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New insights into volcanism and tectonics in the Red Sea Rift

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The Red Sea is one of the few places on Earth where rifting and splitting of a continent by the formation of an ocean basin is presently occurring. Continental rifting takes place in the northernmost Red Sea and ocean floor is continuously created from at least 23°N to the vicinity of the strait of Bab al-Mandab in the south. Here we present a unique collection of recent continuous multibeam bathymetric datasets with a spatial acoustic resolution of 15-30 m from the Thetis Deep at 23°N to the RSR at 16.5°N together with new volcanic sampling over the Red Sea Rift (RSR). This enables us to study in detail the bathymetry of volcanic structures formed during the creation of this young ocean and the relationship between extension and volcanism allows us to make an extensive interpretation of the structural, tectonic, magmatic and sedimentary evolution of the RSR.

Even though the central graben of the RSR is widely covered by sediments and Miocene evaporites north of 20°N (Augustin et al. 2012), the open parts of the rift valley show a wide range of volcanic activity and tectonic features over 700 km of mapped ridge axis. Numerous volcanoes (flat top volcanoes, submarine equivalents of Venusian pancake domes and lava shields) and ridges of hummocky volcanics are scattered all along the RSR. In addition the Red Sea Rift displays typical features of a slow spreading ridge where the slowest spreading, northern section of the Red Sea is strongly tectonically dominated with distinct basins and a strong horst and graben structure with locally very large volcanic edifices. The largest submarine volcano yet observed in the RSR is the Hatiba Mons volcano, previously not recognized as a volcanic edifice. In the south, where the spreading rates are greatest, large basins are not present and instead axial highs are observed as the result of higher recent volcanic activity.

The geochemistry of basalts from sampled volcanoes display MORB signatures with no sign of continental input. From north to south an apparent gradual change in the degree and depth of melting with a strong correlation to the morphology of the RSR can be observed. Geochemical analyses of accurate sampled basalts together with hydro-acoustic data reveal the relation between the various shapes of volcanic edifices and their geochemistry. Our interpretations of morphologic features and geochemistry provide a new, detailed look into the structure, tectonics and magmatic centers of the RSR in larger detail than has been observed before.

References:

Augustin, N., Devey, C. W., Feldens, P., van der Zwan, F. M., Bantan, R. and Kwasnitschka, T. (2012) The transition from rifting to spreading in the Red Sea: No sign of discrete spreading nodes? Abstract OS11E-07 presented at 2012 Fall Meeting, AGU, San Francisco, Calif., 3-7 Dec.