

VOLCANIC FEATURES OF THE CENTRAL ATLANTIC OCEAN: TECTONIC AND MAGMATIC MODELS

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Similar to other ocean basins, the central Atlantic Ocean (roughly latitude 10° to 50° N) contains many (more than a hundred) volcanic seamounts grouped in chains, clusters, and individual features. Although the Atlantic Ocean crust has been forming continuously from the Early Jurassic to the present with tholeiitic rift basalts, most of the seamounts were created during the Middle to Late Cretaceous as alkaline basaltic or bimodal volcanoes, some of which have continued activity into recent times.

Wide-ranging homogeneous upper (?) mantle horizons produced low-Ti, intermediate-Ti, and high-Ti basalts of the Central Atlantic Magmatic Province, which are apparently all between 201 and 198 Ma in age. CAMP magmas formed distinct but overlapping suites of sub-parallel dikes that are related to the geometry and extension of Pangaeian rifts. CAMP dikes do not define a co-magmatic swarm that radiates around a common geographic center, despite many such assertions in the literature. Basaltic magmas flowed obliquely within the dikes as they followed propagating fractures for hundreds of km, but they were not interconnected between suites and swarms. There is no evidence for domal uplift over a “plume center,” and there is no “tail trail” of Jurassic hotspot volcanoes or ocean ridge that proceeds away from any plume center. Rather than becoming dormant and then resurfacing much later with alkaline seamounts, it is more reasonable to believe that mantle convection responsible for CAMP basalts is related to the subsequent and continuing production of Atlantic Ocean crust. Basaltic melts evolved after Pangaeian rifting in the Early Jurassic, progressing from an early magma enriched by continental and older subduction-slab components into a relatively depleted ocean mantle melt.

In the Cretaceous after 125 Ma, geometrically discrete, chemically less-depleted sections of the deeper mantle produced pulses of alkaline magmas to feed numerous and widely-separated volcanoes, within the continent margins as well as the ocean. These magmatic events started when entire plates experienced major tectonic shifts during the Cretaceous, related to a change in plate motions as mantle convection and lithospheric rifting moved northward and southward into the Laurasia and Gondwana super-continents. Sub-lithospheric alkaline magmas collected during this event and moved rapidly to the surface along extensional fracture zones and fracture intersections, in the oceans as well as in adjacent continents within the same plates. The few linear seamount chains in the central Atlantic basin, which may or may not be time-progressive, are all linked to much older continental linear structures that propagated into the ocean crust.

The geographic patterns, compositions, and styles of igneous activity of the seamounts contrast greatly with ocean crust magmatism at the mid-ocean ridge. A

deep mantle plume cannot be responsible for both the initiation of Early Jurassic sea-floor spreading and the younger alkaline seamounts. All of the magmas are probably derived from the upper mantle and can be related to mantle convection, depth of melting, lithospheric structures, stress patterns, and plate tectonism.