The Lateral Variability of the Lower Ocean Crust at an Ultraslow Spreading Ridge: Evidence for Dynamic Accretion

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During Phase I of the SloMo Project, ODP Hole U1473A was drilled 809.4 m into a 700-m deep wave-cut platform at Atlantis Bank on the SW Indian Ridge. This constitutes the eroded top of an oceanic core complex where massive gabbro was emplaced into the footwall of a single detachment fault for 3.74 Myr, with total slip 38.9 km. It was then uplifted to its present position flanking the 6,100 m deep 199-km Atlantis II Transform. The gabbros are back-tilted ~20°S, while a sub-horizontal ~30-km long mantle peridotite-gabbro contact lies along the transform wall at~4200 m depth ~11.5 km west of Hole U1473A. Hole U1473A is 1.4 km north of 158-m deep Hole1105A and 2.2 km NNE of 1508-m deep Hole 735B. Together these holes document the lateral continuity of the lower ocean crust at ultraslow rates (14 mm/yr.), and compare it to 1400-m Hole U1309D in the Atlantis Massif MAR core complex (24 mm/yr.) flanking the 63-km Atlantis Transform. The three Atlantis Bank holes are very similar, consisting of a complex series of intercalated oxide-rich gabbros and olivine gabbros. Several dikes crosscutting the gabbro sections show that they passed through the dike-gabbro transition after crystallizing and cooling deeper in the crust. They all show extensive high-temperature crystal-plastic deformation predating dike intrusion. A small amount of troctolite was recovered only in Hole 735B. By contrast, gabbro, rather than olivine gabbro was the dominant lithology in Hole U1309D, with intercalations of troctolite and mantle peridotite, and subordinate oxide gabbro. Oxide gabbro is often associated with crystal-plastic deformation. While these are concentrated in the upper 1/3 of Hole 735B, they are more uniformly distributed in Hole U1309D. While one section cannot be traced directly to the other at Atlantis Bank, it appears that they can be correlated based on chemical and structural similarities, with the 1105A and 1473A sections lying some hundreds of meters deeper structurally than Hole 735B, consistent with erosion on the platform. All these sections represent sequential emplacement of small gabbro bodies in an active dynamic environment where the lower crust could support a shear stress, and simultaneous upward compaction of late melt through the section. Locally, shear zones related to the uplift of the section into the partially molten gabbro localized late permeable melt flow, hybridizing the olivine gabbro to high evolved oxide gabbro. These simultaneous processes created a stratigraphy of enormous complexity unlike any intrusion seen on land.

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