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Structure and evolution of the West Greenland continental margin

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The geodynamic evolution of the West Greenland continental margin is very complex and still poorly known. The northern Baffin Bay is a key area for testing plate kinematic models for the Paleocene-Eocene motion of Greenland relative to North America and to decipher the evolution of the thick sedimentary basins in this area. Due to lack of data the plate bounday between the North America plate and the Greenland plate is not well defined and the nature of the ocean-continent transition zone is widely unknown. Distribution and stratigraphy of pre-Cenozoic and Cenozoic sedimentary basins influenced by crustal extension and compression in their temporal sequence need to be analysed.

In summer 2010 a multidisciplinary marine geoscientific expedition focussing on the Greenland part of northern Baffin Bay was performed under the direction of the Federal Institute for Geosciences and Natural Resources Hannover, Germany in cooperation with the Alfred-Wegener Institute Bremerhaven. Using 70 days ship time onboard the German RV Polarstern we were able to acquire a comprehensive data set along profiles extending from the deep oceanic basin in the central part of North Baffin Bay onto the Greenland continental margin in an area which was bordered by the Kane Basin in the North and Disco Island in the South. By means of multi channel seismic, wide angle seismic, gravimetric and magnetic methods the structural inventory of the crust in the NW Baffin Bay was investigated. Additionally, heat flow measurements were done and sediment cores for geochemical and geomicrobiological analysis were extracted at selected positions along lines across the Greenland continental to be used for basin modelling and for study the on hydrocarbon generation. Aeromagnetic data were acquired covering part of the marine survey area to investigate magnetic signatures of the oceanic crust and continental margin.

In our presentation we will give an overview of first results of the expedition with special focus on multi-channel seismic data, magnetic and gravity data. Initial interpretation of the 3500 line km multi- channel seismic data, more than 10.000 km of gravity and 30.000 line km of magnetic (including 10.000 km of aeromagnetic) data show that in the Baffin Bay West-Greenland has a typical passive continental margin with large rotated basement blocks, listric faults facing mainly seaward, and deep syn-rift-basins in between. A most prominent reflector is recognized under the shelf and the slope which could indicate the transition from rifting to drifting and therefore the beginning of seafloor spreading in the Baffin Bay, as suggested by erosion above the some basement blocks, subsidence along the slope area, and termination of the prominent reflector in the area of the ocean-continent boundary. The syn-rift sediments have been deposited during two phases and were imaged along several sections of the newly acquired seismic lines. The Quaternary and late Pliocene glacial deposits are characterized by prograding sequences on the western shelf and the upper slope. Some lines are showing that the north-north-west striking Melville Ridge is a compression structure generated by thrusting of Melville Graben sedimentary fill on the western edge of the graben. It is proposed in this presentation that the compression is caused by strike slip faulting active during the northward movement of Greenland in the second drift phase starting in the Eocene. The seismic and magnetic signatures allow identifying the continent ocean boundary. At some segments of the crustal margin the opening of the Baffin Bay could be associated with volcanic activity.