J164-003 **Room: Ocean B** **Time: May 25 16:00-16:15**

Variation of magma supply rate in fast-spreading mid-ocean ridges ~insights from the structure of the sheeted dike complex

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Hole 504B is the deepest oceanic drill hole that penetrated 1815 m into 6.9-Ma oceanic basement formed at Cocos-Nazca Spreading Center, asymmetrically spread at 36 mm/yr to the south and 30 mm/yr to the north. The 506 m-thick pillow-dominated extrusive rocks are gradually replaced by subvertical dikes and changes into 100% sheeted dikes more than 1056 m in thickness. Seismic layer 2/3 boundary lies 1200 m in depth within the sheeted dikes and is associated with gradual change in porosity and alteration, but not a lithological transition from sheeted dikes to gabbro. Multiple dikes are inferred from the presence of multiple chilled margins and the crystal size variations of the sheeted dikes [1].

ODP Hole 1256D is the first successful drill hole in the 40-year long history of scientific ocean drilling to penetrate the entire upper oceanic crust formed at the superfast spreading East Pacific Rise (EPR) [2]. The 250-m thick sediments are underlain by 811 m of extrusive rocks with minor dikes, underlain by 346 m of subvertical sheeted dikes. Hole 1256D was then deepened a further 105 m into the upper gabbroic rocks. Sheet flows are the dominant flow type with minor intervals of pillow lava and hyaloclastite. An intimate association of brecciation, dike intrusions and hydrothermal mineralization characterizes the transition zone and the sheeted dikes, where brecciated massive basalts is cut by numerous fine veins and cataclastic shear zones, and thin glassy to aphanitic dikes are in-situ fragmented into hyaloclastite.

Using lithodensity logging data and magma density calculations, lithostatic and magmastatic pressure variations through the upper crust were estimated for the Holes 504B and 1256D crust. The pillow-dominant extrusives and the lower extrusive/intrusive ratio for 504B crust result in a lower level of neutral buoyancy (LNB) of uprising magma, which favors the intrusion of dikes at this level in the upper crust. In contrast, the dense, sheet flow-dominated crust will have the LMCD at a very shallow level and has virtually no LNB. This is a geometer that favors eruption rather than dike intrusion and density contrast alone (the LNB-control model) cannot explain the formation of the sheeted dike complex.

Considering the typical period of eruptive episodes at the EPR spanning 1-20 hr, relatively thinner (than 30 cm) dikes can be formed by cooling and solidification of uprising magma as dike margins before the dike closes at the end of eruption. However, the formation of common thicker (than 30 cm) dikes most likely occurs during intermittent magma-deficient periods lasting for several thousand years, as deduced by the magnetic study at the southern EPR [3]. Under magma-deficient conditions, reduction of horizontal stress through the brittle upper crust associated with plate spreading triggers a dike intrusion in the shallow crust that shifts the LMCD toward the base of the upper crust and develops a sheeted dike complex overlain by a thin extrusive layer. Resurgent magma supply changes conditions to an eruption-dominated period that gradually buries the sheeted dike complex under a thick extrusive layer.

References

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[2] Teagle, D.A.H., et al. (2006) Proc. IODP, 309/312.
[3] Shah, A.K., et al. (2003) J. Geophys. Res., 108(B2), 2097, doi:10.1029/2001JB000564.