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The origin of tholeiitic vs. alkaline basaltic magmas from the Erongo igneous complex, Namibia: mantle source diversity and implications for the plume controversy in the South Atlantic LIP

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The relative importance of different mantle source regions for basaltic magmas in the Paraná-Etendeka continental flood basalt province (CFB) is still controversial. Three main contenders are deep-mantle material brought up by a plume, subcontinental lithospheric mantle (SCLM), and depleted asthenosphere in the upper mantle. To these may be added contamination by lower and by upper continental crust. There are many arguments for involvement of a mantle plume in the Paraná-Etendeka province but geochemical tests for a deep-mantle source of CFB magmas have turned out equivocal or negative. The situation appears to be different for magmas emplaced as ring complexes in the southern Etendeka province of Namibia, where isotopic and trace element evidence from alkaline basaltic units is consistent with a deep-mantle component. In all three examples, the intrusion of alkaline magmas were preceded by tholeiitic magma with compositions not unlike the CFBs. The relationship of tholeiitic and alkaline magmas has relevance to the larger issues of source diversity in the mantle vs. crustal contamination and can best be addressed by detailed study of a well-dissected complex.

In this contribution we discuss geochronologic, trace element and multi-isotope data (Sr, Nd, Pb, O, Os) from the tholeiitic and alkaline basaltic units of the Erongo com-

plex in terms of mantle source constraints, crustal contamination and the relationship between the two magma series. Key results and inferences are: (1) Ar-Ar and U-Pb zircon ages of all units overlap within the 1Ma uncertainty and place the Erongo magmatism at the peak of Etendeka CFB activity, (2) tholeiitic lavas at the base of Erongo are not indigenous to the complex but represent outliers of the southern Etendeka CFB, (3) tholeiitic intrusions (ring dike, dolerite sills) show characteristics of a lithospheric mantle source (SCLM) and significant contamination by upper crust – consistent with geochemical indication of low-pressure differentiation. (4) Multi-isotope data for the alkaline units are consistent with a deep-mantle source with only minor crustal contamination. The presence of plume-derived magmas in the southern Etendeka province at 130-132 Ma is established by the Namibia ring complexes. Deep-mantle and lithospheric magmas were emplaced within very close time intervals but the alkaline units in all known cases arrived last. The sequence of tholeiitic and alkaline series fits a scenario where the lithosphere and crust were thinned and flushed of fusible components during the tholeiitic “event”, allowing emplacement of deeper and less contaminated magmas to follow.