A quantitative model to explain the bimodal distribution of gabbros from the 16.50ºN core complex: an attempt to explain the compositional heterogeneity of the lower oceanic crust

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The gabbroic rocks recently collected at the 16.50ºN core complex from Mid Atlantic Ridge (MAR) indicate that the lower crust at this region is formed by scattered intrusions of chemically primitive gabbros (i.e. dunites and troctolites), associated with evolved gabbronorites and oxide-rich gabbros. A similar lower crustal composition cannot be reproduced with a process of fractional crystallization starting from a mantle-derived melt. We performed a model to predict the relative amount of different gabbroic lithologies (i.e. dunites, troctolites, olivine gabbros, gabbros and oxide-gabbros). The model reproduces a multistage fractional crystallization process of a primitive MORB [Mg#=100*Mg/(Mg+Fe) ~72], from which at each step of differentiation (ΔMg# ~ 4) a precise amount of liquid is subtracted to produce the actual distribution of the basalts erupted on the sea floor. The model runs at variable erupted basalts/crystallized gabbros ratios (i.e. different degrees of eruptibility). Furthermore, the model takes into account the possibility that part of the initial melts is sequestrated into the crystal framework during postcumulus processes, following differentiation paths separate to those of the initial melt. At high eruptibility (basalts/gabbros ratios ~8/2) and ~5 vol% of postcumulus melts evolving through melt-rock reaction process, the model produces the bimodal distribution seen at the MAR 16.50º N core complexes. In addition, the model can overall explain the compositional heterogeneity of the lower oceanic crust at MAR in terms of eruptibility vs. intercumulus processes. For instance, preponderance of primitive gabbros associated with evolved gabbros is expected at regions characterized by scattered injections intruded within mantle peridotites, such as Kane Megamullion [1]. The prevalence of moderately evolved gabbros and paucity of primitive rocks is expected in region of a thick crust at moderate melt supply, as for instance the Atlantis Massif [2].

[1] Dick HJB, Tivey MA, Tucholke BE (2008), Geochem Geophys Geosyst 9. Q05014. [2] Blackman DK, Ildefonse B, John BE et al (2011). *J Geophys Res* **116**.