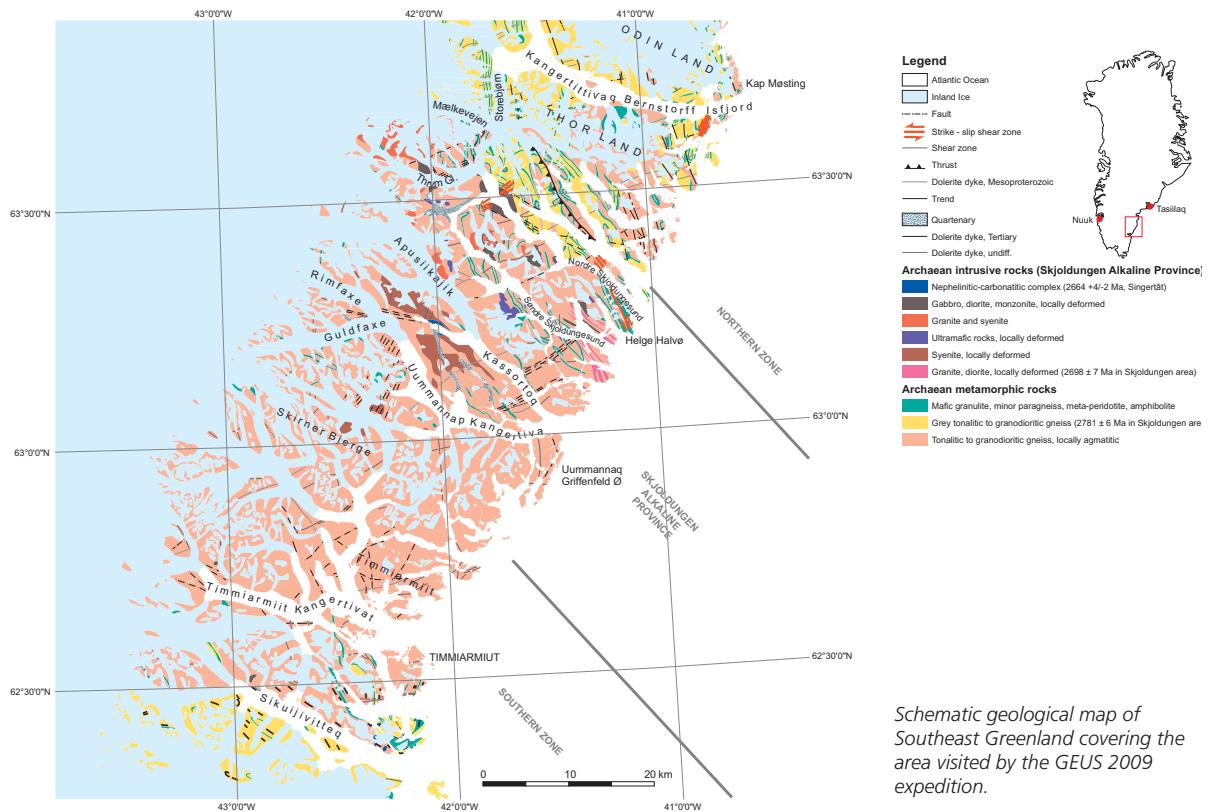


Geology of the South-East Greenland Archaean craton



Schematic geological map of Southeast Greenland covering the area visited by the GEUS 2009 expedition.

The Archaean of South-East Greenland is a part of the North Atlantic craton and encompasses vast areas of agmatitic gneiss and alkaline intrusions in the Skjoldungen Alkaline Province. Alkaline rocks are otherwise absent from the North Atlantic craton in Greenland and many other Archaean cratons elsewhere. The geology has been reinterpreted based on new field data, petrology, and whole rock geochemistry gathered during the 2009 field season of the mineral resource assessment programme – MRAPSEG.

Regional geology

The rocks of the North Atlantic craton in South-East Greenland stretch from north of Kangeq ($61^{\circ}45'N$) and further northward to Umiivik ($64^{\circ}30'N$). The southern and northern boundaries are marked by Proterozoic orogens: the Ketilidian mobile belt and the Nagssugtoqidian mobile belt. The craton is dominated by gneiss with only small supracrustal sequences of up to 1 km in width and strikes of several km, including meta-ultramafic intrusions and several late-tectonic alkaline intrusions in the Skjoldungen area.

Tectono-metamorphic evolution

Three structural zones have been identified: (1) the Northern Zone (NZ), characterised by a north-south to east-west trending foliation and folds with west-plunging fold axis; (2) the Skjoldungen Alkaline Province (SAP), dominated by a strong northwest-southeast trending foliation; and (3) the Southern Zone (SZ), dominated by north-south to northeast-southwest trending foliation. Two stages of granulite facies metamorphism around 2.8 Ga and 2.73 Ga suggest that early metamorphism in the supracrustal rocks was overprinted by a later stage during intrusion of the gneiss protoliths. Retrogression of granulite facies assemblages to amphibolite facies assemblages is common and is associated with deformation at around 2.7 Ga. Un-metamorphosed dolerite dykes dated about 1.5 Ga mark the end of the tectono-metamorphic evolution, and Tertiary dykes represent the youngest recorded event in the area.

Syn- to post-tectonic intrusions

The area south of Søndre Skjoldungen Sund and the inland areas to the north show a number of syn- to post-tectonic intrusions, grouped as the Skjoldungen Alkaline Province (SAP). They intruded the surrounding gneiss and supracrustal rock basement between 2.7 and 2.67 Ga. The Singertat carbonatite was intruded at around 2.66 Ga.

Lithology

In all three structural zones, the supracrustal rocks and the meta-ultramafic intrusions form the basement for the intrusion of the TTG gneiss protoliths and for later granitic to alkaline intrusions. Only the later intrusions have mineral assemblages indicating PT conditions lower than in the granulite facies.

The Northern Zone (NZ). *The bands of supracrustal rocks* are characterised by dark, well foliated mafic granulites and can be followed over 150 – 200 m along the strike. The abundance of mafic and ultramafic lenses in the gneiss increases towards the continuous bands of similar rocks.

The Skjoldungen Alkaline Province (SAP). *Supracrustal rocks occur* in NW–SE trending belts and are characterised by amphibolite and garnet sillimanite gneiss. They are, in places, spatially associated with metamorphosed ultramafic rocks, comprising peridotite, dunite and hornblendite. The *TTG gneiss* has an agmatitic fabric, where the amount of xenoliths increases close to larger bands of supracrustal rocks. In places, the contact with the supracrustal rocks is clearly discordant showing apophyses, which indicates an intrusive relationship. On a larger scale, the gneiss forms layer-parallel sheets of several tens of metres thickness, suggesting a formation as lit-par-lit intrusions into the supracrustal sequences.

There are *Granitic and syenitic rocks*, locally with an agmatitic fabric intruded into the supracrustal belts and TTG gneisses. The syenite sometimes shows a ‘magmatic’ foliation parallel to the foliation in the granitic gneiss. *The Ruinnæsset gabbro complex* is a leucogabbro forming a homogeneous, medium-grained, grey rock.

The Singertat carbonatite-nephelinite complex is intruded into tonalitic gneiss, amphibolite and quartz syenite. The nephelinite forms 5–20 m wide dykes, showing pinch-and-swell fabrics. The dykes are oriented parallel to the regional foliation. In the southeast, the nephelinite forms a larger coherent body. The carbonatite is dolomitic, forms about 1 m wide sills in the northwest, and creates varying fenitisation in the wall rocks. In the southeast, the carbonatite is associated with the conjugate nepheline-pegmatites. Plugs of carbonatite are extremely coarse-grained (up to 30 cm in diameter) and occur in the intersection zone of the conjugate pegmatites.

The Southern Zone (SZ). The SZ is characterised by *agmatitic, tonalitic to granodioritic gneiss*. The few *supracrustal sequences* are restricted to the Timmiarmiut area in the south, often with leucocratic granitic veining. Several are up to 1 m wide, near vertical *ultramafic dykes* trend NNE-SSW. The

dykes have sharp contacts with the surrounding granodioritic gneiss. The dykes most probably represent lamprophyre, where phlogopite forms coarse grains in the dykes. An ovoid body of a *layered alkaline intrusion*, about 15 m in diameter, is spatially associated with the dykes. Locally, these alkaline rocks are associated with carbonatite. The contact to the surrounding TTG gneiss is sharp and has created a 1 m wide halo of fenitic alteration. Within this alteration halo, nepheline-pegmatite dykes have been observed similar to those of the carbonatite-nephelinite complex.

Concluding remarks

The rocks along the South-East coast of Greenland are briefly introduced after the initiation of the reconnaissance study under a new Mineral Resource Assessment Programme. This stretch of coastal Greenland constitutes Archaean rocks rimmed by two Proterozoic orogens. The Archaean craton is dominated by gneiss, with only small supracrustal sequences and several late-tectonic alkaline intrusions in the Skjoldungen area. The field study has outlined the basic regional geology as the probable host for mineral occurrences such as orthomagmatic Ni-PGE-Au, lode-gold, IOCG, and intrusion-related REE types.

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