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SPOTLIGHT 12.

Future Opportunities in Scientific Ocean Drilling: Deep Earth

Innovations in engineering and adaptations of mining technologies over the last 50 years have enabled scientific ocean drilling to reveal much about the deep Earth that would have been impossible using any other methods. However, this so-called "deep" drilling has not penetrated more than the top few hundred meters into igneous basement in most holes, and even when applying multi-expedition approaches, it has only reached as far as two kilometers into in situ oceanic crust (Hole 504B in the eastern equatorial Pacific). Many challenges and questions remain, and new areas need to be pursued through continued drilling efforts. We still have not answered the fundamental Earth science question: Is the Mohorovičić Discontinuity a lithological transition, a geophysical boundary, a serpentinization front, or a combination of those?

Other important questions about the deep Earth that can be answered through scientific ocean drilling include: How does oceanic crust mature over tens of millions of years? How does alteration of deep oceanic crust contribute to microbial life in shallower habitat (and vice versa)? Has Earth experienced true polar wander via a sudden tilt of its rotation axis? How does the chemistry of the mantle and its related oceanic volcanism evolve over geological time? And how does mantle convection work not only at large scales but also at smaller scales, when mantle plumes form at the core-mantle boundary? What have been the environmental effects of large outpourings of magma during the formation of large igneous provinces? Do these eruptions indeed prompt global anoxic events and potentially extinction events? What are the roles of plate tectonics, far-field changes in plate motion, and the impingement of mantle plumes in triggering the formation of new subduction zones and new ocean basins?

To continue making headway in answering these questions requires additional advancements in drilling and coring techniques that permit faster drilling to greater depths into igneous basement over several two-month expeditions. In this scientific ocean drilling field, technological improvements will lead the way.

– Anthony A.P. Koppers

Shipboard scientist Marco Maffione (Utrecht University, The Netherlands) prepares a core for paleomagnetic study aboard *JOIDES Resolution*, IODP Expedition 351, Izu-Bonin-Mariana Arc Origins. *Photo credit: William Crawford, IODP JRSO*