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# Mid-oceanic ridge origin for peridotite xenoliths from sub-Ontong Java Plateau mantle

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The Ontong Java Plateau (OJP), which is the world's largest oceanic plateau, has been extensively investigated by geological, geochemical and geophysical methods. Although the cataclysmic emplacement of the OJP has commonly been attributed to upwelling of a gigantic plume, its nature and conditions are still ambiguous due to an insufficient accumulation of critical evidence. It is well known that the 34 Ma alnöite from Malaita, Solomon Islands, contains a wide variety of mantle xenoliths regarded as fragments of the lithosphere beneath the OJP. Therefore, these xenoliths may be an important resource for further constraining the origin of the OJP.

The most abundant xenoliths are spinel lherzolites with low equilibration temperatures (~750-1000˚C), implying that they formed in the uppermost mantle beneath the OJP. In order to constrain the origin of the source peridotite, we focused on trace element and Sr-Nd isotopic compositions of clinopyroxene in the least-metasomatized samples. All of the clinopyroxene shows systematic LREE-depleted patterns and relatively depleted Sr-Nd isotopic compositions (present-day values: $^{87}Sr/^{86}Sr$ = 0.70237-0.70311, $^{143}Nd/^{144}Nd$ = 0.51311-0.51331). Although no correlation can be seen between $^{87}Sr/^{86}Sr$ and $^{143}Nd/^{144}Nd$ ratios, $^{143}Nd/^{144}Nd$ ratios are positively correlated with $^{147}Sm/^{144}Nd$ ratios. By using mass-balance calculations, we estimated whole-rock $^{143}Nd/^{144}Nd$ and $^{147}Sm/^{144}Nd$ ratios for individual xenoliths, assuming isotopic equilibrium within individual xenoliths at the host eruption and negligible metasomatism. The reconstructed bulk isochron yields a depletion age of 152 ± 21 Ma (95% confidence limit) with an intercept of $\varepsilon_{Nd}$ = +7.8. These values deviate significantly from those of overlying crust of the OJP (121-125 Ma, $\varepsilon_{Nd}$ = +3.7 to +6.5), negating a genetic relationship between the peridotites and overlying OJP-derived crust.

Because the estimated age is consistent with that of neighboring crust inferred from magnetic reversal patterns (~130-155 Ma), we suggest that the peridotites are residual after melt extraction to form Pacific MORB crust, possibly hidden by subsequent eruption of the OJP lavas. Although the whole area of the OJP is too large to be covered by the xenolith data, the present study implies that the emplacement style of the OJP is dissimilar to that of Icelandic-type crustal formation. In particular, in the case of the OJP, the pre-existing lithosphere may have prevented the plume from rising to near-surface levels.

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# Mantle and lower crustal xenoliths from NW Namibia and constraints on Etendeka flood basalt formation

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Two xenolith suites in northwestern Namibia provide a unique opportunity to directly sample the sub-continental lithospheric mantle (SCLM) and lower crust in the vicinity of the Paraná-Etendeka continental flood basalt (CFB) province, formed by the early Tristan plume. One xenolith locality (Okenyenya) falls within the sphere of influence of the early Tristan plume and shows a range of lithologies from refractory harzburgites to modally metasomatized amphibole-bearing peridotites and lower crustal rocks. The second locality (Swakopmund) lies south of the plume influence, but within the same crustal unit of the Damara Mobile Belt. Swakopmund mantle xenoliths lack evidence for metasomatism and their trace element and isotopic composition ($\varepsilon Nd_{ini}$=9.5-18.7, $^{87}Sr/^{86}Sr_{ini}$=0.7025-0.7022, corrected to 124 Ma) implies that the ambient sub-Damara mantle prior to any metasomatic overprint was strongly chemically depleted. Cryptically metasomatized spinel lherzolites from Okenyenya (cpx: $\varepsilon Nd_{ini}$=12.5-16.4, $^{87}Sr/^{86}Sr_{ini}$=0.7031-0.7037) and modally metasomatized amphibole-bearing xenoliths have more enriched isotopic compositions (cpx and amphibole: $\varepsilon Nd_{ini}$=3.4-4.1, $^{87}Sr/^{86}Sr_{ini}$=0.7036-0.7043). Incompatible trace elements in clinopyroxene and amphibole suggest that metasomatism resulted from infiltration by alkaline and carbonatitic melt/fluid. The isotopic data are consistent with derivation of the metasomatizing agents from the early Tristan plume. Thus, interaction of the early Tristan plume head with the lithosphere transformed the depleted SCLM into potentially fusible, hydrous SCLM that could contribute to low-Ti Etendeka CFB formation (high-Ti CFB are found on the edge of the Congo Craton adjacent to the Damara mobile belt). To the extent that the xenolith suites are representative of sub-Damara mantle, they show that melting of hydrous SCLM does not provide the enriched isotopic and the trace element signature with continental affinity for low-Ti Etendeka CFB. Rather, contributions from lower crustal granulites ($\varepsilon Nd_{ini}$=1.7-3.0, $^{87}Sr/^{86}Sr_{ini}$=0.7042-0.705) to Tristan plume melts, combined with variable contamination by upper crust, could explain the compositional variation of low-Ti Paraná-Etendeka CFB. However, quantification shows that this model requires unrealistic mixing conditions. Rather, integrated trace element and isotopic evidence suggests that the Tristan plume head was dominated by a distinct composition relative to the present-day Tristan plume.