Mineral potential of the Thule Basin

The intracratonic Thule Basin straddles northern Baffin Bay and has its largest part submerged. The most extensive onshore exposures are on the Greenland side. The basin is one of several Proterozoic depocentres on the northern rim of the North American craton with comparable development histories: thick sandstone and basalt units in lower levels, often with red beds, are succeeded by carbonate/shale-dominated sequences. Two of these basins are the Athabasca Basin of northern Saskatchewan and the Borden Basin of northern Baffin Island, both known for their economic mineralisation, U and Pb-Zn, respectively.

Geology and mineralisation

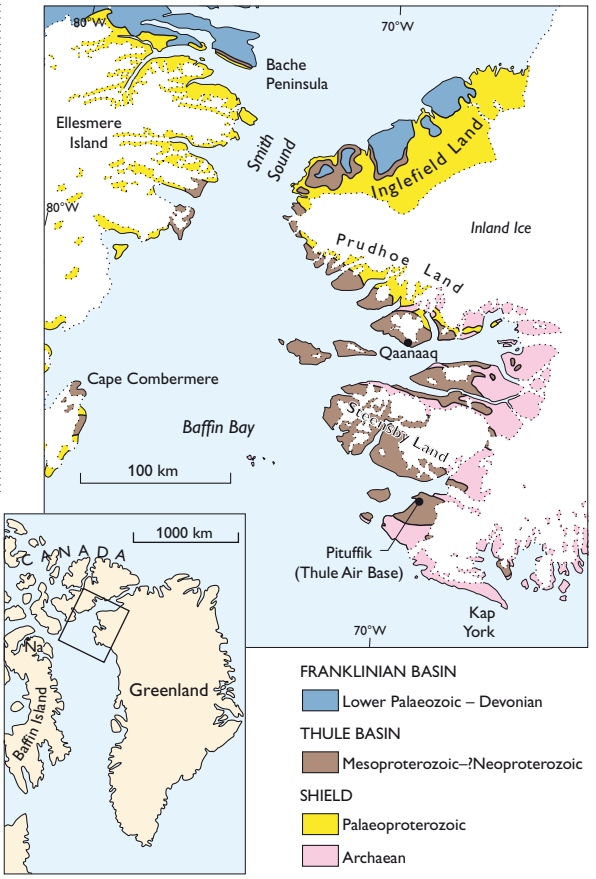
The Thule Basin was mapped in the 1970s. It has seen little commercial exploration but in Greenland intermittent economic reconnaissance was performed 2001–07 by GEUS. The bedrock of the Thule region is dominated by two Precambrian provinces: a high-grade Archaean –Palaeoproterozoic crystalline shield overlain by the unmetamorphosed Mesoproterozoic–?Neoproterozoic strata of the Thule Basin (Thule Supergroup). The profound unconformity between these two provinces is well preserved through the region. To the north, the Super-group is disconformably overlain by the Lower Palaeozoic Franklinian Basin. The Thule Supergroup is a 6–8 km thick multicoloured, continental to shallow marine sequence with one main interval of terrestrial basaltic rocks. Basic sills are common at several levels. The strata are little deformed occurring as shallow-dipping packages in fault blocks.
Five groups are recognised:

Smith Sound Group. This group is up to 700 m thick and represents the northern basin margin sequence. It is composed of varicoloured sandstones and shales, including red beds, with subordinate stromatolitic carbonates.

Nares Strait Group. Up to 1200 m thick, this group represents the oldest strata of the central basin. It is dominated by sandstones with one main interval of tholeiitic volcanics including flows, sills and volcani clastic deposits. The succession represents deposition in alluvial plain, littoral and offshore environments. Malachite, chalcocite and hematite occur as coatings and blebs in various volcanic rocks anomalous in Cu, Ag and Ba. Further, drainage geochemistry indicates a gold potential in the volcanics.

Baffin Bay Group. This group, up to 1300 m thick, consists of shallow water, multicoloured siliciclastic rocks:sandstones and quartz-pebble conglomerates, with important intervals of shales and siltstones, representing mixed continental to marine shoreline environments, with syn-depositional faulting. Malachite staining on pale sandstones in red-bed sequences is widespread with pyrite, chalcopyrite, bornite and chalcocite occurring as flecks and disseminations.

Dundas Group. This 2–3 km thick package is composed of sandstones, siltstones and shales with lesser amounts of carbonate and evaporite. Deposition was in an overall deltaic to offshore environment. Dark shales can contain stratiform pyrite, and minor sphalerite occurs in a se-quence of interbedded shale and limestone. Neopro-terozoic sills and dykes unusually rich in titanium are the source of placer ilmenite on the south coast of Steensby Land where heavy mineral sands on active and uplifted beaches have grades of c. 43% TiO_2 and c. 12% TiO_2, respectively. Sediment/sill and sediment/dyke contacts are characterised by rusty weathering caused by pyrite, chalcopyrite, galena and sphalerite occurring in thin quartz-calcite veins, lenses and pods in both sediments and dolerites.



Geological map of the Thule region. Na = Nanisivik.

The landmark of the Thule region, table mountain Dundas Fjeld (Uummannaq) 225 m high. Dundas Group is capped by a Neoproterozoic Franklinian basalt sill.

Narssârssuk Group. This group represents the youngest strata. It is 1.5–2.5 km thick composed of dominantly fine-grained carbonate–red bed siliciclastic rocks with evaporites representing cyclic deposition in a low energy, hypersaline, peritidal environment.

Regional structures

The entire basin is dissected by the Thule half-graben system dominated by WNW–ESE-trending faults. Along master faults displacement of several kilometres has taken place. The faults can show hydrothermal alteration and be mineralised with quartz, barite, pyrite and chalcopyrite – and drainage geochemistry indicates a potential for gold. This mineralisation is probably associated with the Franklinian Neoproterozoic magmatic episode, well known from Arctic Canada.

Mineral potential

The following deposit types are the most obvious exploration targets:

1. *Unconformity-associated U (-Ni-Co-Au).* The unconformity at the base of the Thule Basin provides a target for this type of mineralisation.
2. *Red-bed type Cu*. Red-bed Cu mineralisation occurs both in the volcanic rocks of the Nares Strait Group and in fluviatile–continental sandstones of the Baffin Bay Group. The volcanic rocks have an additional potential for gold.
3. *Shale-hosted Pb-Zn (SEDEX type).* Pyrite-sphalerite-bearing sequences of alternating black shale and stromatolitic limestone of the Dundas Group could host stratiform Pb-Zn deposits.
4. *Carbonate-hosted Pb-Zn (MVT type).* The Narssârssuk Group is lithologically comparable and a time equivalent to part of the Bylot Supergroup of the Borden Basin, Baffin Island, that hosts the Nanisivik Pb-Zn deposit. The Thule strata thus have a potential for similar MVT deposits.
5. *Contact/Skarn-hosted Cu, Pb, Zn.* The base metal mineralisation associated with sills and dykes of the Dundas Group has a limited tonnage poten tial. It should, however, be tested for gold.
6. *Vein-type Au.* Hydrothermal veins hosted by the WNW–ESE-trending regional faults cutting both the shield and the Thule Basin have a potential for Au mineralisation

Concluding remarks

Given the relatively unexplored character of the region, the Thule Basin seems to offer excellent exploration targets for a number of commodities, especially Zn, Pb, Cu, Au and U.

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