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Ophiolitic crust-mantle decoupling revealed by Cr-spinel compositions of Timor peridotites

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Recent evidence indicates that the crust and underlying mantle in ophiolites may not be cogenetic. To better understand the petrogenetic relationships between these two units, we have investigated the world's youngest ophiolite from Timor. The ophiolite exposed in Timor and the adjacent Moa island have different mafic-ultramafic rock associations. The Timor region consists of island arc tholeiite, lherzolite, harzburgite, and dunite, whereas the Moa region is composed of boninite and harzburgite. The Cr# in Cr-spinel of the peridotites generally increases from lherzolite (0.17-0.23) through harzburgite (0.26-0.44) to dunite (0.53-0.72), apart from a Timor lherzolite sample that is highly foliated and has heterogeneous Cr-spinel grains (Cr# = 0.12-0.52); this foliated lherzolite, together with the positive correlation between Cr# in Cr-spinel and both TiO_2 in Cr-spinel and oxygen fugacity, can be best explained by interaction with hydrous fluids or oxidizing melts[1,2]. The tectonic discrimination diagram of $Ga/Fe^3\#$ versus $Ti/Fe^3\#$ in Cr-spinel[3] reveals that most peridotites represent melt-reacted metasomatized mantle, but parts of the Timor lherzolite and Moa harzburgite appear to represent non-metasomatized residual mantle. This interpretation is supported by the shape of Cr-spinel grains, i.e., those from the residual mantle are anhedral while those from the reacted mantle are euhedral to subhedral. Furthermore, the differences between residual peridotites from Timor and Moa may be linked to the differences between the exposed crustal rocks. Notably, we can infer that flux melting of the Timor residual lherzolite and Moa residual harzburgite during subduction initiation generated the Timor tholeiites and the Moa boninites respectively, leaving reacted peridotites. Therefore, the reacted peridotites are probably cogenetic with the crustal rocks, while the residual peridotites are the products of prior melt extractions. Our findings thus reveal that prior magmatism controlled the compositions of the crustal rocks and caused ophiolitic crust-mantle decoupling.

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[2] Hidas et al. (2016) *Lithos* 262, 636-650.

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