

Greenland's prospective nickel resources

The potential for nickel resources in Greenland is conspicuous and encompasses mineralisation from Precambrian to Palaeogene environments. Nickeliferous sulphides were noted already in the inter-war period and have appeared in Survey reporting since the 1950s. The discovery of the Voisey's Bay deposit in Labrador in 1994 revived the nickel exploration world-wide, not least in Greenland. For decades the detection of Ni has been an accepted aid in the PGE exploration. Likewise, to day Ni-exploration can benefit from the increased search for PGEs in Greenland.

Geological environments

Traces of nickel accumulations are numerous, in the Precambrian terrain located within the Archaean craton as well as in the Palaeoproterozoic orogenic belts.

The Archaean in South-West Greenland hosts anorthositic suites like the Fiskenæsset Complex south of Nuuk, which represents a metamorphic mafic complex, with accumulation of chromite and to a lesser degree of Ni-rich sulphide segregations. Additionally, the Archaean shield north of Nuuk is the host of the Maniitsoq norite belt carrying occurrences of Ni-Cu-sulphides. South of the norite belt a number of large ultramafic bodies and layered mafic complexes locally show signs of Ni-enrichment.

After the discovery of the Voisey's Bay world-class deposit of Ni-Co sulphides in Canadian northern Labrador in 1994 much effort has been performed in order to look for similar deposits in Greenland. A correlation across the Davis Strait with specific emphasis on settings resembling the Palaeoproterozoic Voisey's Bay deposit is considered. Although the correlation is generally accepted, there has so far been no break in locating similar sulphide bodies on the Greenland side. However, the exploration carried out by several companies since the mid-1990s is not yet completed and a number of prospects have turned up. Previous knowledge about Ni-sulphides on the Greenland side has also been reconsidered in the light of this correlation view.

Palaeogene Ni-sulphide accumulations are confined to the West Greenland Basalt Province, where exploration has been carried out in many years. Known occurrences are mainly hosted in presumably sediment-contaminated lava and dykes at the base of the basalt sequence in



Nickel exploration and drilling in the neighbourhood of Illukunnguaq on the Disko Island, West Greenland.

the Disko region. Moreover, the basalt region is generally looked upon as having a large potential for Ni-occurrences. Similar environments in East Greenland are investigated briefly for potential Ni-resources.

Archaean settings

Qeqertarsuaat: *Fiskenæsset Complex*. Chromitite layered anorthosite, covering 4000 km². Associated amphibolite has average Ni-content of 0.04%

Sillisanguit Nunaat: *Maniitsoq norite belt*. A number of bodies of basic igneous rock situated in a 15 x 75 km tract. Dominating rocks are leucogabbro-norite, locally with massive sulphide segregations. Ni-content of the mineralised rocks is up to 2 %.

Fiskefjord: *Mafic and ultramafic intrusions s.l.* Isolated bodies of ultramafics are scattered in the basement, locally with sulphides and up to 0.3% Ni. Investigation of layered mafic complexes with unknown Ni-potential is approaching.

Vestfjord: *Mafic rocks*. Supposed Archaean hosted suite of sulphide-bearing mafic and ultramafic rocks locally with elevated Ni-content of 0.3–2%. cursory investigation of earlier observations supplied limited information on type and setting.

Palaeoproterozoic settings – The Nagssutoqidian Orogen

Kakillattooq: *Nickelliferous sulphides in drill cores*. Mineralisation in stringers with up to 30 vol% of sulphides in amphibolitic sequences within reactivated basement. Maximum Ni-content of 0.67% from drill coring in 150 x 300 m geophysical target. No outcropping.

Arfersiorfik: *Company reports of Ni-traces*. Early reports of discrete Ni-arsenide mineralisation with up to 0.25% Ni. Recent exploration in areas with supracrustal sequences containing several pods of ultramafics along the Nordre Strømfjord failed to locate magmatic nickeliferous sulphides. However, Ni-values of the ultramafics are in the range 0.2-0.3%.

Tasiilaq: *Ammassalik Igneous Complex*. An igneous diorite complex comprised of three plutonic centres is exposed for more than 500 km². Recent exploration reports average Ni-values of around 1% from a couple of sulphide lenses, traceable for several km along the contacts of the complex.

Palaeoproterozoic settings

– The Ketilidian Orogen (and younger deposits)

Amitsoq: *PGE-Ni-sulphides in ultrabasic rocks*. Peridotitic dyke and sill bodies contain zones up to 1.5 m with a concentration of various sulphides including pentlandite. The ultramafics are suggested to be a part of an appinite suite found throughout the Ketilidian. Ni-analyses indicate contents of up to 0.07%.

Stendalen: *Layered gabbro complex*: Sulphide accumulations in assumed rafts within a sequence of a sheet-like layered gabbro complex, covering at least 2–4 km². Rusty zones traceable for 2 km or more with disseminated sulphides carry up to 0.5% Ni.

Ilimmaasaq: *Nickeliferous ore minerals in Gardar intrusions*. A suite of noble Ni-minerals (niccolite a.o.) is known as vein related mineralisation of suggested hydrothermal replacement genesis within an agpaaitic Gardar intrusion. Ni-content in mineralisation in the order of 20-40%.



Palaeogene settings

Illukunnguaq: *Sulphide-rich dyke*: Sulphide occurrence hosted in a sediment-contaminated dyke at the base of the basalt sequence on the eastern coast of Disko Island. A 28 t lump of sulphide ore was dug out in 1931 and several times since then the occurrence was explored. The Ni-content of the sulphide ore reaches 8%.

Hammer Dal: *Sulphide-rich volcanics*: Sediment contaminated dykes and subvolcanic intrusions show signs of sulphide enrichment (together with metallic iron) with at least 1% Ni at several localities in the Disko region. At Nuussuaq an estimated amount of 10 million t nickeliferous sulphide ore should be looked for at the lava base.

Kangerlussuaq: *Mafic intrusions*: Macrodykes and intrusions of gabbroic rocks show local signs of PGE-Cu-Ni bearing sulphide mineralisation related to contaminated contacts. Depletion of the magmas in the region is debated, and specific data on Ni-contents is not yet available.

Nickel exploration

The exploration for Ni benefits from traditionally used methods as well as newly developed geophysical techniques. Mineralisation models referring to Voisey's Bay and Noril'sk style deposits are in particular focus. Geological and geochemical mapping and interpretation together with dating information are useful approaches in the Greenland environment. Traditional geophysical mapping has been conducted successfully, and new geophysical techniques are now introduced (e.g. 'Titan 24'-system) in order to search for sulphides at depths in flood basalt areas.

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