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海洋島弧地殻超深度掘削：なぜこの惑星は地球なのか？
Ultra-deep drilling to the middle crust of the Izu-Bonin-Mariana arc: Why is this planet to be the Earth?

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One characteristic feature of the planet Earth is the bimodal height distribution at the surface. This is caused by the difference both in density and thickness of the oceanic and continental crusts. These two types of crust on the Earth are created at convergent and divergent plate boundaries, respectively. The bulk composition of continental crust is andesitic (60 wt.% SiO2), in marked contrast with the basaltic oceanic crust with ˜50 wt.% SiO2. This raises the question of how intra-oceanic arcs produce continental crust if the dominant product of mantle wedge melting and a major proportion of intra-oceanic arc lava is basaltic. The ultra-deep drilling in the Izu-Bonin Mariana (IBM) arc aims at comprehensive understanding of arc evolution and continental crust formation. We propose to drill a deep hole that penetrates through a complete sequence of intra-oceanic arc upper crust and into the in situ arc middle crust, which may be the birthplace of continental crust. There is no pre-existing continental crust in the IBM arc, yet recent seismic studies of this arc reveal a thick layer in the middle crust (Vp=6.0-6.5 km/s) that is hypothesized to be intermediate/felsic in composition. The primary goals of sampling the in situ arc crust through drilling are: (1) to identify the structure and lithologies present in the upper and middle arc crust, (2) to constrain the petrologic and chronological relationship of mid-crustal rocks to the overlying upper crust, (3) to establish the temporal evolution of arc crust by relating this site with other regional drill sites and exposed sections of arc and continental crust, and (4) to test competing hypotheses of how the upper and middle crust forms and evolves in an intra-oceanic arc setting. These objectives address questions of global significance, but we have specifically identified the IBM arc system as an ideal locale to conduct this experiment. The composition of the pre-subduction upper plate was normal oceanic crust, and the tectonic and temporal evolution of this arc system is well-constrained. Moreover, the IBM system is perhaps the best-studied intra-oceanic arc on Earth, thanks to extensive sampling of the slab inputs and arc outputs through field studies and drilling, and to a series of recent, focused geophysical surveys. We propose returning to the region of ODP Site 792 to drill, via. Eo-Oligocene upper crust, to the middle crust at the proposed site. The mid-crustal layer in this area is shallow enough (˜4000 mbsf) to be reached by drilling, and heat flow is low enough for drilling to proceed at mid-crustal temperatures. Samples recovered from the proposed site will complement the drilling objectives at other proposed sites in temporally distinct Eocene and Neogene arc crust, which are proposed separately.

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