SCHOOL OF OCEAN AND EARTH SCIENCE AND TECHNOLOGY
UNIVERSITY OF HAWAI'I AT MĀNOA

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UH Manoa will Partner with University of Southern California on a New Center to Study the Deep Biosphere

Katrina J. Edwards, professor of biological sciences and Earth sciences in the University of Southern California's (USC) College of Letters, Arts & Sciences, has been recommended for an award of a $25 million NSF grant to establish a new science and technology center: the Center for Dark Energy Biosphere Investigations (C-DEBI). Edwards and her USC team will partner with several major research universities, including the University of Hawaii at Manoa (UHM) and other national laboratories to study the "deep biosphere" beneath the oceans.

A little known fact is that nearly half of the total biomass on earth resides in sub-surface habitats that include mines, aquifers, soils on the continents and sediments and rocks below the ocean floor. This massive area is what Edwards and her research partners plan to explore in three main field projects at North Pond, Juan de Fuca and South Pacific Gyre, where they will conduct a global-scale, international, coordinated mission on the sub-seafloor biosphere.

"Our mission statement is to understand the extent, function, dynamics and implication of the existence of a deep biosphere on earth," Edwards said. "We focus on the marine realm because it is by far the biggest challenge in terms of potential habitat size."

The vision, expertise, and infrastructure invested in the proposal for this Center of Excellence in deep biosphere studies derived from a profoundly intense collaboration among the new Center's 5 principal investigators: Katrina Edwards (USC), James Cowen (UHM), Andrew Fisher (UCSC), Stephen D'Hondt (URI) and Geoff Wheat (U. of Alaska). The focus of C-DEBI's research will be the poorly understood, but potentially vast biosphere deep beneath the seafloor, including both sediments and the underlying basaltic crust (basement). Hydrothermal fluids circulate throughout the highly fractured rocky basement. These fluids are basically bottom seawater that becomes highly altered by chemical reactions between the fluids and the basement rocks, and the microorganisms living there.

In order to study this remote environment, 600 to over 1000 feet beneath the seafloor, scientists drill boreholes through the sediments into the basement rock and then install 'CORK' observatories into the boreholes for semi-permanent windows into the deep biosphere. The CORKs were originally developed to study the hydrogeology of the deep ocean crust. UHM research professor Cowen and his colleagues pioneered the use of CORK observatories for microbial geochemistry and ecology studies. Over the past 18 years, considerable progress has been made toward identifying and meeting the many challenges to accessing this dynamic but remote biosphere, and to the collection of uncompromised fluids for subsequent chemical and microbiological analyses and experimentation. Cowen, UHM colleagues Drs. Michael Rappe and Brian Glazer, and UHM students, post-docs and engineering staff continue to develop instrumentation to exploit the opportunities afforded by the CORK observatories; they are now able to routinely acquire high integrity fluid samples from the deep biosphere which are beginning to yield a realistic view of the remote, yet vast basement environment. The scientific and technological expertise and facilities available at UHM's School of Ocean and Earth Science and Technology (SOEST) will continue to play a major role in C-DEBI. C-DEBI also will provide significant opportunities for UHM researchers through funding and access to CORKs, and for the Hawaii population at large through planned educational outreach at many levels.

The Center will facilitate the achievement of the principle scientific, education and diversity goals of deep sub-seafloor biosphere researchers; advance the suite of scientific tools; train and educate a new and diverse

generation of undergraduate, graduate students and postdoctoral deep sub-seafloor biosphere researchers; and translate knowledge of the deep sub-seafloor biosphere and ocean sciences to a broad and diverse community that includes K-12 children.

Edwards believes the timing of the grant is on target: “Given the maturity of the field and the significant advancement in technology, this is an ideal time to establish the Center,” she said. “My team and I are thrilled to receive this extraordinary opportunity to collaborate with scientists from around the globe as we pursue our ambitious scientific, education and diversity goals.”

The Integrated Ocean drilling Program (IODP) in 2010-11 will dedicate drilling time to sample this frontier habitat in three different areas and habitats: The Southern Pacific Ocean, a site off the Pacific Northwest of North America, and in the mid-Atlantic. “These studies herald a dedicated effort by scientific ocean drilling to in the future study the limits of extreme life on Earth. This quest will also address the question of how life can evolve on terrestrial planets,” said Hans Christian Larsen, IODP vice-president.

The C-DEBI team was one of five teams to win a new Science and Technology Center (STC) award following a recent, merit-based competition in which 247 preliminary proposals had been received. In a statement from NSF, it was reported that the STC program supports integrative partnerships that require large-scale, longer term funding to produce research and education of the highest quality.

"These five new STCs will involve world class teams of researchers and educators, integrate learning and discovery in innovative ways, tackle complex problems that require the long-term support afforded by this program, and lead to the development of new technologies with significant impact well into the future," said NSF Director Arden L. Bement.

Partner universities and laboratories include University of Alaska Fairbanks, University of California (UC) Santa Cruz, University of Hawaii at Manoa, Pacific NW, University of Rhode Island, Lawrence Berkeley National Laboratory, Japan Agency for Marine Earth Science Technology, Harvard University and the University of Bremen.

Link to USC Announcement: http://uscnews.usc.edu/science_technology/usc_awarded_25_million_grant.html

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