Geophysical Research Abstracts,
Vol. 10, EGU2008-A-01504, 2008
SRef-ID: 1607-7962/gra/EGU2008-A-01504
EGU General Assembly 2008

Two-stage magmatism during the evolution of the transitional Ethiopian rift

D. Cornwell (1,3), R. England (1), P. Maguire (1), J-M. Kendall (2) and G. Stuart (3)

(1) Dept. of Geology, University of Leicester, UK, (2) Dept. of Earth Sciences, University of Bristol, UK, (3) Now at the School of Earth and Environment, University of Leeds, UK (d.cornwell@see.leeds.ac.uk / Phone: +44 113-3437012)

The Ethiopian rift marks the transition between continental rifting and incipient seafloor spreading. The Ethiopia Afar Geoscientific Lithospheric Experiment (EAGLE) included a 400 km-long cross-rift profile with 97 broadband passive seismometers with the aim to investigate the change from mechanical to magmatic extension by defining the lithospheric structure and extent of magmatism beneath the rift. Complimentary studies of P- and S-wave receiver functions, shear-wave splitting and teleseismic earthquake arrival times show that the lithospheric structure is inherently different beneath the north-western rift flank, rift valley and south-eastern rift flank, with contrasting crustal thickness and composition, upper mantle velocity and lithospheric anisotropy. Two stages of magmatic addition are interpreted: 1) a 6-18 km-thick underplate lens at the base of the crust, which probably formed synchronous with an Oligocene flood basalt event (and therefore pre-dates the adjacent rifting by $\sim$20 Myr); and 2) a 20-30 km-wide zone of intense dyking and partial melt, which most likely pervades the entire crust beneath the rift valley and marks the locus of current rift extension. Furthermore, Precambrian collision-related lithospheric fabric is proposed to be the main source of the strong anisotropy that is observed along the entire cross-rift profile, which may be augmented by magmatism beneath the rift. An active, followed by a passive magma-assisted rifting model that is controlled by a combination of far-field plate stresses, the pre-existing lithospheric framework and magmatism is invoked to explain the rift evolution.