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Correlation of stratigraphy, structure, metamorphism and intrusion in the Caledonian allochthons of East Greenland and Svalbard

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There are two main hypotheses for the relationships between the Greenland and Svalbard Caledonides. The one regards the Svalbard "terranes" to be a natural, along-strike (via the continental shelves) continuation of the northeast Greenland allochthons, with a minor component in southwest Spitsbergen of rock units with affinities to the Ellesmerian Orogen and Pearya. The other hypothesis regards Svalbard as an assembly of lithospheric fragments that have been moved thousands of kilometres along the axis of the Caledonide Orogen from more southerly latitudes.

It has long been accepted that the Neoproterozoic to Early Paleozoic successions in the Caledonides of north-eastern Greenland and on Nordaustlandet, eastern Svalbard, are closely comparable in stratigraphy, depositional environment and structure and are unambiguous parts of the Laurentian continental margin.Their close correlation provides the foundation for the interpretation that they were deposited adjacent to each other and subsequently separated by vast (1000 km plus) displacements on orogen-parallel sinistral transcurrent faults. Studies of their underlying metamorphic complexes (the Renlandian Orogen in the Hager Berg Allochthon of northeast Greenland and the Nordaustlandet Orogen of northeastern Svalbard), demonstrated that they had very similar histories: latest Mesoproterozoic to earliest Neoproterozoic siliciclastic deposition, followed by mid Tonian deformation, HT/LP metamorphism, migmatization and syn- to post-tectonic granite intrusion (c. 950-930 Ma). On Nordaustlandet, major unconformities and some calc-alkaline volcanics, separate this late Grenvillian "basement" complex from the overlying Cryogenian succession; in northeast Greenland, unconformity is inferred, but has yet to be demonstrated.

Another aspect of the geological history of these two "terranes" is that their Caledonian tectonothermal histories are also remarkably similar, with early to mid Silurian HT/LP metamorphism and migmatization and associated granite intrusion. In northeastern Greenland, the Hager Berg Allochthon, and overlying nearly 20 km thick Neo-proterozoic and Early Paleozoic succession, was emplaced hot, at least 150 km westwards during the mid to late Silurian (perhaps Devonian) over the underlying Niggli Spids Complex and the latter, notably lacking the Silurian granites, was thrust at least a further 100 km westwards over the partly allochthonous Laurentian basement and its Cambro-Ordovician cover. Emplacement of the Caledonian allochthons in northeastern Greenland continued during Devonian deposition of the overlying Old Red Sandstone successions.

Although the Svalbard Caledonides are disrupted by at least three major N-trending, orogen-parallel fault-zones, with vertical displacements of several kilometres and, locally, some clear evidence of sinistral strike-slip movements and orogen-parallel extension, there can be little doubt that the overall Caledonian structure of the archipelago, as in northeast Greenland, is dominated by long-transported allochthons. Those authors favoring strike-slip displacements of thousands of kilometers for the assembly of Svalbard′s Caledonian "terranes" need to explain how these movements can be accommodated within the Baltica-Laurentia collisional framework. However, subordinate sinistral strike-slip displacements are necessary to explain the juxtaposition of the allochthons of northeast Greenland affinities with the co-called "Southwestern Terrane" of westernmost Spitsbergen. The latter shares some of the characteristics of the Pearya Terrane of northernmost Canada (Ellesmere Island). Tectonic extrusion, as in the Himalaya- Tibet Orogen, provides a suitable analogue.