Geophysical Research Abstracts
Vol. 18, EGU2016-7670, 2016
EGU General Assembly 2016

Tracking the Tristan-Gough Mantle Plume Using Discrete Chains of Intraplate Volcanic Centers Buried in the Walvis Ridge

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Explanations for hotspot trails range from deep mantle plumes rising from the core–mantle boundary (CMB) to shallow plate cracking. Such mechanisms cannot explain uniquely the scattered hotspot trails distributed across a 2,000-km-wide swell in the sea floor of the southeast Atlantic Ocean. While these hotspot trails formed synchronously, in a pattern consistent with movement of the African Plate over plumes rising from the edge of the African LLSVP, their distribution is controlled by the interplay between plumes and the motion and structure of the African Plate (O'Connor et al. 2012). A significant challenge is to establish how the vigor and flow of hotspot material to the mid-ocean ridge constructed the Walvis Ridge. ^{40}Ar/^{39}Ar stratigraphy for three sites across the central Walvis Ridge sampled by Ocean Drilling (DSDP Leg 74) (Rohde et al., 2013; O'Connor & Jokat 2015a) indicates an apparent inverse relation between the volume flux of hotspot volcanism and the distance between the mid-ocean ridge and the Tristan-Gough hotspot. Moreover, since $\sim$93 Ma the geometry and motion of the mid-ocean ridge determined where hotspot material was channeled to the plate surface to build the Walvis Ridge. Interplay between hotspot flow, and the changing geometry of the mid-ocean ridge as it migrated relative to the Tristan-Gough hotspot, might explain much of the age and morphology of the Walvis Ridge. Thus, tracking the location of the Tristan-Gough plume might not be practicable if most of the complex morphology of the massive Walvis Ridge is related to the proximity of the South Atlantic mid-ocean ridge. But ^{40}Ar/^{39}Ar basement ages for the Tristan-Gough hotspot track (Rohde et al., 2013; O'Connor & Jokat 2015b), together with information about morphology and crustal structure from new swath maps and seismic profiles, suggest that separated age-progressive intraplate segments track the location of the Tristan-Gough mantle plume. The apparent continuity of the inferred age-distance relation between widely separated age-progressive plume segments implies a connection to a stable or constantly moving source in the mantle.