# An *in situ* trace element study of peridotites from the Gakkel Ridge

M.E. D'ERRICO, J.M. WARREN[1] AND M. GODARD[2]

[1]Stanford University, 450 Serra Mall, Stanford, CA 93405 (mderrico@stanford.edu); (warrenj@stanford.edu)
[2]Université Montpellier II, Montpellier, France mgodard@univ-montp2.fr

Abyssal peridotites from the Gakkel Ridge provide constraints on the roles of ridge segmentation, on-axis cooling, and pre-existing heterogeneity on melt generation at ultraslow spreading rates. At a rate of 6-15 mm/yr, the Gakkel Ridge has a very thin crust and no major transform faults along its entire length. A thick lithospheric lid due to on-axis conductive cooling is predicted to limit the degree of melting. However, we present geochemical data that demonstrates significant compositional depletion in peridotites.

Peridotites in this study span the boundary between the Western Volcanic Zone and the Sparsely Magmatic Zone. We report *in situ* laser ablation ICP-MS trace element data for Cpx, Opx and olivine from a total of 14 samples. Based on lithology and rare earth element (REE) patterns, the harzburgite and lherzolite samples have each been divided into two groups. Group I harzburgites and lherzolites display typical REE patterns, with depletions in light REE relative to heavy REE. A single harzburgite in group II has a spoon-shaped pattern with enriched light REE, yet another sample within the same dredge has a typical REE pattern. Group II lherzolites have the highest degrees of depletion of any samples in this study. The small length-scale of compositional variability combined with thin oceanic crust suggests that pre-existing heterogeneity accounts for some of the depletion observed in peridotite compositions. The Gakkel peridotites thus provide evidence for a mantle that is the consequence of both inherited depletion and recent melting.

# Mysteries of subseafloor sedimentary life

STEVEN D'HONDT[1]*

[1]Graduate School of Oceanography, University of Rhode Island, Narragansett Bay Campus, Narragansett, RI 02882, USA (dhondt@mail.uri.edu)

In recent years, multiple research groups have tremendously advanced understanding of subseafloor sedimentary life. Microbes in subseafloor sediment are now known to be abundant, diverse and characterized by extraordinarily low mean rates of activity.

Some discoveries challenge our sense of what is possible. For example, per-cell energy fluxes are far below the rates believed necessary for reproduction. What mechanisms might allow cells to reproduce at such low rates? Or do many of them live for millions of years without reproducing?

Bulk population studies show that a very large fraction of these cells is active. However, we know essentially nothing about cell-to-cell variation in respiration, biomass turnover or reproduction. Furthermore, we do not clearly understand how organic-fueled respiration can persist for tens of myrs at very slow rates.

Subseafloor community structure is largely unexplored. We have very limited understanding of the ways in which subseafloor microbes compete and almost no understanding of how they cooperate. Roles of viruses, eukaryotes, resting stages and bacterial spores in subseafloor ecosystems are largely unknown.

The proximate causes and ultimate consequences of natural selection in subseafloor communities remain unknown. For the most part, we do not yet know the genetic potential of subseafloor microbes, the extent to which their potential is expressed, or the conditions under which they are expressed. The actual limits to subseafloor life are not yet known.

Advancing understanding of these issues will yield fundamental insight into the nature of life.

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