

An Integrated Geophysical Investigation of Greenland's
Tectonic History

DISSERTATION

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By

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* * * * *

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ABSTRACT

A new model for the crustal evolution of the Labrador Sea region of southwestern Greenland (58.7 - 61.9°N and 48 - 53°W) was developed from gravity-derived Moho estimates and lithologic and geologic features interpreted from correlative geopotential anomalies, and recent seismic surveys [Chian and Loudon, 1994; Chian et al., 1995a, Chian et al., 1995b; Chalmers and Laursen, 1995]. Previous kinematic models [Srivastava, 1978; Srivastava and Tapscott, 1986; Roest and Srivastava, 1989] suggested that the opening of the Labrador Sea caused a counterclockwise rotation of Greenland from ca. 92 to 36 Ma as a part of the opening of the North Atlantic Ocean. These models were based on interpretation of a 150 km wide zone of crust off of the coasts of Greenland and Labrador as oceanic crust with continuous magnetic isochrons through anomaly 33. The structural implications of the gravity-derived Moho and crustal density models challenge this interpretation. Instead, this region is interpreted a combination of rifted-continental and transitional crust. The correlation analysis of free-air gravity and magnetic anomalies determined that rocks within this 150 km zone were more characteristic of rifted-continental or transitional crust, and this was further supported by the results of seismic surveys [Chian and Loudon, 1994; Chian et al., 1995a; 1995b; Chalmers and Laursen, 1995]. The linear magnetic anomalies interpreted as isochrons 31 and 33 by Roest and Srivastava [1995] were interpreted as serpentinization along the crustal rupture and delamination surfaces or

along the base of regional-scale half-grabens. The revised model postulates that the rotational opening of the Canada Basin from 135 to 115 Ma induced a counterclockwise rotation of Greenland, which extended and thinned the Archean crust between Greenland and Labrador. This weakened crust was thus well disposed to rifting when the North Atlantic rift system propagated northward into the region at about 90 Ma. Slow extension rates and an insufficient supply of magma delayed the initiation of oceanic spreading until about 63 Ma when Greenland began to separate from North America and move with Europe.

To Lauren for being loving, supportive, and understanding especially when I was away from home working on all those long, cold, and lonely nights.

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