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Petrogenesis of a highly differentiated section of oceanic crust drilled at the Mid-Atlantic Ridge, 14-16° N (ODP Leg 209, Site 1275D)

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Ocean Drilling Program Leg 209 drilled at four sites (1268, 1270, 1272 and 1275) peridotite variably intruded by gabbroic plutons, exposed on both sides of the Mid-Atlantic Ridge (MAR) between 14°43' and 15°44' N. Core from Site 1275 (ca. 150 m) is mainly gabbroic and contains minor poikilitic lherzolite intruded by oxide gabbro with a few intervals of olivine gabbro. This site is characterized by variably textured gabbro with intervals of very coarse-grained oxide gabbro intruded by fined-grained laminated gabbros and microgabbro. These intervals show a sill-like layered structure of intrusive layers ranging from many tens of centimetres to a few meters in thickness. Olivine gabbro mainly occurs at the bottom of site 1275D and show sharp transitions with most common oxide gabbro. Site 1275 gabbro texturally differs from other crustal section drilled at slow-spreading mid-ocean ridges, such as ODP Site 735B on the SW Indian Ridge and ODP Leg 153 on MAR, which show coarser plagioclase and clinopyroxene grain sizes that are usually interpreted as the result of slow cooling of plutons in the lithosphere oceanic mantle.

Site 1275 oxide gabbros are among the most evolved samples drilled along slow-spreading mid-ocean ridges. This is reflected in their very low whole-rock Mg# (0.28-0.68) and Zr (15-85 ppm) contents, and their high FeO_t (8.4-22.5 wt.%) and TiO_2 (up to 7 wt.%) contents. The highly evolved composition of site 1275 oxide gabbros cannot be accounted for the fractionation trends of MORB in the 14 to 16°N MAR area. This suggests that 1275 gabbroic intrusions are not cumulate rocks complemen-

tary to MORB, but plutonic rocks that formed after extensive crystal fractionation of primitive MORB and that fully crystallized within the oceanic lithosphere without volcanic counterpart. Only primitive gabbronorites at ODP Leg 209 Sites 1268, and impregnated peridotites at Sites 1268, 1270, 1271 and 1275 have appropriately high Mg# and low Zr to represent the refractory cumulate reservoir required by MORB variation.

Clinopyroxene from site 1275 show strong REE variations that are correlated with grain size. Fine-grained clinopyroxene shows over-enrichment of REE relative to other incompatible elements that reflect disequilibrium crystallization, while coarser clinopyroxene are in trace-element exchange with MORB. Trace and transition element variations in clinopyroxene also indicate that different intervals of this site were likely formed at different depths recording polybaric crystal fractionation. We therefore infer that evolved gabbroic rocks sampled on Leg 209 Site 1275 formed at lower temperatures and shallower depths after polybaric crystal fractionation of primitive MORB. Our data suggest that substantial amounts of MORB in slow-spreading mid-ocean ridges crystallize in inter-connected plutonic systems within a thick thermal boundary layer.