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Crystal-Melt reaction within the lower oceanic crust: East Pacific Rise (IODP 345 expedition).

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Mid-Ocean Ridge Basalt (MORB), erupted along spreading ridges, represent the most abundant magma on Earth. Along mid-ocean spreading centres, mantle-derived melt is under-plated at the base of the crust and intrude the lower crust gabbro and crystal mush. Only limited volume is actually erupted on the sea floor, as MORB.

The MORB geochemistry provides a geochemical window into the mantle, giving information about the mantle composition and melting conditions. However, due to differentiation within the crust filter, corrections are required. Fractional crystallization is a predominant process. However, recent research demonstrates that melt differentiation is also affected by crystal-melt reaction within the lower crust, where gabbro is repeatedly under-plated and intruded by hot mantle-derived melt.

We present here a detailed microtextural and geochemical study of the effect of crystal-melt reactions on the mafic lower crust cumulates and the percolating mantle-derived melt. The investigated samples were drilled during the IODP Expedition 345 at Site 1415, at Hess Deep (Galapagos triple junction), where continuous young lower oceanic crust is exposed. Troctolite, gabbro, gabbronorite and ferrogabbro occur in the Hess Deep lower crust (Gillis et al., 2014). Clinopyroxene-oikocryst bearing troctolites and gabbros are common. Clinopyroxene oikocrysts internal texture shows partial resorption associated with sharp zoning. Ti, Cr, Al, Zr, Y, REE decrease, while Mg# and Sr/Sr* increase from core primocryst to rim oikocryst. Geochemical evolution is incompatible with differentiation by fractional or equilibrium crystallization. The clinopyroxene texture and geochemical evolution is best explained by gabbro partial melting and hybridization with mantle-derived melt.

Because of little geochemical contrast between co-genetic magmas, hybridization of gabbro partial melt with mantle-derived melt is difficult to observe in MORB lavas alone. However, poikilitic gabbro shows textural and geochemical evidence for hot crustal gabbro partial melting while intruded by mantle-derived melt. This assimilation process also contributes to the MORB geochemical variability and helps constraining the lower crust geochemical and thermal evolution.

Gillis, KM et al. (2014). Hole U1415I. In: Gillis, KM et al., Proc. IODP, 345: College Station, TX (Integrated Ocean Drilling Program).