The Crust-Mantle Boundary at an Ultraslow Spreading Ridge

DICK, H.J.B[1], KVASSNES, A.[2]

[1]Woods Hole Oceanographic Institution, hdick@whoi.edu
[2]Restone AS, Norway, astri.kvassnes@gmail.com

The crust-mantle boundary is exposed on the western wall of the Atlantis II Transform at 57°E on the SW Indian Ridge adjacent to the Atlantis Bank Gabbro Massif, the largest known exposure of lower crust rock in the oceans. Extending over some 660 km^2 on the seafloor, the section extends from near the dike-gabbro transition at ~700-m water depth to 5100-m depth. Both ocean drilling and seafloor mapping show that the massif consists of an internally complex series of nested intrusions, often with extensive syn magmatic and post magmatic crystal-plastic deformation. The complexity arises due to episodic intrusion, continuous tectonic exstention, and permeable and focused flow of intercumulus melt through the section driven by compaction.

Compilation of dredge and dive data show that the crust-mantle boundary was crossed 5 times over the 30-km's it is exposed on the transform wall. The underlying peridotites are lherzolites, massive granular textured residues of partial melting. No dunite or primitive troctolites were found anywhere along or near the contact, and none in the underlying mantle section. Texturally the gabbros near the contact with one exception are weakly to undeformed, leading to the conclusion that the contact between peridotites and gabbros is intrusive. In all cases, gabbro above the contact is highly evolved, as is the overlying gabbro section, and modelling shows that the gabbros represent liquids that had undergone at least 50% fractional crystallization prior to intrusion. The same is true for the the overlying section on the wall. Primitive gabbros are rare, with only one troctolite identifiedin the 1,124 rocks studied in the seafloor sample suite, while only a short sequence of troctolite dikes were drilled in ODP Hole 735B. There is no evidence for a melt lens, as at the EPR, and there was little evidence for storage of melts parental to MORB in the upper 1500 m of the lower crust there.

Thus, while the original section resembles the ideal Penrose Ophiolite section in its gross stratigraphy, in detail differs subsantially in its internal stratigraphy, and that the gabbro body is clearly laterally as well as vertically strongly zoned in composition, consistent with 3-D focusing of melt from the mantle to the center of the paleo ridge segment..