

Back-arc Mantle Exposed at Mado Megamullion, Shikoku Basin: A Drilling Target?

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Ocean drilling in the deepest layers of the Earth (ie lower crust and upper mantle) can only be done where there are appropriate targets on the ocean floor. These are very few and generally very inaccessible. The Mado Megamullion is an oceanic core complex (OCC) near Japan in the Shikoku back-arc basin within the Philippine Sea Plate. Mantle peridotites (serpentinized) recovered by 6 dredge and submersible stations exhibit signatures of extensive melting, deformation and alteration. Pseudomorphs after plagioclase in many of the samples, as well as plagioclase-spinel intergrowths, are clear evidence of melt stagnation and mantle reaction. Spinels show a wide range of Cr#, Mg# and TiO₂ contents related to partial melting and melt stagnation. The presence of apparently magmatic high-temperature paragonitic amphibole in veins and as replacement of clinopyroxene suggests that it may be a primary or near-primary mineral crystallized from a hydrous melt. This is unusual for abyssal peridotites. Two trace-element populations of clinopyroxenes are in equilibrium with depleted and enriched basaltic melts, respectively. Models of open system melting combined with subsequent mixing of an enriched melt can explain the REE data. Broadly it appears that the peridotites underwent variable degrees of partial melting with a moderate influx of enriched melts, which agrees with the other textural and chemical evidence of melt-rock reaction and re-fertilization. The modeled compositions of the accumulated melts reproduce the enrichments in fluid mobile elements (Ba, U, Pb) observed in basalts dredged from the Shikoku basin. Back-arc basin peridotites at Mado Megamullion thus appear to have unique petrographic and geochemical characteristics that are distinct from those of peridotites derived from mid-ocean ridges. Mado megamullion is an attractive target for ocean drilling as the best-explored OCC in the Shikoku basin, and one that shows a strong back-arc basin character of the mantle peridotites.

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