Brown amphibole in the oceanic crustal sequence at the Atlantis Bank Oceanic Core Complex

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Brown amphiboles [Amph] have been described in the modern oceanic crust and analogue ophiolites. They typically represent late stage crystallization products of melts having relatively high SiO_2 and H_2O contents. The origin of these melts is still matter of debate on whether they represent pure evolved MORBs or include a seawater component. To unravel the interplay among magmatism and hydrothermalism during the formation and exhumation of the lower oceanic crust at slow spreading ridges, we investigated the occurrences of Amph throughout the crustal section recovered in IODP Hole U1473A at the Atlantis Bank Oceanic Core Complex [OCC].

We selected undeformed olivine gabbros, oxide gabbros, diorites, felsic veins and granulite facies mylonites from the depth interval 350-790 mbsf, and Amph veins and amphibolite facies mylonites at shallower depths (≤260 mbsf). Brown Amph in olivine gabbros is vermicular between clinopyroxene and plagioclase, whereas it occurs as relatively coarse grains in oxide gabbros, diorites and felsic veins. Brown Amph in granulite facies mylonites is typically associated with neoblastic clinopyroxene. Geothermometric estimations indicate that Amph in olivine gabbros crystallized at temperatures of 945-840°C, and diorites and felsic veins at 830-680°C. Taken as a whole, brown Amph from undeformed rocks and granulite facies mylonites show wide chemical variations that could be attributed to a magmatic evolution trend. Amph from oxide gabbros however locally deviates from this general trend. The low Cl contents in Amph from depths >350 mbsf suggest a negligible role of seawater during magmatic crystallization and deformation associated with early OCC exhumation. Conversely, the relatively high Cl contents in Amph from the shallower depth-interval indicate that the ductile to brittle transition in the exhuming gabbro was associated with hydration by seawater-derived fluids penetrated along the footwall of the detachment fault.