Astrobiology Science and Technology for Exploring Planets
Abstracts of selected proposals
(NNH11ZDA001N-ASTEP)

Below are the abstracts of proposals selected for funding for the Astrobiology Science and Technology for Exploring Planets program. Principal Investigator (PI) name, institution, and proposal title are also included. Twenty-three proposals were received in response to this opportunity. On May 25, 2012, one proposal was selected for funding.

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SIMPLE: Sub-ice Investigation of Marine and Planetary-analog Ecosystems

We propose to carry out biogeochemical and physical studies of the ice-water interface under the McMurdo Ice Shelf (MIS) in Antarctica using a several phase study including:

1) An aerogeophysical platform with Ice Penetrating Radar (IPR), laser altimetry, imaging, gravimetry and magnetics to study the properties and processes within and below the ice shelf remotely, akin to future remote exploration of Europa.

2) A remotely operated vehicle (ROV), called SCINI (Submersible Capable of under Ice Navigation and Imaging) to do targeted ice shelf habitat characterization in remote regions of the MIS by down-hole deployments through hot water drill hole access too small and inaccessible to accommodate larger vehicles.

3) An autonomous underwater vehicle (AUV), ENDURANCE-L that represents a faster, longer-range configuration of previous vehicles to be used for hypothesis-driven research mapping out organisms and ecosystems in the sub-ice shelf environment. It will provide critical observations of the topography as well as physical and chemical gradients of the ice-water interface--habitat parameters that may create niches for microbial life and that may be detectable remotely by IPR.

Our study addresses the need to understand the extent and limitations of life in sub-ice environments by determining the distribution of any active biological communities under the MIS as well as the fundamental ice and ocean properties that make such communities viable. We address three main hypotheses relevant to the three elements of our proposal: terrestrial ecology (H1), future exploration of icy habitats (H2), and Europa specific analogs (H1-H3).

--H1: The ice-ocean interface is a viable place for life. The extensive spatial coverage of the SIMPLE project will characterize the distribution of life, both microbial and multicellular, focused at the ice-ocean interface of the MIS, analogous to a viable Europian habitat.
The distribution and properties of accreting, melting and brine-infiltrated ice can be determined using a dual-frequency remote IPR approach. We will demonstrate our ability to study ice chemistry, properties, and brine distribution with instruments planned to explore Europa, increase science return from future missions.

Habitats under the MIS are analogs for putative Europan communities. We will determine energy and chemical gradients beneath and within MIS to resolve the degree to which these communities depend upon the ocean, or the qualities of the ice itself in search of Europan analogs.

To address these hypotheses, SIMPLE will focus on critical observations of the Earth’s sub-shelf ecosystems and the ice processes upon which they rely as analogs for active geology and habitable zones on Europa. We address the three ASTEP goals:

**SCIENCE:** Our proposed research marks the first systematic survey for habitats at the ice-water below an ice shelf.

**TECHNOLOGY:** SIMPLE will adapt a novel AUV with an integrated sensor package to identify and define microbial biosignatures at the ice/water interface, develop hierarchical exploration, precision return-to-site capability and automatic determination of locations of interest in long-range survey.

**FIELD CAMPAIGNS:** Our systems-level multi-platform field campaign is targeted for the most relevant Europa-analog environment on Earth.

The excitement over new sub-ice communities makes our study of the sub-ice environment, microbial life and ecology timely, and with the unique capabilities of our team, SIMPLE will make significant advances in our understanding of habitability across the solar system and will allow us to develop a sound technical and scientific basis to search for life and its critical ingredients on ice-ocean worlds including Earth and Europa.