Origin and tectonic significance of the Early Cretaceous Fogo Seamounts

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The Lower Cretaceous Fogo Seamounts were formed along the transform margin of the southwestern Grand Banks, at the northeastern extremity of the mid Jurassic – early Cretaceous central North Atlantic ocean, and have been partially buried by younger progradation of the continental margin. Volcanism of similar age is known from hydrocarbon exploration wells in the Orpheus Graben and the southern Grand Banks and slightly younger volcanic rocks are found in the Newfoundland Seamounts and ODP Site 1276. Otherwise, the Iberia – Grand Banks rift is remarkably non-volcanic.

The J-Anomaly Ridge was sampled by DSDP Site 384 and represents an area of anomalously thick crust formed at the mid-ocean ridge at the southeastern end of the Fogo Seamount chain. New samples were obtained from the Narwhal F-99 exploration well, which penetrated olivine basalts in the northwestern part of the chain and trachybasalt conglomerate was dredged from Seamount G in the central part of the chain. In chemical composition and radiogenic isotopes, the basalts range from mildly alkalic to mildly tholeiitic, with chemical analogues, for example, in Hawaii. The voluminous tholeiitic magmas result principally from decompression melting, with the ocean-island-basalt signature of the alkalic rocks also suggesting upwelling of deeper asthenosphere.

The distribution of the seamounts has been determined from magnetic, bathymetric and seismic data. Some seamounts are flat-topped and resemble guyots in being capped by carbonate platform rocks, penetrated at DSDP Site 384 and Narwhal F-99, and interpreted from seismic-reflection profiles on some other seamounts. A few seamounts appear to define linear trends parallel to the inferred transform faults paralleling the continental margin, but much of their distribution appears random and occurs within a broad zone 200 km wide. There is no systematic pattern to the elevation of flat-topped seamounts.

Various hypotheses for the origin of the magmatism are evaluated. The distribution of the seamounts and the J-Anomaly Ridge suggests that they developed from edge-controled convection in the upper mantle that developed due to thermal and density gradients at the transform transition between the spreading ocean and the continental block of the Grand Banks. The location of the volcanic centres was strongly influenced by crustal-scale strike-slip faulting. The Fogo Seamount chain thus has a different tectonic origin compared with many oceanic seamount chains. The widespread volcanism affected the thermal evolution of the continental margin and may have created conditions favourable to the widely distributed crustal

extension that produced the Cretaceous basins of the Grand Banks and the Iberia – Grand Banks rift.