Fixity of the Iceland "hotspot" on the Mid-Atlantic Ridge: Observational evidence, mechanisms, and implications for Atlantic volcanic margins

Erik R. Lundin*
Geological Survey of Norway, Leiv Erikssons vei 39, 7491 Trondheim, Norway
Anthony G. Doré*
Statoil UK Ltd., Statoil House, 11a Regent Street, London SW1Y 4ST, UK

ABSTRACT

The Iceland anomaly has been attributed to a deeply rooted and fixed mantle plume, and Early Tertiary magmatism in the North Atlantic Igneous Province (NAIP) has commonly been interpreted to relate to an ancient expression of the same plume. We challenge these concepts. A major problem with attributing the Iceland anomaly to a fixed plume is the lack of evidence for a hotspot track. Although the Greenland-Faeroe Ridge has been suggested to be the hotspot track, its symmetric and continuous construction instead suggests in situ development on the plate boundary. Magmatism in the NAIP occurred in two phases, distributed in approximately perpendicular belts. The first phase (ca. 62–58 Ma) occurred along a north-west belt through the British Volcanic Province to west Greenland. We relate this phase to a transient and failed rift, intermediate in time and space between seafloor spreading in the Labrador Sea and the northeast Atlantic. The second phase (ca. 56–53 Ma) followed the incipient northeast Atlantic plate boundary. Both magmatic phases can therefore be associated with plate tectonics. Likewise, the north Atlantic–Arctic breakup can be explained as a natural outcome of plate tectonics and lithospheric strength distribution. We follow other recent research in suggesting that the voluminous magmatism during NAIP phase 2 is related to reactivation and opening along the Caledonian orogen. Specifically, we point to a close correspondence between the reactivated orogen and the north Atlantic volcanic passive margins, and suggest that the extreme magmatism could stem from the melting of eclogitic material, either residing in remnants of the Caledonian-Appalachian orogenic root or within a delaminated root. Extending this idea, we postulate as a testable hypothesis that volcanic margins are the natural products of the Wilson Cycle (i.e., opening of sutures). We have tested the hypothesis on the north, central, and south Atlantic Ocean and have found a broad correlation between volcanic margin segments and reopened Late Neoproterozoic–Phanerozoic fold belts.