Geophysical Research Abstracts,
Vol. 11, EGU2009-9441, 2009
EGU General Assembly 2009

Factors influencing magmatism during continental break-up: new insights from a wide-angle seismic experiment across the conjugate Seychelles-Indian margins

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We present a model of the northern Seychelles continental margin derived from controlled-source wide-angle seismic travel-time inversion and teleseismic receiver functions. This margin has been widely cited as a classic example of rifting in association with a continental flood basalt province, the Deccan Traps. However we do not find the typical set of geophysical characteristics reported at other margins linked to continental flood basalts, such as those of the north Atlantic. The oceanic crust formed immediately after break-up and throughout the first 3 Ma of seafloor spreading is just 5.2 km thick, less than half that typically seen at other volcanic margins. The continent-ocean transition zone is narrow and whilst two packages of seaward-dipping-reflectors are imaged within this transition they are weakly developed. Beneath the thinned continental crust there is an approximately 4 km thick layer of high-velocity material (7.5-7.8 km/s) that we interpret as mafic material intruded and underplating the lower crust. However we believe that this underplating most likely happened prior to the break-up. Overall the observations show that that rifting of India from the Seychelles was characterised by modest magmatism. The spatial extent of the Deccan flood basalt province is therefore smaller than previously thought. We speculate that either the lateral flow of Deccan-related hot material beneath the break-up region was hampered, perhaps as the rifted margins did not intersect the centre of the Deccan source, or there was incomplete melt extraction from the wide melting region that formed between the rapidly diverging plates. If the latter explanation is correct then the rate of plate separation, as indicated by the initial seafloor spreading rate, is more important in controlling the volume of magmatism generated during continental rifting than has been previously recognised.