



Thermal imprints along conjugated continental margins in response to the opening of the northern North Atlantic - case studies from eastern North Greenland and western Svalbard

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Prior to break up of Greenland and Svalbard, the Wandel sea basin with Carboniferous to Cenozoic deposits formed in eastern North Greenland. These deposits were affected by the last major period of Arctic tectonism, the Eocene Eurekan deformation. Vitrinite reflectance data from late Cretaceous rocks along the east coast of North Greenland indicate unusual high thermal maturity in association with a swarm of quartz veins, which exceeds the thermal maturity associated with the Eurekan deformation further inland. This pattern is also observed in Cenozoic sediments further to the north as well as along the conjugated North Atlantic margin, in western Svalbard. However, cause and origin of the elevated heat flow indicated by thermal maturity values are not known so far and the timing is not well constrained. We test the hypothesis whether this pattern was established coevally along both margins of the North Atlantic and marks a post-Eurekan thermal event. Vitrinite reflectance data indicate temperatures high enough to reset low temperature chronometers, therefore we used apatite fission track (AFT) and (U-Th-Sm)/He (AHe) thermochronology to determine the age of the high thermal maturation and associated quartz veins formation.

Our data reveals a more complex thermal history than hypothesized:

For the eastern North Greenland margin thermal history modelling of the combined AFT and AHe ages indicates a pre-Eurekan phase of elevated heat flow between 72 Ma and 66 Ma causing the high vitrinite reflectance and the formation of the quartz veins in the late Cretaceous rocks. Additional petrographic and electron microprobe analysis reveals the growth of feldspar, hematite, amphibole, and tourmaline within the quartz veins. According to most paleogeographic reconstructions, northern Greenland was located to the south of Svalbard close to a volcanic province near Bear Island. Heating may thus be associated with incipient igneous activity of that area, related to initial North Atlantic opening. A second phase of elevated heat flow between 58 Ma and 52 Ma is indicated by thermal history modelling of the AFT and AHe ages from the Cenozoic rocks further north. This frames the timing of the initiation of the dextral displacement between Greenland and Svalbard and might be associated with heat transfer along the transform

fault from the active spreading centres in the North Atlantic and the Arctic Ocean.

Contrasting to the results of North Greenland, thermal history modelling of AFT and AHe ages from the Cenozoic rocks of western Svalbard reveals heating throughout the Eocene and onset of cooling only during the early Oligocene for the Svalbard margin. Thus, even though we cannot exclude a similar thermal history during the Paleocene to early Eocene, the eastern North Greenland and western Svalbard margins are characterized by a differential thermal evolution during the ~middle Eocene to Oligocene.

In conclusion, our data show that the thermal history of the conjugated continental margins along the northern North Atlantic is characterized by episodic heat flow variations predominantly controlled by oceanic plate tectonic processes.