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Amsterdam-St. Paul Hotspot: Composition, Motion and History

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The Amsterdam-St Paul (ASP) plateau results of the excess of melting induced by the interaction between the ASP hotspot and the South-East Indian Ridge. The ASP plume was originally located beneath the Australian Plate and its interaction with the SEIR began about 10 Ma ago. This location provides an unique opportunity to study the hotspot prior to its interaction with the SEIR and its chemical and physical evolution. An exhaustive study of the hotspot characteristics prior to its interaction lead to know its geochemical compositions. The geochemistry of its interaction with the SEIR (i. e. ASP plateau) provides indirect information on the regional Indian Ocean upper mantle.

ASP plume has a moderately enriched composition with resulting seamount melts having $2.5 <$ (La/Sm)C1norm < 2.8. In addition isotope ratios are not as extreme as estimated in previous works [Doucet et al. 2004; Nicolaysen et al., 2007] with $^{86}Sr/^{87}Sr \approx 0.7040$, $^{143}Nd/^{144}Nd \approx 0.5128$, $^{206}Pb/^{204}Pb \approx 19.0$ and $^{208}Pb/^{204}Pb \approx 39.2$. The ASP plateau isotopic composition reveals that the Indian Ocean upper mantle is extremely heterogeneous. It was proposed that the ridge segments across the plateau have interacted 40 My ago with Kerguelen plume [Frey et al. 2000]. We therefore assume that some plume material has been left behind in the Indian Ocean upper mantle during the movement of the Australian plate above it. Consequently, the upper mantle in the area might be a good example of “marble cake” [Allegre&Turcotte, 1986]. When the SEIR approaches the ASP hotspot, plume derived material mixes with the surrounded mantle leading to the complexity seen in ASP plateau materials.

K-Ar datings reveal that the absolute motion of the Australian plate calculated with respect to the fixity of ASP plume is of about 77 km/My. With a spreading rate of about 6-7 cm/yr the accretion at the SEIR axis cannot account for this velocity. In consequence, an absolute motion of the ASP plume of about 10-20km/My, comparable to that of Hawaii [Tarduno et al. 2003], could account for this discrepancy.

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