Geochemistry and geochronology of the Ninetyeast Ridge, Indian Ocean: New constraints on paleotectonics and hotspot dynamics

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We report new geochemical and geochronological data for basalt from seven drill sites and new (2007) dredge sites along the Ninetyeast Ridge (NER), a proposed 5000 km long hotspot track in the Indian Ocean. The NER was created from approximately 80 to 40 Ma as the Indian Plate moved rapidly northward at the fastest known rate for any tectonic plate which includes a fraction of continental crust. Thus, study of the NER provides important constraints on the tectonic history of the Indian Plate, including the Indian-Eurasian collision, as well as of hotspots and mantle dynamics. Basalt from drill cores has been previously dated, but advances in sample preparation techniques and mass spectrometry have enabled determination of more accurate, precise Ar/Ar ages. Based on geophysical evidence (southward jumps of the spreading ridge axis towards the apparent hotspot), the age progression along the NER is expected to be complex. However, our new Ar/Ar age data for six drill sites range from 77 Ma at Site 758 to 42 Ma at Site 254 and define a single, remarkably linear propagation rate of 117 $\pm$6 km/m.y. for the whole period. This rate is consistent with the Indian plate velocity predicted by seafloor spreading anomalies but significantly slower than the velocity predicted by sediment paleolatitude data.

The 2007 cruise RR-KNOX06 recovered basalt from twenty-three dredge sites ranging from 3º north to 25º south along the NER. Our initial focus is on basalt from ten dredge sites, primarily from the northern section of the ridge. Ar/Ar and geochemical data are being acquired. Based on partial data sets for isotopic ratios (Sr, Nd, Hf, and Pb) and incompatible element abundances, two conclusions are: (1) NER basalt contains components derived from both the Kerguelen and Amsterdam/St. Paul hotspots and (2) the depleted component in NER basalt is not derived from the source of Indian Ocean MORB.

Unravelling the geologic dust record

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One of the outstanding problems of dust flux reconstruction from physico-chemical properties of terrigenous sediments stems from the fact that most sediments are mixtures of sediment populations derived from different sources and transported by different mechanisms. We have formulated a 'holistic approach' to tackle the mixing problem which combines (i) laser-diffraction grain size analysis of the siliciclastic sediment fraction, (ii) decomposition of sets of grain-size distributions with the end-member modelling algorithm EMMA [1] to characterise dust transport processes, and (iii) geochemical fingerprinting of the modelled sedimentary components to trace the dust source. Here we report on several Late Quaternary dust records extracted from marine (e.g., Arabian Sea [2], Atlantic [3]) and terrestrial sedimentary records (e.g, Chinese loess [4, 5]). The mixing model of the Mangshan loess-paleosol sequence [6] will be tested by a variety of geochemical analyses (REE and trace elements; $^{87}Rb/^{86}Sr$ - $^{87}Sr/^{86}Sr$ systematics, and U-Pb ages) of specific mineral fractions (K-feldspar, plagioclase, zircons) extracted from narrow size fractions belonging to specific modelled end-members. Such analyses provide transport-invariant measures of sediment composition in which effects of selective transport due to variations of grain size and density can be ignored, and therefore allow the provenance determination of the modelled end-members.

[1] Weltje (1997) *J. of Math. Geol.* **29**, 503-549. [2] Prins & Weltje (1999) *SEPM Spec. Publ.* **62**, 91-111. [3] Weltje & Prins (2003) *Sed. Geol.* **162**, 39-62. [4] Prins *et al*. (2007) *Quat. Sci. Rev.* **26**, 230-242. [5] Prins & Vriend (2007) *G-cubed* **8**, doi:10.1029/2006GC001563. [6] Prins *et al.* (2008) *J. Quaternary Sci.*, doi: 10.1002/jqs.1167.