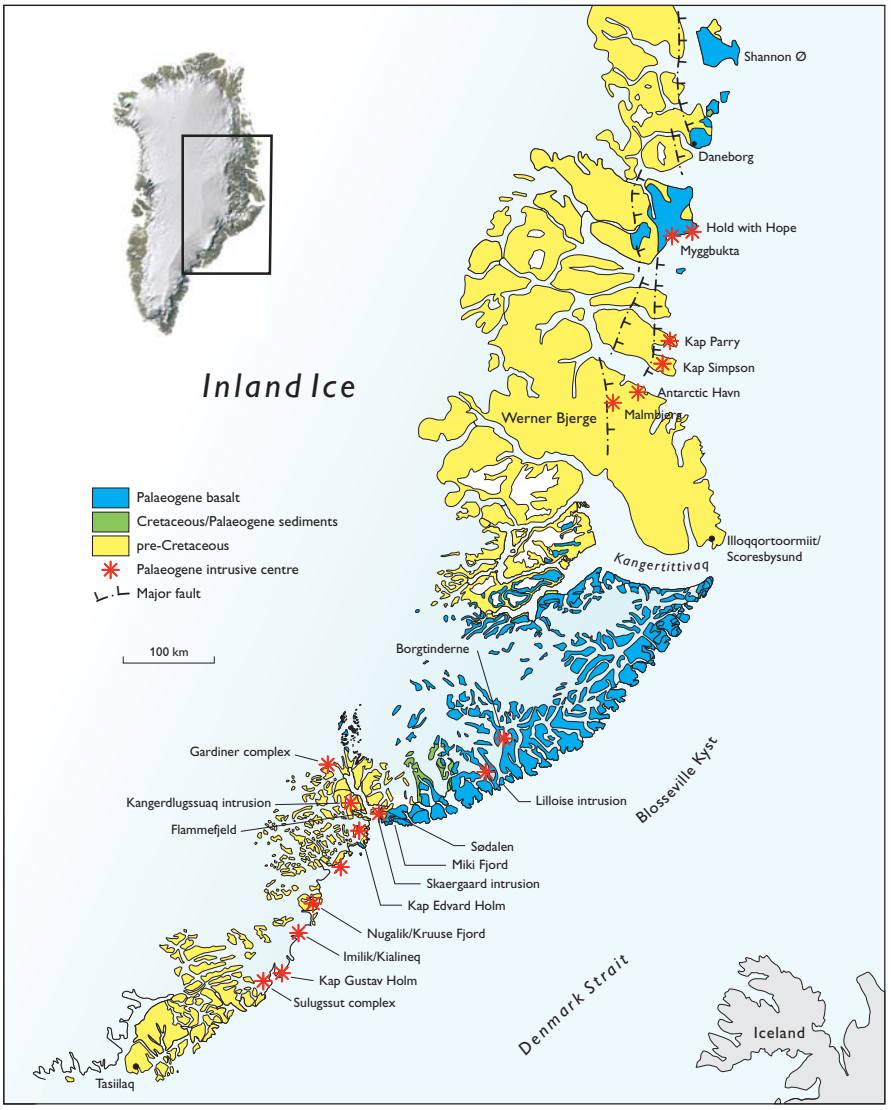
The mineral potential of the Palaeogene intrusions, East Greenland

More than sixty intrusions are catalogued in the Palaeogene East Greenland volcanic rifted margin. The plutonic suites range from ultramafic to felsic, from depleted basaltic to highly alkaline, and from upper crustal intrusions to subvolcanic centres and breccia pipes with related epithermal vein systems. The East Greenland magmatism lasted from 61 to 13 Ma. The Skaergaard PGE and gold deposit and the Malmbjerg molybdenum deposit have the potentials to become world-class size deposits.

Geological setting

The East Greenland volcanic rifted margin developed prior to, during and after the onset of seafloor spreading in the North Atlantic. Picritic to basaltic lavas erupted locally in Palaeocene (61-57 Ma) and were followed (57-54 Ma) by up to 5 km thick regional flood basalts. They correlate across the early North Atlantic to the Faeroe Islands. The flood basalts are preserved between Kangerlussuaq and Kangertittivaq (Scoresby Sund) (68°-70°N) and are in part overlain by 13 Ma old lavas. Major sill complexes occur in Mesozoic to Paleocene sediments below the lavas.



Map of the Palaeogene igneous province, East Greenland.

A large domal uplift at the Kangerlussuaq Triple Junction (68°N) signals the surfacing of the proto-Iceland plume (55-50 Ma). Early picritic lavas show strong similarities to Hawaiian lavas, whereas overlying flood basalts show Icelandic affinities. The transition from intra plate to spreading ridge magmatism is illustrated.

Coast-parallel dyke swarm systems are mostly related to magmatic centres dotted along the East Greenland coast. Deep erosion has exposed a number of magmatic centres south of 68°N. They comprise early gabbros - some with PGE and Au mineralisations, followed by intermediate to felsic intrusions. The volcanic cover is not preserved north of Kangertittivaq (70°-73°N), where large sill and dyke systems intrude Mesozoic sediments. A large number of mostly felsic intrusives and subvolcanic complexes are exposed between 72° and 74°N - some with molybdenum accumulation. Flood basalts to the north of the province (73°-75°N) host a few subvolcanic basaltic to felsic complexes, and underlying sediments are intruded by picrite and basalt sills.

Inland intrusions and lavas are alkaline to highly alkaline, and include a carbonatite-bearing complex.

Exploration history

Regional mapping (1930s to 1960) north of Kangertittivaq (70°-73°N) led to the discovery of several mineral occurrences. The Malmbjerg molybdenum deposit was the main focus between 1950 and 1970 and again from 2004.Other felsic intrusions along the East Greenland coast show signs of mineral accumulation, but no other deposits are located. Veins with precious and base metals are common.

Skaergaard intrusion. A view to Gabbrofjeld and Wagertoppen (1200m) in the northern part of the intrusion.

The Blosseville Coast (70°-68°N) has been subjected to prospecting, whereas the intrusions at Kangerlussuaq (68°N) and down the coast to Nugalik (67°N) have seen more exploration (1969-1971 and 1987-1991). The Skaergaard intrusion was in 1987 recognised as a large low-grade platinum group element-gold deposit. Many other mafic intrusions show signs of platinum group element mineralisation.

Main types of mineralisation

Stratiform PGE and Au mineralisation:
The Skaergaard intrusion (68°N) and the Kap Edvard Holm Complex (68°N) are representatives. Mineralisation is caused by sulphur saturation. Drilling in the Skaergaard intrusion has delineated a 1500 million tonne multi-element (platinum group elements, gold, silver, copper, titanium and vanadium) occurrence. The Kap Edvard Holm complex contains large tonnage, low-grade, stratiform platinum group element-gold horizon.

Contact-related and sulphide-hosted PGE mineralisation:
The Kruuse Fjord intrusion (67°N) and Miki Fjord Macrodyke (68°N) are representatives. Sulphides rich in platinum group elements are found at contacts between mafic intrusive units and basement or other intrusive units.

Porphyry-related molybdenum mineralisation:
The Malmbjerg granite stock and Flammefjeld are representatives of classic stockwork type occurrences in late felsic intrusions. The Malmbjerg deposit is estimated to contain approx. 200 million tonnes of ore grade. Flammefjeld has not been drilled. Several other intrusions show molybdenum mineralisation and may offer potentials.

Epithermal vein deposits:
Faults and shear zones along the East Greenland coast and related to intrusive complexes, which host hydrothermal gold, silver, and lead bearing systems. The Tågegang vein and Yellow Zone, both related to the Flammefjeld molybdenum prospect (68°N), have high lead, gold and silver contents. Large regional, fault controlled, hydrothermal vein systems are only sporadically tested.

The inland carbonatite-bearing ultramafic alkaline Gardiner complex hosts large ring dyke systems composed of apatities with > 50% apatite.

Based on research and exploration carried out so far, it is generally accepted that the Skaergaard platinum group element and gold deposit as well as the Malmbjerg molybdenum deposit have the potential to become world-class size deposits.

Key references

Escher, A. & Watt, W.S. (eds): Geology of Greenland, Copenhagen: Grønlands Geologiske Undersøgelse, 603 pp.

Harpøth, O., Pedersen, J.L., Schønwandt, H.K. & Thomassen, B. 1986: The mineral occurrences of central East Greenland. Meddelelser om Grønland, Geoscience **17**, 139 pp.

Nielsen, T.F.D. 1987: Tertiary alkaline magmatism in East Greenland: a review. In: Fitton, J.G. & Upton, B.G.J. (eds): Alkaline igneous rocks. Special Publication, Geological Society of London **30**, 489-515.

Nielsen, T.F.D. 2002: Palaeogene intrusions and magmatic complexes in East Greenland, 66° to 75°N. Danmarks og Grønlands Geologiske Undersøgelse Rapport 2002/**113**, 249 pp.

Nielsen, T.F.D., Andersen, J.C.Ø. & Brooks, C.K. 2005: The Platinova Reef of the Skaergaard intrusion. In: Mungall, J.E. (ed.): Exploration for Platinum-Group Element Deposits. MAC Short Course **35**, 431-455. Ottawa: Mineralogical Association of Canada.

Bureau of Minerals and Petroleum (BMP)
Government of Greenland
P.O. Box 930
DK-3900 Nuuk
Greenland

Tel: (+299) 34 68 00
Fax.: (+299) 32 43 02
E-mail: bmp@gh.gl
Internet: www.bmp.gl

GEUS

Geological Survey of Denmark and Greenland (GEUS)
Øster Voldgade 10
DK-1350 Copenhagen K
Denmark

Tel: (+45) 38 14 20 00
Fax.: (+45) 38 14 20 50
E-mail: geus@geus.dk
Internet: www.geus.dk

Author:
T. F.D. Nielsen
Editor: K.Secher
Layout: GEUS, Grafisk

ISSN: 1602-8171