Investigation of Hydrothermal Processes on the Gakkel Ridge (2007)

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The Gakkel Ridge is a key target for hydrothermal studies because it has distinctive geological characteristics as a result of ultra-slow spreading (full spreading rate of 3-7 mm/yr), and because it is hydrographically isolated from the rest of the world's ocean basins, which has important implications for vent field biological communities. Although thermal and particulate signatures indicative of hydrothermal fluids were found in nearly 80% of the CTD casts from the recent US/German AMORE expedition to the ridge in 2001, no vent fields have yet been sampled because the ice cover precludes the use of ROVs and submersibles, which are the standard platforms for sampling fine-scale vent field studies in the open ocean.

We are now in a position to solve the technical challenges imposed by the ice pack by utilizing nested surveys with autonomous underwater vehicles (AUVs) to map water column plumes, locate buoyant plume stems, conduct fine-scale micro-bathymetric surveys, and to generate photomosaics of the biological communities. We have raised just over $3M from NASA's Astrobiology program to use AUVs to search for and sample hydrothermal vents in the Arctic as an analogue for future missions to Europa, and we envision a Gakkel vents expedition in 2007 that would use AUV survey data to identify geological and biological sampling targets, and then use a combination of wireline and semi-autonomous, and fully autonomous methods to obtain the samples. We propose to complement and guide our technologically intensive AUV and sampling efforts with a more traditional, comprehensive CTD/hydrocast program to measure key parameters such as methane, hydrogen, and manganese in the overlying hydrothermal plumes.

Based on the CTD, dredging, and mapping results from the AMORE expedition, we have identified two target areas with contrasting geological characteristics for our investigations. The first target is the 85°E segment, which generated the largest water column hydrothermal anomaly observed during AMORE in 2001, and which is believed to be a magmatically robust, basalt hosted hydrothermal system. The second target is the 7°E segment, which is believed to be magmatically starved and features ubiquitous peridotite exposures. Hydrothermal circulation in this area may be influenced by serpentinization, and sub-surface circulation may follow different sets of faults and fractures resulting from amagmatic deformation. Our objective is to find, characterize, and

sample vent fields on these two segments.

Given the widespread international interest in the Arctic mid-ocean ridge and hydrothermal processes this would seem to be a natural expedition for international cooperation, particularly with our European colleagues. Many scientists at Alfred Wegener Institute in Germany have similar scientific interests, and both Germany and England have active programs to use AUVs under the Arctic ice cap. Such an expedition would provide an engaging mix of exciting science and cutting edge oceanographic technology.

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