

Mantle, ocean crust and seawater: where are we, and what's next in scientific ocean drilling?

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This lecture will draw from the latest results of IODP drilling in both fast-spread and slow-spread ocean crust, highlighting scientific questions related to accretion and cooling processes at mid-ocean ridges. In fast-spread crust, observations from the lower crust gabbros are essential to answer these questions. Latest results from Expedition 345 at Hess Deep (Dec 2012 – Feb 2013) will be summarized. At site 1256, in intact East Pacific superfast spread crust, operations during IODP Expedition 335 in 2011 proved challenging throughout, and the lower crustal gabbros are yet to be recovered. The material recovered from the complex dike-gabbro transition zone document evolving geological conditions and the coupling between temporally and spatially intercalated intrusive, hydrothermal, contact-metamorphic, partial melting, and retrogressive processes at the interface between the magma chamber and the hydrothermal system. In 2004-2005, Expeditions 304 and 305 illustrated the role of detachment faulting and associated hydrothermal alteration, together with localized and protracted magmatic construction recorded in the footwall of these faults, in building crust in volcanic-poor regions of slow-spreading ridges. This lecture will also shed light on some of the next challenges for scientific drilling in the ocean lithosphere, exemplified by the shallow coring project on the Atlantis Massif oceanic core complex on the Mid-Atlantic Ridge, and by the "MoHole to the Mantle" project, which aims to reach and sample the uppermost mantle beneath the Pacific fast-spread crust.