Granulitic rocks from the transition zone between gabbro and sheeted dike complex from Hole 1256D

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The Superfast Spreading Rate Crust mission is a multi-cruise program to drill a complete section of the upper oceanic crust into the underlying gabbros. Hole 1256D was initiated during Ocean Drilling Program Leg 206 in the eastern equatorial Pacific in 15 Ma crust that formed at the East Pacific Rise during a period of superfast spreading (220 mm/y). During Integrated Ocean Drilling Program (IODP) Expeditions 309 and 312, Hole 1256D was deepened it to 1507 mbsf. The hole now extends through 810 m of extrusive normal mid-ocean-ridge basalt, 345 m of sheeted dikes, and 101 m into plutonic rocks, completing the first penetration of an intact section of the upper oceanic crust.

Dike contacts, and mineralized breccias indicate a lithologic transition from 1004 to 1061 mbsf. The transition zone marks a change from predominantly low temperature alteration minerals to greenschist hydrothermal assemblages. Hornblende and secondary plagioclase occur within 100-200 meters of the dike transition indicating a very steep thermal gradient in the dikes. The lowermost 50 m of dikes are strongly recrystallized to granoblastic minerals. The plutonic complex comprises a 60 m thick upper gabbroic body that intrudes the sheeted dikes, separated from a lower gabbroic body with 20 m thick by a screen of granoblastic dikes. Gabbroic rocks are highly altered, fine to coarse grained and range from gabbro to oxide gabbro and gabbronorite with some differentiated rocks (quartz-rich oxide diorite and trondhjemite). The lower gabbroic rocks comprised mainly of gabbronorites that are further subdivided into upper medium-grained gabbronorites to orthopyroxene-bearing gabbro and lower fine-grained gabbronorites. At the upper margin of this zone, gabbronorite intrudes and invades the metabasalt of the Dike Screen, isolating and detaching centimeter-sized blocks of metabasalt (two-pyroxene granulite). Below the medium-grained gabbronorites is a fine-grained gabbronorite of uncertain origin (Unit 94). There is some ambiguity as to whether this unit is a metabasalt derived from sheeted dikes, or a fine-grained intrusive gabbronorite.

To solve this ambiguity, we have analysed down hole variations of mineral compositions from the sheeted dike complex to the basal Unit 94. Clinopyroxenes of the gabbroic bodies show a wide compositional range from 0.86 to 0.69 in terms of Mg# (Mg/(Mg+Fe). In a single thin section, the igneous clinopyroxenes show comparatively wide compositional range due to the normal zoning. Usually Mg# of clinopyroxene decreases from the core to the margin with increasing TiO2. The TiO2 contents of clinopyroxene range from 0.23 to 0.90 wt % and negative correlation with the Mg# is apparent. This correlation is explained by normal fractional crystallization. On the other hand, TiO2 contents of the clinopyroxene from typical granulitic rocks are low less than 0.2 wt% regardless of variable Mg#. Therefore, behavior of TiO2 contents in clinopyroxene may give a criterion between recrystallized pyroxenes from igneous pyroxenes.