Signatures of Life in Ice (SLIce): An analog study for *in situ* detection of biosignatures elsewhere

D.J. TOBLER[1], L.G. BENNING[2], M.L. FOGEL[3], M. GLAMOCLIJA[3], L. KERR[3], A. STEELE[3], H.E.F. AMUNDSEN[4], THE 2008 AMASE TEAM AND J.L. EIGENBRODE[1]*

[1]NASA Goddard Space Flight Center, and the Goddard Center for Astrobiology, Greenbelt, MD 20771, USA (*correspondence: Jennifer.Eigenbrode@nasa.gov)
[2]Earth and Biosphere Institute, School of Earth and Environment, University of Leeds, Leeds, LS29JT, UK
[3]Geophysical Laboratory, Carnegie Institution of Washington, Washington, DC 20015, USA
[4]Earth and Planetary Exploration Services, Jac Aals Gt 44b, 0364 Oslo, Norway

Ice is characterised by subzero temperatures, the absence or lack of any substantial quantities of liquid water, and chemically dilute conditions, thus allowing the long-term preservation of biomolecules and other organics that get trapped within the ice. Moreover, glacial ice is a repository for aerosol and wind-blown dust. It may also harbor biosignatures from ice dwelling life, as well as organic matter from extinct life and meteorites. As such, modern glacial ice environments are key field study sites to distinguish allochthonous (i.e., formed in the ice) from autochthonous (i.e., of foreign sources) organic records and to develop sampling strategies to detect biosignatures from extraterrestrial ice environments (e.g., polar regions of Mars, Europa, Titan, Enceladus).

The Signatures of Life in Ice (SLIce) project is a multidisciplinary, comprehensive investigation of organic biosignatures and abiogenic organics in near-surface (0-1.25 m depth) glacial ice on Svalbard. Much like planetary missions, one of the biggest challenges for this study is forward contamination. For this, contamination was carefully controlled and monitored *in-situ* using adenosine-5'-triphospate (ATP) and lipopolysaccharides (LPS) abundances on surfaces; where, ATP is a marker for metabolic activity and LPS is used as a marker for Gram negative bacteria and used as a proxy for total bacterial loads. ATP and LPS were also measured for >0.2 μm filtered particulates. These data along with live/dead cell counts and 16S rDNA analyses indicate that active microbial consortia are most abundant / diverse in ice layers close to the surface snow and in some sediment-rich ice. Fatty acid profiling and hydrocarbon detection is being used to estimate microbial biomass and to identify potential allochthonous organic sources.

Hf isotopic evidence for small-scale heterogeneity in the mode of mantle wedge enrichment: Southern Havre Trough back-arc

ERIN TODD[1]*, J.B. GILL[1], R.J. WYSOCZANSKI[2], M. HANDLER[3], I.C. WRIGHT[4] AND J. GAMBLE[5]

[1]Dept of Earth & Planetary Sciences, University of California, Santa Cruz, USA (*correspondence: etodd@ucsc.edu)
[2]National Institute of Water and Atmospheric Research (NIWA), Wellington, New Zealand
[3]School of Geography, Environmental, and Earth Sciences Victoria University of Wellington, New Zealand
[4]National Oceanography Centre, University of Southampton, Southampton, UK
[5]Dept of Geology, University College Cork, Cork, Ireland

Morphologic and petrologic segmentation in the southern Havre Trough (SHT) reflects changes in along-arc melt-generation processes at a transitional rifting-to-spreading back-arc. Widespread reflective seafloor and fresh basalts indicate magmatism throughout the back-arc synchronous with progressive extension. Source heterogeneity appears to occur at along-arc intervals resembling the "Hot Fingers" proposed for NE Japan (Tamura *et al.* 2002). Locally concentrated zones of high melt productivity may explain the formation of across-arc shallow (≤ 2200 mbsl) constructive volcanic ridges (e.g. 36°S, 34.7°S, 33.5°S). Intervening deep elongate rift basins (>2600 to >4000 mbsl) are floored by low-relief axial mounds of fresh pillows.

SHT basalts span a wide range in Nb/Yb, from E-MORB-like (ridges) to N-MORB-like (basins). Most SHT are enriched in LILE, Th and LREE relative to MORB; elevated LILE are more prominent among basin samples, whereas REE + Th tend to be higher in ridge samples. Ridges include more isotopic enrichment, and positive correlations between $^{176}Hf/^{177}Hf$ and Hf/Hf* suggest addition of sediment melts where zircon is variably residual. Variable $^{176}Hf/^{177}Hf$ in samples lacking REE + Th enrichment and with Hf/Hf* ≈ 1.0 indicates isotopically heterogeneous mantle independent of subduction.

The diversity of SHT basaltic compositions suggests along-arc variability in petrogenesis consistent with morphologic contrasts. Cross-arc ridge segments are derived from locally focused zones of high-productivity melting fluxed by sediment partial melts. Segments with abundant deep basins have basalt compositions indicating only fluid fluxing.