# Constraints on the origin of Hess Deep Lower Crustal Layering

ROMAIN MEYER[1], GEORGES CEULENEER[2], TYLER BROWN[3], MICHAEL J. CHEADLE[3], BARBARA JOHN[3], YUMIKO HARIGANE[4] AND IODP EXPEDITION 345 SCIENTIFIC PARTY

[1]University of Bergen, Norway, Romain.Meyer@geo.uib.no
[2]Toulouse University, CNRS UMR 5563, France, georges.ceuleneer@get.obs-mip.fr
[3]University of Wyoming, US, cheadle@uwyo.edu
[4]National Institute of Advanced Industrial Science and Technology, Japan, y-harigane@aist.go.jp

Ophiolite studies predict that fast spread, gabbroic, lowermost oceanic crust should consist of layered igneous cumulates. As a result, igneous layering formation processes must play an important role during the accretion of fast spread ocean crust at mid-ocean ridges. Given the complexity of igneous layering described from mafic intrusions, direct observations of rocks sampled at actual spreading centers are critical. IODP Exp. 345 to the Hess Deep Rift, provides the ocean science community with the first significant *in-situ* sections of primitive, layered lower-crustal rocks from fast spread crust (Gillis et al, 2014). We present here mineralogical, chemical, and crystallographic data from a high resolution transect across the well-developed layered series in Hole U1415 I. This series shows simple, centimetre to decimetre modal and/or grainsized layering. Lithologies include troctolite, olivine gabbro and olivine gabbronorite. Mineral chemical variations do not correlate with the cm-lengthscale of the spectacular modal variations within the studied core. Olivine, ortho- and clinopyroxene Mg#'s show a subtle metre scale variation, but plagioclase anorthite content is constant with depth. The trace element geochemistry reveals rather homogeneous plagioclase and orthopyroxene compositions but stronger variation in clinopyroxene at the mineral and/or thin section scale, including zoning. The lack of correlation between the modal layering and the variation in downhole phase chemistry challenges a pure fractional crystallization model for the layered series at Hess Deep and together with the other data suggests a more complicated model that includes interstial melt migration and crystal – melt interaction after crystal accumulation. Plagioclase crystallograpic preferred orientations (CPO) over the single 4.5 m long core are very variable ranging from a strong crystallographic foliation with no lineation (upper troctolites), to a distinct lineation but no foliation (gabbros), to no significant CPO at all (lowermost gabbros). Some of these fabrics indicate *in-situ* growth/accumulation and are similar to those found in mafic layered intrusions.