

Petrological characteristics and the origin of the Mariana Trough peridotites

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The Mariana Trough is an active back-arc basin located between the Mariana volcanic arc and the West Mariana Ridge, having a slow spreading rate. On the inner slope of the Central Graben in the northern trough, a wide exposure of lower crustal rocks and upper mantle peridotites has been known. During the JAMSTEC KR02-01 cruise (Arima et al., 2002), total number of 308 peridotites were sampled at three dredge sites (D01, D03, and D05) of the Central Graben near 20N.

The samples of 137 peridotite, examined in this study, are composed of a uniform lithology of harzburgite and lherzolite. Ultramafic and mafic veins of dunite, olivine websterite, olivine orthopyroxenite, olivine gabbro, and hornblende gabbro, are also observed in contact with some harzburgites. The harzburgite and lherzolite show a coarse-grained protogranular texture consisting of olivine (70.1-86.2 vol.%), orthopyroxene (10.3-27.7%), clinopyroxene (0-7.7%), and spinel (0.2-1.8%). Although most the samples are strongly serpentinized, a considerable amount of primary mantle minerals are well preserved in part, and are free from a severe deformation. Major element chemistry of the primary cores of olivine (Mg#=90.0-91.4, NiO=0.31-0.48wt%), orthopyroxene (Mg#=90.6-91.7, Al₂O₃=2.77-4.48wt%), clinopyroxene (Mg#=91.6-93.2, Al₂O₃=4.02-5.40wt%), and spinel (Mg#=67.0-74.6, Cr#=24.0-42.5) indicates that the Mariana Trough peridotites are residues after a moderate degree of depletion of basaltic melts generated in the upper mantle. The mineralogy are different from those of the surrounding areas of the Mariana fore-arc, the Parece Vela Basin, and the Pacific, and are similar to those of the MARK peridotites of Mid-Atlantic Ridge. It is suggestive from their similar slow-spreading rate of 2-3 cm/year that the Mariana Trough was generated as an active slow-spreading ridge system. Additionally, the occurrence of the ultramafic and mafic veins in the peridotites suggests an active magmatic event generated at a shallower lithospheric mantle beneath the spreading back-arc basin.

References

Arima et al., 2002, KR02-01 Northern Mariana Trough 2002 Cruise Onboard Report, JAMSTEC, p.216