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Crustal structure of the West Greenland margin in North Baffin Bay

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The tectonic and geodynamic evolution of the Baffin Bay is interpreted to be closely associated with mantle dynamics and plume activity. The initial opening of the Baffin Bay coincides with the volcanic activity along the West Greenland margin between 60.7 and 59.4 Ma (Storey at al., 1998), attributed to the arrival of the Iceland plume beneath Greenland (Lawver and Müller, 1994, Larsen and Saunders, 1998).
Rifting in the Baffin Bay is linked to oceanic spreading in the Labrador Sea, but there is no consensus about the nature of the underlying crust in central Baffin Bay.
The geodynamic evolution of the Baffin Bay and plate tectonic reconstructions for Greenland relative to North America are still a matter of debate though they are of special importance in the circum-Arctic geodynamic framework.
Due to lack of data the plate boundary between the North American plate and the Greenland plate is not well defined and the nature of the continent-ocean transition zone is widely unknown.
Evidence indicating that the deep sea area of the Baffin Bay crust is oceanic has been provided by Keen and Barrett (1972) based on seismic refraction data. However, Reid and Jackson (1997) did not find evidence for layered oceanic crust and interpreted the deep part of Baffin Bay as serpentinized mantle material. They suggest that rifting was amagmatic and separation of passive continental margins was comparable to ultra-slow spreading ridges. Linear magnetic anomaly patterns in this region were not clearly identified. The position of the extinct spreading axis was defined by a northwest-trending linear gravity anomaly of central Baffin Bay (Chalmers and Pulvertaft, 2001). Spreading in the Baffin Bay took obviously place in Paleocene and Eocene times in two phases which may be distinguished by a reorientation of the directions of plate motion for Greenland starting about 55 Ma ago (Chalmers and Pulvertaft, 2001).
It is not fully explained how a postulated major transform fault accommodated the northward movement of Greenland following the opening of the Baffin Bay. There is no geological evidence for significant strike slip motion in the northern part of Baffin Bay (Tessensohn et al., 2006, Harrison, 2006, Dawes, 2009). To account for the absence of such fault system in this area Harrison (2006) locates the plate boundary in the Arctic Islands. In a most recent paper Pulvertaft and Dawes (2011) do not accept the necessity for a major strike-slip fault to accomodate the extension in the Baffin Bay and do not consider Greenland and North America as separate plates.
In summer 2010, during the multidisciplinary marine geoscientific expedition ARK-XXV/3 new multichannel seismic data with a total length of 4000 km has been acquired in Greenland territorial waters of central and northern Baffin Bay. Interpretation of these data gives new insight in the evolution of Baffin Bay, the existence of oceanic crust, the nature of the West Greenland continental margin, the continent-ocean-transition zone and the evolution of sedimentary basins.
Our data show that oceanic crust forms the deeper part of Baffin Bay and Greenland has a typical passive continental margin with large rotated basement blocks, listric faults facing mainly seaward, and deep syn-rift-basins in between. At some segments of the crustal margin the opening of the Baffin Bay was associated with volcanic activity. Seaward dipping reflectors were discovered along a line crossing the Greenland margin and help to identify the continent ocean boundary. A most prominent reflector is recognized under the shelf and the slope which might indicate the transition from rifting to drifting and therefore the beginning of seafloor spreading in the Baffin Bay. Erosion above some basement blocks, subsidence along the slope area, and termination of the prominent reflector in the area of the ocean-continent boundary allow to clearly distinguish between continental and oceanic crust.