Massive outpouring of magma in the western Pacific during the Cretaceous suggests deep mantle source

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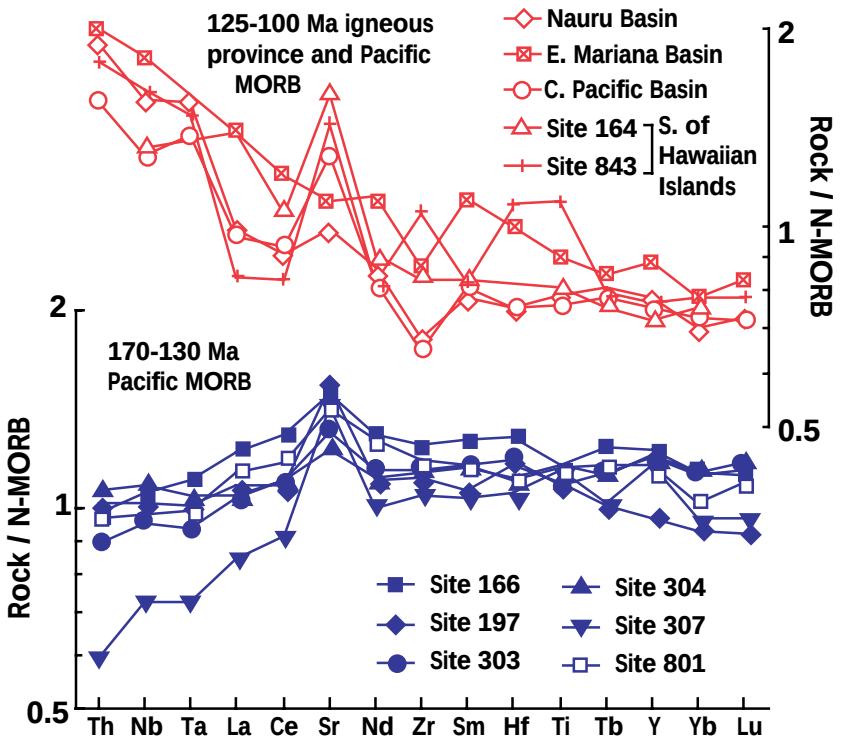
Massive outpouring of magma into the western Pacific during the Cretaceous (~115 - 105 million years ago) formed a huge igneous rock complex in oceanic basins such as the Nauru, East Mariana, Central Pacific, and Pigafetta. This complex was discovered serendipitously, while DSDP and ODP expeditions were attempting to drill into older Jurassic crust. The origin of this complex is mysterious, although it has been linked to the formation of the adjacent Ontong Java Plateau. From drilling results and other data, two explanatory hypotheses have arisen. The first suggests that the complex is a sequence of oceanic flood basalts that erupted through cracks in the Jurassic (>140 Ma) seafloor formed by the massive load imposed by the emplacement of the plateau [*Larson and Schlanger,* 1981]. An alternative theory argues that the complex is a section of seafloor created along a short-lived spreading center initiated by the vigorous volcanism that formed the plateau [*Janney and Castillo,* 1996]. Magnetic lineation data, though uncalibrated, support the first hypothesis. Chemical analyses of complex rock samples support the second hypothesis, but they also provide clues concerning the source of the magma. Basalts from the various parts of the complex are nearly uniform in chemical composition. Furthermore, their composition is similar to that of normal mid-ocean ridge basalts (N-MORB), except for a mild enrichment of elements (e.g., thorium) that are generally incompatible in basaltic magmas (see figure). From an isotopic perspective, the complex basalts have lower $^{143}Nd/^{144}Nd$, higher $^{87}Sr/^{86}Sr$ and higher $^{208}Pb/^{204}Pb$, for a given $^{206}Pb/^{204}Pb$, than modern Pacific N-MORB. The complex is chemically and isotopically similar to mid-Cretaceous (~125-100 Ma) Pacific MORB as well as modern MORB erupted near hotspots in the Indian and South Atlantic Oceans. Jurassic-Early Cretaceous (170-130 Ma) Pacific MORB is geochemically identical to modern Pacific N-MORB. In contrast, the chemical and isotopic enrichments of the mid-Cretaceous Pacific MORB and the complex rocks indicate regional contamination of the upper mantle with “enriched mantle” components. These components are probably deep mantle materials that were convected into the Pacific upper mantle during the mid-Cretaceous intraplate volcanism [*Janney and Castillo,* 1997].



References:

Larson, R.L. and S.O. Schlanger, Geological evolution of the Nauru Basin and regional implications, *Initial Repts. Deep Sea Drill. Proj.*, *61*, 841-862, 1981.

Janney, P.E. and P.R. Castillo, Basalts from the Central Pacific Basin: evidence for the origin of Cretaceous igneous complexes in the Jurassic Western Pacific, *J. Geophys. Res.*, 101, 2875-2893, 1996.

Janney, P.E. and P.R. Castillo, Geochemistry of Mesozoic Pacific MORB: Constraints on melt generation and the evolution of the Pacific upper mantle, *J. Geophys. Res.*, in press.