Structures of sheeted dike and gabbro sections from ODP-IODP Hole 1256D in the East Pacific

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Hole 1256D is located in the equatorial East Pacific crust formed at the East Pacific Rise ˜15 Ma ago with spreading rate of ˜220 mm/y. Hole 1256D was opened during ODP Leg 206 and deepened through IODP Exp. 309 and Exp. 312. The entire Superfast Spreading Rate Crust mission successfully penetrated into gabbros and provides a complete and intact section of the upper oceanic crust: 810 m of extrusive normal mid-ocean-ridge basalt, 345 m of sheeted dikes, and 101 m of plutonic rocks. The occurrence of gabbros in a shallow depth (1407 mbsf) supports the inverse relationship between spreading rate and the depth to axial low-velocity zones hypothesized by seismic experiments. We report structures observed in the sheeted dikes and gabbros, based on visual core descriptions acquired during IODP Exp. 309 and Exp. 312.

The transition between the volcanic sequence and sheeted dike complex is from 1004 to 1061 mbsf and is marked by a rapid change in the alteration mineral assemblage to green-schist facies. Below this transition zone the rocks of sheeted dike complex have a rather gradual mineralogical and textural change toward opx-rich, granoblastic textures approximately 60 m above the contact with gabbro section. Dike contacts are subvertical and are often accompanied by dike-margin breccias and additional intrusions of glassy magmatic veins. Hydrothermal veins also dip steeply in the upper part of the dike complex and become shallower in the granoblastic dikes. Gabbros are distributed in two discrete bodies (Gabbro 1 & 2 from above) separated by a screen of granoblastic dike rocks with diffuse veins. Dike/gabbro contacts and flow foliations developed in the lower-most part of the Gabbro 2 dip ˜45 degrees. We propose that the gabbros were intruded as a thin sheet, although the nature of drilling only allows a 2-dimensional view. Leucocratic melt patches are concentrated toward the top of the upper Gabbro 1 section, perhaps due to upward migration of light leucocratic melts through channels. A thin vein of trondhjemite was observed above the zone of melt patch concentration. Gabbro 2 is underlain by granoblastic dike rocks that are intruded by a later basaltic dike that is less altered than the dike screen, but has a development of well-defined veins. The crust at Hole 1256D is relatively unstrained, and was not tilted, suggesting that axial extension was accommodated by magmatic intrusion, and any deformation was coupled by hydrothermal processes.