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Tristan da Cuhna hotspot tracks and the seafloor spreading history of the South Atlantic

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Careful mapping of more than 50 distinctive seafloor spreading magnetic anomalies between magnetochrons C5 and M4 has been used to develop a detailed spreading history for the South Atlantic between 15°S and 45°S and to investigate spreading axis interactions with the Tristan hotspot. Spreading appears to be roughly symmetrical with 3 separate phases identified: (1) steady spreading of ~30 mm/yr from 10 to ~45 Ma, (2) slower (15-18 mm/yr) and more variable spreading from 45 to ~70 Ma, and (3) an earlier faster spreading (45 mm/yr) from 70 to 84 Ma. C34-M0 distances provide an average value for pre-C34 spreading of ~27mm/yr. The noticeably larger C34-M0 distance on the S. American side near 32°S, 40°W is attributed to one or more eastward ridge jumps that occurred between 84 and 120 Ma.

Residualized free air satellite gravity data have been used to delineate fracture zones (FZs) associated with the Early Cretaceous through Tertiary opening. More than 20 flow lines determined from these FZs intersect the magnetic lineations mapped between C5 and M4. The FZs and isochron data have been used to compute stage poles from 130 Ma to the present for both the South American and African sides, and the corresponding total reconstruction poles.

Features attributed to hotspot activity on each plate have been rotated about these poles to determine when the hotspot was beneath the spreading axis. Coincident on-axis locations and the age of the underlying oceanic crust have then been used to document the history of the interaction of the Tristan hotspot with the spreading axis. In a fixed Africa reference frame the hotspot appears to move west-southwest. From 120 Ma to ~ 70 Ma, spreading was sufficiently rapid that the hotspot was maintained on or close to the ridge axis by eastward ridge jumps. From 70 to ~45 Ma the slower spreading allowed the hotspot to remain on the ridge without ridge jumps. At 45 Ma the hotspot crossed beneath the Meteor transform fault, was displaced from the ridge axis and became isolated beneath the African plate. The subsequent increase in spreading rate resulted in the hotspot remaining beneath the African plate where it has produced that part of the Walvis Ridge track between the Meteor FZ and Tristan from 45 Ma and the present.

Comparison of paleolatitudes determined for Walvis Ridge features north of the Meteor FZ with Tristan's present location suggests no significant latitudinal motion of the Tristan hotspot since ~80Ma. Between 130 Ma and 80Ma, however, the paleolatitude of hotspot features are roughly 10° more northerly that present day Tristan.