Origin of the interlayered series at Atlantis Bank (SWIR): New insights on lower oceanic crust accretion processes

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Oceanic crust accreted at mid-ocean ridges represents ~70% of Earth's surface; nevertheless the magmatic processes implicated in the formation of lower crust remain poorly understood. Yet, fossilized sections document its complexity in structure and composition, and recent studies show that melt migration and interactions within a crystallizing mush are key processes that shape the crust petrographic and geochemical characteristics.

The slow-spreading lower oceanic crust exposed and drilled at the Atlantis Bank Oceanic Core Complex (SW Indian ridge) presents at various depths dm-thick repetitive horizons of gabbros, displaying variable grain size and modal composition that define interlayered series. These layers document igneous processes ongoing during crust formation, and provide us with the opportunity to quantify them.

We have realized a high-resolution (20 samples over a 1.2 m section) petrographic, microstructural, and geochemical study on some of the interlayered series that were drilled at IODP Hole U1473A (Atlantis Bank, IODP Expedition 360) in order to decipher on those processes.

Petrographic characteristics and crystal preferred orientations indicate a clear magmatic origin of both coarse- and fine-grained layers, and that the coarse-grained were emplaced before the intrusion of a new melt that subsequently crystallize the fine-grained layers. Geochemical data indicate that the former crystallized from slightly more evolved melts than the latter, and highlight a complex interplay between late interstitial melt and the newly injected melt, partially overprinting the initial magmatic signature. The strong incompatible trace elements enrichment at mineral rims in the coarse-grained domains also suggests the occurrence of melt-rock reactions at an early stage of mush formation. Our results eventually provide new constraints on melt migration and interaction processes in a crystallizing lower oceanic crust section.