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Episodic exhumation along the northern Canadian margin, with implications of the tectonic, geotectonic and environmental evolution of the Arctic from Paleocene to Oligocene times

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The Arctic history is characterized by high complexity with the Eocene Eurekan Orogeny representing one of the most important tectonic events. It resulted from plate re-organisation and opening of North Atlantic Ocean. Related to that, multiple and changing tectonic regimes affected the wider region, causing differentiated deformation in the different parts of the Arctic Ocean margin. Our study focuses on the area of northern Ellesmere Island (Canadian High Arctic), the northernmost land exposures studied so far. We investigate the temporal and spatial exhumation patterns along the western part of the Eurekan orogen in relation to the wider geotectonic settings. For this, we applied low-temprerature thermochronology (apatite fission track and (U-Th-Sm)/He) methods, along with palynological analysis from Paleocene to Early Eocene sedimentary deposits, and we correlate the results with the history of the spreading ridges in North Atlantic, as well as with climatic changes in the Arctic. Our data show that from Palaeocene to Oligocene, significant exhumation occurred along the Canadian Arctic margin. This was episodic, and highly differentiated from exhumation documented for southern Ellesmere Island. This difference may be well explained by considering our study area as part of a mega-transform-fault-system that extends all the way to Svalbard and NE Greenland. The activity of major strike-slip fault segments, according to the changing tectonic regimes, may have been responsible for increased exhumation and intermittent periods of quiescence. Since the Palaeocene, we distinguish four main periods of enhanced exhumation: (i) ~64-59 Ma (pre-Eurekan), related to crustal stretching and basin formation during the Paleocene, contemporaneously to the opening of the Baffin Bay / Labrador Sea; (ii) ~55 to 48 Ma (Eurekan I), related to strike-slip regime with continuation of deposition in the earlier formed Palaeocene basins, and controlled by the initiation of the Norwegian-Greenland Sea opening. Sediment deposition (that started already in the Palaeocene) occurred in a coastal swamp environment under a warm and humid climate that lasted into the Early Eocene; (iii) ~44 to 38 Ma (Eurekan II), again related to strike-slip movements, leading to rapid exhumation, and presumably to topography build-up and the rise of the Eurekan Belt, and inversion of the Palaeocene basins. This period coincides with the deposition of ice-rafted debris off East Greenland, and therefore we suggest the rise of the Eurekan belt was an important trigger for the formation of continental icecap(s) in Greenland during the Eocene and Oligocene. During this stage, collision between Greenland and the eastern Canadian archipelago may have caused slow-down of spreading rates in the Norwegian-Greenland Sea; and (iv) ~34 to 26 Ma (post-Eurekan), related to strike-slip movements, cessation of Labrador Sea/ Baffin Bay spreading, and unification of Greenland with the North American plate. We explain the cessation of rapid exhumation at ~26 Ma with continental separation between Northeast Greenland and Svalbard due to changes of the active spreading centres in the North Atlantic. This in turns caused decoupling of northern Ellesmere Island from strike-slip movements along the De Geer fault zone, eventually leading to the opening of the Fram Strait.