Geophysical Research Abstracts
Vol. 14, EGU2012-9608, 2012
EGU General Assembly 2012

The structure of Ellesmere Island – a 400 km long transect across the northern margin of North America

K. Piepjohn (1), W. von Gosen (2), and F. Tessensohn (3)

(1) Federal Institute for Geosciences and Natural Resources (BGR), Hannover, Germany (Karsten.Piepjohn@bgr.de), (2) Geo-Center of Northern Bavaria, University Erlangen-Nuremberg, Erlangen, Germany, (3) Adelheidsdorf, Germany

The margin of North America on Ellesmere Island is characterised by two major structural units. In the north, the exotic Pearya Terrane at the coast of the Arctic Ocean consists of Meso- and Neoproterozoic basement rocks and Paleozoic metasediments. The area between Pearya and the Greenland shield in the southeast is dominated by the several kilometres thick Franklinian Basin deposits of Neoproterozoic to Devonian age. During the Caledonian Orogeny, Pearya was partly affected by deformation and metamorphism, whereas the Franklinian Basin represented the passive Laurentian margin until Devonian times.

In the earliest Carboniferous, the northern passive margin of Laurentia was affected by Ellesmerian deformation caused by docking of the Pearya Terrane and. Between Pearya in the NW and Nares Strait in the SE, the Ellesmerian structures are dominated by a km-scale folding of the Franklinian Basin deposits. With some minor exceptions, the folds are characterized by subvertical axial planes and a corresponding cleavage. Transports were directed towards SE to SSE as indicated by displacements along several thrust. Between the boundary to Pearya in the NW and Nares Strait in the SE the Ellesmerian Fold-and-Thrust Belt is probably underlain by a regional compressional detachment in an estimated depth of 7 to 10 kilometres.

In contrast to the folding-dominated Ellesmerian deformation, the Eurekan (Early Tertiary) tectonic event in the Franklinian Basin is characterized by the formation of brittle thrust faults and strike-slip faults, which partly reactivated Ellesmerian thrust faults. Parallel to Nares Strait, up to 500 m wide, NNE-SSW trending sinistral strike-slip fault zones are exposed on northern Judge Daly Promontory. Towards SSW, at Cape Back, the strike-slip faults were reactivated by ESE-directed reverse faulting, and from Cape Lawrence towards Princess Marie Bay, Eurekan structures are dominated by large thrust zones. These carried km-thick sedimentary units of the Franklinian Basin over Paleocene conglomerates.

Northwest of the Hazen Plateau, several NE-SW trending thrust fault zones are affected by later dextral movements. In contrast to the faults along Nares Strait, these lateral displacements took place after the compressive phase. Along Ellesmerian reverse faults (e.g., Archer Fiord Fault Zone), the Ellesmerian cleavage is sometimes affected by Eurekan folding related to reactivation of thrusting during Tertiary times.

The transport directions along the Eurekan thrust zones are towards ESE and SE. They change between the end of Yelverton Inlet in the NW and Yelverton Lake in the SE. There, the Yelverton Pass Thrust Zone and Inlet Head Thrust show NW-directed transports. The latter is the northwesternmost compressional structure of the Eurekan deformation on Ellesmere Island. Eurekan fault zones between the Inlet Head thrust and the Arctic coast are mostly dextral structures.

The Eurekan deformation reactivated the Ellesmerian detachment and was restricted to distinct thrust and/or strike-slip zones only. The blocks between Eurekan fault zones were not significantly affected by Tertiary tectonics. It seems that the tight Ellesmerian folding of the Franklinian Basin deposits, that led to a shortening of approximately 50%, did not permit a refolding during the Eurekan overprint.