possessions)**: $7,400
- **Foreign**: $3,900

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#### F. PARTICIPANT SUPPORT COSTS

- **Stipends**: $0
- **Travel**: $0
- **Subsistence**: $0
- **Other**: $0

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<th>CAL</th>
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#### G. OTHER DIRECT COSTS

- **Materials and Supplies**: $2,650
- **Publication Costs/Documentation/Dissemination**: $2,500
- **Consultant Services**: $0
- **Computer Services**: $1,800
- **Subawards**: $0
- **Other**: $13,832

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#### H. TOTAL DIRECT COSTS (A THROUGH G)

- **Total Direct Costs**: $87,937

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#### I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)

- **MTDC (TDC-GSR fees, tuition, permanent equip (Rate: 51.5000, Base: 76455)**: $39,374

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#### J. TOTAL DIRECT AND INDIRECT COSTS (H + I)

- **Total Direct and Indirect Costs**: $127,311

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#### K. RESIDUAL FUNDS

- **Residual Funds**: $0

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#### L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)

- **Total Requested**: $127,311

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Person-months</th>
<th>Funds Requested By NSF</th>
<th>Funds Granted by NSF</th>
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<tbody>
<tr>
<td>Total Requested</td>
<td>127,311</td>
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#### M. COST SHARING PROPOSED LEVEL $ 0 AGREED LEVEL IF DIFFERENT

<table>
<thead>
<tr>
<th>Name</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Person-months</th>
<th>Funds Requested By NSF</th>
<th>Funds Granted by NSF</th>
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<tbody>
<tr>
<td>Cost Sharing Proposed Level</td>
<td>0</td>
<td>0</td>
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### FOR NSF USE ONLY

#### ORG. REP. NAME* Jean Chan

<table>
<thead>
<tr>
<th>Name</th>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean Chan</td>
<td></td>
<td></td>
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</tr>
<tr>
<td>ORGANIZATION</td>
<td>FOR NSF USE ONLY</td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>University of California-Santa Cruz</td>
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<table>
<thead>
<tr>
<th>PROPOSAL NO.</th>
<th>DURATION (months)</th>
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<tr>
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<table>
<thead>
<tr>
<th>PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR</th>
<th>AWARD NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Andrew J Fisher</td>
<td></td>
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</table>

<table>
<thead>
<tr>
<th>A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates</th>
<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>(List each separately with title, A.7. show number in brackets)</td>
<td>CAL</td>
<td>ACAD</td>
<td>SUMR</td>
</tr>
<tr>
<td>1. Andrew T Fisher - Professor</td>
<td>6.50</td>
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<td>0.00</td>
</tr>
<tr>
<td>2.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>6. (        ) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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<tr>
<td>7. (        ) TOTAL SENIOR PERSONNEL (1 - 6)</td>
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<table>
<thead>
<tr>
<th>B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)</th>
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</thead>
<tbody>
<tr>
<td>1. (        ) POST DOCTORAL SCHOLARS</td>
<td>36.00</td>
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<tr>
<td>2. (        ) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
<td>0.00</td>
</tr>
<tr>
<td>3. (        ) GRADUATE STUDENTS</td>
<td>0.00</td>
</tr>
<tr>
<td>4. (        ) UNDERGRADUATE STUDENTS</td>
<td>0.00</td>
</tr>
<tr>
<td>5. (        ) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)</td>
<td>34,920</td>
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<td>6. (        ) OTHER</td>
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<tr>
<td>TOTAL SALARIES AND WAGES (A + B)</td>
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<tr>
<th>C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)</th>
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<tbody>
<tr>
<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
<td>77,738</td>
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<table>
<thead>
<tr>
<th>D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)</th>
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<tbody>
<tr>
<td>TOTAL EQUIPMENT</td>
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<table>
<thead>
<tr>
<th>E. TRAVEL</th>
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<tr>
<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
<td>31,110</td>
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<td>2. FOREIGN</td>
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<tr>
<th>F. PARTICIPANT SUPPORT COSTS</th>
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<tr>
<td>1. STIPENDS</td>
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</tr>
<tr>
<td>2. TRAVEL</td>
<td>$0</td>
</tr>
<tr>
<td>3. SUBSISTENCE</td>
<td>$0</td>
</tr>
<tr>
<td>4. OTHER</td>
<td>$0</td>
</tr>
<tr>
<td>TOTAL NUMBER OF PARTICIPANTS</td>
<td>(0)</td>
</tr>
<tr>
<td>TOTAL PARTICIPANT COSTS</td>
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<table>
<thead>
<tr>
<th>G. OTHER DIRECT COSTS</th>
<th></th>
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<tbody>
<tr>
<td>1. MATERIALS AND SUPPLIES</td>
<td>45,250</td>
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<tr>
<td>2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION</td>
<td>10,200</td>
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<tr>
<td>3. CONSULTANT SERVICES</td>
<td>$0</td>
</tr>
<tr>
<td>4. COMPUTER SERVICES</td>
<td>9,000</td>
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<tr>
<td>5. SUBAWARDS</td>
<td>$0</td>
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<tr>
<td>6. OTHER</td>
<td>70,465</td>
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<tr>
<td>TOTAL OTHER DIRECT COSTS</td>
<td>134,915</td>
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<table>
<thead>
<tr>
<th>H. TOTAL DIRECT COSTS (A THROUGH G)</th>
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<tbody>
<tr>
<td>1. INDIRECT COSTS (F&amp;A)(SPECIFY RATE AND BASE)</td>
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<tr>
<td>TOTAL INDIRECT COSTS (F&amp;A)</td>
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<td>J. TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
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</tr>
<tr>
<td>K. RESIDUAL FUNDS</td>
<td>0</td>
</tr>
<tr>
<td>L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)</td>
<td>1,072,126</td>
</tr>
</tbody>
</table>

| M. COST SHARING PROPOSED LEVEL $ | 0 | AGREED LEVEL IF DIFFERENT $ |

<table>
<thead>
<tr>
<th>PI/PD NAME</th>
<th>FOR NSF USE ONLY</th>
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</thead>
<tbody>
<tr>
<td>Andrew J Fisher</td>
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</table>

<table>
<thead>
<tr>
<th>INDIRECT COST RATE VERIFICATION</th>
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<tbody>
<tr>
<td>ORG. REP. NAME*</td>
<td>Jean Chan</td>
</tr>
<tr>
<td>Date Checked</td>
<td>Date Of Rate Sheet</td>
</tr>
</tbody>
</table>

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
Budget Detail and Justification: UCSC

Salaries and benefits

Co-PI Fisher requests salary support of 1.5/yr in years 1, 2, and 5, and 1.0/yr in years 3 and 4. Fisher will be responsible for overseeing hydrogeologic experiments involving seafloor observatories, is project leader for these aspects of the Juan de Fuca flank (JdF) project (described in IODP Proposal 545Full) and the Dorado outcrop project, and a participant on the North Pond project. The JdF project was on the IODP operations schedule in 2008, but was delayed due to the schedule for vessel refit, and is now waiting to be scheduled with the IODP Operations Task Force. NSF has supported engineering development in preparation for the next JdF expedition and follow up experiments, so the rest of this program can proceed as soon as scheduled. Funds requested in this STC proposal would support work leading up to the next drilling expedition and for subsequent experiments, but are not for work during the drilling expedition itself. Fisher will coordinate program activities associated with JdF preparation and follow-up operations, including interaction with UNOLS and DSRV personnel, cruise staffing and preparation, compilation of data lists and transfer of data to the NGDC and other data centers, and organization of dive programs. Fisher also will take primary responsibility for ROV-based heat flow programs, data processing, data integration and synthesis, and numerical modeling.

Fisher will work on these studies with graduate student researcher (GSR), Dustin Winslow, and a post-doctoral student researcher, to be named, who will be involved in essentially all components of the proposed work. Fisher will collaborate with co-PIs on these aspects of the project. Graduate student researcher (GSR) support is requested for two academic quarters/year and summers. Additional support will come from departmental fellowships, teaching assistantships, and external sources. The STC will offer numerous opportunities for Ph.D. research, comprising a mixture of field work, lab work, modeling, and synthesis, addressing questions of global significance. Funds are requested to support a UCSC post-doctoral researcher to participate in years 2, 3, and 4 of the project period. The post-doc will work with Fisher in cruise planning, operations, data interpretation, and modeling. Specific components of the observational and modeling work will be broken out for focus by the post-doctoral researcher. There is more than enough data to be collected and analyzed and modeling to be completed for Fisher, the GSR, and the post doc to take the lead on individual components. Funds are included to support undergraduate lab assistants who can work on senior thesis projects as part of the expeditions and post-expedition analyses. Fisher has supervised 27 undergraduate research projects since 2000. Experience has shown that four experienced people are needed to run around-the-clock heat flow operations on 12-hour shifts, ideally with an extra 1-2 people per shift to provide relief and assist with probe preparation, deployment, and recovery. Additional personnel are also helpful for Alvin dive operations. Between the PI, post doc, and students (graduate and undergraduate) we will have sufficient people to complete proposed operations, experiments, and analyses, and to participate in STC meetings and other activities.

Permanent Equipment

Funds are requested to service, refurbish, and/or replace vintage-1997 Alvin-style heat flow probes purchased as part of an earlier field program. These instruments operate in the lab, but pressure cases should be retested, and basic functionality and stability needs to be confirmed prior to use at sea. We have discussed the status of these tools with Lane Abrams at WHOI, who built them for earlier studies, and he is concerned that replacement system components are likely to be unavailable. Thus we may wish to refurbish these probes with new hardware and/or software, or replace them completely with newer systems (salvaging what can be reused from the current probes).

Travel

Fisher will visit with the NDSF and other WHOI personnel to prepare for two expeditions, either in port or at WHOI, and to verify functionality of the hydraulic insertion frame to be used for ROV-based heat flow surveys. Funds are requested for four people to travel to/from U.S. ports for the start of JdF expeditions (Fisher, post doc, GSR, undergraduate student). Funds are requested to support travel to/from foreign ports for two North Pond expeditions (Fisher and/or post doc and/or GSR). Funds are requested for the post doc and GSR to attend AGU or other meetings in years 2–5 to present research results.

Other Direct Costs

Materials and Supplies:

<table>
<thead>
<tr>
<th>Item</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Totals</th>
</tr>
</thead>
<tbody>
<tr>
<td>Matlab and other software licenses, support</td>
<td>950</td>
<td>850</td>
<td>850</td>
<td>950</td>
<td>850</td>
<td>4,450</td>
</tr>
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</table>
Funds are requested for MATLAB and other software licenses (academic prices plus updates and maintenance) to prepare codes for analysis of heat flow data and prepare numerical models. Funds are requested to help maintain computers used in this study in PI's office and the UCSC Hydroscience Computing Lab (including a new student computer and a field computer for operation of the heat flow probes), and for computer media and backups. Funds are requested to support black and white and color printers and plotters for preparation of theses, manuscripts, and posters for meetings. The NDSF provided an estimate of costs to refurbish the hydraulic insertion frame for heat flow measurements, and funds are also requested for hand tools and supplies needed for the at-sea program. Funds are requested to replace three linux workstations for use in numerical modeling by the PI, post doc, and GSR. Funds are requested for purchase and maintenance of a RAID backup system for modeling and developed of graphics and animations of model results. Tools and expendable supplies are for use during marine expeditions.

Publication and page charges will support student, post doc, and co-PI authored papers describing observational and modeling results. Computer (ADPE) services include network, operating software, and departmental technical support.

### Other Direct Costs:

<table>
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<tr>
<th>Item</th>
<th>Yr 1</th>
<th>Yr 2</th>
<th>Yr 3</th>
<th>Yr 4</th>
<th>Yr 5</th>
<th>Totals</th>
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<tbody>
<tr>
<td>Long-distance telephone</td>
<td>250</td>
<td>300</td>
<td>350</td>
<td>250</td>
<td>350</td>
<td>1,500</td>
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<tr>
<td>Photographic/drafting/copies</td>
<td>150</td>
<td>300</td>
<td>300</td>
<td>150</td>
<td>300</td>
<td>1,200</td>
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<tr>
<td>Equipment/supply shipping</td>
<td>1,500</td>
<td>2,400</td>
<td>1,500</td>
<td>1,500</td>
<td>1,500</td>
<td>8,400</td>
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<tr>
<td>Overnight shipping of papers, documents</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>200</td>
<td>1,000</td>
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<td>Out-of-state tuition</td>
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<td>0</td>
<td>0</td>
<td>0</td>
<td>10,488</td>
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<td>GSHIP</td>
<td>1,734</td>
<td>1,907</td>
<td>2,098</td>
<td>2,308</td>
<td>2,539</td>
<td>10,586</td>
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<td>GSR student fees</td>
<td>6,108</td>
<td>6,719</td>
<td>7,391</td>
<td>8,130</td>
<td>8,943</td>
<td>37,291</td>
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<tr>
<td><strong>Totals</strong></td>
<td>20,430</td>
<td>11,826</td>
<td>11,839</td>
<td>12,538</td>
<td>13,832</td>
<td>70,465</td>
</tr>
</tbody>
</table>

Long distance phone, fax, and shipping charges are for exchange of information and components between co-PIs. Equipment shipping costs include UCSC gear to be shipped to/from WHOI and ports prior to and after expeditions. Student fees, first-year tuition, and insurance are at standard UCSC rates.

### Indirect costs

Overhead is assessed by UCSC at the federally-negotiated rate of 51.5% on Modified Total Direct Costs, equal to Total Direct Costs - [GSR fees and insurance] - [permanent equipment].

---

*Budget justification, UCSC*
## SUMMARY PROPOSAL BUDGET

**Organization**

University of Hawaii

**Proposal No.**

**Award No.**

**Principal Investigator / Project Director**

Katrina J Edwards

### A. Senior Personnel: PI/PD, Co-PI's, Faculty and Other Senior Associates

<table>
<thead>
<tr>
<th>Name</th>
<th>Rank</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Funds Requested by Proposer</th>
<th>Funds Granted by NSF</th>
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</thead>
<tbody>
<tr>
<td>James P Cowen</td>
<td>Professor</td>
<td>1.00</td>
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<td>0.00</td>
<td>13,352</td>
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### B. Other Personnel (Show numbers in brackets)

<table>
<thead>
<tr>
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<tr>
<td>1. Post Doctoral Scholars</td>
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</tr>
<tr>
<td>2. Other Professionals (Technician, Programmer, etc.)</td>
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<tr>
<td>3. Graduate Students</td>
<td></td>
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<tr>
<td>4. Undergraduate Students</td>
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<tr>
<td>5. Secretarial - Clerical (If charged directly)</td>
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<td></td>
</tr>
<tr>
<td>6. Other</td>
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<td></td>
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**Total Salaries and Wages (A + B):** 96,576

### C. Fringe Benefits (If charged as direct costs)

Total Fringe Benefits: 27,414

### D. Equipment (List item and dollar amount for each item exceeding $5,000)

- Custom elevator design/fabrication: $5,000
- Custom fluid connectors: $8,000
- Electronic Controller/software development: $15,000
- Others (See Budget Comments Page...): $65,000

**Total Equipment:** 93,000

### E. Travel

1. Domestic (Incl. Canada, Mexico and U.S. Possessions): 7,300

2. Foreign: 0

### F. Participant Support Costs

- Stipends: 0
- Travel: 0
- Subsistence: 0
- Other: 0

**Total Number of Participants:** 0

**Total Participant Costs:** 0

### G. Other Direct Costs

1. Materials and Supplies: 5,000
2. Publication Costs/Documentation/Dissemination: 0
3. Consultant Services: 0
4. Computer Services: 500
5. Subawards: 0
6. Other: 2,450

**Total Other Direct Costs:** 7,950

### H. Total Direct Costs (A through G)

Total Direct Costs: 232,240

### I. Indirect Costs (F&A) (Specify rate and base)

- MTDC UHawaii rate (Rate: 38.4000, Base: 138740)
  - Total Indirect Costs (F&A): 53,276

### J. Total Direct and Indirect Costs (H + I)

Total Direct and Indirect Costs: 285,516

### K. Residual Funds

Residual Funds: 0

### L. Amount of This Request (J) or (J minus K)

Amount of this Request: 285,516

### M. Cost Sharing

Proposed Level $ 0

Agreed level if different $ 0

**PI/PD Name**

Katrina J Edwards

**Org. Rep. Name**

Jean Chan

---

*Electronic Signatures Required for Revised Budget*
** D- Equipment
  microfluidics/pressure/temp control engin/fab (Amount: $ 55000)
  Misc. engineering fabrication (Amount: $ 10000)
SUMMARY PROPOSAL BUDGET

<table>
<thead>
<tr>
<th>PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR</th>
<th>AWARD NO.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katrina J Edwards</td>
<td></td>
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**A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates**

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>CAL</th>
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<th>SUMR</th>
<th>Funds Requested by Proposer</th>
<th>Funds Granted by NSF</th>
</tr>
</thead>
<tbody>
<tr>
<td>James P Cowen</td>
<td>Professor</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>13,886</td>
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**B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)**

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<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. POST DOCTORAL SCHOLARS</td>
<td></td>
</tr>
<tr>
<td>2. OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
<td>49,920</td>
</tr>
<tr>
<td>3. GRADUATE STUDENTS</td>
<td></td>
</tr>
<tr>
<td>4. UNDERGRADUATE STUDENTS</td>
<td>10,000</td>
</tr>
<tr>
<td>5. SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)</td>
<td>0</td>
</tr>
<tr>
<td>6. OTHER</td>
<td>4,809</td>
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**C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
<td>12,400</td>
</tr>
<tr>
<td>2. FOREIGN</td>
<td>9,000</td>
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</table>

**D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)**

<table>
<thead>
<tr>
<th>Item Description</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>Custom fluid connectors</td>
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**TOTAL EQUIPMENT**

<table>
<thead>
<tr>
<th>Amount</th>
</tr>
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<tbody>
<tr>
<td>15,000</td>
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**E. TRAVEL**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
<td>12,400</td>
</tr>
<tr>
<td>2. FOREIGN</td>
<td>9,000</td>
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**F. PARTICIPANT SUPPORT COSTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. STIPENDS</td>
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</tr>
<tr>
<td>2. TRAVEL</td>
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<tr>
<td>3. SUBSISTENCE</td>
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<td>4. OTHER</td>
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**TOTAL NUMBER OF PARTICIPANTS**

<table>
<thead>
<tr>
<th>Amount</th>
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<tr>
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**TOTAL PARTICIPANT COSTS**

<table>
<thead>
<tr>
<th>Amount</th>
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<tbody>
<tr>
<td>0</td>
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**G. OTHER DIRECT COSTS**

<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
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<tbody>
<tr>
<td>1. MATERIALS AND SUPPLIES</td>
<td>10,000</td>
</tr>
<tr>
<td>2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION</td>
<td>1,000</td>
</tr>
<tr>
<td>3. CONSULTANT SERVICES</td>
<td>0</td>
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<tr>
<td>4. COMPUTER SERVICES</td>
<td>750</td>
</tr>
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<td>5. SUBAWARDS</td>
<td>0</td>
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<tr>
<td>6. OTHER</td>
<td>15,450</td>
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**TOTAL OTHER DIRECT COSTS**

<table>
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<tr>
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<tbody>
<tr>
<td>27,200</td>
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**H. TOTAL DIRECT COSTS (A THROUGH G)**

<table>
<thead>
<tr>
<th>Amount</th>
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<tbody>
<tr>
<td>197,089</td>
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**I. INDIRECT COSTS (F&A) (SPECIFY RATE AND BASE)**

<table>
<thead>
<tr>
<th>Rate</th>
<th>Base</th>
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<tbody>
<tr>
<td>38.4000</td>
<td>181339</td>
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**MTCD at University of Hawaii**

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<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
<td>154,299</td>
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**TOTAL INDIRECT COSTS (F&A)**

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<td>199,089</td>
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**J. TOTAL DIRECT AND INDIRECT COSTS (H + I)**

<table>
<thead>
<tr>
<th>Amount</th>
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<td>266,723</td>
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**K. RESIDUAL FUNDS**

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<tr>
<th>Amount</th>
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**L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)**

<table>
<thead>
<tr>
<th>Amount</th>
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<tr>
<td>266,723</td>
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**M. COST SHARING PROPOSED LEVEL**

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<th>Proposed Level $</th>
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<table>
<thead>
<tr>
<th>AGREED LEVEL IF DIFFERENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
</tr>
</tbody>
</table>

**PI/PD NAME**

| Katrina J Edwards |

**FOR NSF USE ONLY**

<table>
<thead>
<tr>
<th>ORG. REP. NAME*</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean Chan</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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</tr>
</tbody>
</table>

*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
### Summary Proposal Budget

**Organization:** University of Hawaii  
**Principal Investigator / Project Director:** Katrina J Edwards

<table>
<thead>
<tr>
<th>A. Senior Personnel: PI/PD, Co-PI's, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. James P Cowen - Professor</td>
</tr>
<tr>
<td>1.00</td>
</tr>
<tr>
<td>2.</td>
</tr>
<tr>
<td>3.</td>
</tr>
<tr>
<td>4.</td>
</tr>
<tr>
<td>5.</td>
</tr>
<tr>
<td>6. (0) Others (List Individually on Budget Justification Page)</td>
</tr>
<tr>
<td>7. (1) Total Senior Personnel (1-6)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>B. Other Personnel (Show Numbers in Brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (0) Post Doctoral Scholars</td>
</tr>
<tr>
<td>2. (1) Other Professionals (Technician, Programmer, Etc.)</td>
</tr>
<tr>
<td>3. (1) Graduate Students</td>
</tr>
<tr>
<td>4. (0) Undergraduate Students</td>
</tr>
<tr>
<td>5. (0) Secretarial - Clerical (If Charged Directly)</td>
</tr>
<tr>
<td>6. (1) Other</td>
</tr>
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</table>

**Total Salaries and Wages (A + B):** 108,556

<table>
<thead>
<tr>
<th>C. Fringe Benefits (If Charged as Direct Costs)</th>
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<tbody>
<tr>
<td>Total Salaries, Wages and Fringe Benefits (A + B + C): <strong>138,426</strong></td>
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<table>
<thead>
<tr>
<th>D. Equipment (List Item and Dollar Amount for Each Item Exceeding $5,000.)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Equipment: <strong>0</strong></td>
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</table>

<table>
<thead>
<tr>
<th>E. Travel</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Domestic (Incl. Canada, Mexico and U.S. Possessions): <strong>9,000</strong></td>
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<tr>
<td>2. Foreign: <strong>9,000</strong></td>
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<table>
<thead>
<tr>
<th>F. Participant Support Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Stipends: $0</td>
</tr>
<tr>
<td>2. Travel: $0</td>
</tr>
<tr>
<td>3. Subsistence: $0</td>
</tr>
<tr>
<td>4. Other: $0</td>
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**Total Number of Participants (0):** **0**  
**Total Participant Costs:** **0**

<table>
<thead>
<tr>
<th>G. Other Direct Costs</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Materials and Supplies: <strong>10,000</strong></td>
</tr>
<tr>
<td>2. Publication Costs/Documentation/Dissemination: <strong>1,500</strong></td>
</tr>
<tr>
<td>3. Consultant Services: <strong>0</strong></td>
</tr>
<tr>
<td>4. Computer Services: <strong>750</strong></td>
</tr>
<tr>
<td>5. Subawards: <strong>0</strong></td>
</tr>
<tr>
<td>6. Other: <strong>8,500</strong></td>
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**Total Other Direct Costs:** **20,750**  
**Total Direct Costs (A Through G):** **177,176**

<table>
<thead>
<tr>
<th>I. Indirect Costs (F&amp;A) (Specify Rate and Base)</th>
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<tbody>
<tr>
<td>MTDC UHawaii rate (Rate: 38.4000, Base: 176425)</td>
</tr>
<tr>
<td><strong>Total Indirect Costs (F&amp;A): 67,747</strong></td>
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</tbody>
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| J. Total Direct and Indirect Costs (H + I): **244,923** |
| K. Residual Funds: **0** |
| L. Amount of This Request (J) or (J Minus K): **244,923** |

**M. Cost Sharing Proposed Level $0**  
**Agreed Level if Different $0**

---

**For NSF Use Only**

<table>
<thead>
<tr>
<th>PI/PD Name</th>
<th>Katrina J Edwards</th>
</tr>
</thead>
<tbody>
<tr>
<td>Org. Rep. Name*</td>
<td>Jean Chan</td>
</tr>
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*Electronic Signatures Required for Revised Budget*
<table>
<thead>
<tr>
<th>A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates</th>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF (if different)</th>
</tr>
</thead>
<tbody>
<tr>
<td>James P Cowen - Professor</td>
<td>1.00</td>
<td>0.00</td>
<td>0.00</td>
<td>15,019</td>
<td></td>
<td></td>
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<td>2.</td>
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<td>3.</td>
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<tr>
<td>4.</td>
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<td>5.</td>
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<tr>
<td>6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
<td>0.00</td>
<td>0.00</td>
<td>0.00</td>
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</tr>
<tr>
<td>7. (1) TOTAL SENIOR PERSONNEL (1 - 6)</td>
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<td>0.00</td>
<td>15,019</td>
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<table>
<thead>
<tr>
<th>B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (0) POST DOCTORAL SCHOLARS</td>
</tr>
<tr>
<td>2. (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
</tr>
<tr>
<td>3. (1) GRADUATE STUDENTS</td>
</tr>
<tr>
<td>4. (0) UNDERGRADUATE STUDENTS</td>
</tr>
<tr>
<td>5. (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY)</td>
</tr>
<tr>
<td>6. (1) OTHER</td>
</tr>
<tr>
<td>TOTAL SALARIES AND WAGES (A + B)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)</th>
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</tr>
</thead>
<tbody>
<tr>
<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
<td>144,567</td>
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<table>
<thead>
<tr>
<th>D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)</th>
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<tbody>
<tr>
<td>TOTAL EQUIPMENT</td>
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</table>

<table>
<thead>
<tr>
<th>E. TRAVEL</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS)</td>
</tr>
<tr>
<td>2. FOREIGN</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>F. PARTICIPANT SUPPORT COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. STIPENDS</td>
</tr>
<tr>
<td>2. TRAVEL</td>
</tr>
<tr>
<td>3. SUBSISTENCE</td>
</tr>
<tr>
<td>4. OTHER</td>
</tr>
<tr>
<td>TOTAL NUMBER OF PARTICIPANTS (0)</td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>G. OTHER DIRECT COSTS</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. MATERIALS AND SUPPLIES</td>
</tr>
<tr>
<td>2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION</td>
</tr>
<tr>
<td>3. CONSULTANT SERVICES</td>
</tr>
<tr>
<td>4. COMPUTER SERVICES</td>
</tr>
<tr>
<td>5. SUBAWARDS</td>
</tr>
<tr>
<td>6. OTHER</td>
</tr>
<tr>
<td>TOTAL OTHER DIRECT COSTS</td>
</tr>
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| H. TOTAL DIRECT COSTS (A THROUGH G) | 165,617 |

<table>
<thead>
<tr>
<th>I. INDIRECT COSTS (F&amp;A)(SPECIFY RATE AND BASE)</th>
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</thead>
<tbody>
<tr>
<td>MTCD at University of Hawaii (Rate: 38.4000, Base: 164868)</td>
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</tbody>
</table>

| J. TOTAL DIRECT AND INDIRECT COSTS (H + I) | 228,926 |

| K. RESIDUAL FUNDS | 0 |

| L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K) | 228,926 |

| M. COST SHARING PROPOSED LEVEL $ | 0 | AGREED LEVEL IF DIFFERENT $ |

<table>
<thead>
<tr>
<th>PI/PD NAME</th>
<th>FOR NSF USE ONLY</th>
</tr>
</thead>
<tbody>
<tr>
<td>Katrina J Edwards</td>
<td>INDIRECT COST RATE VERIFICATION</td>
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<table>
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<tr>
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<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jean Chan</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>ORGANIZATION</td>
<td>University of Hawaii</td>
<td></td>
<td></td>
</tr>
<tr>
<td>--------------</td>
<td>---------------------</td>
<td></td>
<td></td>
</tr>
<tr>
<td>PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR</td>
<td>Katrina J Edwards</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### A. SENIOR PERSONNEL: PI/PD, Co-PI's, Faculty and Other Senior Associates

- **James P Cowen - Professor**
  - Personnel and/or salary: 1.00
  - Total Personnel: 15,620

**Note:** (List each separately with title, A.7. show number in brackets)

<table>
<thead>
<tr>
<th>CAL</th>
<th>ACAD</th>
<th>SUMR</th>
<th>Funds Requested by Proposer</th>
<th>Funds Granted by NSF</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td></td>
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<td></td>
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</table>

### B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)

- (0) POST DOCTORAL SCHOLARS: 0.00
- (1) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.): 12.00
- (1) GRADUATE STUDENTS: 29,415
- (0) UNDERGRADUATE STUDENTS: 0.00
- (0) SECRETARIAL - CLERICAL (IF CHARGED DIRECTLY): 0.00
- (1) OTHER: 5,409

**TOTAL SALARIES AND WAGES (A + B):** 118,597

### C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)

- TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C): 150,915

### D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)

**TOTAL EQUIPMENT:** 0

### E. TRAVEL

- DOMESTIC (INCL. CANADA, MEXICO AND U.S. POSSESSIONS): 9,000
- FOREIGN: 9,000

### F. PARTICIPANT SUPPORT COSTS

- STIPENDS: 0
- TRAVEL: 0
- SUBSISTENCE: 0
- OTHER: 0

**TOTAL NUMBER OF PARTICIPANTS:** 0

**TOTAL PARTICIPANT COSTS:** 0

### G. OTHER DIRECT COSTS

- MATERIALS AND SUPPLIES: 10,000
- PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION: 2,000
- CONSULTANT SERVICES: 0
- COMPUTER SERVICES: 750
- SUBAWARDS: 0
- OTHER: 18,500

**TOTAL OTHER DIRECT COSTS:** 31,250

### H. TOTAL DIRECT COSTS (A THROUGH G)

**TOTAL DIRECT COSTS:** 200,165

### I. INDIRECT COSTS (F&A)(SPECIFY RATE AND BASE)

- **MTCD at University of Hawaii (Rate: 38.4000, Base: 199416):**
  - TOTAL INDIRECT COSTS (F&A): 76,576

### J. TOTAL DIRECT AND INDIRECT COSTS (H + I)

**TOTAL COSTS:** 276,741

### K. RESIDUAL FUNDS

**RESIDUAL FUNDS:** 0

### L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)

**AMOUNT OF THIS REQUEST:** 276,741

### M. COST SHARING PROPOSED LEVEL

- PROPOSED LEVEL: 0
- AGREED LEVEL IF DIFFERENT: 0

### PI/PD NAME

- Katrina J Edwards

### FOR NSF USE ONLY

<table>
<thead>
<tr>
<th>ORG. REP. NAME*</th>
<th>Jean Chan</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
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5 **ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET**
<table>
<thead>
<tr>
<th>Category</th>
<th>Amount</th>
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<tbody>
<tr>
<td><strong>D. EQUIPMENT</strong></td>
<td>$108,000</td>
</tr>
<tr>
<td><strong>TOTAL EQUIPMENT</strong></td>
<td>$108,000</td>
</tr>
<tr>
<td><strong>F. PARTICIPANT SUPPORT COSTS</strong></td>
<td>$0</td>
</tr>
<tr>
<td><strong>G. OTHER DIRECT COSTS</strong></td>
<td>$103,900</td>
</tr>
<tr>
<td><strong>H. TOTAL DIRECT COSTS (A THROUGH G)</strong></td>
<td>$972,287</td>
</tr>
<tr>
<td><strong>I. INDIRECT COSTS (F&amp;A)(SPECIFY RATE AND BASE)</strong></td>
<td>$330,542</td>
</tr>
<tr>
<td><strong>J. TOTAL DIRECT AND INDIRECT COSTS (H + I)</strong></td>
<td>$1,302,829</td>
</tr>
<tr>
<td><strong>K. RESIDUAL FUNDS</strong></td>
<td>$0</td>
</tr>
<tr>
<td><strong>L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)</strong></td>
<td>$1,302,829</td>
</tr>
</tbody>
</table>

**M. COST SHARING PROPOSED LEVEL $** | $0 |
| **AGREED LEVEL IF DIFFERENT $**          | $0 |
C-DEBI: coI James Cowen, University of Hawaii

A and B. Personnel
James Cowen (1 calendar mo support requested per year) will serve as co-I and Executive Committee member of the C-DEBI project. He will also coordinate technological/instrument development for in situ sampling and monitoring at the subseafloor CORK observatories; and participate in the education outreach activities (especially Teacher-at-Sea; NAI Winter course; Deep Biosphere Workshops; Ali’i Teacher Workshops). Cowen and his lab will participate in and support all Juan de Fuca and North Pond site expeditions; they will pursue their microbial geochemistry studies and support all participants in obtaining fluid samples.

A Technician is required to both support Cowen’s research program and to provide critical support of the 4 or more GeoMICROBE instrument sleds; these latter are complex platforms that require significant attention to maintain for repeated (re)deployments and to integrate other investigator sensors (etc) into the fluid, power, and communications stream. This sort of sustained technical support requires the dedicated focus of a technician.

Graduate Students: Funding for one graduate student is requested; a second graduate student will join the Cowen team via the SOEST matching support for a five-year Native Hawaiian minority graduate fellowship. Both students will be intimately integrated into all aspects of the research projects, from instrumentation to microbial geochemistry at both the JDF and NP sites; both will participate in cruises.

Undergraduate Assistance: Support for 2 part time undergraduate assistants is requested. They will assist the graduate students and technician in all aspects of instrumentation maintenance, cruise and sample preparation, and analyses. Undergraduate students are often able to join the research expeditions.

Education Specialist (Mary Kadooka): One month of support is requested for Mary Kadooka to allow her to devote significant time adapting her EO activities to fully embrace the Deep Biosphere environment and C-DEBI program. She will be particularly active with the Teacher-at-Sea and Ali’i Teacher Workshops.

Note: SOEST Cost Share: SOEST will fund a five-year Native Hawaiian minority graduate fellowship in support of this project

C. Fringe Benefits: Fringe benefits are requested for all personnel at rates of 38.26% (PI, Tech, and EO specialist), 9.11% (Grad student) and 0.9% (Undergrads).

D. Permanent Equipment/Engineering Support:
Funds are requested to support the development of an in situ sampling/incubation system for metabolic rate experiments. Our intention is to adapt many design features of various existing systems to the specific challenges of the CORK observatories (specialized connectors, powered flow requirements, elevated temperature, high pressure, etc.). Our system will incorporate machined microfluidics components with off-the-shelf high pressure tubing/fittings/chambers/pumps. We have the in-house capability to engineer and fabricate all electronics/software/mechanical hardware needs with our experienced Engineering Support Facility. A majority of the
‘Permanent Equipment’ costs are anticipated to be engineer/machinist salaries, with the balance for materials (housings, HP tubing/fittings/pumps).

**E. Travel:**
Travel support is requested to both planning/coordination meetings, to ports of call for cruises, and to national meetings to report results. Due to the broad interdisciplinary nature of these projects and the complex instrumentation engineering design/plans and the expedition and sampling logistics, planning meetings are essential. Cruise participation (# people) will vary from 2-6, depending on operations.

<table>
<thead>
<tr>
<th>Travel:</th>
<th>Year 1</th>
<th>Year 2</th>
<th>Year 3</th>
<th>Year 4</th>
<th>Year 5</th>
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<tr>
<td>Domestic</td>
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<td>JFR Cruises 2-6 persons per</td>
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<td>Cruise Planning meetings (west coast)</td>
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<td>Instrumentation planning (west/east coast)</td>
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<td>Scientific meeting/conf. (for 2)</td>
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<td>Domestic subtotal</td>
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<td>Foreign</td>
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<td>NP Cruises 6 persons per</td>
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<td>Total Travel</td>
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**G. Other Direct Costs.**
Materials and Supplies are needed for instrument sled maintenance and preparation, sample collection (plastic sample vials/bottles; filters; filter holders; acids and other chemicals) and analyses (plastic and glassware; chemicals and standards; HPLC columns; maintenance of water purification system/HPLC/CHN analyzer/MS/electron and light microscopes/balances).

Funds are requested to cover publication costs (graphics, printing, page costs) and computer services.

Other: Analytical recharge costs include those for stable isotope analyses, gases (especially TCO₂, H₂, CH₄) and electron microscopy. Shipping costs include the round trip freight costs of the large/heavy GeoMICROBE instrument sleds (sleds, instruments, Deep Sea Power and Light batteries) to both JDF and NP cruise ports of call. Finally, funds are requested to cover yearly telephone, photocopy, and email charges.

**I. Indirect Costs:**
The University of Hawaii charges a federally negotiated indirect cost rate of 38.4% on top of direct costs, but excluding Permanent Equipment and Computer Facility costs.
## Summary Proposal Budget

<table>
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<tr>
<th>Organization</th>
<th>Proposed</th>
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<td>University of Rhode Island</td>
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### Proposal No. AWARD No.

#### Principal Investigator / Project Director
- **Steven J D'Hondt**

#### Senior Personnel: PI/PD, Co-PI's, Faculty and Other Senior Associates

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Funds Requested</th>
<th>Funds Granted by NSF</th>
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<tr>
<td>Steven L D'Hondt</td>
<td>Professor</td>
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**Note:** Funds requested by proposer and funds granted by NSF may be different.

#### Duration (months)
- Proposed
- Granted

### Cal ACAD SUMR

**For NSF Use Only**

**Indirect Cost Rate Verification**

<table>
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<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
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<td>Jean Chan</td>
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1. **Electronic Signatures Required For Revised Budget**
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<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF (if different)</th>
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<td>4. (0) UNDERGRADUATE STUDENTS</td>
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<td>6. (0) OTHER</td>
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| TOTAL NUMBER OF PARTICIPANTS | 0 |
| TOTAL PARTICIPANT COSTS | 0 |

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| TOTAL OTHER DIRECT COSTS | 44972 |
| TOTAL DIRECT COSTS (A THROUGH G) | 156965 |

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| M. COST SHARING PROPOSED LEVEL $ | 0 |
| AGREED LEVEL IF DIFFERENT $ | |

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<tr>
<th>ORG. REP. NAME*</th>
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</tr>
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<tbody>
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<td>Jean Chan</td>
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*ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
<table>
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<tr>
<th>A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates</th>
<th>NSF Funded Person-months</th>
<th>Funds Requested by proposer</th>
<th>Funds granted by NSF (if different)</th>
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<td>6. (0) OTHER</td>
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<tr>
<td>E. TRAVEL</td>
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<td>3. SUBSISTENCE</td>
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<td>TOTAL NUMBER OF PARTICIPANTS</td>
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<tr>
<td>J. TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
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<th>PI/PD NAME</th>
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<th>Date Checked</th>
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<td>1. STIPENDS</td>
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<td>G. OTHER DIRECT COSTS</td>
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<td>1. MATERIALS AND SUPPLIES</td>
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<td>6. OTHER</td>
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<tr>
<td>TOTAL OTHER DIRECT COSTS</td>
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<td>H. TOTAL DIRECT COSTS (A THROUGH G)</td>
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<td>I. INDIRECT COSTS (F&amp;A)(SPECIFY RATE AND BASE)</td>
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<tr>
<td>MTDC minus tuition URI Rate (Rate: 49.0000, Base: 146023)</td>
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<td>TOTAL INDIRECT COSTS (F&amp;A)</td>
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<td>K. RESIDUAL FUNDS</td>
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<td>M. COST SHARING PROPOSED LEVEL $</td>
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<td>AGREED LEVEL IF DIFFERENT $</td>
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**FOR NSF USE ONLY**

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**INDIRECT COST RATE VERIFICATION**

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<th>Date Checked</th>
<th>Date Of Rate Sheet</th>
<th>Initials - ORG</th>
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## Proposal Budget

### Summary

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<th>Organization</th>
<th>University of Rhode Island</th>
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<tr>
<td>Principal Investigator / Project Director</td>
<td>Steven J D'Hondt</td>
</tr>
<tr>
<td>Award No.</td>
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#### A. Senior Personnel: PI/PD, Co-PI's, Faculty and Other Senior Associates

<table>
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<tr>
<th>Name</th>
<th>PI/PD Name</th>
<th>Role</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
<th>Grade</th>
<th>Rate Code</th>
<th>Rate Base</th>
<th>Funding</th>
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<tbody>
<tr>
<td>Steven L D'Hondt</td>
<td>Professor</td>
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<td></td>
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#### B. Other Personnel

<table>
<thead>
<tr>
<th>Category</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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<tbody>
<tr>
<td>Post Doctoral Scholars</td>
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<tr>
<td>Other Professionals (Technician, Programmer, etc.)</td>
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<td>Graduate Students</td>
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<tr>
<td>Undergraduate Students</td>
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<tr>
<td>Secretarial - Clerical (if charged directly)</td>
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<tr>
<td>Other</td>
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#### C. Fringe Benefits (if charged as direct costs)

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<tr>
<th>Description</th>
<th>Credits</th>
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#### D. Equipment

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<tr>
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<th>Credits</th>
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<th>Hours</th>
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#### E. Travel

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#### F. Participant Support Costs

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<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
</tr>
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#### G. Other Direct Costs

<table>
<thead>
<tr>
<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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</table>

#### H. Total Direct Costs

<table>
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<tr>
<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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#### I. Indirect Costs (F&A) (Specify Rate and Base)

<table>
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<tr>
<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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#### J. Total Direct and Indirect Costs

<table>
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<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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#### K. Residual Funds

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<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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#### L. Amount of this Request (J) or (J minus K)

<table>
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<tr>
<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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#### M. Cost Sharing Proposed Level $ | $0 | Agreed Level if different |

### Summary Table

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<thead>
<tr>
<th>Column</th>
<th>Description</th>
<th>Credits</th>
<th>Tuition</th>
<th>Hours</th>
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<tr>
<td>F1</td>
<td>1. Stipends</td>
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<tr>
<td>F2</td>
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<td>F3</td>
<td>3. Subsistence</td>
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<td>F4</td>
<td>4. Other</td>
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<tr>
<td>F5</td>
<td>Total Number of Participants</td>
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<tr>
<td>F6</td>
<td>Total Participant Costs</td>
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</tr>
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<td>G1</td>
<td>1. Materials and Supplies</td>
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<tr>
<td>G2</td>
<td>2. Publication Costs/Documentation/Dissemination</td>
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<tr>
<td>G3</td>
<td>3. Consultant Services</td>
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<tr>
<td>G4</td>
<td>4. Computer Services</td>
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<td>G5</td>
<td>5. Subawards</td>
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<td>G6</td>
<td>6. Other</td>
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<td>H1</td>
<td>Total Other Direct Costs</td>
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<td>H2</td>
<td>Total Direct Costs (A through G)</td>
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### Signatures

**For NSF Use Only**

<table>
<thead>
<tr>
<th>ORG. REP. NAME</th>
<th>Jean Chan</th>
</tr>
</thead>
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5 *Electronic signatures required for revised budget
### SUMMARY PROPOSAL BUDGET

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<thead>
<tr>
<th>ORGANIZATION</th>
<th>University of Rhode Island</th>
</tr>
</thead>
<tbody>
<tr>
<td>PRINCIPAL INVESTIGATOR / PROJECT DIRECTOR</td>
<td>Steven J D’Hondt</td>
</tr>
<tr>
<td>A. SENIOR PERSONNEL: PI/PD, Co-PI’s, Faculty and Other Senior Associates (List each separately with title, A.7. show number in brackets)</td>
<td></td>
</tr>
<tr>
<td>1. Steven J D’Hondt - Professor</td>
<td>CAL</td>
</tr>
<tr>
<td>2.</td>
<td>0.00</td>
</tr>
<tr>
<td>3.</td>
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<tr>
<td>4.</td>
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<tr>
<td>5.</td>
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<tr>
<td>6. (0) OTHERS (LIST INDIVIDUALLY ON BUDGET JUSTIFICATION PAGE)</td>
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</tr>
<tr>
<td>7. (1) TOTAL SENIOR PERSONNEL (1 - 6)</td>
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<tr>
<td>B. OTHER PERSONNEL (SHOW NUMBERS IN BRACKETS)</td>
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<tr>
<td>1. (0) POST DOCTORAL SCHOLARS</td>
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<td>2. (5) OTHER PROFESSIONALS (TECHNICIAN, PROGRAMMER, ETC.)</td>
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<td>3. (5) GRADUATE STUDENTS</td>
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<td>4. (0) UNDERGRADUATE STUDENTS</td>
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<td>6. (0) OTHER</td>
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<td>TOTAL SALARIES AND WAGES (A + B)</td>
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<tr>
<td>C. FRINGE BENEFITS (IF CHARGED AS DIRECT COSTS)</td>
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<td>TOTAL SALARIES, WAGES AND FRINGE BENEFITS (A + B + C)</td>
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<td>D. EQUIPMENT (LIST ITEM AND DOLLAR AMOUNT FOR EACH ITEM EXCEEDING $5,000.)</td>
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<tr>
<td>TOTAL EQUIPMENT</td>
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<tr>
<td>E. TRAVEL</td>
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<td>TOTAL PARTICIPANT COSTS</td>
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<td>G. OTHER DIRECT COSTS</td>
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<tr>
<td>1. MATERIALS AND SUPPLIES</td>
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<td>2. PUBLICATION COSTS/DOCUMENTATION/DISSEMINATION</td>
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<td>3. CONSULTANT SERVICES</td>
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<td>4. COMPUTER SERVICES</td>
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<td>5. SUBAWARDS</td>
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<td>6. OTHER</td>
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<tr>
<td>TOTAL OTHER DIRECT COSTS</td>
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<tr>
<td>H. TOTAL DIRECT COSTS (A THROUGH G)</td>
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<tr>
<td>I. INDIRECT COSTS (F&amp;A) (SPECIFY RATE AND BASE)</td>
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<tr>
<td>TOTAL INDIRECT COSTS (F&amp;A)</td>
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<tr>
<td>J. TOTAL DIRECT AND INDIRECT COSTS (H + I)</td>
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<td>K. RESIDUAL FUNDS</td>
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<tr>
<td>L. AMOUNT OF THIS REQUEST (J) OR (J MINUS K)</td>
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<td>M. COST SHARING PROPOSED LEVEL $</td>
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<tr>
<td>AGREED LEVEL IF DIFFERENT $</td>
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</tbody>
</table>

**FOR NSF USE ONLY**

**PI/PD NAME**

Steven J D’Hondt

**INDIRECT COST RATE VERIFICATION**

Jean Chan

*C *ELECTRONIC SIGNATURES REQUIRED FOR REVISED BUDGET
Budget Justification

Salary
We request no salary for Co-PI D’Hondt because he is fully supported by URI on a calendar-year basis. D’Hondt will be responsible for the entire project and will be the principal advisor of the two students.

We request salary funds for the laboratory manager of the Geomicrobe Field Laboratory, Dennis Graham (6 months/yr). Graham will maintain all of the laboratory instruments and reagents, handle all aspects of shipping them to and from expeditions, make many of the shipboard biogeochemical analyses, and advise and oversee students, postdocs and visiting scientists from throughout C-DEBI in the laboratory.

We also request funds for two graduate student stipends for the duration of C-DEBI. One student’s thesis will principally focus on quantifying rates of subseafloor microbial activity, in-situ thermodynamics and microbially driven rates of biogeochemical change, using such tools as transport-reaction modeling, mass-balance modeling, etc. The other student’s thesis will primarily focus on quantification of cell abundance and DNA/RNA-based assays of community composition and taxonomic richness.

Fringe Benefits
Fringe benefits are calculated at the University’s required rates.

Travel
Travel funds are requested to support attendance of one domestic meeting per year by three of the URI participants (Co-PI and two students) and one international meeting by two of the URI participants (e.g., Co-PI and one student or two students in each year).

Other Direct Costs
Materials and Supplies
We request funds of $15,000 in year 1 for lab supplies and consumables (e.g., sample handling supplies, reagents for the biogeochemical analyses, PCR reagents, nucleic acid stains, etc.). This number is increased by 3.5%/year through year five. The URI Genomics and Sequencing Center (http://www.uri.edu/research/gsc/) will be used for in-house sequencing work. While use of these instruments is at no charge, users must supply their reagents and consumables. Other sequencing work will be done in collaboration with C-DEBI partner institutions.

Computer Services
We request $3,000/year (increasing by 3.5%/year) for computer services. These funds will cover costs of software, replacement hardware, and IT support for URI participation in C-DEBI-wide videoconferencing and videoconferences, etc.

Publication, Photocopying, Fax, Phone
Funds are requested for publication costs in years 2 and 3, and for computer services, fax, telephone, etc. in all three years.

Expedition Shipping
We request $3,000/year in years 1 and 2 for shipping of equipment and materials to and from the South Pacific gyre and North Pond drilling expeditions. While most shipboard equipment and materials will be provided by IODP, critical instruments that are not regularly used on drilling expeditions must be provided by our laboratory (examples include optodes for O2 analyses and a Marianda DIC system).

Tuition
We request funds for the two graduate students’ tuition for the duration of the project. Because URI has agreed to limit tuition recovery for this grant to the level of in-state tuition for three of the five grant years, tuition is charged at the in-state level for three years and the out-of-state level for two years.

Indirect Costs
Indirect costs are calculated at the University’s required rates (49%) on all direct costs except tuition.
<table>
<thead>
<tr>
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<tr>
<td>Collaborative Research: Lō‘ihi Seamount as an Observatory for the Study of Neutrophilic Iron-Oxidizing Bacteria and the Microbial Iron Cycle (C. Moyer, H. Staudigel, B. Tebo, D. Emerson, Co-Pis)</td>
<td>NSF; MCB-0348425</td>
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<td></td>
<td>8/31/06 to 8/31/09</td>
<td>$ 268,629</td>
<td>USC</td>
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<tr>
<td>Development and testing of Materials and Methods for In-situ Incubations and subsurface microbial observatories at North Pond (J. Bernhard, Co-PI, subcontracted from USC)</td>
<td>NSF; OCE-0737300</td>
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<td>3/16/07 to 3/31/09</td>
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<td>Collaborative Research: Hydrothermal fluxes and their impact on ocean biogeochemistry: An integrated pre- and post-eruption study at the EPR, 9-10 degrees N (C. German &amp; O. Rouxel, Co-Pis)</td>
<td>NSF; OCE-0648287</td>
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<td>4/01/07 to 3/31/09</td>
<td>$132,850</td>
<td>USC</td>
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<td>Collaborative Research: Site survey and initial characterization of North Pond – Microbiology, Biogeochemistry, Seismic Profiles (Teske, A., J. McManus, Co-Pis)</td>
<td>NSF; OCE-ODP</td>
<td>1.0</td>
<td>1.0</td>
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<td>6/01/08 to 5/31/10</td>
<td>$ 212,524</td>
<td>USC</td>
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<td>The Deep Subsurface Biosphere at North Pond: A Mid-Atlantic Ridge Microbial Observatory** (PI)</td>
<td>Gordon and Betty Moore</td>
<td>1.0</td>
<td>1.0</td>
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<td>10/01/07 to 12/31/10</td>
<td>$3,900,000</td>
<td>USC</td>
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<tr>
<td>A Deep-Biosphere Research Coordination Network (PI with J. Amend, Washington Univ., Co-PI, via sub-contract)</td>
<td>NSF; BIO</td>
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<td>1/1/09-12/31/13</td>
<td>500,000</td>
<td>USC</td>
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<tr>
<td>Center for Dark Energy Biosphere Investigations (C-DEBI) (PI with J. Cowen, S. D'hont, A. Fisher, G. Wheat Co-Pis)</td>
<td>NSF; OIA</td>
<td>2.0</td>
<td>2.0</td>
<td>2.0</td>
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<td>6/1/10-5/31/14</td>
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<td>ETBC: Collaborative Research: Massive, low-temperature hydrothermal flows at mid-plate outcrops - linking sub-seafloor microbial activity and marine biogeochemical cycles</td>
<td>NSF; OCE</td>
<td>0.5</td>
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<td>10/01/2009-09/30/2012</td>
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<td>Collaborative Research: Microbial Alteration of Submarine Basaltic Glass: Relating Experimental and Natural Samples</td>
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<td>Modeling Bacterial Community Composition and Activity Along Gradients of Iron Concentrations in Hydrothermal Plumes at the East Pacific Rise and East Lau Spreading Center (co-PI Jason Sylvan, PostDoc)</td>
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<td>Collaborative Research: Hydrothermal Fluxes and Their Impact on the Ocean: Integrating Biogeochemistry, Microbiology &amp; Physics at the R2K EPR ISS (PI with C.R. German, L.F. Robinson, O.J. Rouzel and A.M. Thurnherr)</td>
<td>NSF; OCE</td>
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**This project involves 6 subcontracts to other institutions, for infrastructure such as hardware, instrumentation, and engineering costs associated with CORK observatories. These costs are normally incurred by the NSF for US-lead IODP CORK programs excepting this so far unique exception.**
<table>
<thead>
<tr>
<th>Support:</th>
<th>Current</th>
<th>Pending</th>
<th>Submission Planned in Near Future</th>
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<tbody>
<tr>
<td>Project Director: James Cowen</td>
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<tr>
<td>Project/Proposal Title: Center: Dark Energy Biosphere Investigations</td>
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<td>Source of Support: NSF via subcontract from USC</td>
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<td>Person-Months Per Year Committed to the Project: Cal: 1</td>
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<tr>
<td>Project Director: James Cowen</td>
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<td>Project/Proposal Title: Collaborative research: Large-scale, long-term, multi-directional, cross-hole experiments in the upper oceanic crust using a borehole observatory network</td>
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<tr>
<td>Project Director: James Cowen</td>
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<tr>
<td>Project/Proposal Title: The Deep Subsurface Biosphere at North Pond: A Mid-Atlantic Ridge Microbial Observatory</td>
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<tr>
<td>Project/Proposal Title: Collaborative Research: Microbial Ecology of Ocean Basement Aquifers: IODP Borehole Observatories</td>
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<td>Person-Months Per Year Committed to the Project: % Cal: 2/yr</td>
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<td>Project Director:</td>
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</table>

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*

USE ADDITIONAL SHEETS AS NECESSARY
The following information should be provided for each project director and other senior personnel. Failure to provide this information may delay consideration of this proposal.

| Other agencies (including NSF) to which this proposal has been/will be submitted. | NONE |

Support: __ Current __ Pending __ Submission Planned in Near Future __ *Transfer of Support

| Project Director: | |
| Project/Proposal Title: | |

Source of Support:

| Total Award Amount: | $ |
| Total Award Period Covered: | |
| Location of Project: | |
| Person-Months Per Year Committed to the Project: | Cal: |

Support: __ Current __ Pending __ Submission Planned in Near Future __ *Transfer of Support

| Project Director: | |
| Project/Proposal Title: | |

Source of Support:

| Total Award Amount: | $ |
| Total Award Period Covered: | |
| Location of Project: | |
| Person-Months Per Year Committed to the Project: | Cal: |

Support: __ Current __ Pending __ Submission Planned in Near Future __ *Transfer of Support

| Project Director: | |
| Project/Proposal Title: | |

Source of Support:

| Total Award Amount: | $ |
| Total Award Period Covered: | |
| Location of Project: | |
| Person-Months Per Year Committed to the Project: | Cal: |

Support: __ Current __ Pending __ Submission Planned in Near Future __ *Transfer of Support

| Project Director: | |
| Project/Proposal Title: | |

Source of Support:

| Total Award Amount: | $ |
| Total Award Period Covered: | |
| Location of Project: | |
| Person-Months Per Year Committed to the Project: | Cal: |

Support: __ Current __ Pending __ Submission Planned in Near Future __ *Transfer of Support

| Project Director: | |
| Project/Proposal Title: | |

Source of Support:

| Total Award Amount: | $ |
| Total Award Period Covered: | |
| Location of Project: | |
| Person-Months Per Year Committed to the Project: | Cal: |

Support: __ Current __ Pending __ Submission Planned in Near Future __ *Transfer of Support

| Project Director: | |
| Project/Proposal Title: | |

Source of Support:

| Total Award Amount: | $ |
| Total Award Period Covered: | |
| Location of Project: | |
| Person-Months Per Year Committed to the Project: | Cal: |

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.

USE ADDITIONAL SHEETS AS NECESSARY
### Current and Pending Support

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

<table>
<thead>
<tr>
<th>Investigator: Steven D’Hondt</th>
<th>Other agencies (including NSF) to which this proposal has</th>
</tr>
</thead>
</table>

**Support:**
- [x] Current
- [ ] Pending
- [ ] Submission Planned in Near Future
- [ ] *Transfer of Support

**Project/Proposal Title:** Collaborative Research: Drilling Site Survey-Life in Subseafloor Sediments of the South Pacific Gyre

**Source of Support:** NSF-OCE- 0527167 (PI)
**Total Award Amount:** $396,773  
**Total Award Period Covered:** 11/1/05-10/31/09

**Location of Project:** University of Rhode Island Graduate School of Oceanography
**Person-Months Per Year Committed to the Project:**
- Cal: 1.0
- Acad: 
- Sumr: 

**Support:**
- [x] Current
- [ ] Pending
- [ ] Submission Planned in Near Future
- [ ] *Transfer of Support

**Project/Proposal Title:** Oceanographic control and global distributions of subseafloor microbial life and activity

**Source of Support:** NSF-OCE- 0752336 (PI)
**Total Award Amount:** $817,544  
**Total Award Period Covered:** 9/1/08-8/31/2011

**Location of Project:** University of Rhode Island Graduate School of Oceanography
**Person-Months Per Year Committed to the Project:**
- Cal: 2.0
- Acad: 
- Sumr: 

**Support:**
- [x] Current
- [ ] Pending
- [ ] Submission Planned in Near Future
- [ ] *Transfer of Support

**Project/Proposal Title:** SGER: An Amino Acid-based Isotopic Method for Studying the Dynamics of Ancient Ecosystems

**Source of Support:** NSF-EAR-SEDIMENTARY GEO & PALEOBIOLOGY- 0845015 (Co-PI)
**Total Award Amount:** $23,409  
**Total Award Period Covered:** 12/1/08-11/30/09

**Location of Project:** University of Rhode Island Graduate School of Oceanography
**Person-Months Per Year Committed to the Project:**
- Cal: 2.0
- Acad: 
- Sumr: 

**Support:**
- [ ] Current
- [x] Pending
- [ ] Submission Planned in Near Future
- [ ] *Transfer of Support

**Project/Proposal Title:** COLLABORATIVE RESEARCH: Origin and implications of enigmatic seamount moats in the central Equatorial Pacific Ocean

**Source of Support:** NSF-OCE-MG&G (Co-PI)
**Total Award Amount:** $694,938  
**Total Award Period Covered:** 1/1/2010-12/31/2012

**Location of Project:** University of Rhode Island Graduate School of Oceanography
**Person-Months Per Year Committed to the Project:**
- Cal: 2/1/1
- Acad: 
- Sumr: 

**Support:**
- [ ] Current
- [x] Pending
- [ ] Submission Planned in Near Future
- [ ] *Transfer of Support

**Project/Proposal Title:** (THIS PROPOSAL)  Center for Dark Energy Biosphere Investigations (C-DEBI)

**Source of Support:** NSF-STC (Co-PI)
**Total Award Amount:** 1,250,676  
**Total Award Period Covered:** 6/1/2010-5/31/2015

**Location of Project:** University of Rhode Island Graduate School of Oceanography
**Person-Months Per Year Committed to the Project:**
- Cal: 1.0
- Acad: 
- Sumr: 

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*
The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

<table>
<thead>
<tr>
<th>Investigator: Andrew Fisher</th>
<th>Other agencies (including NSF) to which this proposal has been/ will be submitted.</th>
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<tbody>
<tr>
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### Current and Pending Support: Fisher, UCSC

(See GPG Section II.D.8 for guidance on information to include on this form.)

<table>
<thead>
<tr>
<th>Support:</th>
<th>Current</th>
<th>Pending</th>
<th>Submission Planned in Near Future</th>
<th>*Transfer of Support</th>
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<table>
<thead>
<tr>
<th>Project/Proposal Title: Large-scale, long-term, multi-directional, cross-hole experiments in the upper oceanic crust using a borehole observatory network</th>
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<tbody>
<tr>
<td>[NB: Mainly engineering development to prepare for IODP drilling, to be scheduled]</td>
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<tr>
<td>Source of Support: NSF-ODP</td>
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<td>Total Award Amount: $190,653</td>
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<td>Person-Months Per Year Committed to the Project.</td>
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<tr>
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<th>*Transfer of Support</th>
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<tr>
<th>Project/Proposal Title: Vegetative treatment systems and farm water quality plan implementation to abate nutrient loading in the Pajaro River watershed</th>
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<tr>
<td>Source of Support: Santa Cruz County Resource Conservation District</td>
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<td>Total Award Amount: $290,000</td>
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<tr>
<th>Project/Proposal Title: Improving Managed Aquifer Recharge to Reduce Nutrient Load and Benefit Water Supply</th>
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<tr>
<th>Project/Proposal Title: Marine Heat Flow Capability for Academic Science and Implementation on UNOLS Vessels</th>
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<th>*Transfer of Support</th>
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<table>
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<tr>
<th>Collaborative Research: Integrative study of Marine Ice Sheet Stability and Subglacial Life Habitats in West Antarctica - Robotic Access to Grounding</th>
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<tbody>
<tr>
<td>Source of Support: NSF-ANT</td>
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<td>Total Award Amount: $447,051</td>
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<td>Person-Months Per Year Committed to the Project.</td>
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*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*
## Current and Pending Support: Fisher, UCSC

(See GPG Section II.D.8 for guidance on information to include on this form.)

The following information should be provided for each investigator and other senior personnel. Failure to provide this information may delay consideration of this proposal.

<table>
<thead>
<tr>
<th>Investigator: Andrew Fisher</th>
<th>Other agencies (including NSF) to which this proposal has been/will be submitted.</th>
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### Support:

- Current
- Pending
- Submission Planned in Near Future
- *Transfer of Support

| Project/Proposal Title: Collaborative Research: Integrative study of Marine Ice Sheet Stability and Subglacial Life Habitats in West Antarctica – Lake and Ice Stream |
| Source of Support: NSF-ANT |
| Total Award Amount: $530,785 |
| Location of Project: UCSC |
| Person-Months Per Year Committed to the Project: Cal: 0 Acad: 0 Sumr: 0.5,1,1,1,0.5 |

### Other agencies (including NSF) to which this proposal has been/will be submitted.

- None

### Support:

- Current
- Pending
- Submission Planned in Near Future
- *Transfer of Support

| Project/Proposal Title: ETBC: Collaborative Research: Massive, low-temperature hydrothermal flows at mid-plate outcrops-linking sub-seafloor microbial activity and marine biogeochemical cycles |
| Source of Support: NSF-OCE/BIO (ETBC) |
| Total Award Amount: $392,539 |
| Location of Project: UCSC |
| Person-Months Per Year Committed to the Project: Cal: Acad: Sumr: 1.5,1,5,1.5 |

### Support:

- Current
- Pending
- Submission Planned in Near Future
- *Transfer of Support

| Project/Proposal Title: University of California Recharge Initiative (UCARI) |
| Source of Support: University of California |
| Total Award Amount: $5,007,000 |
| Location of Project: UCSC |
| Person-Months Per Year Committed to the Project: Cal: Acad: Sumr: 1,1,1,1,1,1 |

### Support:

- Current
- Pending
- Submission Planned in Near Future
- *Transfer of Support

| Project/Proposal Title: Center for Deep Energy Biosphere Investigations (C-DEBI) [this proposal] |
| Source of Support: USC (subcontract to NSF grant) |
| Total Award Amount: $1,072,126 |
| Location of Project: UCSC |
| Person-Months Per Year Committed to the Project: Cal: Acad: Sumr: 1.5,1.5,1,1,1.5 |

| Project/Proposal Title: |
| Source of Support: |
| Total Award Amount: |
| Location of Project: |
| Person-Months Per Year Committed to the Project: Cal: 0 Acad: 0 Sumr: |

*If this project has previously been funded by another agency, please list and furnish information for immediately preceding funding period.*
## Current Support for C. Geoff Wheat

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<th>Supporting Agency</th>
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<th>2011</th>
<th>2012</th>
<th>2013</th>
<th>Start/End Dates</th>
<th>Award Amounts</th>
<th>Location of Research</th>
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<tr>
<td>The Collaborative research: The Collaborative research: Large-scale, long-term, multi-directional, cross-hole experiments in the upper oceanic crust using a borehole observatory network</td>
<td>National Science Foundation</td>
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<td>1 APR 2007 to 31 AUG 2009</td>
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<td>Collaborative Research: Borehole Studies of ODP Site 1200, South Chamorro Seamount: A Window into Active Serpentinite Mud Volcanism</td>
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<td>Moss Landing, CA</td>
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<tr>
<td>The Deep Subsurface Biosphere at North Pond: A Mid-Atlantic Ridge Microbial Observatory</td>
<td>Gordon and Betty Moore Foundation</td>
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<td>1 JAN 2008 to 31 DEC 2009</td>
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<td>Moss Landing, CA</td>
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<td>1 JUN 2008 to 30 MAY 2009</td>
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<td>Collaborative Research: Chemical, pressure, temperature, and flow constraints on hydrologic horizons in the Costa Rica Subduction zone, ODP Sites 1253 and 1255</td>
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## Pending Support

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<th>2013</th>
<th>Start/End Dates</th>
<th>Requested Amount</th>
<th>Location of research</th>
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<tr>
<td>ETBC: Collaborative Research: Massive, low-temperature hydrothermal flows at mid-plate outcrops - linking sub-seafloor microbial activity and marine biogeochemical cycles</td>
<td>National Science Foundation</td>
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<td>Collaborative research: Characterization of spatial and temporal relationships between hydrothermal activity and microbial dynamics at the Lau back-arc spreading center</td>
<td>National Science Foundation</td>
<td>2.0</td>
<td>1.0</td>
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<td>1 SEP 2009 to 30 AUG 2010</td>
<td>$125,462</td>
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<td>Center for Dark Energy biosphere Investigations (C-DEBI)</td>
<td>National Science Foundation</td>
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<td>1 JUN 2010 to 31 May 2015</td>
<td>$1,283,810</td>
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Has the current proposal been submitted to any other funding source? No
If "Yes" list name of funding source:

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PI time (months/calendar year)
C-DEBI FACILITIES, EQUIPMENT AND OTHER RESOURCES at USC

Marine Environmental Biology

The Edwards labs include a microscopy facility, a molecular lab, a prep lab (media, anaerobic and sterile cultivations, gassing stations) and a general use laboratory (~2200 sq ft), equipped as follows.

**Laboratory Equipment:**
- 2 Laminar flow bio-hoods
- 2 chemical fume hoods
- Coy anaerobic glove box
- Barnstead Water distillation & purification (UV/UF)
- Shimatzu UV-1601 Spectrophotometer & printer
- High-speed refrigerated centrifuge (epindorff)
- Controlled temperature & benchtop shakers
- Benchtop microfuges
- Benchtop pH meter, Stirring hot plates, analytical & top loading balances
- -20 & -80°C freezers, refrigerators
- Water bath & dry-block incubators
- Hybridization ovens
- Vortexes, Bead beaters, Water-bath sonicator
- 3 PCR machines, including a 7500 fast ABI Q-PCR machine
- Electrophoresis power supply, transilluminator & photodocumentation
- Pressure-filtration equipment

**Microscopic analysis:**
- Leica TCS SPE Tunable Spectral Confocal System (UV and Visible)
- Zeiss Primostar microscope
- Zeiss Axiostar microscope
- Axiocam

**Field/lab equipment:**
- Voltammetry: DLK-60 potentiostat (Analytical Instrument Systems, NJ), custom Labview software, DAQcard-1200 (National Instruments), Au-wire working, Pt-wire working, counter and reference electrodes, DC converter for potentiostat, AIS Advanced Analysis software
- PA2000 picoammeter (Unisense, Denmark), OX100 oxygen electrode (Unisense), MM-33 micromanipulator (Unisense), combination pH needle electrode (Diamond General Development Corp., Michigan).
- Portable pH meter.
- Digital cameras

The Ziebis Laboratory (total of ~2000 sq ft) includes a main laboratory for biogeochemical and microbiological investigations as well as a separate radioisotope laboratory specifically equipped for microbial rate measurements (i.e. sulfate reduction, methanogenesis, methane oxidation, carbon respiration, which are equipped as follows.

**The Ziebis Lab includes:**
- 1 Nikon Epifluorescence microscope (Eclipse 80i) equipped with high-resolution camera (SPOT, Diagnostic Instruments) and G5 Macintosh computer with SPOT software,
- 1 large refrigerated centrifuge (Eppendorf)
- 1 combustion furnace (Barnstead-Thermolyne),
- 1 GC with FID (Shimadzu Model 2014)
1 portable micro-Winkler stand for precise oxygen measurements,
1 portable flow-injection lab for the analyses of $\Sigma CO_2$ and $NH_4$.
1 Stratagene Gradient 96 Robocycler,

**Microsensor equipment:**
complete systems (Unisense) for computer controlled microsensor measurements (amperometric) are available, including: pico-ammeter (PA2000 UNISENSE), motor-controlled micromanipulators, multi channel A/D converters, high-impedance pH/mV meter, submersible pico-ameters, data loggers, as well as field equipment, like a small benthic lander for in-situ profiling.

The lab also has a number of as well as standard equipment (balances, centrifuges, hybridization ovens, water baths, spectrophotometers, refrigerators, incubators, etc.)

**Radioisotope laboratory includes:**
1 double-sized chemical fume hood,
1 Beckmann scintillation counter (Model LS6500), 2 Monitors, 1 computer (Dell), 1 printer
1 large refrigerated centrifuge (Eppendorf),
1 16-place distillation unit (sulfate reduction measurements)
1 large shaking table,
1 tube furnace (Barnstead-Thermolyne),

The lab also has standard equipment (incubators, balances, etc.) as well as special equipment and glassware for incubation experiments and rate measurements.

**Computers:** ten computers (Mac and PC) are connected in a local network, as well to the WWW

**Departmental Equipment:**
- Autoclaves
- -80 basement freezer farm
- Liquid Scintillation Counters
- Sorval and Beckman High Speed Refrigerated Centrifuges
- Beckman Preparative Centrifuge
- Philips APD Q/2Q powder X-Ray diffractometer
- walk-in freezer and coldrooms

**Trace metal clean laboratory - ICPMS**
We also have access to a trace metal clean laboratory and an ICPMS (Dr. S. Sanudo-Wilhemy at USC). The lab is equipped for trace metal analyses which will employ Inductively Coupled Plasma Mass Spectroscopy using a High Resolution, Magnetic Sector ICPMS (Element 2).

**Shared USC facilities** Instrumentation that is accessible on campus include:
- Ultracentrifuges
- Molecular Dynamics STORM radioactivity/fluorescence gel imager/analyzer
- Scintillation counters
- Salinity units
- Fluorometers
- Gel documentation systems
- Electroporation units
- PCR thermal cyclers including a shared use BioRad Q-PCR, and a BD FACSCaliber Flow Cytometer
- Beckman shared use DNA sequencer

On campus, the Center for Electron Microscopy and Microanalysis (CEMMA) has TEMs (one with an X-ray fluorescence microprobe / elemental analyzer) and SEMs, available on an hourly recharge basis, and also thin sectioning facilities and a darkroom. A machine shop is located on campus, which is very well equipped to build diverse custom equipment.
The K. Heidelberg Laboratories are well equipped to undertake this proposal. K. Heidelberg maintains laboratories at both the USC main campus and the Wrigley Institute of Marine Science (located on Catalina Island ca. 25 miles from L.A.)

Major Equipment in the K. Heidelberg Laboratories:
- 454 FLX sequencer (Titanium upgrade compliant)
- Agilent 2100 bioanalyzer
- Turner fluorometer for DNA/RNA quantification
- Qiagen TissueLyser
- AlphaInnotech gel documentation system
- BioRad DNA engine thermocyclers
- Centrifuges
- Balances
- fume hoods
- water baths
- -20 and -80 °C freezers
- Hitachi variable pressure tabletop scanning electron microscope (TM-1000)
- Olympus BX-51 compound phage microscope and image analysis system
- Olympus SZS10 stereoscope with image analysis system

K. Heidelberg maintains a dedicated bioinformatics computer (Dell Precession 490 workstation with 2 dual core Xeon processors, 8 Gb RAM, and 1 Tb hard drive) in the island lab. There is a request in this proposal for a duplicate bioinformatics dedicated computer for the mainland lab for student and postdoc use.

Relevant field equipment needed for collection:
- Variable speed peristaltic pumps
- Vacuum pumps
- Stainless steel deep submersible water pump
- Six 142 mm impact membrane IN LINE FILTERS
- Pellicon2 Acrylic TFF 50Kda filter system for viral work
- LN2 dry shipper
- Coolers
- Cruise boxes

K. Heidelberg also has full access to Wrigley Marine Science Center general laboratory facilities and equipment, including clean flowing seawater, an isotope lab, spectrophotometers, fluorometers, centrifuges, microscopes, sampling equipment, scintillation counter, power supplies, gel electrophoresis equipment with digital image documentation, etc., and general use computers on the Internet. There is dedicated office space and 2 laboratory work computers (1 PC, 1 MAC) available for students involved in this project.

She has access to a Dell Precision 490 with dual Xeon Core chips and 500 GB disk space and access to the USC High Performance Computing Cluster (HPCC). This facility is available to faculty for large computing jobs. The center has 1893-node computing cluster with 2-4 GB of RAM per node and a total of 6020 CPUs, and a large memory cluster with 5 nodes each with 32-64 GB of RAM (80 total CPUs). A 45Mbps connection from the island to the mainland is sufficient for data transfer to and from this facility.

J. Heidelberg’s Laboratory at Wrigley Marine Science Center on Santa Catalina Island is well-equipped for the sequencing and bioinformatics aspects of the proposed work. It is comprised of approximately 450 sq ft of lab space with nearby facilities for autoclaves, refrigerators, and freezers.
The J. Heidelberg Lab contains all equipment and expertise necessary to carrying out the 454 FLX sequencing runs (Including a 454 FLX on Catalina Island. Equipment in the lab includes:

- Agilent 2100 bioanalyzer
- Qiagen TissueLyser
- DNA engine thermocyclers
- Dedicated bioinformatics computer
- Dell Precession 490 workstation with 2 dual core Xeon processors, 8 Gb RAM, and 1 Tb hard drive

Additionally, the Wrigley Marine Science Center facilities and equipment mentioned above are available for use. This center was renovated as part of the Wrigley Institute for Environmental Studies, which is a marine field laboratory located on Catalina Island (ca. 25 miles from L.A.) (See [http://wrigley.usc.edu/msc/index.html](http://wrigley.usc.edu/msc/index.html) for further information).

The laboratory of Dave Caron is comprised of approximately 2500 sq ft of contiguous lab space.

Additional space on the same floor as the Caron Lab provides this space:

- Six large upright incubators
- Several refrigerators and freezers (two -20°C and one -80°C)

The lab contains all equipment and expertise necessary to carrying out the analysis of protistan community analysis (18S work), microscopy, culture and physiological experimentation. The lab is versed in, and equipped for, microbiological and molecular biological studies of protists.

Major facilities include:

- Leica inverted compound microscope equipped for phase, differential interference and epifluorescence microscopy, and outfitted with a Hamamatsu digital camera, image grabbing and processing
- BX51 Olympus compound microscope equipped for phase, differential interference and epifluorescence microscopy, and outfitted with a DP76 digital camera
- Two high quality dissecting microscopes (one Leica, one Wild)
- Zeiss standard upright microscope equipped for phase and epifluorescence microscopy
- Becton Dickinson FacsCaliber flow cytometer
- Fluid Imaging Technologies FlowCAM
- Laminar flow transfer hood
- Three fume hoods
- VersaDoc gel documentation system
- Biorad iCycler
- Biorad Mycycler
- Fluorometer
- Spectrophotometer
- Variety of smaller equipment (balances, centrifuge and microfuges, drying ovens, shaker tables, shaking incubator, water bathes, temperature blocks, etc.)

Elsewhere in the department are shared items of equipment including:

- Ultracentrifuges
- Molecular Dynamics STORM radioactivity/fluorescence gel imager/analyzer
- Fluorometers
- Gel documentation systems
- Electroproporation units
- Other PCR thermal cyclers including a shared use BioRad Q-PCR temperature cycler
- Beckman shared-use CEQ 8000 DNA sequencer.
Nearby on the USC campus, the Center for Electron Microscopy and Microanalysis (CEMMA) has TEMs (one with an X-ray fluorescence microprobe/elemental analyzer) and SEMs, available on an hourly recharge basis, and also thin sectioning facilities and a darkroom.

**The E. Meng’s Biomedical Microsystem Laboratory** has 1,000 sq.ft. lab space and 500 sq.ft. class 1000 cleanroom located in Ronald Tutor Hall. The lab is designated for the development of microfluidics, implantable biomedical microdevices, and bioelectronic interfaces using polymer MEMS technology.

Major equipment includes:
- Chemical wet benches
- Thinky polymer hybrid mixer
- Parylene deposition systems
- Epilog laser machining center
- Taig computer numerical control (CNC) milling station
- AB Machinery injection molder
- Servo drill press
- Mechanical convection ovens
- Sun Electronics environmental chamber
- Programmable hot plates
- Signatone probe station
- National Instruments data acquisition systems
- Keithley precision source meters and data acquisition system
- Textronix digital oscilloscope
- Agilent power supplies
- SRS high voltage power supply
- Nikon microscope with fluorescence and Nomarski modes
- Harvard syringe pumps
- Vision Engineering stereoscope
- Digital thickness gauge
- Contact angle meter
- Laurell spin processor
- Stencil printing
- Thin film photoresist laminator
- OAI UV exposure system
- Technics reactive ion etcher
- Anodic bonder
- Kinetic vibration isolation tables
- Computing stations

The W.M. Keck Photonic Laboratory is a 6500 sq.ft. class 100 shared cleanroom facility dedicated for research and features fabrication and metrology equipment for photolithography, wet and dry etching, metal and dielectric deposition, oxidation and diffusion.

Major equipment includes:
- Electron beam lithography (down to 30 nm)
- Electron cyclotron resonance etching (ECR) system
- Deep reactive ion etching
- Reactive ion etching
- XeF₂ gas phase etching
- Chemical vapor deposition
- E-beam metal deposition
- Ellipsometer
- Surface profilometer
- Scanning electron microscope
- Dicing saws
- Optical microscopes
- Fume hoods
- Chemical wet benches
- Desktop computers

Earth Science Department

The Earth Science Department at USC can provide strong facilities support for rock magnetic studies and magnetic bacteria studies for this project. Resources at the department can make selected measurements on early diagenesis in oceanic rocks or sediments and detect evidence for iron mobility and biomagnetic materials.

The Paleomagnetism and Rock Magnetism Laboratory (PRML) at the University of Southern California is well equipped to carry out discrete sample paleomagnetic and rock magnetic measurements for the proposed work.
- Two-story magnetic-field shielded room complex, which houses a 2-G cryogenic magnetometer with inline AF demagnetizer (up to 200 mT)
- Molspin spinner magnetometer
- ASC thermal and A.F. demagnetizers
- AGICO KLY-4s AMS (anisotropy of magnetic susceptibility) system with attached furnace for high temperature measurements, all under computer control.

A separate rock magnetism laboratory houses:
- Princeton Applied MicroMag with low temperature (<10°K) capability
- Bartington susceptibility bridge (including frequency-dependent capability)
- ASC 1T pulse magnetizer for related rock magnetic studies
- Refrigerated walk-in 12'x14' core repository with storage racks for 1000 D-tubes

The PRML has unlimited access to other departmental facilities (sedimentology laboratory, rock cutting/preparation facility, SEM with EDAX attachment) to carry out a variety of related sample preparation activities and sedimentologic studies.

The Corsetti lab has the following equipment:
- Struers Labopol-21 dual polisher
- 12 in. rock saw
- Microdrilling setup for extracting small samples from polished slabs
- Rocklabs ring mill (for crushing large samples)
- Ball mill with agate and steel heads (for crushing small samples)
- EGLA Purelab classic 18.2 MΩ water purification system
- Assorted glassware
- Zeiss Petrographic Axioskop Microscope with 1.25x, 2.5x, 10x, 20x, 40x, and 100x, objectives
- Zeiss MRm 12 bit digital imaging system and computer
- ECM-34 Luminoscope (cathodoluminescence)
- Nikon D-70 digital SLR camera
- Nikon F100 film camera
In addition, we are set up to extract carbonate associated sulfate from carbonate powders and have completed a sulfide extraction line for sulfide analysis.

Viterbi School of Engineering
The Robotic Embedded Systems Laboratory at USC is directed by Gaurav Sukhatme (http://robotics.usc.edu/resl). It is housed at the USC University Park Campus, in the Ronald Tutor Hall of Engineering.

The laboratory consists of
- 1800 sq. ft of space
- student work areas
- open experimental areas
- storage areas
- multi-purpose secured lockable room with about 40 sq. ft of space that is used as a conference room and as a human-subjects experimental area.

The computing environment consists of a mix of desktop platforms (over 10 units) supporting, Windows, Linux, and Macintosh OSX. All computers are networked by 1 GB/s of 100 MB/s switched local Ethernet. There is routine automated backup of all critical systems, and UPS on all servers.

In addition, the lab has over 25 robots of various configurations. The robots in the laboratory most relevant to this proposal include:
- 16 Pioneer mobile robots, each equipped with laser scanners and embedded computers
- 20 iRobot Roomba Creates equipped with network cards, and embedded computers
- 2 Segway RMPs each equipped with laser scanners and embedded computers.

Additional robots include 2 Bergen 60 helicopters each equipped with a full GPS/INS and a high-end stereo pair, and 2 OceanScience ASVs equipped with a full GPS/INS and a high end stereo pair. The ASVs are networked using WiFi for short range communication and with long-range Freewave modems for fieldwork. The lab also has shared access to 2 Slocum AUVs (gliders) from Webb Research with a full suite of instruments for biological sampling and oceanic measurements. The gliders are also networked using long-range freewave modems. In arrangements with the cities of Redondo Beach and Marina del Ray, we have permanent harbor access for testing located within easy driving distance of the laboratory.

The Networked Aquatic Microbial Observing System (NAMOS) system (http://robotics.usc.edu/_namos) will be used as an experimental robot and sensor node testbed. The system is composed of 10 stationary sensing nodes (buoys) and 2 robotic vehicles (boats). The goal is to provide in situ, real-time presence for observing plankton dynamics (e.g. chlorophyll concentration), linking them to environmental variables (e.g. temperature, light, nutrients, etc.). All current communication on the NAMOS system is via 802.11b wireless over the air and most field work over the past two years has been done in shallow (< 6m) water. The NAMOS team is planning extensions of the work to ocean-going systems at significantly greater depths (using submersible gliders instead of boats) - this will naturally require underwater communication.

Thus, we are instrumenting the boats with underwater acoustic transducers (see below). Each robotic boat operates autonomously and is capable of navigating to waypoints. Thus in principle, it is possible to place an acoustic transmitter (receiver) at arbitrary underwater coordinates (using a winch for variable depth) for experimental trials. The boats are also GPS-enabled. These instruments allow for careful and repeatable experimental design.

Underwater Acoustic Testbed Development
The underwater acoustic testbed at USC is a fully configurable, real-time, single-transducer testbed. It supports a carrier frequency ranges from 100 Hz to 20 kHz, with useful bandwidth up to 5 kHz. The setup is shown in Figure 1 - a laptop serves as the modem. The information bits are encoded, pulse shaped and up-converted in the digital domain by the computer. The generated digital samples of the transmit waveforms are converted into analog domain by the external sound card. The receiver chain provides a high performance system for the narrowband underwater acoustic testbed. All signals are generated in discrete-time complex baseband equivalent form and are directly converted to the modulated carrier frequency in digital form. Figure 1 depicts a preliminary channel sounding study done in a swimming pool.
at USC. Preliminary multipath channel characterization has been undertaken: single element transceivers with omnidirectional underwater transducers are employed at a distance of 4m. The underwater communication channel being measured is narrowband with 480Hz band-width at 13KHz carrier frequency. Successful data transmission (QPSK) has been accomplished in a smaller water tank with the testbed system. In swimming pool validation of the various communication sub-systems will be completed in Spring 2009.

The Information Sciences Institute (ISI), Engineering

Dr. Wei-Min Shen's Polymorphic Robotics Lab has more than 1000 square feet of lab space, including a general electronics/assembly room/workshop, four large offices, and one experiment room for robotic experiments.

The lab has more than 50 robots
• 8 mobile robots for in/outdoor maneuver and navigation
• 1 autonomous underwater robot
• 28 reconfigurable robots
• 10 Create robots with radio links

The lab has:
• One simulated-space testing environment with zero gravity and overall monitoring systems
• One large Viper SLA fast prototyping machine (~$200K for the purchasing price)
• Many instruments for electronics and mechanics
• Access to internet and a large cluster of >1346 computers
• Access to a MOSIS lab
• Access to a machine shop with about 10 machines
• Technical support
• Multimedia simulation systems
• Access of fabrication facilities such as NC machines, SLA machine, and other machining tools
• existing mobile robot hardware and software
• Various innovative robotic platforms
• Large collection of most advanced self-reconfigurable robotic modules.

The Information Sciences Institute (ISI), located at Marina del Rey approximately 15 miles from the main USC campus, is a research facility of the USC School of Engineering. ISI works on a broad spectrum of information processing research and the development of advanced computer and communication technology and systems. The staff at ISI consists of over 100 full time researchers, about half at the Ph.D. level, a technical support staff of 33, and over 60 graduate research assistants. Additional personnel are associated with ISI as consultants or in other support activities. ISI maintains close academic ties with USC, particularly with the Departments of Computer Science and Electrical Engineering. ISI is a large, university-based research center with an emphasis on programs that blend basic and applied research. It has a distinguished history of producing exceptional research contributions and successful prototype systems under DARPA, NSF, and NASA support.

ISI has built a reputation for excellence in computer science research, experimental computer services, and production services. ISI takes a system approach to problem solving; the end product is usually an experimental system as well as research papers. ISI has sponsored research projects underway in many areas, such as networking, databases, software engineering, AI, and robotics. Also, ISI runs the MOSIS brokerage service for VLSI fabrication. ISI labs and offices amount to about 60,000 square feet of space. All computers are networked together on an Ethernet-based local area network, and all employees and researchers are provided access to wide-area communication networks, including the Internet, MilNet, and Los Nettos. The environment contains over 150 Sun, HP, and SGI UNIX workstations, and over 100 PCs and Apple Mac computers. The Operations and Network Services Group provides services for most machines, including security of operations, disk and tape mounts, daily back ups of storage devices, and monitoring. The group also maintains directory accounts on all machines, manages storage on the hosts
and servers, maintains machine accounting records, and provides training and documentation functions. The Hardware Group maintains a large variety of machines at ISI. Spare parts are kept on hand to ensure the fastest possible repairs. The Software Group maintains all system software at the ISI, customizing systems to meet user needs, and installing new releases of vendor software. This group also obtains and installs software packages such as mail systems, distributed relational and object-oriented data base systems, spread sheets, editors, document management systems, etc. ISI also houses an excellent technical library for research. In addition to computing facilities, ISI also has a mechanical workshop that offer a large variety of machine tools, including a Viper SLA fast prototype machine, that are need to build custom systems such as robotics devices and electronic devices.

USC/ISI possesses two special strengths regarding the proposed work. First, USC/ISI has a blend of talent and experience in the areas of autonomous and self-reconfigurable robots, intelligent and multi-robot systems, knowledge representation, high-performance AI systems, and real-time AI systems that, taken together, are matched by few, if any other research institutions. USC/ISI's second strength lies in its willingness to direct its work towards the needs of the practical systems, demonstrated throughout its 30 years of existence.
**Ethics Statement:** USC is committed to maintaining an environment that promotes high ethical standards in the conduct of research without inhibiting productivity or creativity of persons involved in research, regardless of the position or level of responsibility of those involved. The University does not tolerate misconduct in any aspect of research and will deal with misconduct associated with research forthrightly, in accordance with academic due process, and with respect for practices commonly accepted within the scientific community.

**Ethics Training:** The Center will develop a set of published guidelines with regard to standards of ethics as well as hold specific programs of ethics training for all Center and subawardee personnel, including faculty, visiting faculty, industrial fellows, postdoctoral researchers, graduate and undergraduate students. The training sessions will be offered at the initiation of the Center and at various meetings and annual retreats of the Center. The training sessions will be developed in conjunction with the Trojan Integrity group on campus with whom we have partnered in ethics training for our summer REU program in Geobiology. We will also engage colleagues from the USC Law School to help us develop a robust training program for all personnel particularly in the area of intellectual property. Ethics and intellectual property training topics will include the nature of the research, the methodologies used by the Center, ownership of research and ideas developed through the Center, and roles and responsibilities regarding intellectual property development within the Center.

**General Policy: Ownership of Intellectual Property:** A goal of USC is to encourage creative activity and the prompt and open dissemination of ideas and inventions by recognizing and rewarding individual members of the faculty and staff. The commitment to develop new knowledge includes facilitating the practical application of that knowledge for public use. The University wishes to demonstrate that the public and private investment in funded research at USC results in the creation of ideas and inventions that benefit society.

The University wishes to preserve the academic tradition of faculty ownership of certain scholarly works within the context of applicable law. Both California and federal law provide that the University own all intellectual property created or developed by an employee within the scope of his or her employment, including works developed under sponsored research or other agreements and works that make significant use of University funds or facilities. In seeking an appropriate balance between academic tradition and law, USC's Intellectual Property Policy recognizes certain exceptions to the law that are well-established traditions in the academic setting.

The purpose of this Policy is to educate members of the University community about their rights and responsibilities regarding intellectual property. This Policy also describes the ways in which USC faculty, staff and students can protect the intellectual property that they create for their benefit as well as preserve the interests of the University and the public. This Policy obviously cannot address every situation that may arise in the development, enforcement and management of intellectual property rights. Rather, this Policy is intended to serve as a set of guideline for USC’s faculty, staff, students and visitors. The principles discussed in this Policy apply to the University Park Campus, Health Sciences Campus and any other USC programs and locations.

The full policy including exceptions is available at: [http://policies.usc.edu](http://policies.usc.edu).
Postdoctorals Mentoring Plan

C-DEBI aims to foster the next generation of marine deep biosphere researchers in the US through mentoring and STC financial support of postdoctoral fellows for two years. The success of these efforts will be monitored and adjusted as needed by ExCom and S/T; feedback from the fellows will be regularly sought. Explicit program checks and balances to ensure balanced and equitable mentoring among all C-DEBI postdoctorals include:

**Primary advisor and oversight committee: roles and responsibilities.** We propose to formalize the interdisciplinary nature of this research by facilitating guidance to our fellows. Each postdoctoral applicant will identify a primary advisor who agrees to sponsor them and manage logistical aspects of their support (office and lab space, materials and supplies for conducting research). The primary advisor will be required to commit to meeting with the postdoctoral to discuss research progress at least twice monthly and to provide means of allowing broader discussion about her or his research—this can be in the form of departmental seminars, group meetings, etc. The primary advisor is also required to provide support for the postdoctoral to attend a national meeting (e.g., AGU, ASM, ISME, ASLO) that is appropriate for deep biosphere researchers to attend.

Additionally, fellows will submit a report on their yearly achievements to the Postdoctoral Program committee, comprised of Jennifer Biddle, a recent postdoctoral, and Dave Caron, who has supervised many successful postdoctorals. The Postdoctoral Program Committee will review and comment on this summary and report results to ExCom. Their approval will be required for the release of the second year of fellowship funding. This provides a checkpoint to ensure that the fellows are making credible progress and that their primary advisers are assisting to their best ability. It also exposes the fellow to established researchers in the field and will likely create opportunities for ship-going experiences and broadening of research horizons.

**C-DEBI postdoctoral networking opportunities.** C-DEBI coordination requires significant emphasis on directed networking—our annual meetings, web and cyber infrastructure, theme-team conferencing, interdisciplinary expeditions—these components are critical for the broader success of C-DEBI, but also intrinsically provide opportunities for our postdoctorals. Coupled to each C-DEBI annual meeting, we will initiate a one-day meeting exclusive to postdoctorals and students to foster both academic and social networking. C-DEBI will allocate 10% of participant costs for supporting postdoctorals, with an additional 10% allocated for student participation. Furthermore, we will involve postdoctorals and students directly in the planning and development of these meetings. This was done for our first meeting in February 2008 and is under development for our second meeting, planned for October 2009.

In addition to this formal meeting, we will also encourage and support an informal, grass-roots level of support through social-networking sites such as Facebook, a strategy already proven for other scientific communities and groups. An additional opportunity for networking is presented in our T/T conferencing; the postdoctoral integration into that program is described in the technology transfer section.

The advising plan outlined herein and direct involvement in the kinds of coordination activities such as described above expose young scientists to leaders in their field, which is inarguably critical for successful career development, and also serves as a major confidence building experience at a career stage when lack of confidence can be a significant obstacle.
Shared Facilities

C-DEBI links several cutting-edge laboratories, many of which are run formally or informally as “facilities”. Herein we highlight a few of the dozens of examples of some of our more specialized deep biosphere facilities (omitting some of the most common and ubiquitous to all institutions, e.g., sequencing facilities) to illustrate our global and interdisciplinary communities and the rich resources we together bring to C-DEBI.

**University of Southern California.** USC shared facilities serve two purposes: 1) a clearinghouse for CORK and subseafloor microbial observatory design and installation expertise, and 2) state-of-the-art microscopy equipment and integrative analytical expertise in microscopy and microanalysis for application to deep biosphere samples.

**CORKs.** Many west coast C-DEBI participants (Edwards, Fisher, Orcutt, Wheat) have unique first-hand experience in designing, installing and servicing CORK systems and microbial observatories at multiple sites for hydrogeology and microbiology. Edwards and Orcutt have lead the fabrication and testing of the *in situ* microbial observatories to be deployed within CORK boreholes, in collaboration with Wheat, C-DEBI participant Bach, and the USC machine shop. Wheat is the leading expert in use of osmotically-driven, non-mechanical pumps for collecting time series chemical samples in CORK systems and for fluid delivery to flow-through microbial incubation chambers. Fisher is an expert in application of pressure and temperature sensors in CORK systems. Both Fisher and Wheat have significant shipboard experience in assembly and installation of CORK systems. USC will serve as the central facility for coordinating CORK hardware and for organizing knowledge transfer about designing and constructing these systems with interested collaborators. We also work closely with Cowen and the UH GeoMICROBE observatory systems described below.

**Microscopy and Microanalysis.** USC is home to the Center for Electron Microscope and Micro Analysis, a shared-user facility equipped with many new, state-of-the-art scanning electron microscopes (SEM). USC also supports close collaboration with the Ahmanson Center for Advanced Electron Microscopy at The House Ear Institute, another shared-user facility with cutting edge transmission electron microscope (TEM) and SEM expertise. Edwards currently operates an inverted objective confocal laser scanning microscope equipped with four solid state lasers (405, 488, 532, and 635 nm) which is primarily used for analyzing microbial communities associated with hard rock and mineral surfaces. We are also in the process of acquiring an automated stage, laser microdissection (LMD) microscope for a variety of single-cell microbial ecology and biofilm analyses. LMD technology can be used to excise live or fixed cells or other materials of interest from a sample using laser cutting; the cells or material can then be transferred into sterile media (for culturing from single cells), into extraction buffer (for single-cell genome analysis). The laser can also be used for etching materials, such as silicon wafers used in fluorescence *in situ* hybridization-secondary ion mass spectrometry (FISH-SIMS) protocols. Coupling of LMD with FISH-SIMS will significantly improve material and location recall in SIMS application (SIMS are available at Caltech and the MPI in Bremen). The automated stage of the LMD would allow for novel time series imaging of live cultures grown in microfluidic chambers that have relevance to design of *in situ* borehole incubation experiments. Epifluorescent visualization capabilities on the LMD system would allow for precise collection of specific cells that are 1) naturally autofluorescent (for example, methanogenic archaea which contain fluorescent proteins), or 2) tagged with fluorescent labels (such as DNA- and RNA-based fluorescent oligonucleotides, DNA stains, or redox/growth/activity indicators). The LMD system can mill through relatively thick (on the order of 20+ \( \mu \text{m} \)) hard substrates such as sections of basalt and metal oxides, which would allow for excision of cells in biofilms on the surfaces of rocks and mineral particles. A short video demonstrating LMD applications relevant to deep biosphere samples may be viewed at http://www.youtube.com/watch?v=c_hMygEEmBQ.

**University of Hawaii:** Cowen has experience in the design and application of instrumentation used to interface between fluid delivery systems of CORK Observatories. Second and third generation seafloor
instrument sleds (GeoMICROBE sleds) will be available for use in C-DEBI related deep biosphere research projects.

**GeoMICROBE.** The GeoMICROBE (GeoMicrobial In situ CORK Research Observatory for Biosphere Experiments) instrument sled interfaces with borehole CORK fluid delivery lines (FDLs). GeoMICROBE allows in situ analyses of basement fluids with in-line sensors, in situ filtrations, and in situ scavenging of dissolved chemicals. In-situ analyses are immediately processed, thereby minimizing artifacts associated with sample transport and storage. GeoMICROBE makes simultaneous measurements of O₂, H₂O₂, H₂S, HS⁻, S(0), S²⁻, S₂O₃⁻, S₂O₄⁻, Fe(II), Fe(III), FeS(aq), Mn(II), and Zn(II). Other sensors can be integrated into the system, including water sampling and filtration systems for geochemical and microbiology assays. GeoMICROBE systems can be used for short- to long-term (e.g., 4-year) deployments.

The GeoMICROBE connects to the CORK FDLs via an “Aeroquip-like” connector and Teflon tubing with an exterior armor. The newest generation GeoMICROBE (III) will have an integrated pump and three-to-one valve system to sequentially draw basement fluids up from multiple (1 to 3) depth horizons and deliver it to the sensors and filtration/sampling systems. Other standard components include an in-line in situ electrochemical analyzer (ISEA) for determination of redox chemical species (supplied by C-DEBI proponent Glazer); a modified 24 or 48 port McLane Water Transfer System (WTS) (i.e., a time-series multi-sampler) for in situ filtrations, enrichment cultures, extractions and fluid collections; temperature and flow sensors; and power and control systems. A central Rabbit™ computer provides integrative communication control and power distribution over the individual components of the GeoMICROBE sled. The system is operated in real-time (ODI™ wet-mate-able pin connector communication with submersible) or in “program mode” for remote time-series operations. The controller is also equipped with an over-ride that allows direct communication between the submersible and individual GeoMICROBE components (e.g., TSMS or ISEA). The open architecture of the GeoMICROBE sled allows in-line sensors and samplers to be self-contained or ‘Rabbit’ controlled.

**University of Rhode Island:** D’Hondt is a long-standing leader in developing and leading deep-biosphere research projects. URI offers its stand-alone Field Laboratory for C-DEBI-related deep-biosphere projects.

**Geomicrobiology Field Laboratory:** This University National Oceanographic Laboratory System (UNOLS)-standard containerized facility is designed for sea-going fieldwork, and includes a fume hood, lab benches, sink, a Millipore MilliQ Synthesis water purifier, under-counter refrigerator, under-counter freezer, and air conditioning. It is fully outfitted for: (1) microbiological and biogeochemical sampling and analysis of diverse subsurface and aquatic environments; (2) on-site analyses of biologically significant transient properties; and (3) on-site analyses of chemical, physical and biological properties used to guide sampling strategies. A full listing of instruments/major equipment can be found at [http://www.gso.uri.edu/dhondtlab/Geobiology%20Laboratory.html](http://www.gso.uri.edu/dhondtlab/Geobiology%20Laboratory.html). Shipboard protocols supported by the laboratory include sampling and storage of samples for microbiological and molecular assays, core description, and sampling of interstitial water for chemical analyses (with both Manheim squeezers and Rhizon samplers). Standard analyses supported by the laboratory include cell counts, quantification of concentrations of major dissolved chemicals and biologically significant chemicals (e.g., O₂, low molecular weight fatty acids, hydrogen, hydrocarbons, both oxidized and reduced species of S, N, Fe, Mn, and other metals), quantification of basic core properties (e.g., resistivity), and quantification of radiotracer activities. The laboratory is a multi-user facility managed by Dennis Graham and directed by D’Hondt. Graham has over 15 years of at-sea experience; for most of that time, he was responsible for shipboard chemistry operations and (recently) microbiology laboratories on the U.S. drillship JOIDES Resolution.

**Woods Hole Oceanographic Institution:** WHOI houses two national analytical facilities: the National Ocean Sciences AMS Facility (dedicated to ¹⁴C) and the Northeast National Ion Microprobe Facility (dedicated to element and isotope analyses at high spatial resolution by ion microprobe techniques). Other analytical facilities, such as the Plasma Mass Spectrometry Facility, primarily serve
the analytical needs of the local scientific community, but are also open to outside users. Those facilities will be available for use by the C-DEBI related deep biosphere research community.

**Plasma Mass Spectrometry.** This laboratory includes two single collector, magnetic sector Element 2 and the multi-collector, magnetic sector Neptune ICP-MS. Neptune can be also coupled to the NewWave™ 213 nm or Excimer UP-193 laser ablation systems for *in situ* isotope analysis. The Element 2 is ideally suited for routine major and trace element composition of solid and aqueous samples. This facility spends considerable effort developing state-of-the-art techniques to ensure the highest accuracy and precision, including participation in both internal and external inter-calibration studies. C-DEBI participant Rouxel has in-depth experience with these techniques and has applied metal and metalloid isotopes as biogeochemical tracers of seawater-rock interactions and deep biosphere activity.

**The Northeast National Ion Microprobe (NENIMF).** This is one of two National Ion Microprobe Facilities supported by NSF in the US. It is charged with providing first class service, scientific expertise and educational outreach activities to the research community in the U.S. and beyond. NENIMF enables measurements of both the abundances of diverse trace elements as well as stable and radiogenic isotopes, both essential components of C-DEBI. This facility is equipped with the IMS 3f and IMS1280: the IMS 1280 is a new generation high transmission-high mass resolution SIMS instrument with extended capabilities for deep biosphere research, providing in particular high-precision light stable isotope analysis (*e.g.*, H, C, O, N, S) with spatial resolution better than 10 μm.

**The National Ocean Sciences Accelerator Mass Spectrometry Facility (NOSAMS).** NOSAMS provides analyses of 14C at natural abundance levels to the ocean sciences research community ([http://www.nosams.whoi.edu](http://www.nosams.whoi.edu)). Accelerator mass spectrometry is a method of radiocarbon analysis where atoms of 14C contained in a sample are directly counted. The facility was established in 1989 for analysis of radiocarbon in samples collected during the World Ocean Circulation Experiment, but now is routinely used by a diverse ocean community, including many C-DEBI participants.

**The Advanced Light Source (ALS):** The ALS (a division of the Lawrence Berkeley National Lab) is a national user facility that generates intense light for scientific and technological research. As one of the world's brightest sources of ultraviolet and soft x-ray beams—and the world's first third-generation synchrotron light source in its energy range—the ALS makes previously impossible studies possible. The facility welcomes researchers from universities, industries, and government laboratories around the world. It is funded by the U.S. Department of Energy's Office of Basic Energy Sciences.

Edwards, Toner, and other C-DEBI researchers have used the ALS and collaborated with beamline scientists and C-DEBI participants Sirine Fakra and Matthew Marcus for years on the analysis of deep-sea and subseafloor materials. A few beamlines of particular relevance for subseafloor research include 10.3.2 ([http://xraysweb.lbl.gov/uxas/Index.htm](http://xraysweb.lbl.gov/uxas/Index.htm)), for micro X-ray adsorption spectroscopy (μXAS) and micro extended x-ray adsorption fine structure (μEXAFS) analyses, enabling spatially-resolved chemical and mineralogical analyses on materials such as subseafloor rock, sediments, and biofilms. It is possible to couple approaches, for example, in laser dissection microscopy (see USC facilities above) with these analyses. Additionally, beamline 11.0.2. the scanning transmission x-ray microscope (STXM) for Molecular Environmental Science will be highly useful to C-DEBI researchers for mineralogical and bioinorganic chemical analyses ([see http://www.als.lbl.gov/als/microscopes/scope11.0.2.html](http://www.als.lbl.gov/als/microscopes/scope11.0.2.html)).

**The Japan Agency for Marine-Earth Science and Technology.** JAMSTEC is one of the leading organizations of the Integrated Ocean Drilling Program (IODP) using the deep-earth research riser-drilling vessel Chikyu. JAMSTEC organizes one of three IODP official core repositories at Kochi (JAMSTEC-Kochi) in collaboration with Kochi University. The geomicrobiology group of JAMSTEC-Kochi (PI: Fumio Inagaki) has recently developed a fluorescent microscopic image system equipped with an automated slide roader for discriminative cell detection and enumeration in sub-seafloor sediment/rock cores. A flowcytometry and cell sorting system (Beckman) is available for cell enumeration and sorting in borehole fluid samples. JAMSTEC-Kochi equips twelve 430-litter liquid nitrogen tanks at -160°C, which will be available for long-term storage of RNA and oxygen-sensitive fragile bio-molecules or legacy
samples. Using an electric diamond-tipped band saw system equipped in a HEPA-filtered clean booth, aseptic sub-sampling of frozen cores is possible without sample melting. These core-dedicated (but not limited to) microbiological facilities in JAMSTEC-Kochi will be available in the international collaboration framework of the C-DEBI, and JAMSTEC-Kochi will accept the research visit of students and researchers working on the C-DEBI related projects.

**Harvard University. The Mobile High Pressure Laboratory (Pressure Lab).** The Pressure Lab was developed to enable the study of deep-sea animals and microbial communities at in situ conditions on board ship. The current facility is the third generation, and is the product of fifteen years of research and development. In collaboration with UNOLS, the Pressure Lab is available for C-DEBI related efforts.

Specifically, this facility enables investigators to study the rates of all organismal processes at environmentally relevant conditions. The Pressure lab consists of a 20 foot (6.3 meter) refrigerated intermodal shipping container capable of maintaining temperatures between -20°C and 50°C. The container houses six independent high-pressure incubation systems, a geochemical analytical system and a small ultra-cold freezer for sample storage. Nine high-pressure vessels capable of operating at pressures up to 6000 PSI (400 atmospheres) are available for the six high-pressure incubation systems (Lewa diaphragm pumps). The geochemical analytical system consists of two shipboard membrane inlet mass spectrometers (SRS RGA-200 quadrupole mass spectrometer; Stanford Research Systems) outfitted with Alcatel turbomolecular pumps and KNF-Neuberger roughing pumps, spectrophotometers, pH and other ion-specific electrodes, and a customized Agilent 5890 Series II gas chromatograph for additional gas analyses. Three precision temperature controlled circulating water baths enable independent temperature control. A Kendro -80°C ultra-cold chest freezer enables samples to be frozen for shore-based analyses.

Guirguis and collaborators are designing and fabricating a second system specifically to enable C-DEBI investigators to use the Pressure Lab as needed. Consultation on operation and experimental design is readily available to those interested in using this facility.

**University of Bremen.** The University of Bremen is home to the MARUM - Center for Marine Environmental Sciences (http://www.marum.de), a leading center in Marine Geosciences in Germany. MARUM hosts one of the three core repositories of the IODP and provides shore-based facilities and laboratories for deep drilling expeditions with mission-specific platforms administered by the European Consortium for Ocean Research Drilling (ECORD). MARUM examines the significance of the oceans within the framework of global change, quantifies interactions between the marine geosphere and biosphere, and provides information for a sustainable use of the ocean. MARUM offers its facilities to marine scientists from national and foreign institutions and engages in international graduate education. The Organic Geochemistry group (http://www.marum.de/en/Organic_Geochemistry_group.html) at MARUM led by Prof. Kai-Uwe Hinrichs is dedicated to studying geomicrobial processes and microbial communities in marine subsurface environments. Its facilities will be available to C-DEBI related research initiatives and projects. The group has a history of hosting researchers from leading international institutions (http://www.marum.de/en/Guests_2.html) and will continue to do so in the framework of C-DEBI. The laboratory facilities of the Organic Geochemistry group are designed for the quantitative, structural, and isotopic analysis of biologically relevant organic molecules ranging from 1 to ~100 C-atoms in size. The group is a leader in the analysis of complex lipid molecules, which are considered “life markers”, and in the isotopic analysis of short-lived intermediates such as acetate. Visiting C-DEBI researchers will have access to state-of-the-art instrumentation for molecular-isotopic analysis of such molecules; this includes multiple solvent extraction systems, gas chromatography (GC; three instruments), gas chromatography-mass spectrometry (GC-MS; two instruments, a third instrument will be purchased in summer 2009), isotope-ratio-monitoring GC- and LC-MS (ThermoFinnigan Delta plus XP, one instrument with two peripherals), high-performance liquid chromatography-mass spectrometry (HPLC-MS; ThermoFinnigan LCQ, one instrument) operated either in electrospray ionization multistage or atmospheric pressure chemical ionization mode. An additional instrument, the linear-ion-trap mass spectrometer ThermoFisher LTQ, will be purchased in late 2009.
### Partner Institutions

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### Project Personnel

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<td>D’Hondt, Steve</td>
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<td>Edwards, Katrina</td>
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<td>Amend, Jan</td>
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### C-DEBI Education Instructors, Facilitators, and Evaluators

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<tr>
<td>Biddle, Jennifer</td>
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### Liaisons: Education, Outreach, Communications, Technology

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### Science Theme Leaders

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**C-DEBI Senior Research Personnel**

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1NP= North Pond; JDF=Juan de Fuca; SPG=South Pacific Gyre; GY=Guaymas Basin; DO= Dorado
2Themes: 1=Activity; 2= Biogeography & dispersal; 3=Limits of life; 4= Evolution
3Continental deep biosphere liaisons (involved in marine and continental projects)
Institutional Commitment

**USC.** USC will provide matching funds in the amount of $180,825/ year for five years ($904,125 total). USC College will cost-share equal in amount to the indirect costs on the subcontracts of $50,000 or less, a cost share of $186,000/ year ($930,000 total). Matching funds will be provided for computer support, faculty salaries and administrative support. Edwards will be released from half of her teaching commitment for her directorship responsibilities. USC will provide 3,000 net sq. ft. space for the Center in the new University Gateway building currently scheduled for completion in early 2010. This will include a multimedia conference room, student and post-doc space and offices for visiting scholars.

**Additional Commitments:**
- The College will also support academic year and summer research of undergraduates working with USC Faculty under its SOAR and SURF programs (described in the Education section).
- Tuition and benefits for College PhD students in the center will be cost shared by the College.
- Facilities will be available to support this STC by USC College's Wrigley Institute for Environmental Studies (WIES), which has a major facility on Catalina Island. This facility can support a variety of educational and research programs in environmental science, and can host workshops and conferences, including accommodations for participants (see http://wrigley.usc.edu). Funds from WIES and the College Dean supported the February 2008 Catalina C-DEBI meeting (~$15,000), which has been instrumental in the development of this proposal.

USC has recently (past seven yrs) raised and invested over $25 million of private funds in its marine programs including rebuilding the Catalina facilities, hiring numerous new faculty and program leaders, including C-DEBI faculty (Edwards, Nealson, J. Heidelberg, K. Heidelberg, Ziebis, Berelson). USC has invested heavily in new research infrastructure to support marine microbiology and biogeochemistry, including two micro-array facilities, an electron microscopy facility with three new JEOL microscopes, extensive molecular sequencing capabilities, all to improve the opportunities for the faculty to excel in research and teaching. This combination of pre-existing investments set the stage for this proposal, but it is also a sign of USC’s ongoing commitment to continue to build in this area in the future. USC College commitment for the Center over the duration of the project is > 3 million dollars.

**UAF.** UAF is committed to providing necessary space and facilities to complete the work proposed by Wheat, including administrative and technical support through the Global Undersea Research Unit of the School of Fisheries and Ocean Sciences. In addition, the lease (~$22K) for Wheat's laboratory, which is located at MBARI in Moss Landing, California where Wheat has resided for the last 14 years, will be supported by the School and the overhead rate for Wheat's portion of the proposal work has been reduced from 47.5% (nominal UAF rate) to 26%, an effective difference of ~$220K.

**UCSC.** UCSC is committed to providing space and facilities to complete the work proposed by Fisher, including necessary levels of administrative and technical support through the Earth and Planetary Sciences Department. In addition, the EPS Department will leverage graduate research support with fellowship and teaching assistantship support, and participate in E&O through the CalTeach and ISEE programs for future and current teachers at the university and K-12 levels.

**UH.** The School of Ocean and Earth Science and Technology (SOEST) at UH will provide offices for Cowen, a postdoctoral fellow, and a technician and have access to administrative/outreach specialists. To support the educational goals of the C-DEBI and to enhance the representation of minority groups in deep biosphere research, SOEST will sponsor a five-year-long graduate student fellowship for Native Hawaiians or Part-Hawaiians at the UH in oceanography.

**URI.** The Graduate School of Oceanography at the URI will provide all of the space, facilities and administrative support to complete the work proposed by D’Hondt. To share the salary cost of the program, URI will pay D’Hondt’s salary for the entire duration of C-DEBI. To support C-DEBI educational goals, URI will limit tuition charges to in-state rates for three of the five program years (forgoing >$100K in out-of-state tuition) and leverage the graduate research support with teaching assistantships.