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Melt-Rock Reaction in Oceanic Gabbros and its Implications for the Genesis of Mid-Ocean Ridge Basalt

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Gabbros from the Kane Core Complex (23°N Mid-Atlantic Ridge) show abundant evidence for melt-rock reaction. These gabbros are characterized by a troctolitic matrix with two types of clinopyroxene oikocrysts. The first have intergranular habits, and are relatively small. Their Mg&35;'s and Cr2O3 contents are high (up to 91 and 1.33%, respectively), despite having intermediate to high TiO2 contents. This suggests the Mg&35; and Cr content of variably evolved, pyroxene-saturated, interstitial melts were buffered by host rock olivine and spinel, leading to the formation of Mg and Cr rich clinopyroxene. The second type of oikocryst is large (up to 5 cm), encloses resorbed plagioclase, and is commonly surrounded by anorthositic patches. Olivine, which is abundant in the host rock, is notably absent as chadacryst. The clinopyroxene oikocrysts have high Mg&35;'s (up to 89); the plagioclase chadacrysts have An contents significantly lower than host rock plagioclase, and are reversely zoned. Clinopyroxene Mg&35; is thus significantly higher at a given An than expected for fractional crystallization. We envision the following crystallization history: a melt saturated in clinopyroxene + low-An plagioclase percolated a troctolitic crystal mush. Due to melt-rock disequilibrium, olivine was completely resorbed; plagioclase underwent dissolution-reprecipitation. During progressive melt-rock reaction, the Mg&35; and Ca&35; of the melt increased, leading to the formation of reversely zoned low-An plagioclase and high-Mg&35; clinopyroxene. Highly magnesian clinopyroxenes do thus not form by high-pressure crystallization as is frequently proposed. The compositional evolution of the reacting melt is modeled by AFC calculations. These suggest that the melt- rock reaction history deduced from the gabbros results in a decrease in CaO at a given MgO. This compositional shift is the same as that expected from fractional crystallization at elevated pressure, and calculated crystallization pressures for reacted melts are higher than the pressure calculated for the unreacted starting composition. We thus conclude that melt-rock reaction can account for both lines of evidence cited in favor of high-pressure fractionation of MORB.