Precambrian and Palaeozoic development of northern Greenland

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Abstract

Regional Proterozoic and Palaeozoic structural and stratigraphic trends in northern Greenland form a subrectilinear pattern flanking the crystalline Greenland shield (Fig. 1). The shield forms a core that is bordered on three sides by sedimentary basins; the intracratonic Thule basin of Proterozoic rocks on the west, the North Greenland geosyncline (Proterozoic to Devonian) on the north and the East Greenland geosyncline (Proterozoic to Silurian) on the east. The regional trends in each basin conform to the general configuration of the subcontinent.

The Thule basin and the North Greenland geosyncline have westerly extensions in adjacent Ellesmere Island and this indicates the close juxtaposition of Greenland and Canada north of 76° N in late Precambrian and Palaeozoic time. Recent geological and geophysical data from the Nares Strait region places restraints on overall transcurrent movement between Greenland and Ellesmere Island. Pre-drift fits that show Ellesmere Island and Greenland widely displaced are not in agreement with the regional geology.

Post-Archean earth movements of three main ages affected northern Greenland: late Proterozoic, Palaeozoic, and late Phanerozoic (Fig. 2). The Proterozoic movements produced graben and block fault tectonics in the Thule basin and folding and metamorphism in East Greenland. The Palaeozoic movements deformed the North and East Greenland geosynclines into orogenic belts of contrasting styles defined by a dominant northerly sense of tectonic transport away from the platform in the northern belt and a westerly directed thrusting towards the platform in the eastern belt (Table 1). The orogenic movements were initiated at various times: middle to late Ordovician in central East Greenland, Silurian and ?younger in northern East Greenland, and Devonian and ?younger in the North Greenland geosyncline.

The North Greenland fold belt is regarded as a marginal compressional structure of a Palaeo-Arctic ocean involving interaction of oceanic and continental crust. The East Greenland fold belt, as part of the circum-Atlantic Caledonian orogenic system, is generally thought to be the result of contraction of a Palaeo-Atlantic ocean, involving collision of opposing continental margins with their accreted geosynclinal tracts. The E–W compression causing intense folding and thrusting in East Greenland spanned some 60 m.y. from late Ordovician to latest Silurian and Devonian. This diastrophism transgressed northwards as indicated by the contrasted stratigraphical record between the segments of the fold belt north and south of latitude 76° N. The stratigraphical record and timing of orogenesis in the northern segment of the East Greenland fold belt and the North Greenland fold belt show certain similarities and it is suggested that both orogenic belts (which both show certain geological similarities to Svalbard) may be part of a single orogenic system linked with the Lomonosov Ridge.

The junction of the two orogenic belts in the north-east corner of Greenland became the site of a regional depression, the Wandel Sea basin, in late Palaeozoic time. This basin contains a late Palaeozoic, Mesozoic and Tertiary sedimentary sequence and is now a NW-trending tectonic zone.

Table 1

Summary diagram illustrating the nature and timing of the mid-Palaeozoic orogeny in the North and East Greenland fold belts.

		North Greenland fold belt	East Greenland fold belt	
			76° N to 82° N	70° N to 76° N
Sedimentary regime	Age of youngest known geosynclinal strata	Lower Devonian (Gedinnian)	Upper Silurian (Ludlovian)	Middle or ?Upper Ordovician
	Age of oldest known post-orogenic strata	Upper Carboniferous (late Pennsylvanian)	Lower Carboniferous (Mississippian)	Middle Devonian (Givetian)
Tectonic regime	Direction of main tectonic transport	North towards the Arctic Ocean	West away from the Atlantic Ocean	
	Character of fold belt margin	Autochthonous – gradual incoming of structural elements	Allochthonous – thrust and nappe front	
	Tectonic status of platform	Hinterland	Foreland	

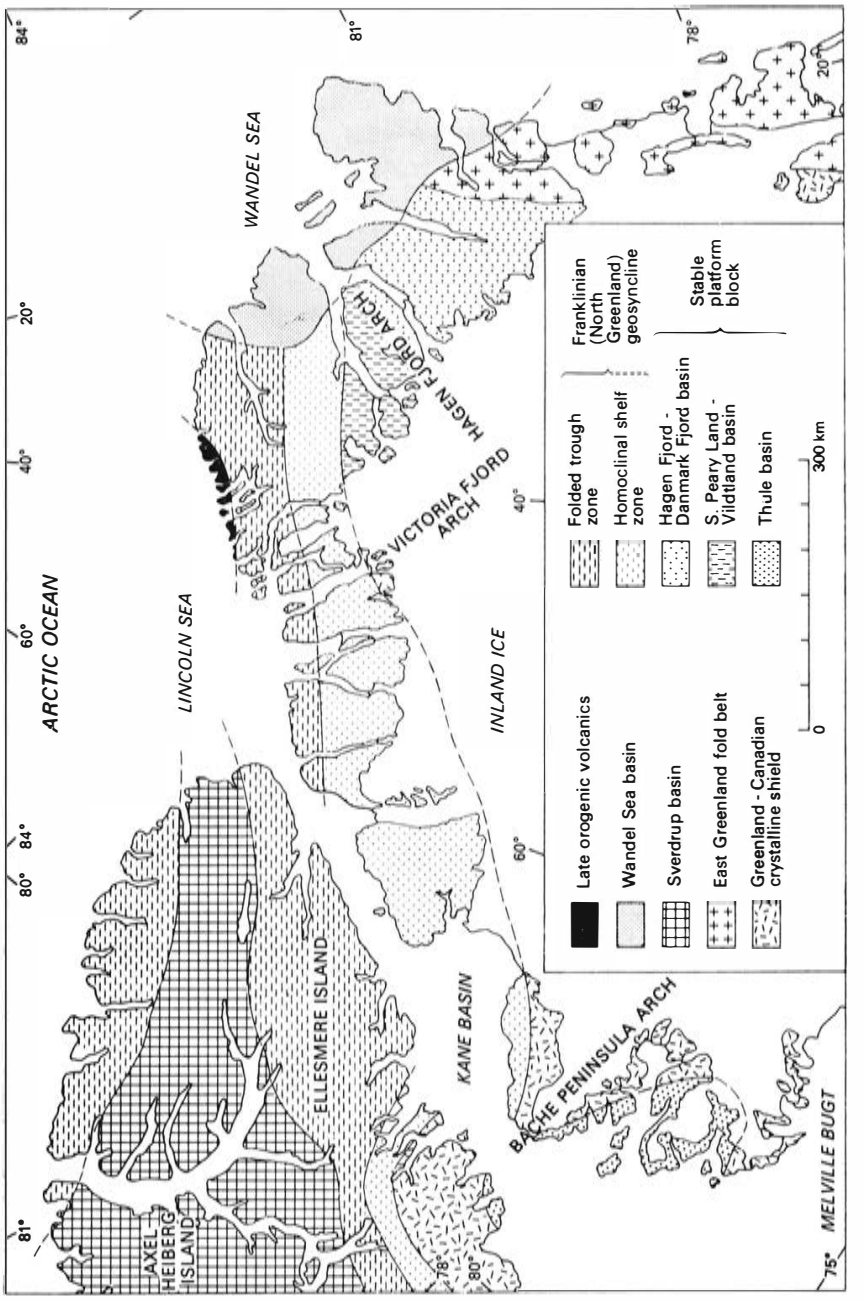

Fig. 1. *Main stratigraphical-structural units of northern Greenland and adjacent Canada.*

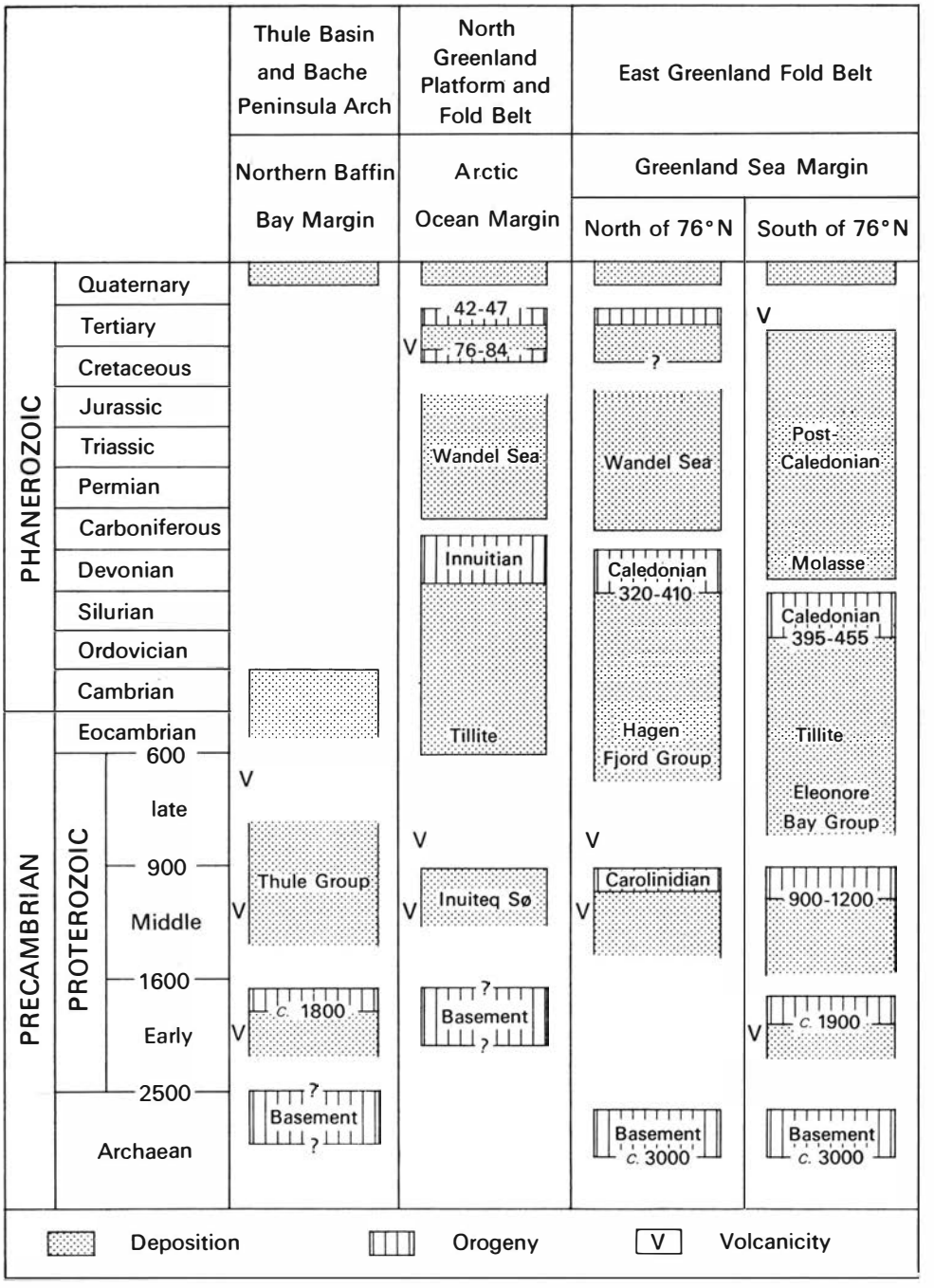

Fig. 2. *Chronological chart illustrating the main depositional. orogenic and volcanic events of northern Greenland.*