[PS]Structural Evolution of the North Margin of the Canadian Arctic Archipelago: A Passive Continental Margin Dominated by Eurekan Strike-Slip Tectonics*

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Abstract

The northern margin of the Canadian Arctic Archipelago towards the Amerasian Basin and the Alpha Ridge has been affected by a number of tectonic and magmatic events since late Early Cretaceous times due to the break-up of the Laurasian supercontinent. The location of the arising passive continental margin of North America is most probably the consequence of the formation of fault zones and grabens on Ellesmere Island (e.g. Mount Rawlinson, Lake Hazen and Feilden fault zones), North Greenland (Harder Fjord Fault Zone) and Svalbard (Lomfjorden and Billefjorden fault zones) after the Svalbardian/Ellesmerian deformation in the Earliest Carboniferous. Those pre-existing structures gave way for the final break-up of Laurasia during the Cretaceous/Tertiary plate-tectonic re-organisation of the Arctic and may be the explanation for the 2,500 kilometres long, linear trend of the present passive continental margin of North America between MacKenzie Delta in the SW and Northeast Greenland in the NE. The development of the present continental margin is characterized by the following succession of magmatic and tectonic events: i) intrusion of tholeiitic basaltic dikes between 123 and 97 Ma ago indicating an extensive or transtensive regime; ii) intrusion of the Wootton Intrusive Complex (WIC) 93 - 92 Ma ago; iii) km-scale vertical movements between 93 and 80 ma ago which uplifted the igneous rocks of the WIC to their present level; iv) extrusion of the Hansen Point Volcanic Complex 80 Ma ago; v) both sinistral and dextral tectonics along pre-existing, continent margin-parallel fault zones, post-Early Paleocene. Compared with the tectonic evolution of the Atlantic and Arctic oceans, the emplacement of the tholeiitic dikes (i), the Wootton Intrusive Complex (ii), and the vertical movements (iii) took place contemporaneously with the rifting in Labrador Sea. The extrusion of the Hansen Point Volcanics (iv) coincides with the onset of sea-floor spreading in southern Labrador Sea and rifting in Baffin Bay. The sinistral and dextral strike-slip tectonics (vi) affected both the Hansen Point Volcanics and the Tertiary sediments of the Eureka Sound Group and can be related to the onset of the Eurekan deformation and/or the onset of the separation of Lomonossov Ridge from Eurasia. However, two observations cannot be explained until now: i) the absence of tectonic and/or magmatic activity during the opening of the Amerasian Basin (136 – 130 Ma ago) and ii) the reason for the dextral regime along the SW-NE trending major fault zones parallel to the continental margin of Ellesmere Island.

Bundesanstalt für Geowissenschaften und Rohstoffe

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Structural evolution of the north margin of the Canadian Arctic Archipelago: a passive continental margin dominated by Eurekan strike-slip tectonics

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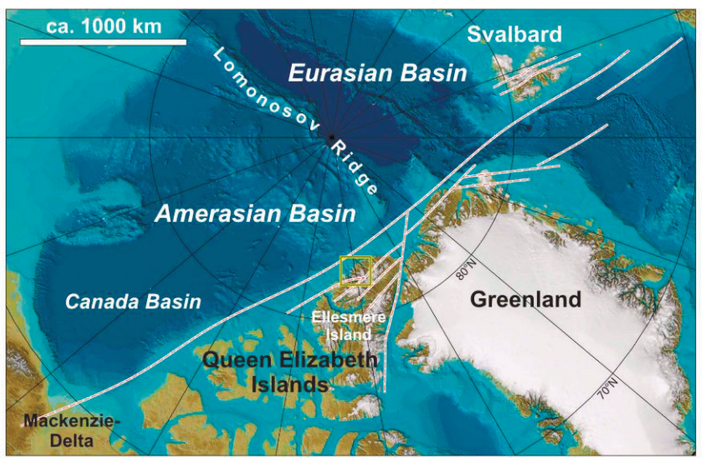
The present Arctic margin of North America has been affected by a number of tectonic and magmatic events since late Early Cretaceous times. The location of the arising passive continental margin of North America is most probably the consequence of the formation of fault zones on Ellesmere Island (e.g. Mount Rawlinson, Lake Hazen and Feilden fault zones), North Greenland (Harder Fjord Fault Zone) and Svalbard (Lomfjorden and Billefjorden fault zones) after the Ellesmerian deformation in the Earliest Carboniferous.



The linear passive continental margin of North America and location of the most important fault zones

The pre-existing fault zones probably gave way for the final break-up of Laurasia during the plate-tectonic re-organisation of the Arctic in Cretaceous/Tertiary times and may be the explanation for the 2,500 km long, linear trend of the present passive continental margins of North America between the Mackenzie Delta in the SW and Northeast Greenland in the NE and the Barents Shelf west of Svalbard.

The development of the present continental margin of North America is characterized by the following succession of magmatic and tectonic events:

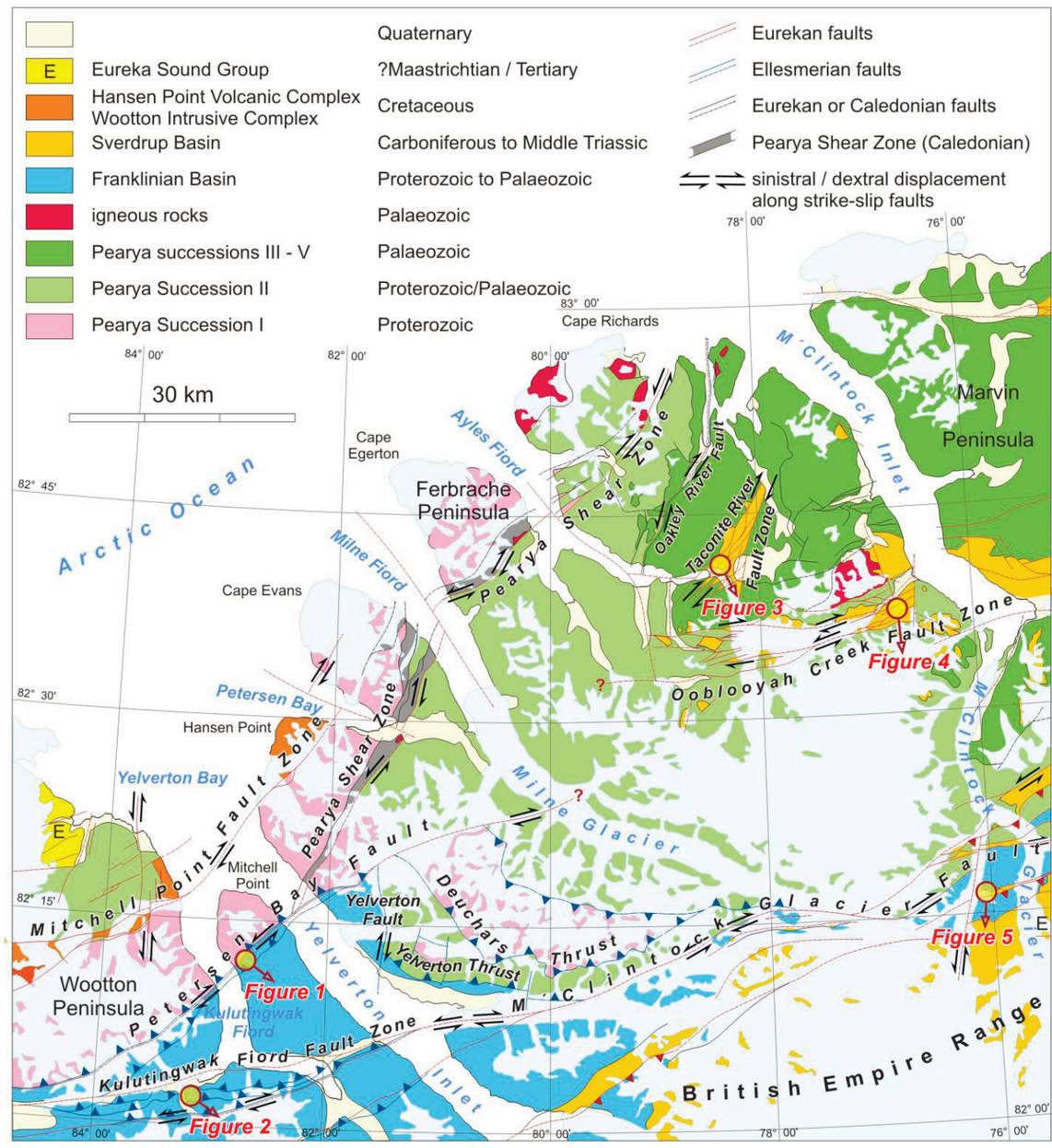
i) intrusion of tholeiitic basaltic dikes between 123 and 97 Ma ago;

ii) intrusion of the Wootton Intrusive Complex (WIC) 93 - 92 Ma ago;

iii) km-scale vertical movements between 93 and 80 ma ago which uplifted the igneous rocks of the WIC to their present level;

iv) extrusion of the Hansen Point Volcanic Complex 80 Ma ago;

v) both sinistral and dextral tectonics along pre-existing, continent margin-parallel fault zones, post-Early Paleocene.



Geological Map of the southwest part of the Pearya terrane and the characteristic large sinistral and dextral fault zones

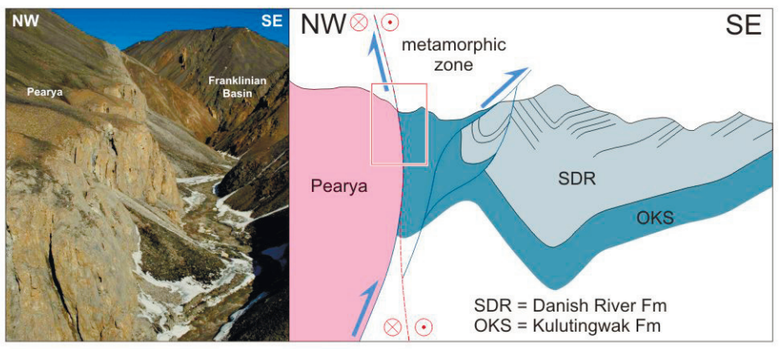


Fig. 1: Ellesmerian plate-boundary between North-America and Pearya (Petersen Bay Fault)

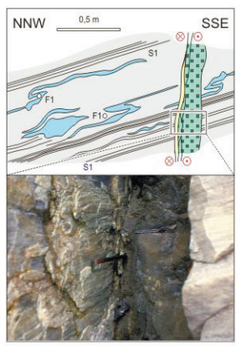


Fig. 2: Cretaceous dyke with dextral slickensides

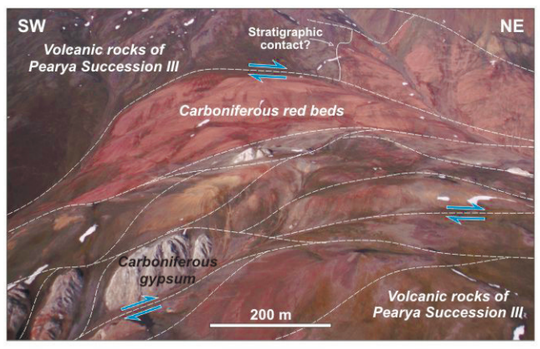


Fig. 3: Dextral faults along the Taconite River Fault Zone

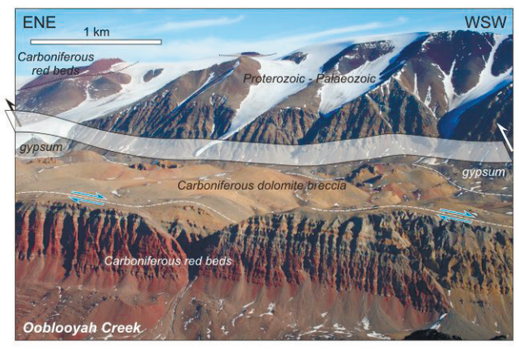


Fig. 4: Carboniferous dolomite and red beds within the Ooblooyah Creek Fault Zone

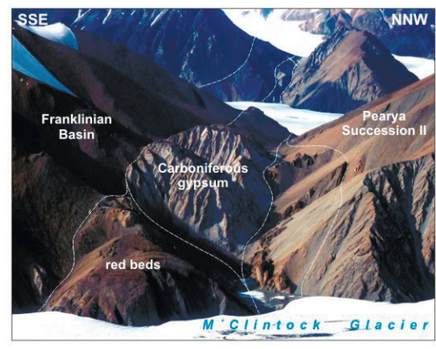
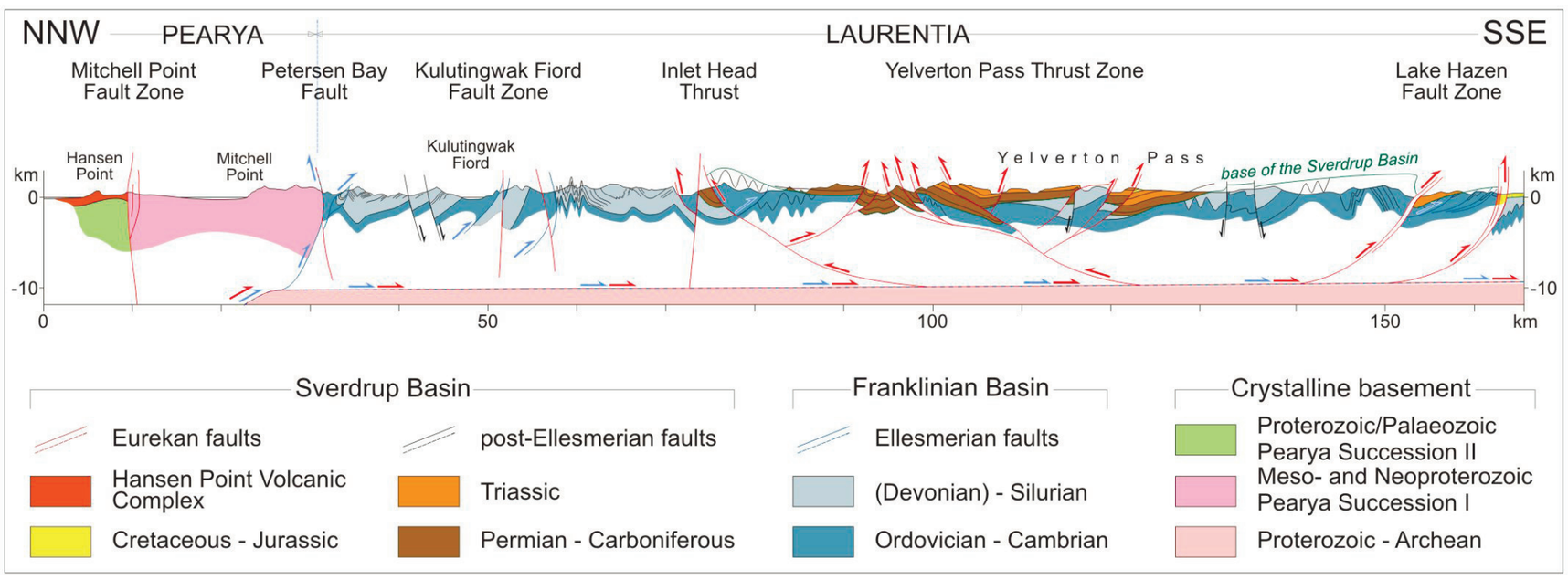
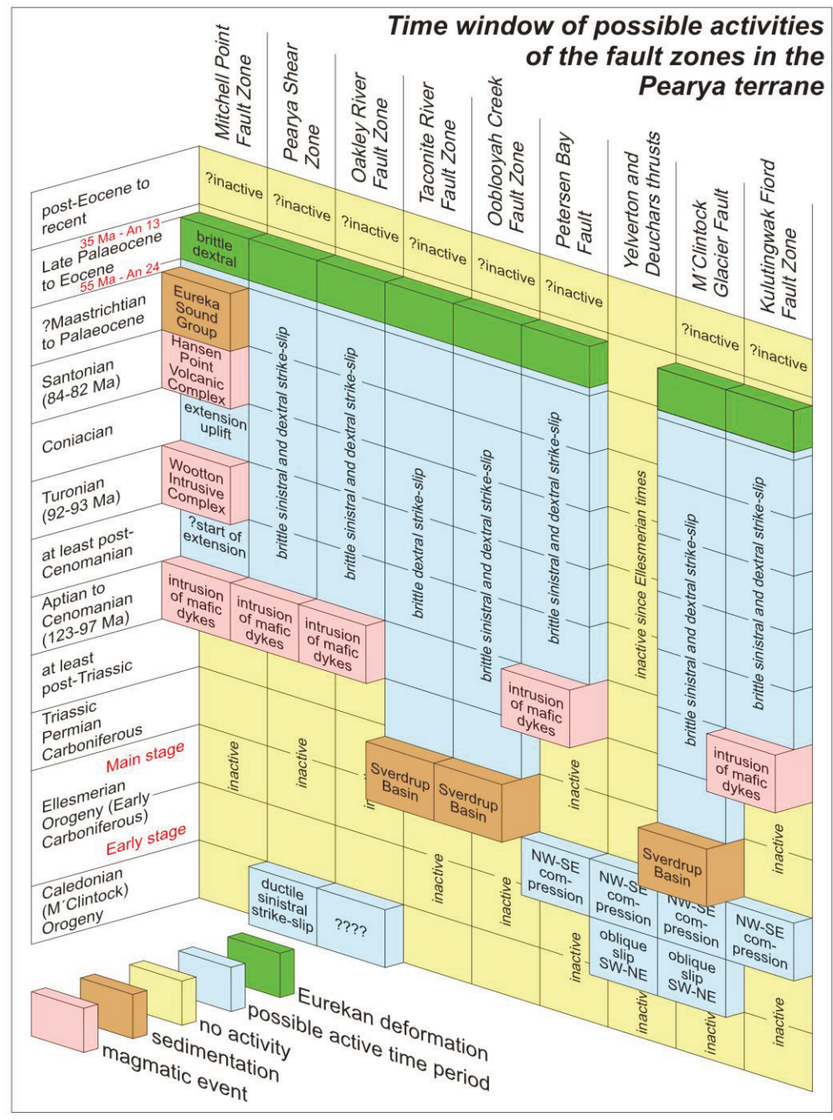


Fig. 5: Carboniferous gypsum within the M´Clintock Glacier Fault

Compared with the tectonic evolution of the Atlantic and Arctic oceans, the emplacement of tholeiitic dikes (i), the Wootton Intrusive Complex (ii), and the vertical movements (iii) took place contemporaneously with rifting in Labrador Sea. The extrusion of the Hansen Point Volcanics (iv) coincides with the onset of sea-floor spreading in south Labrador Sea and rifting in Baffin Bay. The sinistral and dextral strike-slip tectonics (vi) affected both the Hansen Point Volcanics and the Tertiary sediments of the Eureka Sound Group and can be related to the onset of the Eurekan deformation and the onset of the separation of Lomonossov Ridge from Eurasia.



Cross section through the north part of Ellesmere Island



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