Seismic Structure of the Arabian Shield Lithosphere and Red Sea Margin

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Summary

In this MARGINS project we are using broadband seismic data from the Saudi Arabia National Digital Seismic Network (SANDSN) to investigate crust and upper mantle structure beneath the eastern margin of the Red Sea and the Arabian Shield. The SANDSN has been operated since 1998 by the King Abdulaziz Cityfor Science and Technology (KACST), and consists of 38 stations mostly distributed across the Arabian Shield (Figure 1) [*Al-Amri and Al-Amri, 1999*]. Twenty-seven of the stations are equipped with broadband (Streckeisen STS-2) sensors. Five years of data (1999- 2003) from the network have been made

available for this project, and the data are being used to 1) map first-order structure surrounding the ruptured Red Sea lithosphere, 2) evaluate the heterogeneity of the continental lithosphere prior to rifting, and 3) constrain ambient stress fields and lithospheric rheology using local seismicity. Here we report preliminary findings from a surface wave tomography study to map differences in upper mantle structure

between the eastern margin of the Red Sea, the Arabian Shield, and the Arabian Platform (Figure 1). The basement of the study region consists of an amalgamation of Proterozoic terrains, and across the Arabian Shield these terrains have been subjected to Cenozoic uplift and volcanism. The locations of the volcanic

regions are shown in Figure 1a. The oldest volcanic rocks on the Shield are contemporaneous with flood basalt volcanism in Yemen and Ethiopia and the initiation of rifting in the Red Sea c. 30 Ma [*Mohr, 1988*; *Camp et al., 1991*; *Coleman and McGuire, 1988*]. Younger volcanic rocks (c. 12 Ma to present; *Camp and Roobol, 1992*) are found in the central and northern part of the Shield (Figure 1a). The average elevation across the Shield is 1 km, but in some areas near the Red Sea elevations are as high as 3 km. The uplift of the Shield probably occurred between 20 and 13 Ma, postdating the onset of rifting in the Red Sea

by at least 10 Ma [*McGuire and Bohannon, 1989*; *Bohannon et al., 1989*]. Although a great deal of work has been done to understand the origin of Cenozoic uplift and volcanism in the Arabian Shield, the development of these features in relation to rifting in the Red Sea remains enigmatic and must be ascertained before the tectonic evolution of the Red Sea rift can be fully understood. The surface uplift and volcanism are generally assumed to be due to hot, buoyant material in the upper mantle that may have eroded the base of the lithosphere [*Camp and Roobol, 1992*]. However, the lateral and vertical extent of the thermal anomaly in the upper mantle under the Shield is uncertain, as is its relationship to rifting in the Red Sea.