DANMARKS OG GRØNLANDS GEOLOGISKE UNDERSØGELSE RAPPORT 2004/42

Mineral exploration of selected targets in the Qaanaaq region, North-West Greenland: follow-up on *Qaanaaq 2001*

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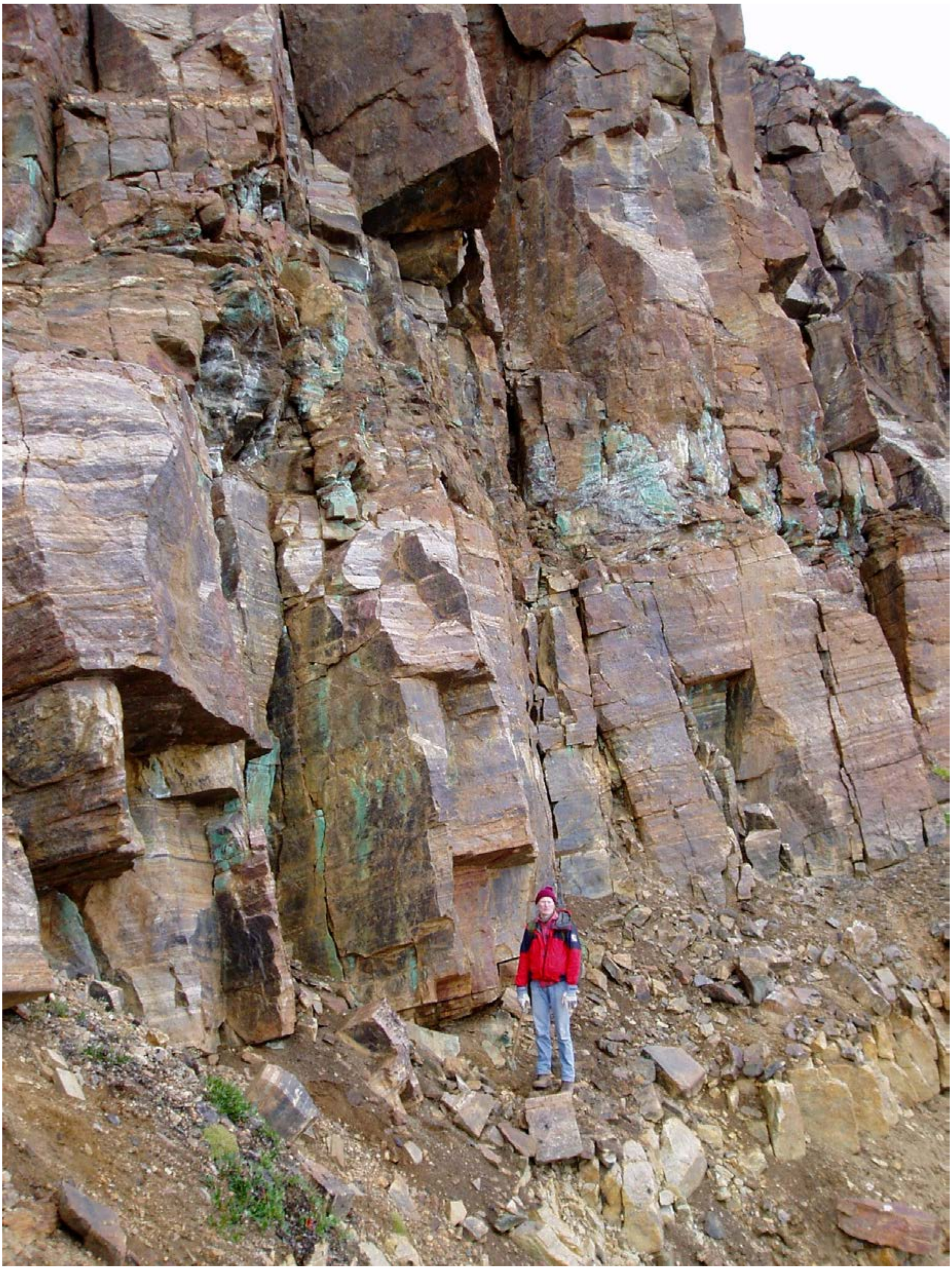

Frontispiece. *Malachite-stained amphibolite sheet in the Palaeoproterozoic Prudhoe Land supracrustal complex, west of Hubbard Gletscher.*

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1. Abstract

In 2003, field work in the Qaanaaq region, North-West Greenland, was a follow-up on previous reconnaissance mineral exploration – project *Qaanaaq 2001*. The work, directed towards the most promising mineralisation and geochemical anomalies, was carried out by two geologists from boat-supported camps in areas centred on Hubbard Gletscher and Northumberland Ø (Map 1).

The Qaanaaq region is underlain by two bedrock provinces: a high-grade Archaean–Palaeoproterozoic crystalline shield overlain by unmetamorphosed Mesoproterozoic strata of the intracratonic Thule Basin.

The Archaean *Thule mixed-gneiss complex* contains widespread oxide and silicate facies banded iron-formation that is regarded as a part of an iron province of Greenland and Canada. Sulphiditic quartz-garnet rocks, investigated in the Hubbard Gletscher area, have about 15% Fe but low base- and noble-metal concentrations. Although further exploration is not recommended, the iron-formation is believed to have a regional potential for sedimentary-exhalative gold and lead-zinc deposits.

The Palaeoproterozoic *Prudhoe Land supracrustal complex* comprises pelitic, semi-pelitic and quartzitic rocks, minor marble and some mafic units. Scattered chalcopyrite mineralisation with about 0.3% Cu was found in amphibolite sheets in the Hubbard Gletscher area. The mineralisation seems to be widespread and further testing for magmatic segregations of base and noble metals should be undertaken.

The Thule Basin hosts the *Thule Supergroup*, a thick multicoloured, continental to marine succession with one formation of basaltic volcanics. Geochemical gold anomalies on northern Northumberland Ø could not be reproduced and no gold mineralisation was detected but the area yielded hematite-chalcocite mineralised volcanic float. This could represent a red-bed type mineralisation or an iron oxide-copper-gold type mineralisation. It is recommended to re-examine the area for the latter type.

In the Hubbard Gletscher area, a geochemical gold anomaly in the Thule Supergroup was partly confirmed but the gold source was not disclosed. It could stem from heavy mineral horizons in sandstones or from speculative vein-type mineralisation hosted by NW-striking faults. The latter hypothesis should be tested.

Syn- to post-depositional fault systems. The main regional structures in the Thule Supergroup are NW- to WNW-striking fault blocks, grabens and large-scale flexures. On southern Northumberland Ø, quartz-baryte-pyrite mineralisation at a Neoproterozoic dolerite dyke contact is near a major NW-directed fault system and a distinct gold-barium anomaly occurs along the fault trend. The entire fault zone across the island should be re-examined for vein-type gold mineralisation. Minor quartz-baryte-pyrite-chalcopyrite veins in the Hubbard Gletscher area confirms the regional extent of vein-type mineralisation; this might be associated with the Neoproterozoic magmatic episode and constitute a new target for gold exploration in the Qaanaaq region.

2. Introduction

The work reported on here was in the *Gold in Thule* project, a follow-up on the *Qaanaaq 2001* project. The latter aimed at assessing the mineral potential of the Qaanaaq region, North-West Greenland and was jointly run by the Geological Survey of Denmark and Greenland (GEUS) and the Bureau of Minerals and Petroleum (BMP), Government of Greenland, being mainly funded by the latter (Thomassen *et al*. 2002a). The follow-up work was an all-GEUS effort.

In our terminology, the Qaanaaq region is that between Olrik Fjord and Kap Alexander (77°10′N–78°10′N) and so indicated on Map 1. It comprises 4300 km^2 ice-free land centred on Qaanaaq, the administrative capital of Qaanaap (Thule) municipality. The climate is high arctic and the whole area is underlain by permafrost.

The 2003 field work was directed towards specific targets classified as the most promising mineralisation and geochemical anomalies in the recommendations in the final report of *Qaanaaq 2001* (Thomassen *et al*. 2002b). These targets are in two areas – the Hubbard Gletscher area and Northumberland Ø – that were investigated between 24 July and 28 August by the authors from four camps. Transport was by local boat chartered on a day to day basis. The weather was extremely poor (storm, snow, rain and fog) and this seriously hampered the work, with 13 days totally lost.

The logistical aspects of the field work have been presented by Thomassen (2003). This report covers the geological aspects and presents the geological framework, exploration targets and work carried out, as well as field descriptions of the investigated mineral occurrences and analytical results of the collected samples. The results are commented on and recommendations for further investigations are given.

3. Previous investigations

The Qaanaaq region was mapped by the former Geological Survey of Greenland (GGU) between 1971 and 1980, mainly by shoreline investigations with limited helicopter traversing inland. The results of this campaign have been compiled into the Survey's 1:500 000 geological map sheet, Thule, sheet 5 (Dawes 1991), the explanatory notes for which should be published later this year (Dawes in press). Unless otherwise stated, rock unit names in this report are taken from this map sheet. Earlier geological investigations are summarised in Dawes (1997).

Limited mineral exploration has been carried out in the Qaanaaq region and no major mineral occurrences are known. In 1969, the commercial company Greenarctic Consortium reconnoitred the southern part of the region (Stuart Smith & Campbell 1971) and in 1975 and 1977, GGU investigated selected mineral occurrences found during regional mapping (Cooke 1978; Dawes 1991). Nunaoil A/S explored the Qaanaaq region in 1994 and 1995 (Gowen & Sheppard 1994; Gowen & Kelly 1996). In 2001, systematic stream sediment sampling and reconnaissance mineral exploration, partly guided by a pre-season Landsat study, was carried out in the region by GEUS and BMP during the *Qaanaaq 2001* project (Steenfelt *et al*. 2002; Thomassen *et al*. 2002a,b). Several mineralised rock samples from the Qaanaaq region collected by Greenlandic residents have been submitted to the Greenland mineral hunt programme, *Ujarassiorit* (Dunnells 1995, Olsen 2002).

Two geochemical surveys have been carried out in the Qaanaaq region:

In 1994–95, Nunaoil A/S collected a total of 126 stream-sediment samples scattered throughout the region. These show modest metal concentrations viz. max. 56 ppb Au, 100 ppm Cu, 52 ppm Pb, 140 ppm Zn and 4400 ppm Ba (Gowen & Sheppard 1994; Gowen & Kelly 1996).

During *Qaanaaq 2001*, systematic stream sediment sampling covered the whole region. The 343 samples collected had the following maximal concentrations: 55 ppb Au, 151 ppm Cu, 77 ppm Pb, 225 ppm Zn and 5400 ppm Ba (Steenfelt *et al.* 2002).

4. Regional geology and mineralisation

The Qaanaaq region is underlain by two bedrock provinces: a high-grade Archaean–Palaeoproterozoic crystalline shield overlain by unmetamorphosed Mesoproterozoic strata of the intracratonic Thule Basin (Map 1). The profound unconformity between these two units is well preserved. The Thule Basin straddles Baffin Bay and the western outcrops are in coastal Ellesmere Island, Canada. In Greenland, exposures form islands and the outer coastal areas bordered on the east by the shield.

4.1. Precambrian shield

Thule mixed-gneiss complex. This Archaean complex of highly deformed amphibolite- to granulite-facies gneisses crops out in the southern part of the region (Map 1). It is composed of quartzo-feldspathic to pelitic paragneisses, multiphase orthogneisses with genetically related granitic rocks, as well as minor mafic and ultramafic bodies. Para- and multiphase orthogneisses are structurally complex and intricately associated on all scales. In many places the gneisses show pronounced compositional layering and the distinction of para- and orthogneisses can only be unravelled by detailed mapping. At the head of Inglefield Bredning pale garnet-bearing quartzitic layers associated with variable gneiss are conspicuous. At the head of Olrik Fjord, such rock associations contain a rusty unit of banded iron-formation (BIF), e.g. north-east of ‘Mount Gyrfalco’.

The shield contains widespread oxide and silicate facies banded iron-formation interpreted by Thomassen *et al.* (2002a, b) as the northward extension of the Archaean iron province that stretches for 350 km along the coast of Melville Bugt and into the Pituffik (Thule Air Base) area (Dawes 1976, 1991; Dawes & Frisch 1981). This probably continues to the south-west on Baffin Island in northern Canada and correlates with the Algoma-type iron deposits of the Mary River Group (Jackson 2000). Disseminated iron sulphides and chalcopyrite also occur in paragneiss, as well as in amphibolites and ultramafic lenses in orthogneiss.

Smithson Bjerge magmatic association. This Archaean meta-igneous association is composed of the Qaqujârssuaq anorthosite and various basic, dioritic and granitic intrusions, including the Heilprin Gletscher complex of Nutman (1984). The main anorthosite mass is predominantly anorthosite *senso stricto* with minor leucogabbro, gabbro and ultramafic rocks. The magmatic association that was intruded into the Thule mixed-gneiss complex has been affected by granulite-faces metamorphism. No mineralisation is known.

Undifferentiated gneiss complex. The gneisses of this unit are mainly of Palaeoproterozoic age but Archaean gneisses, corresponding to those of the Thule mixed-gneiss complex, probably occur. The unit, as shown on Map 1, contains the Prudhoe Land granulite complex of Dawes (1991), and the Etah Group, Etah meta-igneous complex and associated gneisses of Inglefield Land (Dawes *et al*. 2000). In the Qaanaaq region, the main rocks are high-grade, polydeformed and polymetamorphosed orthogneisses with thin units of quartzo-feldpathic to pelitic paragneiss. The pelitic gneisses, commonly graphitic, are conspicuous by their rusty weathering and they are considered to be correlatives of the larger tracts of supracrustal rocks that make up the following map unit. The only known mineralisation is in moraine blocks of paragneiss: disseminated sulphides with slightly enhanced gold and base metal concentrations.

Prudhoe Land supracrustal complex. These Palaeoproterozoic supracrustal rocks comprise a thick succession of pelitic, semi-pelitic and quartzitic rocks (including pure quartz rocks) and marble with some mafic units (amphibolite and pyribolite) that form large, rusty-weathering outcrops in two main areas: around Morris Jesup Gletscher and to the east from Bowdoin Fjord to Josephine Peary Ø (Map 1). As described by Dawes (1979, p. 16), the supracrustal rocks and gneisses have been folded by large recumbent isoclines so that they now occur as shallow-dipping units that can be flanked both below and above by gneiss (Figure 1). The contacts examined between supracrustal rocks and the gneisses are tectonised but structural considerations suggest that the supracrustal rocks represent a cover sequence to the Thule mixed-gneiss complex. The view that the supracrustal rocks are a correlative of the Etah Group of Inglefield Land was discussed by Thomassen *et al.* (2002b).

East of Bowdoin Fjord, this map unit is characterised by conspicuous red and yellow rust zones in sulphiditic semi-pelitic schist corresponding to concentrations of Landsat anomalies indicating hydrothermal mineralisation (Thomassen *et al.* 2002b). During *Qaanaaq 2001*, units of highly graphitic and pyritic schist several tens of metres thick with intense clay alteration were investigated. Remobilisation of pyrite into veinlets in quartz-rich pinch-and-swell layers was interpreted as due to hydrothermal overprinting, but no significant concentrations of economic metals were recorded. The presence of metasedimentary units with concentrations of REE-rich minerals is suggested by stream-sediment geochemistry (Steenfelt *et al*. 2002). To the west at Morris Jesup Gletscher, highly pyritic units have not been observed and hydrothermal alteration is not evident. However, quartzite-hosted copper mineralisation is widespread in this area.

4.2. Thule Basin

The Thule Basin developed on the peneplaned surface of the Precambrian shield. The basin fill – the Thule Supergroup – is a multicoloured, continental, littoral to shallow marine sedimentary succession, possibly up to 8 km thick, with one main interval of basaltic volcanic rocks. Dolerite sills are common at several levels. Five groups are recognised (Dawes 1997). The lower four groups are Mesoproterozoic in age (basal volcanics *c*. 1270 Ma) and all these are exposed in the Qaanaaq region. In Inglefield Land to the north, the Supergroup is overlain by Lower Palaeozoic deposits of the Franklinian Basin.

Smith Sound Group. This group, directly overlying the shield, represents the northern basin margin equivalent of the Nares Strait and Baffin Bay Groups of the south. It is composed of varicoloured sandstones and shales, including red beds, with subordinate stromatolitic carbonates. No mineralisation is known.

Nares Strait Group. This group, up to 1200 m thick and representing the oldest strata of the central basin, is dominated by sandstones (both red beds and clean white quartz arenites), with siltstone/shale- and carbonate-dominated intervals, and one main unit of basaltic volcanics including flows, sills and volcaniclastic deposits – Cape Combermere Formation. This formation has its maximum thickness in Greenland on Northumberland Ø, about 200 m (reaches 340 m in Canada) and it thins eastwards towards the basin margin petering out somewhere between Hubbard Gletscher and Kangerlussuaq. The Group is taken to represent deposition in alluvial plain, littoral and offshore environments.

Mineralisation is known from Northumberland Ø, where malachite occurs as coatings and blebs on blocks of volcanic rocks of the Cape Combermere Formation near the NW–SE-trending Kiatak Fault. It is a hematite-dominated mineralisation with lesser amounts of covellite and digenite. Thomassen *et al.* (2002b) proposed a 'volcanic red bed copper' deposit type, possibly associated with the Kiatak Fault. The geochemical surveys carried out by Nunaoil A/S in 1994–95 and *Qaanaaq 2001* indicate that the volcanics might be gold anomalous (Gowen & Sheppard 1994; Gowen & Kelly 1996; Steenfelt *et al.* 2002). Malachite staining is also reported from the Cape Combermere Formation at Clarence Head, Ellesmere Island (Frisch & Christie 1982).

Baffin Bay Group. This group represents the most widespread strata of the Thule Basin with a composite thickness of at least 1300 m. It is subdivided into five formations, four of which are present in Greenland. In the central part of the basin (western part of the Qaanaaq region) the group conformably overlies the Nares Strait Group; in the east it overlaps onto the crystalline shield. The group consists of shallow water, multicoloured siliciclastic rocks: sandstones, quartz grits and quartz-pebble conglomerates, with important intervals of shales and siltstones, representing mixed continental to marine shoreline environments, with syn-depositional faulting. The sandstones vary from highly ferruginous red beds to clean quartz sands. The uppermost strata (Qaanaaq Formation) indicate a gradually deepening depositional regime from predominantly alluvial plain to shallow-shelf, tide-dominated deposition that is part of a regional transgression of the shoreline that continues into the more basinal sequence of the Dundas Group.

Faint malachite staining on pale sandstones is common in the Qaanaaq Formation, e.g. at 'Hill 620', Olrik Fjord (Map 1). This is caused by oxidation of minor chalcopyrite, bornite, digenite and pyrite as flecks and disseminations. This red bed type mineralisation is partially controlled by local faults. The copper concentrations encountered until now are very modest.

The Dundas Group conformably overlies the previous group along a gradational contact. Its upper limit is marked by Quaternary deposits and the present erosion surface. The group has a dark weathering, monotonous lithology without conspicuous markers and regional correlation of sections is not obvious. Its estimated thickness is between 2000 and 3000 m being composed of sandstones, siltstones and shales with lesser amounts of carbonate and evaporite. Some carbonate beds have stromatolites and dark shales can contain stratiform pyrite. Deposition was in an overall deltaic to offshore environment. Sporadic dolerite sills of Neoproterozoic age are present; these are particularly conspicuous south of the Qaanaaq region.

On Northumberland Ø, the Group shows various signs of mineralisation. Stratiform pyrite is common at some levels in sandy shales, particularly in the Steensby Land Formation but no significant base metal concentrations are known. In interbedded shale and stromatolitic limestone, minor sphalerite has been observed at the base of a limestone unit. In the same area minor galena-baryte mineralisation occurs at a basic sill / shale contact. It is worth noting that extensive outcrops of the Group (Steensby Land Formation) with widespread sulphide mineralisation associated with sills and dykes, and detectable as Landsat anomalies, occur in the Pituffik region south of the Qaanaaq region (Krebs *et al*. 2003).

4.3. Regional structures

Compared to the gneisses and supracrustal rocks of the Precambrian shield, the Thule Supergroup is little disturbed. The regional structures are fault blocks, grabens, large-scale flexures, as well as some local folds associated with faults. Prominent faults vary from NW–SE-trending, for example, the fault blocks of Prudhoe Land, to WNW–ESE-trending as in the Olrik Fjord graben. Over much of its extent, the Thule Basin has preserved sedimentary contacts with the shield but in some places, for example, in northern Prudhoe Land and in Olrik Fjord, faults delimits the basin. The Dundas Group is downthrown against the shield in the Olrik Fjord graben and displacement is in the order of several kilometres. Such faults are parallel to the most conspicuous basic dyke swarm of the region that is Neoproterozoic in age cutting all strata of the Thule Basin. The NW–SE-trending Kiatak Fault crossing Northumberland Ø represents appreciable downthrow with juxtaposition of the Nares Strait and Baffin Bay Groups against the Dundas Group. It may be a continuation of the Olrik Fjord graben fault.

The syn- to post-depositional faults of the Thule Basin can be mineralised with quartz, baryte, pyrite and minor chalcopyrite, an observation supported by the stream sediment geochemistry (Steenfelt *et al*. 2002).

5. Mineral exploration in 2003

The field work in 2003 was specifically to check the geochemical anomalies and mineralisation delineated during *Qaanaaq 2001*. It was designed as visual inspection for signs of mineralisation and carried out on foot traverses within a radius of 4–5 km from four camps. Outcrops, scree cones and stream beds, as well as lateral and terminal moraines of active glaciers, were investigated and sampled and the work was supplemented by sampling of sediments from streams.

Rock samples. A total of 71 mineralised rock samples were collected. These were grab and chip samples from outcrop (31) and loose blocks from screes, stream beds and moraines (40). They are briefly described in Table 1 with GPS geographical co-ordinates; sample localities are indicated on Maps 2 and 4. The samples have been analysed for 49 elements by a combination of instrumental neutron activation and inductively coupled plasma emission spectrometry at Activation Laboratories Ltd., Ontario, Canada. Consequently, 12 of the samples yielding enhanced gold values or other interesting aspects, were assayed for gold, platinum and palladium by fire-assay methods. The analytical results are presented in Table 2. In addition, 25 polished thin sections have been prepared.

Stream sediment samples. Thirty samples were collected from active streams, each weighing 500–700 g. At each sample site a number of digital photos were recorded as documentation. In Copenhagen, the samples were dry sieved at 0.1 mm and splits of the fine fraction were analysed for 49 elements in the same manner as the rock samples. Samples are listed in Table 3 and analytical results shown in Table 4. Sample localities are indicated on Maps 3 and 5.

Heavy mineral concentrates. These were additionally collected at six of the stream sediment sample localities, see list in Table 5. About 12 litres of active sediments were wet-sieved at 1.0 mm on location and a pre-concentrate was produced by panning of the fine fraction. In Copenhagen, a concentrate with a density >2.8 was produced from the preconcentrate by heavy liquid separation and a split of this was analysed for 39 elements, as shown in Table 6. Sample localities are indicated on Maps 3 and 5.

Six-digit sample numbers starting with 470 (rock samples), 502 (stream sediment samples) or 501 (heavy mineral concentrates) refer to those with an official prefix GGU that are stored in the archives of the Geological Survey of Denmark and Greenland, Copenhagen. Samples with the letter U identify those collected during the Greenland mineral hunt programme *Ujarassiorit.*

In the following sections local geology, exploration targets, activities and results from the two investigated areas, Hubbard Gletscher area and Northumberland Ø, are presented. The descriptions are based on field observations and analytical results, supplemented by some preliminary microscope observations in reflected light.

6. Hubbard Gletscher area

Hubbard Gletscher is a *c.* 2.5 km wide and 20 km long, heavily crevassed glacier draining from the Inland Ice into Inglefield Bredning (Maps 1, 2 and 3). The surrounding area is of moderate relief (500–700 m), largely moraine covered, and mostly accessible on foot apart from some steep cliffs along the glacier and at the coast.

6.1 Local geology

As shown on Map 1, the area comprises rocks of the shield – Thule mixed-gneiss complex overlain by the Prudhoe Land supracrustal complex – overlain west of the glacier by the Thule Supergroup. The supracrustal rocks expose spectacular folds like the 'Hubbard Isocline' on the western side of the glacier (Figure 1). East of the glacier the mixed gneisses form an east–west-striking, slightly north-dipping package, well exposed in the near vertical cliffs along Inglefield Bredning and, more accessible, along the east side of the glacier.

The Thule Supergroup is well exposed in coastal cliffs, where red strata of the Nares Strait and lower Baffin Bay Groups (Robertson Fjord Formation) are overlain by white sandstones of the upper Baffin Bay Group (Qaanaaq Formation). A *c.* 25 m thick dolerite sill occurs in red sandstones of the Robertson Fjord Formation at the mouth of Qoorupaluk, and can be followed into this valley (Figure 5; see also section 21, fig. 12 in Dawes 1997).

6.2 Targets

The exploration targets discussed in this section were defined on the basis of work during *Qaanaaq 2001* and they have been described in Steenfelt *et al.* (2002) and Thomassen *et al*. (2002b).

Thule mixed-gneiss complex. In 2001, it was found that quartz-garnet (-pyroxene-amphibole) rocks, often banded, and with disseminated pyrrhotite, magnetite and traces of chalcopyrite occur at several localities in the eastern part of the Qaanaaq region. Regarded as silicate facies iron-formation (Nutman 1984; Thomassen *et al*. 2002b), they were also depicted as base metal anomalies in the geochemical survey (Steenfelt *et al*. 2002).

The coast between Quinissut and Qattarsuit forms a steep and mostly inaccessible cliff, up to 600 m high, exposing banded gneisses. In 2001, faint malachite staining was observed from rubber dinghy over several kilometres of this cliff (see Thomassen *et al.* 2002b, fig. 12). At a locality 9 km ENE of Quinissut, disseminated pyrite and chalcopyrite was found in melanocratic paragneiss, together with scree blocks of garnet quartzite with pyrrhotite, magnetite and traces of chalcopyrite, but no significant base metal values were recorded. Furthermore, three stream sediment samples from this coast define a multi-element Ni-Zn-Pb-Cu anomaly (146–245 ppm Ni, 99–142 ppm Cu, 46–61 ppm Pb and 194–225 ppm Zn) (Steenfelt *et al.* 2002).

Thule Supergroup. A stream sediment sample collected at the mouth of the stream Qoorupaluk, draining the Nares Strait and Baffin Bay Groups, yielded 55 ppb Au, the maximal gold value of the 2001 survey (Steenfelt *et al*. 2002). Simultaneously with the sampling, a boulder of vesicular basalt was noted in the stream bed and it was speculated that it might represent Cape Combermere Formation volcanics and be the source rock for the gold. The stream 4 km to the west is slightly anomalous with 6 ppb gold

6.3 Activities

In 2003, the Hubbard Gletscher area was investigated during seven work days from two camps located east and west of the glacier (Maps 2 and 3).

Thule mixed-gneiss complex. This was investigated along the eastern side of the glacier, along the top of the coastal cliffs east of Quinissut, and at Noorupaluk, the only place where the coastal cliffs are accessible. Twenty rock samples (470951–57, 59–71), four stream sediment samples (502877–80) and three heavy mineral concentrates (501854–56) were collected.

Prudhoe Land supracrustal complex. Rocks of this complex were examined in the cliff along the west side of the glacier and in a valley leading north-west from the glacier. Nine rock samples (470906–14) and one stream sediment sample (502858) were collected.

Thule Supergroup. These strata were checked in the Qoorupaluk valley, which was traversed until it forked two kilometres inland. Five rock samples (470901–05), seven stream sediment samples (502801–07) and one heavy mineral concentrate (501851) were collected.

6.4 Results

Thule mixed-gneiss complex. At Noorupaluk, very faint malachite staining was noted on mafic gneisses in the lower part of the 200 m coastal section of banded gneisses. However, no corresponding sulphides were observed apart from disseminated pyrrhotite in float of garnet quartzite (470951). At 100 m a.s.l., a 1–2 m thick BIF-unit was observed, composed of interbedded, 5–10 mm thick layers of quartz and hornblende-pyrrhotite-magnetite (Figure 4; 470952), along with nearby float of pyrrhotite-bearing garnet quartzite (470953). About one kilometre further east, at the top of the cliff, a 1 m thick unit of yellow-weathering garnet quartzite with disseminated magnetite and pyrrhotite was grab-sampled (470961, 62).

Three stream sediment samples collected at Noorupaluk (502877, 78, 80) confirm nicely the base metal anomalous values of the sample collected here in 2001 (506099): 136–157 versus 146 ppm Ni, 71–102 versus 99 ppm Cu, 43–60 versus 61 ppm Pb and 170–233 versus 204 ppm Zn. Two heavy mineral concentrates show nothing noteworthy.

In the well-exposed north–south section along the east side of the glacier, the shallow northwards-dipping gneissic units (070°/30°N), were sampled over 2 km, corresponding to a true thickness of the package of *c.* 1 km. The section consists of bands a few metres thick, of various gneisses with abundant 0.5–4.0 m thick units of rusty weathering garnet quartzite with disseminated pyrrhotite, pyrite and magnetite, with minor chalcopyrite and traces of sphalerite (Figures 2 and 3). This represents the main type of mineralisation in the Thule mixed-gneiss complex; the thickest unit (4 m) was chip sampled (470954) and 10 grab samples were collected from thinner units.

Analysis of 17 samples of sulphide-bearing garnet (-amphibole/pyroxene) quartzite show the following median values, with maximum values in brackets: 65 (1088) ppm Ni, 148 (545) ppm Cu, 17 (1057) ppm Pb, 112 (4139) ppm Zn, 8 (90) ppb Au, 15.1 (20.0)% Fe and 1.6 (13.3)% S. Only one of the samples shows noticeable base metal concentrations: 1057 ppm Pb and 4139 ppm Zn (470964; Figure 3).

A few 1–10 cm wide, discordant (120°/90°) quartz-baryte veins with blebs of malachite, chalcopyrite and pyrite were observed at one locality at the east side of the glacier. A composite sample returned 0.41% Cu and 11.0% Ba (470958).

Prudhoe Land supracrustal complex. Copper mineralisation was discovered in the up to 400 m high cliff immediately west of the glacier, which exposes the 'Hubbard Isocline'. In its southern part, gneiss and quartzite with several sheets of amphibolite occur. Here abundant, irregular malachite staining caused by disseminated chalcopyrite was discovered on a *c.* 20 m thick amphibolite unit in the lower part of the cliff (Frontispiece). In addition to chalcopyrite, variable amounts of pyrrhotite and pyrite were noted. The mineralised amphibolite was followed and grab sampled 1.2 km along strike, and the malachite staining was seen to continue north-eastwards for several hundred metres. Scattered malachite was also observed, but not sampled, in other amphibolites at lower and higher levels in the cliff.

Seven chalcopyrite-bearing grab samples gave the following median values, with maximum values in brackets: 0.33 (0.83)% Cu, 5 (81) ppb Au, 319 (857) ppm Ni, 135 (225) ppm Zn, 1.2 (1.6)% Ti, 11.3 (12.4)% Fe and 1.3 (2.2)% S (470907–11, 13, 14). Two samples tested for platinum assayed maximum values of 11 ppb Pt and 38 ppb Pd, and a stream sediment sample collected 50 m below the mineralised amphibolite returned 334 ppm Cu, 104 ppm Ni and <2 ppb Au (502858).

Rusty biotite-garnet gneisses were inspected in a valley west of this locality but no significant concentrations of sulphides were observed. Appreciable amounts of pyrite were only noted in a single float sample (470906).

Thule Supergroup. The bedrock in the Qoorupaluk valley consists of red and white sandstones of the Baffin Bay Group that contain a *c*. 25 m thick dolerite sill which shows offsets due to faulting parallel to the north-west valley (Figure 5). The sill is black with a greenish tint and comprises various igneous phases but no vesicular portions were observed and the source of the vesicular float found in 2001 could not be localised. The sill is cut by a few centimetres thick quartz-chalcedony-calcite-hematite veins of various orientations but without sulphides.

Grab and composite samples of the hematite-bearing veinlets (470901–03, 05) show no noticeable gold or base metal concentrations. A scree block of dolerite with disseminated magnetite (470904) returned 1151 ppm Cu.

Seven stream sediment samples were collected in the Qoorupaluk valley from the coast and two kilometres inland, where the valley splits (502801–07). Gold is detected in three of the samples with 97, 6, and 5 ppb. The 97 ppb Au sample (502857), representing the highest gold value recorded in stream sediments from the Qaanaaq region, stems from the western branch of Qoorupaluk. The sample locality is surrounded by scree slopes of red sandstone without obvious source for the gold. A single heavy mineral concentrate (501851) panned at the mouth of the stream shows nothing noteworthy.

6.5 Comments

Thule mixed-gneiss complex. The investigated sulphide-bearing garnet quartzite with about 15% Fe is regarded as a silicate facies-iron formation or a chemical sediment with a potential for especially sedimentary-exhalative gold and lead-zinc deposits. However, the negative results of the present investigations have downgraded this potential and no further investigations of the gneiss complex in this area seems justified. The geochemical base metal anomaly at the coast, probably caused by this mineralisation, has been reconfirmed.

The vein-type mineralisation found in the gneiss complex is in itself insignificant but it demonstrates the regional extent of quartz-baryte-pyrite (-chalcopyrite) veins. Similar veins in the Thule Supergroup are associated with syn- to post-depositional faults and a corresponding Meso-Neoproterozoic or younger age for the basement-hosted veins is probable.

Prudhoe Land supracrustal complex. Widespread, sub-economic copper mineralisation in amphibolite sheets in this unit represents a new mineralisation style in the region. It should be further examined for magmatic segregations of base metal sulphides and noble metals.

Thule Supergroup. The dolerite sill in the lower Baffin Bay Group does not appear to be the source for the gold in the geochemical anomaly in Qoorupaluk. However, renewed stream sediment sampling has confirmed anomalous gold in the drainage system although no definite distribution pattern is evident. The gold source remains enigmatic. The best guess is that it stems from heavy mineral horizons in the sandstones or from vein type mineralisation hosted by NW-striking faults. It would be worthwhile to traverse the valley further inland to test the latter hypothesis.

7. Northumberland Ø

Northumberland Ø is a *c.* 230 km^2 island situated some 50 km WSW of Qaanaaq, fully exposed to the open sea of northern Baffin Bugt with its awesome arctic gales (Maps 1, 4 and 5). Its Greenlandic name Kiatak translates as 'the high island' and it does indeed form a 1000 m high plateau dissected by numerous glaciers. Due to steep topography, accessibility on foot is restricted, with the mostly crevasse-free glaciers forming the main access inland (Figure 6).

7.1 Local geology

The island forms a NNW-orientated, slightly southwards tilted horst exposing in the north crystalline shield rocks overlain by Nares Strait Group, with Baffin Bay Group to the south. The eastern end of the island exposes upper Baffin Bay Group overlain by Dundas Group, with several dolerite sills. This forms a downfaulted block along the NW-striking Kiatak Fault, which has a throw of 1–2 km (Dawes 1997, fig. 48; Maps 4 and 5).

The Nares Strait Group represents the oldest strata of the central fill of the Thule Basin (Dawes 1997). It is *c.* 950 m thick on Northumberland Ø and consists of siliciclastic strata with one c. 200 m thick formation of basaltic extrusive and intrusive rocks – Cape Combermere Formation – comprising sills, flows and pyroclastics (Figure 7). The outcrop pattern of this formation is indicated on Maps 4 and 5.

The Cape Combermere Formation represents rift volcanicity in the axial part of the basin with both effusive and hybabyssal basalts belonging to the same continental flood basalt province (Dawes 1997). The composition is mainly tholeiitic but some lavas tend towards andesites, and the presence of pyroclastic rocks with quartz porphyry clasts, as encountered in moraine blocks on Kissel Gletscher, indicates that rock types other than typical plateau basalts occur. The flows are typical terrestrial effusives while local pillow structure indicates proximity of a shoreline. A volcanic vent on the west side of Robins Gletscher is illustrated by Dawes (1997, fig. 61).

7.2 Targets

Mineralisation and geochemical anomalies constituting exploration targets are known from a number of settings.

Northumberland Formation (Nares Strait Group). On the east side of Kissel Gletscher, malachite has been recorded in red-brown sandstone below a diabase sill *c*. 30 m above the shield (Jackson 1986).

Cape Combermere Formation (Nares Strait Group). On the small unnamed glacier east of Robins Gletscher (Figure 6), hematite-malachite-chalcocite mineralisation was observed in volcanic moraine blocks during *Qaanaaq 2001*. Noticeable samples are an agglomerate with malachite, covellite and digenite, and 1.0% Cu, 11 ppm Ag and 0.9% Ba, and a solitary, walnut-size, ‘high grade’ malachite-hematite fragment with >10% Cu, 0.2% Pb, 96 ppb Au, 156 ppm Ag, 44 ppb Pt, 127 ppb Pd, 31.9% Fe, 0.43% S and 1.4% Ba. The moraine stems from the steep mountain immediately south of the glacier where the Cape Combermere Formation is in contact with the Baffin Bay Group along the Kiatak Fault. It is interesting that a Landsat anomaly indicating hydrothermal mineralisation exists near the Kiatak Fault *c.* 2 km SSE of the copper-mineralised moraine blocks (Thomassen *et al*. 2002b).

This copper mineralisation was suggested by Thomassen *et al*. (2002a, b) to be a ‘volcanic red bed copper’ deposit type (Kirkham 1996), possibly associated with the Kiatak Fault. Alternatively, the iron-copper association with sporadic gold, and the setting in a Mesoproterozoic rift environment, could represent an iron oxide-copper (-gold) or Olympic Dam deposit type, see e.g. Sillitoe (2003). The latter possibility is supported by a number of gold-anomalous stream sediment samples stemming from streams draining the Cape Combermere Formation: 38, 8 and 4 ppb Au east of Kissel Gletscher, and 14 ppb Au east of Robins Gletscher (Gowen & Sheppard 1994; Steenfelt *et al.* 2002).

Baffin Bay and Dundas Groups. At the eastern margin of Sermiarsussuaq glacier, a grab sample of pyrite-bearing hornfels shale with 0.5 ppm Au and 3.8% Fe, probably from the Baffin Bay or the Dundas Group, was reported by Gowen & Kelly (1996). During *Qaanaaq 2001*, many blocks of rusty Qaanaaq Formation (Baffin Bay Group) sandstone with minor disseminated pyrite, and with occasionally malachite and chalcopyrite, were found in the eastern moraines of the glacier.

Stratiform pyrite is common in sandy shales of the Dundas Group (particularly the Steensby Land Formation) but no significant base metal concentrations were recorded in pyritic shales during *Qaanaaq 2001*. However, minor sphalerite was observed at the base of a limestone unit in a sequence of interbedded shale and stromatolitic limestone (Thomassen *et al*. 2002b).

At a locality 5 km WSW of Kap Henson, Marcos Zentilli (personal communication 2002) observed that cavities and veinlets in the upper, altered part of a dolerite sill were filled with calcite, tabular baryte and sulphides, mainly galena. Copper connected with diabase veins on Northumberland Ø was mentioned by Koch (1920).

Furthermore, an *Ujarassiorit* sample of *in situ* chalcopyrite with quartz and feldspar, >10% Cu, 0.26% Pb, 49 ppm Ag and 1.5% Ba (U94-388) stems from the eastern part of the island. Another *Ujarassiorit* sample, a boulder of massive sulphide with pyrite, sphalerite and calcite, and 7.1% Zn, 58.5% Fe_2O_3 and 6 ppm Hg, (U94-010) claimed to come from east of Kiatak Gletscher, is probably a fake sample from the Black Angel Mine, central West Greenland (Ujarassiorit 1995).

Faults. As already stated, the north-west end of the Kiatak Fault is spatially associated with copper mineralisation and a Landsat anomaly. Its southernmost exposure at Asungaaq is coincident with the highest barium concentrations in stream sediments from both the Nunaoil survey (4400 ppm Ba) and *Qaanaaq 2001* (5400 ppm Ba) (Gowen & Sheppard 1994; Steenfelt *et al.* 2002).

7.3 Activities

Two areas of Northumberland Ø were inspected from camps on the northern and south-eastern sides of the island during eight field days. The tent camp on the moraine of Kissel Gletscher (camp 2a) was completely destroyed by a gale on August 7th, after which we thankfully retreated to a fortuitously placed hut, west of Parish Gletscher (camp 2b).

Parts of the moraines and scree slopes of eastern Kissel Gletscher (Figure 7), Parish Gletscher and Kiatak Gletscher were checked for mineralised boulders, especially Cape Combermere volcanics. *In situ* volcanics were inspected on the slopes east of Kissel Gletscher. Furthermore, the coastal section at Ujaassuk, and parts of the Kiatak Fault zone north and south of Kiatak Gletscher were investigated. A total of 36 rock samples were collected (470915–50).

Ten stream sediment samples (502859–68) and one heavy mineral concentrate (501852) were collected from streams draining the Cape Combermere Formation, and eight stream sediment samples (502869–76) and one heavy mineral concentrate (501853) were collected from streams draining the south-eastern branches of the Kiatak Fault.

7.4 Results

Northumberland Formation. Float and moraine blocks of various sandstones with red bed type malachite-chalcocite mineralisation were noted on Kissel Gletscher and Parish Gletscher. They probably stem from the Northumberland Formation but could also originate from higher in the sequence. Maximal values of 2.7% Cu, 53 ppm Ag, 11 ppb Au and 0.95% Ba were recorded from three samples of this mineralisation (470915, 20, 21). Malachite staining was also noted in crushed sandstones at the fault contact to gneisses at the coast below Ujaassuk (cf. fig. 51 in Dawes 1997). The NNW-striking fault zone hosts a one metre wide, grey fault gauge accompanied by a zone of crushing and potassic alteration in the gneiss several metres wide. A composite sample of malachite-stained sandstone and shale returned 0.85% Cu, 1.5 ppm Ag, 17 ppb Au and 0.14% Ba (470926).

Cape Combermere Formation. Four types of mineralisation were encountered in volcanic scree and moraine blocks. These are described below; a summary of selected element concentrations is given in Table 7.

1. Veins and vein-meshes of quartz-hematite (-calcite) varying from millimetres to a few centimetres thick are fairly common in basaltic scree and moraine blocks along Kissel Gletscher and Parish Gletscher (470916, 17, 19, 22, 27–33, 35–38). The hematite occurs both as specular needles in veins and cavity fillings and as fine-grained hematisation of the wall rocks. The quartz may be developed as chalcedony and often hosts a greenish component, perhaps prehnite. Analysis shows enhanced iron but only low copper and noble metal concentrations (Tables 2 and 7).

2. Veined, brecciated or vesicular basalts with quartz, calcite, specular and massive hematite, malachite and chalcocite were found along Parish Gletscher (Figures 8, 9 and 11). They returned up to 21.9% Fe, 1.7% Cu, 48 ppb Au, 34 ppb Pt and 31 ppb Pd (470923, 24, 34, 39).

3. Pegmatitic material rich in specularite but without copper or noble metals, were found at one locality in scree east of Parish Gletscher (Figure 12; 470940–42). This locality is situated 400–500 m from a scree cone yielding the previous type of mineralisation (Figures 10, 11; 470939). At both localities, the mineralised blocks seem to originate from a white or bleached, possibly silicified horizon *c*. 100 m higher up the mountainside, approximately in the middle of the volcanic formation. Found at the end of the last field day, we were not able to check this accessible locality.

4. Abundant, up to 0.5 m large blocks of totally silicified breccia of probable volcanic rocks were observed in the lateral moraines of western Parish Gletscher, indicating the existence of a substantial silicified breccia zone higher up along the glacier (Figure 13). Sulphide mineralisation in the form of chalcopyrite-bornite-pyrrhotite blebs was only detected in one block (470925). This returned 0.62% Cu and 0.74% Ba.

Table 7. Chemical summary of selected elements for mineralised Cape Combermere Formation volcanics: median and (maximum) values.

Type	Au ppb	Ag ppm	Cu ppm	Ba ppm	Fe pct.	S pct.	Samples
1	2 (9)	<0.3 (2.0)	85 (585)	130 (820)	11.0 (31.8)	<0.01 (0.02)	15
2	7 (48)	5.7 (9.9)	11530 (16501)	400 (600)	8.3 (21.9)	0.35 (0.41)	4
3	2 (9)	<0.3	32 (192)	130 (410)	16.5 (28.2)	<0.01	3
4	<2	3.4	6189	7400	0.9	0.55	1

The geochemical response from stream sediments is meagre. Gold is only detected (16 ppb Au) in one of the ten stream sediment samples collected below the formation and no other significant element concentrations occur. The site of the *Qaanaaq 2001* sediment samples with 38 and 4 ppb Au was resampled (stream sediments 502859–60 and heavy mineral concentrate 501852), the only noteworthy value being 5800 ppm Ba in the concentrate.

The exposure of Cape Combermere Formation at the base of the section north of Kiatak Gletscher (Figure 14), indicated by Dawes (1997, fig. 48), was not located. The oldest rocks we saw exposed here were of the upper Nares Strait Group (Clarence Head Formation), identified by a thin red bed (Dawes 1997, fig. 78).

Faults. Alteration and minor copper mineralisation associated with a NNW-striking fault at Ujaassuk was mentioned at the start of this section.

The southern branches of the Kiatak Fault are poorly exposed north-east of Kiatak Gletscher and the only signs of mineralisation detected here were float of brecciated and quartz-calcite veined white sandstone of the Baffin Bay Group (?) with rare specks of pyrite and chalcopyrite. Maximum concentrations are 0.21% Cu and 3 ppb Au (Figure 14; 470944–46). The fault zone is, however, clearly registered in stream sediment samples as a gold-barium anomaly with relatively high gold concentrations in three, and barium in two, of the five samples collected: 57 ppb Au, 49 ppb Au and 15 ppb Au, with 0.44% Ba and 0.32% Ba (502869, 70, 74–76).

On the slope south of Kiatak Gletscher, the south-western branch of the Kiatak Fault is scree covered. In a gully near the fault zone, quartz-baryte-pyrite mineralisation was found in association with a 3–4 m wide, WNW-striking Neoproterozoic dolerite dyke (Figures 15 and 16). The mineralisation occurs as silicification, pyrite disseminations and baryte veinlets in a few metre wide contact zone in conglomerate and sandstone of the Baffin Bay Group on the north side of the near vertical dyke. Grab samples from this locality returned 0.3–14.0% Ba (470948–50). Three stream sediment samples collected in the gully below the mineralisation returned 0.24–0.41% Ba, and gold (6 ppb Au) was detected in one of the samples (502871–73). From the distance, this mineralisation was seen to follow the dyke across the mountain slope eastwards (Figure 15).

7.5 Comments

Cape Combermere Formation. The previously recorded geochemical gold anomalies could not be reproduced and no obvious gold mineralisation was detected in the volcanic rocks. The iron-copper mineralised float blocks with slightly enhanced noble metals found along Parish Gletscher are comparable to the 2001 find further east. Although red-bed type mineralisation seems the most obvious, iron oxide-copper-gold type cannot be totally excluded. Thus, we recommend that the possible silicified zone east of Parish Gletscher be checked for further evidence of this type, as well as the Robins Gletscher area. The source of the moraine blocks of siliceous breccia of western Parish Gletscher should also be located and investigated.

Kiatak Fault. The contact quartz-baryte-pyrite mineralisation near the Kiatak Fault zone is probably of the same age as the dyke, i.e. Neoproterozoic. It is interesting to note, that widespread pyrite-dominated mineralisation is associated with mafic sills and dykes of the same age in the Thule Supergroup, especially in Steensby Land immediately south of the Qaanaaq region (Dawes 1991; Krebs *et al*. 2003). The stream sediment gold-barium anomaly at the southern end of Kiatak Fault indicates potential for vein-type gold mineralisation along the fault zone, and follow-up work should be carried out along the accessible parts of the zone, including the Landsat anomaly to the north-west. In a regional context, the continuation of the fault south of Olrik Fjord offers additional potential, as do other similar fault zones in the region.

8. Conclusions and recommendations

Thule mixed-gneiss complex. The widespread occurrence in this Archaean complex of sulphide-bearing garnet quartzite, regarded as silicate facies iron-formation, has been confirmed by the present study. These rocks are believed to cause geochemical base metal anomalies and to have a potential for especially sedimentary-exhalative gold and lead-zinc deposits. However, investigations east of Hubbard Gletscher show that they contain about 15% Fe and low base and noble metal concentrations, a result not encouraging for further investigation.

Prudhoe Land supracrustal complex. Scattered copper mineralisation was found in amphibolite sheets west of Hubbard Gletscher in this Palaeoproterozoic unit. Although economic metal concentrations have not been detected, it is recommended to test further the amphibolites for magmatic segregations of base metal sulphides and noble metals.

Thule Supergroup. Stream sediment gold anomalies previously recorded on northern Northumberland Ø could not be reproduced and no gold mineralisation was found in the volcanic rocks of Cape Combermere Formation. On the other hand, iron-copper mineralisation with slightly enhanced noble metals was found in basaltic float at Parish Gletscher, comparable to earlier finds farther east and probably representing a volcanic red-bed type mineralisation. However, an iron oxide-copper-gold mineralisation type cannot be excluded and it is recommended to check the possible silicified zone east of Parish Gletscher, and the Robins Gletscher area, for further evidence of this type. Also, the source for abundant moraine blocks of silicified volcanic breccia on western Parish Gletscher should be investigated.

At Qoorupaluk west of Hubbard Gletscher, renewed stream sediment sampling confirmed anomalous gold in a local drainage system. However, no definite distribution pattern is evident and the gold source remains unknown. A dolerite sill intruded in the Baffin Bay Group does not appear to be the source for the gold, and the best guesses are that the gold stems from heavy mineral horizons in the surrounding sandstones, or from vein type mineralisation hosted by NW-striking faults. Our recommendation is to re-investigate the locality to test the latter hypothesis.

Kiatak Fault. The quartz-baryte-pyrite contact mineralisation of probable Neoproterozoic age found near the Kiatak Fault on southern Northumberland Ø, combined with a distinct gold-barium stream sediment anomaly along the fault trace, indicate potential for vein-type gold mineralisation. It is recommended that the accessible parts of the fault zone be investigated. In a wider perspective, the possible continuation of fault-controlled gold mineralisation in the fault system south of Olrik Fjord and in other major fault systems offers an additional potential. Vein-type mineralisation found in shield rocks east of Hubbard Gletscher confirms the regional extent of quartz-baryte-pyrite (-chalcopyrite) veins and this mineralisation is probably associated with the major Neoproterozoic magmatic episode responsible for widespread sulphide mineralisation further south.

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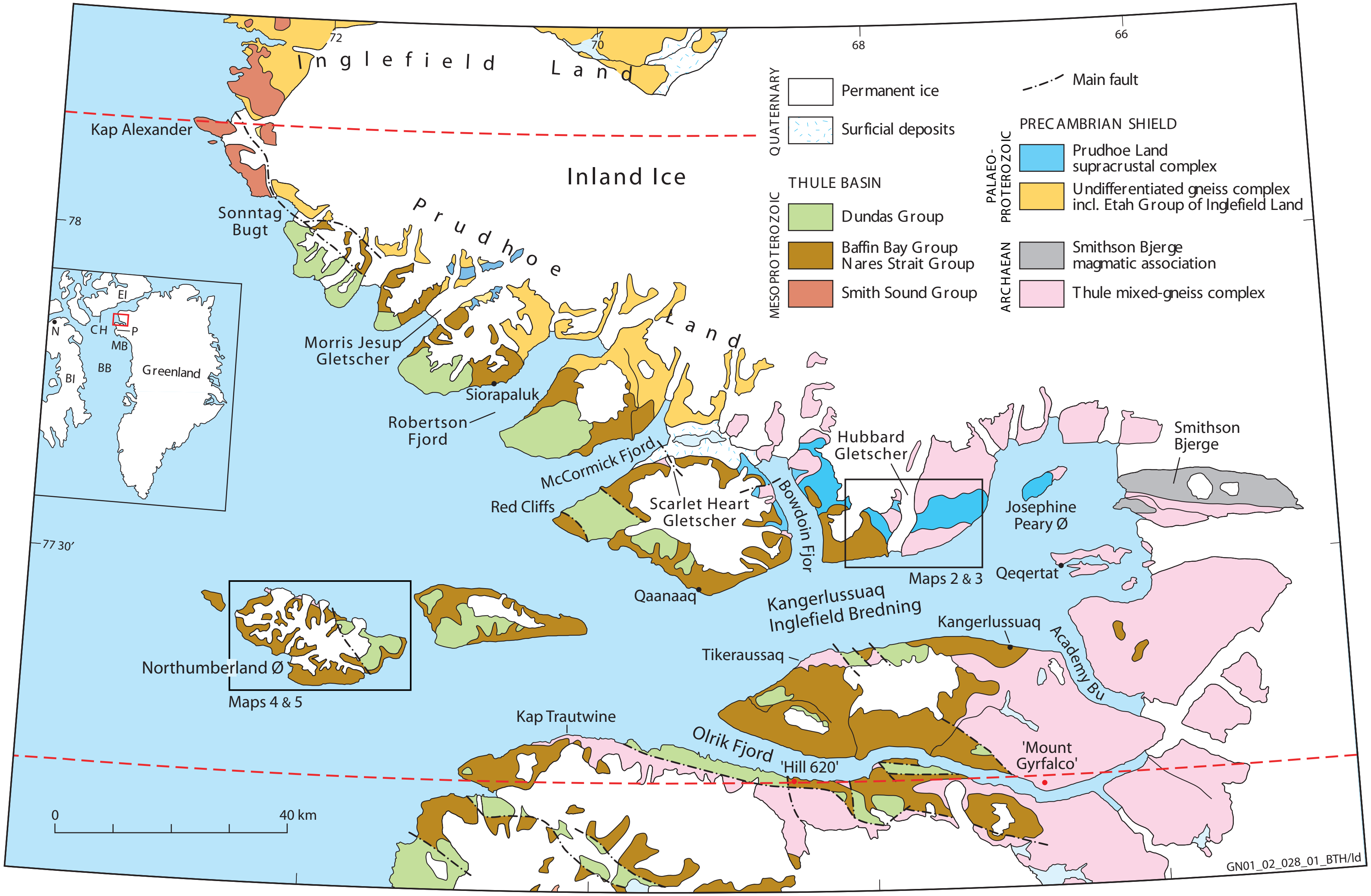
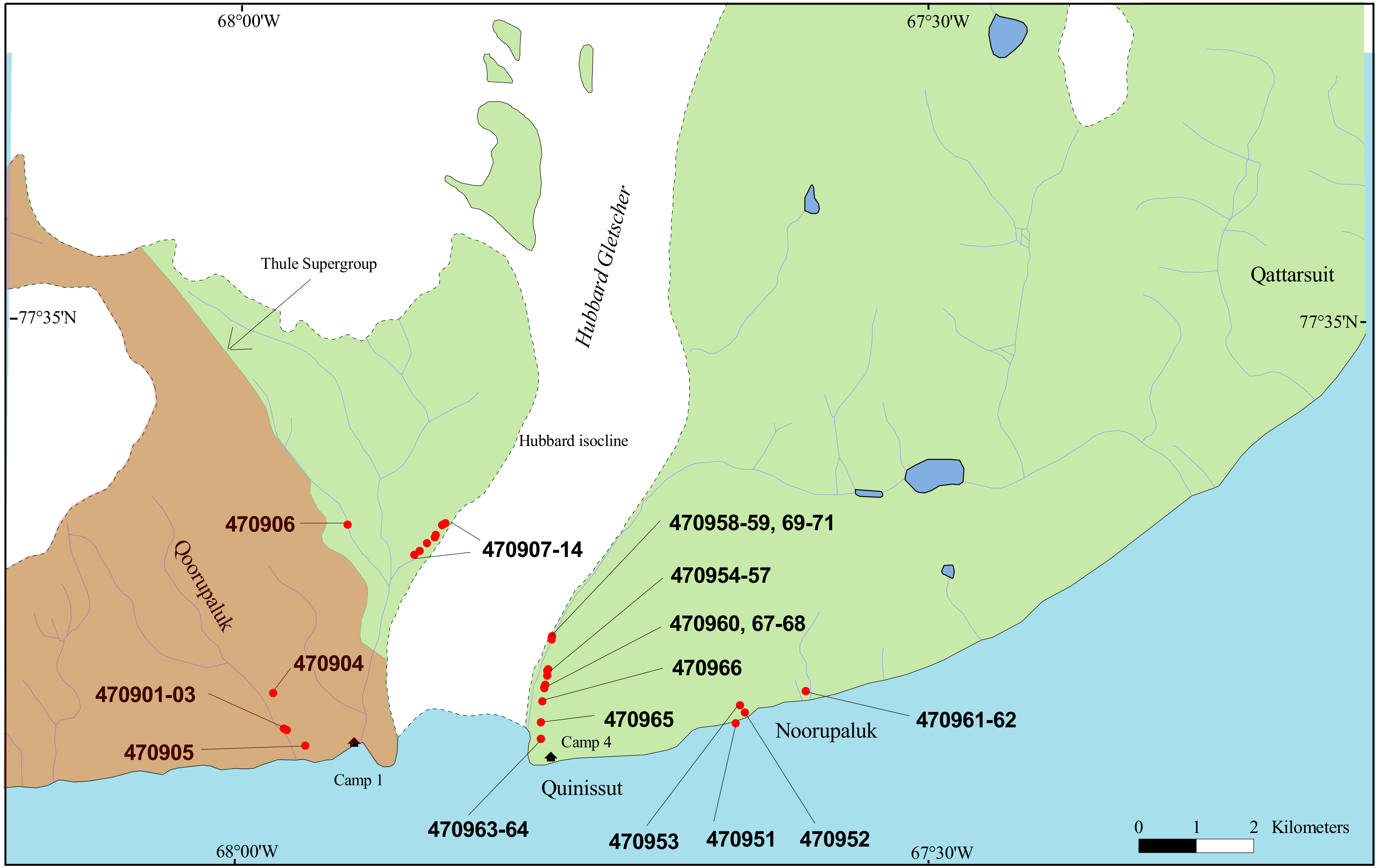
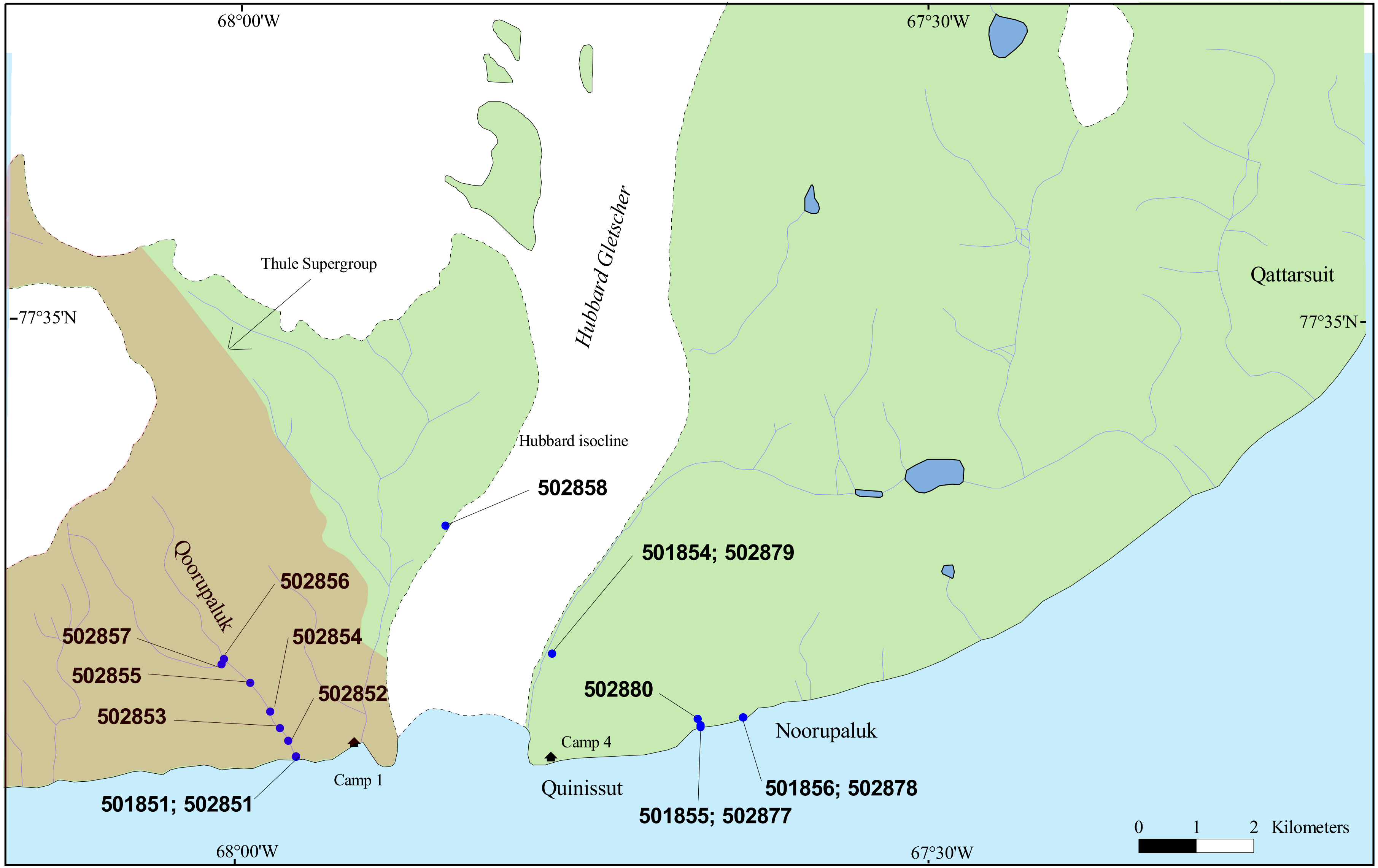


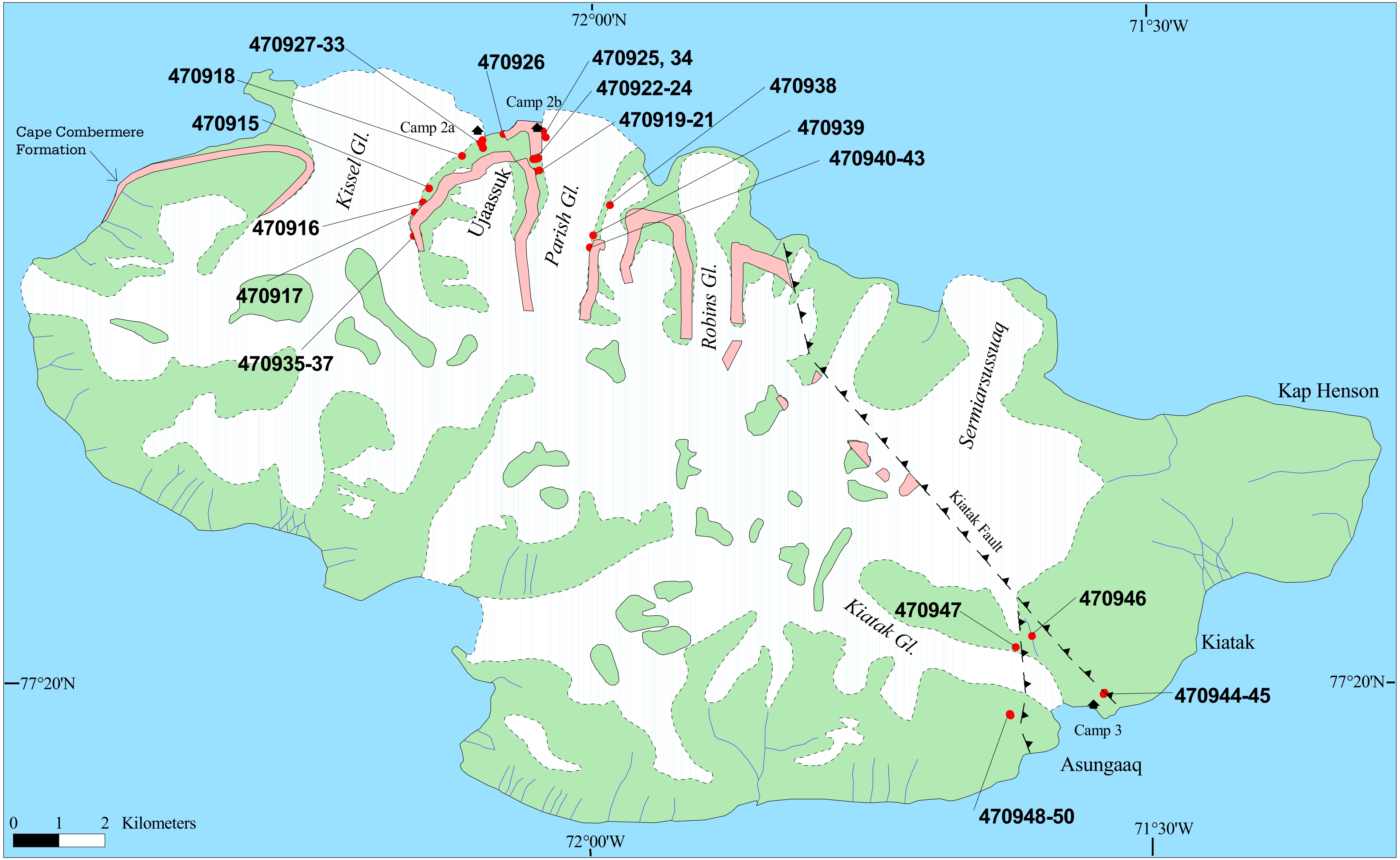
Map 1. *Geological map of the Qaanaaq region with limits of project Qaanaaq 2001 shown by* ***red dashed lines****. Basic sills, that in some areas of the Dundas Group form large outcrops, are not shown. Only faults affecting disposition of groups of the Thule Supergroup are depicted.* ***Black dots*** *are settlements;* ***red dots*** *other localities. Inset map:* ***BB****, Baffin Bay;* ***BI,*** *Baffin Island;* ***CH****, Clarence Head;* ***EL****, Ellesmere Island;* ***MB****, Melville Bugt;* ***N****, Nanisivik;* ***P****, Pituffik (Thule Air Base). Areas investigated in 2003 are framed. Modified from Thomassen et al. (2002b).*



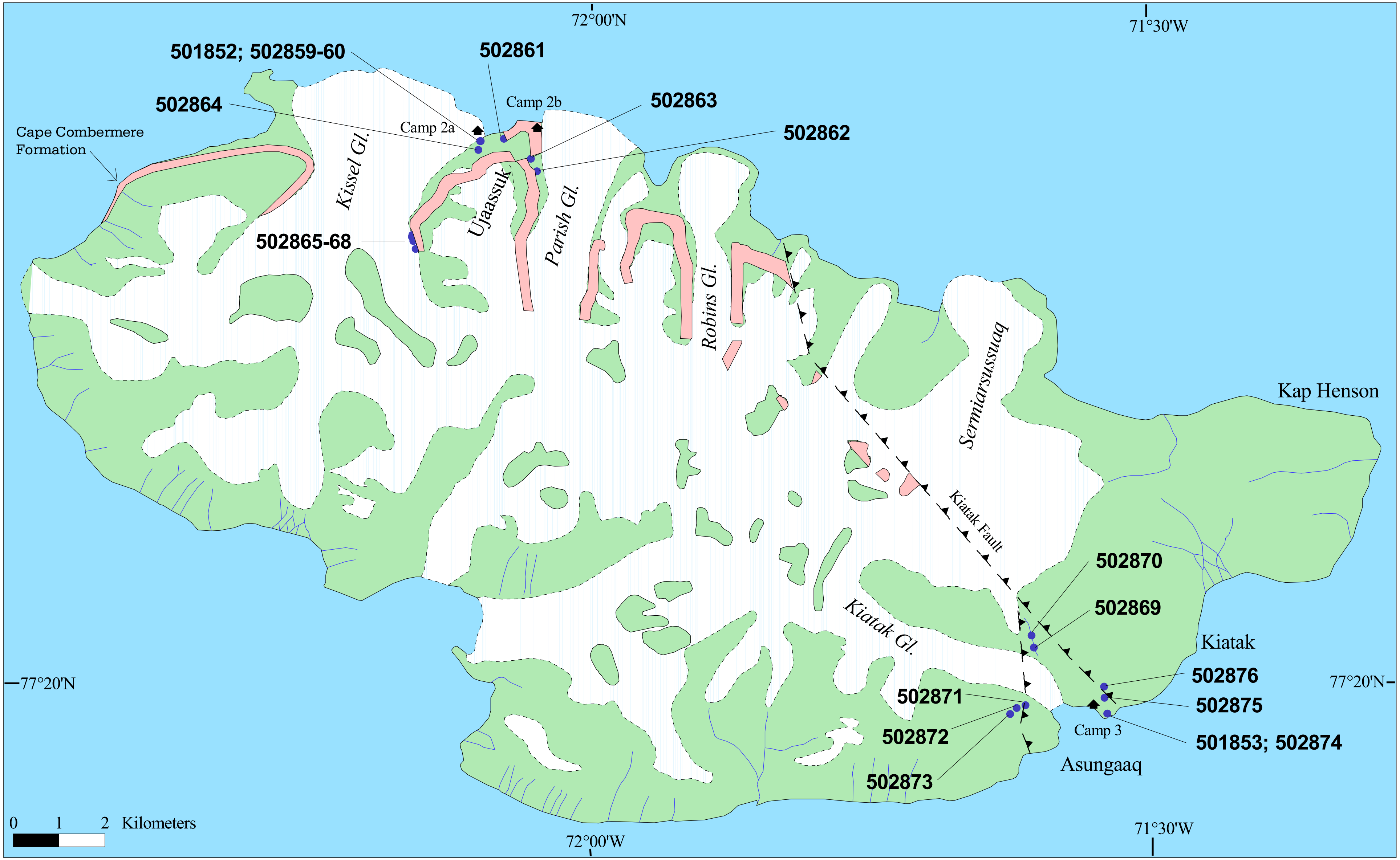
Map 2. *Locality map of the Hubbard Gletscher area showing rock sample sites. Outcrop of the Thule Supergroup is from Dawes (1991).*



Map 3. *Locality map of the Hubbard Gletscher area showing stream sediment sample and heavy mineral concentrate sites. Outcrop of the Thule Supergroup is from Dawes (1991).*



Map 4. *Locality map of Northumberland Ø showing rock sample sites. Geological features are from Dawes (1997).*



Map 5. *Locality map of Northumberland Ø showing stream sediment sample and heavy mineral concentrate sites. Geological features are from Dawes (1997).*

Figure 1. *The 'Hubbard Isocline' seen from the south. The c. 400 m high cliff exposes rocks of the Thule mixed-gneiss complex (pale units) and the Prudhoe Land supracrustal complex (dark units). The copper-mineralised amphibolite is out of the picture to the left.*

Figure 2. *Typical limonite-stained unit of sulphide-bearing garnet quartzite with 15% Fe in the Thule mixed-gneiss complex, east of Hubbard Gletscher (470954).*

Figure 3. *Cut surface of pyrite-bearing garnet quartzite with 0.1% Pb, 0.4% Zn, 0.03% Cu and 10.3% Fe. Thule mixed-gneiss complex, east of Hubbard Gletscher (470964). Match is 5 cm. Photo: Jakob Lautrup.*

Figure 4. *Cut surface of pyrrhotite-magnetite bearing BIF with 16% Fe. Thule mixed-gneiss complex, Noorupaluk (470952). Match is 5 cm. Photo: Jakob Lautrup.*

Figure 5. *The stream valley Qoorupaluk seen from the south. Conspicuous west of the valley is a dark dolerite sill within the varicoloured sandstones of Baffin Bay Group. Height of cliffs c. 300 m.*

Figure 6. *Northern Northumberland Ø, seen from north-east. From left to right the glaciers are: unnamed glacier, Robins Gletscher, Parish Gletscher and Kissel Gletscher*

Figure 7. *Eastern side of Kissel Gletscher showing Cape Combermere Formation volcanics . View is to the north, height of cliff c. 500 m. For details see Dawes (1997, figs 58, 59).*

Figure 8. *Cut surface of volcanic scree block with hematite-chalcocite-bearing quartz-calcite veins and 1.1% Cu, 8.9% Fe. West side of Parish Gletscher (470924). Match is 5 cm; photo: Jakob Lautrup*.

Figure. 9. *Moraine block from Parish Gletscher of vesicular lava with hematite-chalcocite blebs and 1.3% Cu, 5.3% Fe (470934). Match is 5 cm; photo: Jakob Lautrup.*

Figure 10. *Mountainside east of Parish Gletscher exposing Cape Combermere Formation. Hematite-chalcocite-mineralised scree blocks found in the foreground (470939) probably stem from the white (silicified?) horizon c. 100 m higher up, above snow patch.*

Figure 11. *Cut surface of hematite-chalcocite-bearing volcanic float with 1.7% Cu, 21.9% Fe (470939). From locality shown on Figure 10. Match is 5 cm; photo: Jakob Lautrup.*

Figure 12. *Float of pegmatitic rock with hematite (28.2% Fe) from Cape Combermere Formation, east of Parish Gletscher (470941). Match is 5 cm; photo: Jakob Lautrup.*

Figure 13. *Moraine block from western Parish Gletscher of silicified volcanic rocks with blebs of chalcopyrite-pyrrhotite and 0.6% Cu, 0.9% Fe and 0.7% Ba (470925).*

Figure 14. *View from the south over Kiatak Gletscher and valley with geochemical gold anomaly (502869, 70). A branch of the Kiatak Fault follows the valley. Relief c. 300 m.*

Figure 15. *View from the west of Asungaaq. A dolerite dyke crossing the 400 m high mountain (above left cross) is accompanied by quartz-baryte-pyrite contact mineralisation, that was investigated in a main gulley (above right cross), see Figure 16.*

Figure 16. *Quartz-baryte-pyrite-mineralised, 2–3 m wide contact zone (between person and black dyke) in Baffin Bay Group conglomerate (470948–50). Asungaaq, cf. Figure 15.*

Table 1. *Rock sample list*

GGU no.	Latitude	Longitude	Alt. m	Type	Geol. unit	Field description
470901	77.5196	-67.9631	76	oc	S	Vqz. in sill
470902	77.5196	-67.9631	77	b	S	Vqz., trace hem. in sill
470903	77.5198	-67.9648	85	b	S	Vqz., hem. in sill
470904	77.5253	-67.9732	219	b	S	Dolerite with dissem. mag.
470905	77.5171	-67.9493	116	oc	S	Vqz., hem. in sill
470906	77.5516	-67.9200	161	b	P	Gneiss neosome with py.
470907	77.5471	-67.8718	188	o	P	Amphibolite with trace cpy.
470908	77.5477	-67.8682	176	o	P	Gneiss with dissem. cpy
470909	77.5489	-67.8624	170	o	P	Amphibolite with trace cpy.
470910	77.5498	-67.8574	208	o	P	Amphibolite with dissem. cpy.
470911	77.5501	-67.8566	199	o	P	Amphibolite with dissem. cpy.
470912	77.5517	-67.8521	192	b	P	Quartzite with pyrrh., cpy
470913	77.5518	-67.8511	197	o	P	Amphibolite with cpy., py., pyrrh.
470914	77.5520	-67.8493	186	o	P	Amphibolite with cpy., pyrrh.
470915	77.4311	-72.1615	143	b	N	Sandstone with cc., mal, on joints
470916	77.4282	-72.1678	157	b	C	Mafic rock with vqz., hem., prehnite
470917	77.4266	-72.1770	153	b	C	Vqz. with hem., prehnite
470918	77.4376	-72.1281	48	b	C	Mafic rock with trace cpy.
470919	77.4344	-72.0576	188	b	C	Vqz. with hem.
470920	77.4345	-72.0564	176	b	N	Sandstone with mal., cc.
470921	77.4347	-72.0538	173	b	N	Sandstone with mal., cc.
470922	77.4371	-72.0610	164	b	C	Vqz. with hem.
470923	77.4370	-72.0627	147	b	C	Basalt with mal., hem./cc.-veinlet
470924	77.4371	-72.0596	143	b	C	Brecciated basalt with mal.,hem., cc.
470925	77.4425	-72.0575	62	b	C	Siliceous breccia with cpy., pyrrh.
470926	77.4414	-72.0958	20	o	N	Crushed sandstone with mal.
470927	77.4385	-72.1125	98	o?	C	Vesicule with hem., calcite
470928	77.4385	-72.1125	98	o?	C	Vqz.,prehnite, hem. in basalt
470929	77.4385	-72.1125	98	b	C	Vesicular rock with hem., mag.
470930	77.4392	-72.1138	64	b	C	Altered basalt with hem.
470931	77.4392	-72.1138	64	b	C	Hem. veinlet in basalt
470932	77.4395	-72.1146	44	b	C	Vqz., hem. in basalt
470933	77.4400	-72.1130	19	b	C	Vqz., hem. in basalt
470934	77.4413	-72.0553	40	b	C	Vesicular basalt with hem.
470935	77.4216	-72.1702	228	b	C	Hem.-cemented, brecciated basalt
470936	77.4218	-72.1689	224	b	C	Basalt with vqz., prehnite, hem.
470937	77.4218	-72.1729	218	b	C	Basalt with vqz., prehnite, hem.
470938	77.4280	-71.9928	135	b	C	Basalt with vqz., prehnite, hem.
470939	77.4225	-72.0098	234	b	C	Basaltic breccia with hem., mal.
470940	77.4198	-72.0157	249	b	C	Quartz-feldspar-hem. breccia
470941	77.4198	-72.0156	251	b	C	Quartz-feldspar-hem. breccia
470942	77.4198	-72.0156	251	b	C	Hematised basalt
470943	77.4198	-72.0156	252	b	C	Silicified volcanic rock with trace py.
470944	77.3317	-71.5475	10	b	B	Brecciated sandstone with cpy., pyrrh.
470945	77.3320	-71.5467	98	b	B	Vqz. with calcite, trace cpy.
470946	77.3433	-71.6113	137	b	B	Brecciated sandstone with trace cpy.
470947	77.3411	-71.6258	153	b	N	Sandstone with hem.

Table 1. *Rock sample list*

GGU no.	Latitude	Longitude	Alt. m	Type	Geol. unit	Field description
470948	77.3277	-71.6310	281	o	B	Baryte veinlet with trace py.
470949	77.3279	-71.6313	278	o	B	Pyritised conglomerate
470950	77.3280	-71.6316	268	o	B	Sandstone with qtz.-baryte-py. veinlet
470951	77.5210	-67.6391	70	b	T	Garnet quartzite with dissem. pyrrh.
470952	77.5227	-67.6324	105	o	T	Banded quartzite (BIF) with pyrrh.
470953	77.5238	-67.6364	121	b	T	Quartzite with Fe-sulphides
470954	77.5284	-67.7755	92	c 4.0	T	Garnet quartzite with dissem. pyrrh.
470955	77.5284	-67.7755	93	o	T	Garnet quartzite with dissem. pyrrh.
470956	77.5291	-67.7751	87	o	T	Garnet quartzite with dissem. pyrrh.
470957	77.5293	-67.7748	82	o	T	Garnet quartzite with dissem. py.
470958	77.5344	-67.7720	107	oc	V	Vqz. with baryte and cpy.
470959	77.5342	-67.7721	111	o	T	Garnet quartzite with dissem. pyrrh.
470960	77.5265	-67.7775	83	b	T	Garnet quartzite with py.
470961	77.5260	-67.5890	308	o	T	Garnet quartzite with mag., pyrrh..
470962	77.5260	-67.5890	307	o	T	Quartzite with trace pyrrh.
470963	77.5185	-67.7794	29	o	T	Garnet quartzite with mag., pyrrh..
470964	77.5185	-67.7794	29	o	T	Rusty garnet quartzite with py.
470965	77.5211	-67.7796	30	o	T	Garnet quartzite with dissem. pyrrh.
470966	77.5243	-67.7788	65	o	T	Garnet quartzite with mag., pyrrh..
470967	77.5264	-67.7773	72	b	T	Garnet quartzite with Fe-sulphides
470968	77.5269	-67.7769	74	b	T	Garnet quartzite with pyrrh., trace cpy.
470969	77.5344	-67.7717	111	o	T	Garnet quartzite with py.
470970	77.5345	-67.7720	120	o	T	Garnet-quartz gneiss with py.
470971	77.5340	-67.7722	116	o	T	Brecciated marble with trace py.

Abbreviations

o = sample from outcrop
oc = composite sample from outcrop
b = boulder or scree sample
c1.0 = chip sample over 1.0 m

cpy. = chalcopyrite
cc. = chalcocite
hem. = hematite
mag. = magnetite
mal. = malachite
py. = pyrite
pyrrh. = pyrrhotite
vqz. = vein quartz

V = Quartz vein
S = Dolerite sill
B = Baffin Bay Group
C = Cape Combermere Formation, Nares Strait Group
N = Nares Strait Group, undifferentiated
P = Prudhoe Land supracrustal complex
T = Thule mixed-gneiss complex

Table 2. *Rock samples: analytical results*

Element	Detection limit		Analytical method	Element	Detection limit		Analytical method
Ag	0.3	ppm	ICP	Mo	1	ppm	ICP
Au	2	ppb	INAA	Na	0.01	pct	INAA
Au	2	ppb	FA	Nd	5	ppm	INAA
Al	0.01	pct	INAA	Ni	1	ppm	ICP
As	0.5	ppm	INAA	P	0.001	pct	ICP
Ba	50	ppm	INAA	Pb	3	ppm	ICP
Be	1	ppm	ICP	Pd	4	ppb	FA
Bi	2	ppm	ICP	Pt	5	ppb	FA
Br	0.5	ppm	INAA	Rb	15	ppm	INAA
Ca	0.01	pct	ICP	S	0.001	pct	ICP
Cd	0.3	ppm	ICP	Sb	0.1	ppm	INAA
Ce	3	ppm	INAA	Sc	0.1	ppm	INAA
Co	1	ppm	INAA	Se	3	ppm	INAA
Cr	5	ppm	INAA	Sm	0.1	ppm	INAA
Cs	1	ppm	INAA	Sn	0.01	pct	INAA
Cu	1	ppm	ICP	Sr	0.5	ppm	ICP
Eu	0.2	ppm	INAA	Ta	0.5	ppm	INAA
Fe	0.01	pct	INAA	Tb	0.5	ppm	INAA
Hf	1	ppm	INAA	Th	0.2	ppm	INAA
Hg	1	ppm	INAA	Ti	0.01	pct	ICP
Ir	5	ppb	INAA	U	0.5	ppm	INAA
K	0.01	pct	ICP	V	2	ppm	ICP
La	0.5	ppm	INAA	W	1	ppm	INAA
Lu	0.05	ppm	INAA	Y	1	ppm	ICP
Mg	0.01	pct	ICP	Yb	0.2	ppm	INAA
Mn	1	ppm	ICP	Zn	1	ppm	ICP

Analysis by Activation Laboratories Ltd., Ontario, Canada.

Analytical methods:
INAA: Instrumental neutron activation
ICP: Inductively coupled plasma emission spectrometry
FA: Fire assay

Table 2. *Rock samples: analytical results*

GGU no.	Au ppb	Au (FA) ppb	Ag ppm	Pt ppb	Pd ppb	Ir ppb	As ppm	Sb ppm	Se ppm	Hg ppm
470901	3		<0.3			<5	3.6	0.2	<3	<1
470902	<2		<0.3			<5	2.5	<0.1	<3	<1
470903	<2		<0.3			<5	3.7	0.1	<3	<1
470904	5		3.2			<5	3.9	0.3	<3	<1
470905	<2		<0.3			<5	8.0	0.2	<3	<1
470906	4		<0.3			<5	1.5	<0.1	9	<1
470907	<2		3.2			<5	1.7	0.3	<3	<1
470908	5		2.7			<5	2.2	<0.1	<3	<1
470909	4		3.4			<5	2.1	<0.1	<3	<1
470910	10		3.8			<5	2.5	<0.1	3	<1
470911	75	49	4.3	<5	<4	<5	3.9	<0.1	<3	<1
470912	<2		<0.3			<5	1.6	<0.1	<3	<1
470913	5		3.8			<5	1.7	<0.1	<3	<1
470914	61	81	4.2	11	38	<5	1.7	<0.1	10	<1
470915	<2		1.1			<5	2.5	<0.1	<3	<1
470916	3		<0.3			<5	1.8	<0.1	<3	<1
470917	<2		<0.3			<5	1.8	<0.1	<3	<1
470918	<2		0.6			<5	2.5	0.2	<3	<1
470919	2		<0.3			<5	1.8	0.2	<3	<1
470920	11		52.9			<5	3.5	<0.1	<3	<1
470921	3		29.6			<5	3.2	0.2	<3	<1
470922	2		<0.3			<5	4.2	<0.1	<3	<1
470923	6		1.9			<5	<0.5	<0.1	<3	<1
470924	12	8	3.2	34	31	<5	2.3	<0.1	<3	<1
470925	<2		3.4			<5	2.2	<0.1	<3	<1
470926	35	17	1.5	29	15	<5	2.4	<0.1	<3	<1
470927	5		<0.3			<5	2.4	<0.1	<3	<1
470928	8		<0.3			<5	<0.5	<0.1	<3	<1
470929	12	9	2.0	16	27	<5	1.8	<0.1	<3	<1
470930	<2		<0.3			<5	2.9	<0.1	<3	<1
470931	6		<0.3			<5	3.2	0.2	<3	<1
470932	5		<0.3			<5	2.7	<0.1	<3	<1
470933	<2		<0.3			<5	2.4	<0.1	<3	<1
470934	<2		9.9			<5	<0.5	<0.1	<3	<1
470935	<2		<0.3			<5	1.8	<0.1	<3	<1
470936	2		<0.3			<5	1.9	<0.1	<3	<1
470937	<2		<0.3			<5	1.4	<0.1	<3	<1
470938	3		<0.3			<5	1.4	<0.1	<3	<1
470939	57	48	8.1	9	15	<5	2.3	0.3	<3	<1
470940	27	9	<0.3	<5	6	<5	<0.5	<0.1	<3	<1
470941	<2		<0.3			<5	4.3	<0.1	<3	<1
470942	2		<0.3			<5	2.8	<0.1	<3	<1
470943	<2		0.4			<5	4.2	<0.1	<3	<1
470944	3		1.2			<5	3.4	<0.1	<3	<1
470945	<2		<0.3			<5	1.3	<0.1	<3	<1
470946	<2		0.3			<5	4.7	0.1	<3	<1
470947	<2		<0.3			<5	3.2	0.9	<3	<1
470948	<2		<0.3			<5	1.0	<0.1	<3	<1
470949	<2		<0.3			<5	1.2	0.1	<3	<1
470950	<2		<0.3			<5	2.5	0.1	<3	<1

Table 2. *Rock samples: analytical results*

GGU no.	Au ppb	Au (FA) ppb	Ag ppm	Pt ppb	Pd ppb	Ir ppb	As ppm	Sb ppm	Se ppm	Hg ppm
470951	8		<0.3			<5	1.6	<0.1	<3	<1
470952	10		<0.3			<5	2.2	<0.1	<3	<1
470953	55	55	<0.3	<5	<4	<5	1.6	<0.1	<3	<1
470954	11		<0.3			<5	2.0	<0.1	<3	<1
470955	4		<0.3			<5	2.5	0.1	<3	<1
470956	<2		0.6			<5	2.9	<0.1	<3	<1
470957	8		<0.3			<5	21.4	<0.1	<3	<1
470958	<2		1.0			<5	3.4	<0.1	<3	<1
470959	35	37	<0.3	10	17	<5	<0.5	<0.1	<3	<1
470960	<2		<0.3			<5	4.5	0.1	<3	<1
470961	5		<0.3			<5	2.2	<0.1	<3	<1
470962	3		0.8			<5	1.8	<0.1	<3	<1
470963	7		<0.3			<5	1.7	<0.1	<3	<1
470964	<2		1.0			<5	8.3	0.2	<3	<1
470965	80	82	<0.3	<5	<4	<5	2.0	<0.1	<3	<1
470966	116	90	<0.3	<5	<4	<5	6.7	<0.1	<3	<1
470967	7		<0.3			<5	<0.5	<0.1	<3	<1
470968	15		<0.3			<5	1.9	<0.1	<3	<1
470969	18		<0.3			<5	2.2	0.4	<3	<1
470970	64	65	0.6	<5	<4	<5	1.2	<0.1	<3	<1
470971	3		<0.3			<5	2.0	<0.1	<3	<1
Samples	71	12	71	12	12	71	71	71	71	71
Minimum	<2	8	<0.3	<5	<4	<5	<0.5	<0.1	<3	<1
Maximum	116	90	52.9	34	38	<5	21.4	0.9	10	<1

Table 2. *Rock samples: analytical results*

GGU no.	Cu ppm	Pb ppm	Zn ppm	Ba ppm	Cd ppm	Bi ppm	Mo ppm	Ni ppm	Co ppm	Cr ppm	S pct
470901	19	13	11	<50	0.4	9	<1	46	17	20	0.002
470902	54	8	15	110	0.7	8	<1	14	13	12	<0.001
470903	12	5	19	110	0.4	3	<1	30	14	17	<0.001
470904	1151	13	101	410	1.5	<2	3	34	32	<5	0.040
470905	38	13	25	<50	<0.3	<2	1	13	3	18	<0.001
470906	10	23	12	300	<0.3	<2	1	26	4	17	7.240
470907	1804	15	225	310	1.7	<2	<1	253	39	32	0.240
470908	3316	23	75	340	1.3	<2	3	147	20	23	0.875
470909	2822	9	131	230	1.1	<2	3	276	45	46	0.345
470910	5635	13	155	150	1.0	<2	1	380	65	34	1.425
470911	6722	5	107	100	1.2	<2	2	347	64	29	1.295
470912	778	4	32	110	<0.3	<2	2	41	29	41	2.270
470913	3083	12	144	230	1.2	<2	<1	319	69	36	1.281
470914	8308	33	135	80	1.6	<2	<1	857	89	49	2.225
470915	2496	7	7	400	<0.3	<2	<1	6	2	15	0.092
470916	148	38	18	<50	1.0	<2	<1	54	15	198	<0.001
470917	37	25	14	<50	1.0	3	<1	50	15	191	<0.001
470918	719	35	51	520	2.0	5	<1	65	35	113	0.096
470919	53	<3	6	<50	<0.3	3	<1	13	3	28	<0.001
470920	27095	17	21	9500	0.4	<2	<1	44	15	286	0.688
470921	12109	26	18	3100	<0.3	<2	<1	26	12	105	0.313
470922	373	6	25	820	0.4	<2	<1	26	10	43	0.022
470923	10558	9	75	550	1.8	<2	2	120	41	313	0.361
470924	10534	7	58	600	0.7	<2	<1	71	29	165	0.340
470925	6189	6	12	7400	<0.3	<2	1	6	2	18	0.552
470926	8513	5	38	1400	<0.3	<2	1	12	7	36	0.075
470927	65	10	<1	300	0.8	6	<1	10	4	51	0.002
470928	85	29	29	600	1.3	3	<1	16	5	142	<0.001
470929	589	8	61	<50	1.0	<2	<1	43	15	37	0.013
470930	282	21	31	360	0.8	4	<1	29	6	179	<0.001
470931	139	38	28	300	1.9	3	<1	38	12	101	<0.001
470932	18	15	10	65	0.8	3	<1	29	7	110	<0.001
470933	531	18	9	<50	1.2	<2	<1	39	7	110	0.013
470934	12502	13	49	250	1.1	<2	2	126	39	331	0.410
470935	82	9	37	<50	1.7	<2	1	70	19	191	<0.001
470936	59	23	8	130	1.0	<2	<1	54	10	161	<0.001
470937	96	36	60	130	1.7	2	<1	91	22	187	<0.001
470938	81	12	44	510	1.3	<2	1	127	36	261	<0.001
470939	16501	17	30	420	0.9	<2	9	77	22	537	0.034
470940	32	10	51	410	0.6	<2	2	5	5	<5	<0.001
470941	192	25	26	130	1.9	5	2	4	11	9	<0.001
470942	13	7	91	130	0.8	<2	1	12	13	12	<0.001
470943	43	6	14	140	<0.3	<2	4	11	12	8	0.066
470944	2121	<3	40	100	<0.3	<2	<1	12	12	12	0.318
470945	59	<3	3	360	<0.3	2	<1	30	11	20	0.046
470946	34	24	12	430	<0.3	<2	2	7	2	12	0.025
470947	13	13	14	360	0.7	3	4	4	2	13	<0.001
470948	11	<3	5	140000	<0.3	<2	<1	6	9	11	0.391
470949	12	13	12	2800	0.4	<2	<1	2	3	13	0.159
470950	32	5	7	80000	<0.3	<2	<1	17	55	12	0.916

Table 2. *Rock samples: analytical results*

GGU no.	Cu ppm	Pb ppm	Zn ppm	Ba ppm	Cd ppm	Bi ppm	Mo ppm	Ni ppm	Co ppm	Cr ppm	S pct
470951	148	12	89	300	1.7	4	1	48	11	57	1.067
470952	107	12	112	180	1.3	4	<1	59	14	43	1.358
470953	425	8	99	55	1.6	<2	5	107	21	53	5.664
470954	51	17	98	260	1.4	5	2	23	9	64	0.973
470955	55	16	135	80	1.7	3	3	32	11	52	1.006
470956	545	78	409	280	1.8	<2	14	109	89	89	3.962
470957	37	17	30	100	1.3	3	13	35	62	62	13.314
470958	4131	14	29	110000	<0.3	<2	4	114	59	59	2.342
470959	540	26	517	290	1.9	10	20	1088	1620	1620	3.488
470960	428	15	118	270	1.3	<2	5	162	101	101	5.023
470961	43	21	91	92	0.6	3	2	6	6	108	0.191
470962	44	14	95	310	1.2	<2	1	31	14	108	0.372
470963	108	10	128	81	1.0	3	<1	65	13	49	0.880
470964	317	1057	4139	300	12.8	<2	7	99	29	87	2.216
470965	450	15	141	<50	1.2	<2	5	197	33	42	2.083
470966	430	61	130	120	1.2	<2	<1	120	34	18	2.044
470967	171	23	70	140	1.6	<2	9	60	19	49	1.575
470968	106	21	63	240	0.5	<2	2	82	15	62	0.689
470969	333	107	301	360	1.7	<2	2	172	35	127	1.716
470970	234	108	147	920	1.1	<2	15	109	18	46	1.090
470971	7	<3	<1	190	<0.3	4	<1	16	5	6	0.149
Samples	71	71	71	71	71	71	71	71	71	71	71
Minimum	7	<3	<1	<50	<0.3	<2	<1	2	2	<5	<0.001
Maximum	27095	1057	4139	140000	12.8	10	20	1088	1620	1620	13.314

Table 2. *Rock samples: analytical results*

GGU no.	W ppm	Ta ppm	Sn pct	Be ppm	Br ppm	Rb ppm	Sr ppm	Sc ppm	Cs ppm	Hf ppm	Y ppm
470901	<1	<0.5	<0.01	<1	1.4	<15	11	2.3	<1	<1	36
470902	<1	<0.5	<0.01	<1	3.3	<15	14	1.8	<1	<1	35
470903	<1	<0.5	<0.01	<1	2.4	<15	29	1.6	<1	<1	20
470904	<1	<0.5	<0.02	4	2.7	56	98	26.0	<1	4	21
470905	<1	<0.5	<0.01	<1	5.2	<15	13	5.1	<1	<1	3
470906	<1	0.7	<0.01	<1	0.5	25	57	1.1	<1	<1	2
470907	<1	<0.5	<0.01	5	<0.5	69	102	30.0	2	2	17
470908	<1	<0.5	<0.01	4	<0.5	84	276	14.7	<1	2	18
470909	<1	<0.5	<0.01	5	<0.5	54	110	35.9	<1	3	19
470910	<1	<0.5	<0.01	4	<0.5	<15	127	37.3	<1	3	20
470911	<1	<0.5	<0.01	4	<0.5	<15	124	34.2	<1	3	15
470912	<1	<0.5	<0.01	<1	<0.5	<15	17	7.0	<1	<1	4
470913	<1	<0.5	<0.01	5	<0.5	<15	90	39.1	<1	3	20
470914	<1	<0.5	<0.01	4	<0.5	<15	62	33.2	<1	2	17
470915	<1	<0.5	<0.01	<1	2.0	44	36	1.4	<1	7	5
470916	<1	<0.5	<0.01	2	10.5	<15	10	30.0	<1	1	9
470917	<1	<0.5	<0.01	1	13.3	<15	20	26.8	<1	1	8
470918	<1	<0.5	<0.01	2	3.6	52	21	25.3	<1	2	20
470919	<1	<0.5	<0.01	<1	9.7	<15	22	2.5	<1	<1	6
470920	<1	<0.5	<0.01	2	<0.5	76	156	9.0	1	4	174
470921	<1	<0.5	<0.01	2	<0.5	78	60	10.6	2	5	13
470922	<1	<0.5	<0.01	<1	6.4	60	22	8.2	<1	2	13
470923	<1	1.3	<0.01	3	3.9	52	91	34.3	<1	3	22
470924	<1	<0.5	<0.01	1	4.3	<15	25	19.2	<1	2	19
470925	<1	<0.5	<0.01	<1	14.4	<15	162	1.2	<1	<1	1
470926	<1	<0.5	<0.01	<1	2.4	20	27	2.0	<1	4	6
470927	<1	<0.5	<0.01	<1	4.5	<15	43	6.2	<1	<1	4
470928	<1	<0.5	<0.02	1	5.2	<15	69	19.6	<1	1	14
470929	<1	<0.5	<0.02	4	13.2	<15	30	35.3	<1	2	18
470930	<1	<0.5	<0.01	1	4.4	68	23	24.3	<1	<1	7
470931	<1	<0.5	<0.01	<1	5.9	47	22	12.5	<1	1	10
470932	<1	<0.5	<0.01	1	8.0	<15	13	18.9	<1	1	10
470933	<1	<0.5	<0.01	1	7.0	<15	10	16.7	<1	<1	10
470934	<1	<0.5	<0.02	3	4.0	27	126	40.5	<1	2	23
470935	<1	<0.5	<0.02	2	6.3	<15	31	27.3	<1	2	19
470936	<1	<0.5	<0.01	1	10.5	<15	11	22.5	<1	<1	7
470937	<1	<0.5	<0.01	2	6.9	<15	32	28.9	2	1	13
470938	<1	<0.5	<0.01	2	7.2	<15	49	31.2	<1	1	13
470939	<1	<0.5	<0.02	2	3.3	<15	39	17.9	<1	2	11
470940	<1	<0.5	<0.02	1	9.7	<15	15	10.4	<1	2	6
470941	<1	<0.5	<0.01	<1	3.0	<15	19	1.3	<1	<1	4
470942	<1	<0.5	<0.02	2	11.4	<15	33	30.6	<1	3	24
470943	<1	<0.5	<0.01	<1	8.3	<15	12	6.5	<1	<1	6
470944	<1	<0.5	<0.01	<1	4.2	<15	22	2.2	<1	1	5
470945	<1	<0.5	<0.01	<1	2.8	<15	19	4.5	<1	<1	35
470946	<1	<0.5	<0.01	<1	3.6	<15	15	1.3	<1	2	5
470947	<1	<0.5	<0.01	<1	3.0	<15	36	1.0	<1	4	7
470948	<1	<0.5	<0.01	<1	2.5	<15	631	0.7	<1	2	2
470949	<1	0.6	<0.01	<1	3.6	<15	95	1.1	<1	3	4
470950	<1	<0.5	<0.01	<1	3.7	<15	392	1.0	<1	<1	2

Table 2. *Rock samples: analytical results*

GGU no.	W ppm	Ta ppm	Sn pct	Be ppm	Br ppm	Rb ppm	Sr ppm	Sc ppm	Cs ppm	Hf ppm	Y ppm
470951	<1	<0.5	<0.01	1	<0.5	<15	60	6.5	<1	<1	11
470952	14	<0.5	<0.01	2	<0.5	<15	32	5.8	<1	<1	16
470953	<1	<0.5	<0.01	<1	<0.5	<15	69	11.6	<1	<1	16
470954	12	<0.5	<0.01	1	2.6	27	211	7.4	1	1	11
470955	<1	<0.5	<0.01	1	2.2	23	100	5.9	<1	<1	11
470956	<1	<0.5	<0.01	2	<0.5	67	37	13.6	<1	2	16
470957	<1	<0.5	<0.01	<1	<0.5	<15	11	6.0	<1	<1	11
470958	<1	<0.5	<0.01	1	1.8	60	1279	4.6	<1	3	3
470959	<1	<0.5	<0.01	2	<0.5	30	26	50.6	<1	2	8
470960	12	<0.5	<0.01	1	<0.5	41	51	20.1	2	2	16
470961	<1	<0.5	<0.01	<1	<0.5	25	25	14.3	<1	2	14
470962	<1	<0.5	<0.01	2	<0.5	38	496	12.3	1	2	7
470963	<1	<0.5	<0.01	<1	<0.5	24	48	6.5	<1	<1	10
470964	<1	1.1	<0.01	2	<0.5	39	71	14.8	2	3	12
470965	2	0.9	<0.01	<1	<0.5	<15	9	13.4	<1	<1	13
470966	<1	<0.5	<0.01	<1	2.2	<15	33	3.9	<1	<1	22
470967	<1	<0.5	<0.01	<1	<0.5	24	78	18.9	<1	3	20
470968	<1	<0.5	<0.01	2	<0.5	<15	187	10.3	<1	1	15
470969	<1	<0.5	<0.01	2	<0.5	24	113	20.2	<1	2	20
470970	<1	<0.5	<0.01	6	<0.5	40	137	4.9	<1	2	6
470971	<1	<0.5	<0.01	<1	2.8	20	78	1.6	<1	<1	29
Samples	71	71	71	71	71	71	71	71	71	71	71
Minimum	<1	<0.5	<0.01	<1	<0.5	<15	9	0.7	<1	<1	1
Maximum	14	1.3	<0.02	6	14.4	84	1279	50.6	2	7	174

Table 2. *Rock samples: analytical results*

GGU no.	U ppm	Th ppm	La ppm	Ce ppm	Nd ppm	Sm ppm	Eu ppm	Tb ppm	Yb ppm	Lu ppm
470901	<0.5	0.3	9.9	24	10	5.7	2.2	2.0	4.9	0.75
470902	<0.5	<0.2	4.4	14	7	3.3	0.9	1.1	4.3	0.65
470903	<0.5	<0.2	5.2	10	<5	2.1	0.7	0.5	1.5	0.22
470904	2.0	5.9	22.3	48	21	5.2	2.0	<0.5	3.0	0.45
470905	<0.5	<0.2	1.3	3	<5	0.7	0.4	<0.5	0.5	0.08
470906	<0.5	1.8	6.8	12	5	0.8	0.7	<0.5	0.2	<0.05
470907	1.7	2.1	10.0	25	9	3.7	1.6	<0.5	1.7	0.25
470908	<0.5	1.4	5.8	13	7	2.9	1.2	0.6	1.4	0.21
470909	<0.5	1.5	11.8	29	17	4.9	1.8	<0.5	2.7	0.41
470910	<0.5	2.3	12.5	25	11	3.8	1.5	0.6	2.8	0.42
470911	<0.5	2.7	11.6	24	10	3.7	1.2	0.9	2.6	0.40
470912	<0.5	1.4	5.4	11	<5	1.0	0.3	<0.5	0.4	0.06
470913	2.1	2.8	12.7	26	14	3.7	1.6	<0.5	3.0	0.45
470914	<0.5	1.9	8.1	18	8	2.7	1.1	<0.5	2.0	0.32
470915	0.9	2.3	4.6	9	<5	0.8	0.3	<0.5	0.9	0.15
470916	<0.5	0.4	4.6	11	5	1.8	1.0	<0.5	1.7	0.27
470917	<0.5	0.5	7.4	14	6	1.8	1.0	0.6	1.6	0.25
470918	1.7	2.0	17.3	21	12	2.5	0.8	0.5	2.0	0.31
470919	0.7	<0.2	31.5	42	12	1.6	0.7	<0.5	0.3	<0.05
470920	4.6	1.5	11.6	35	13	15.0	9.9	11.0	10.7	1.60
470921	2.8	3.9	7.1	21	9	3.7	0.9	0.6	2.0	0.30
470922	1.8	1.0	16.0	29	10	1.9	0.6	<0.5	2.3	0.33
470923	<0.5	2.0	18.7	38	16	3.5	1.0	0.7	2.6	0.40
470924	1.0	1.6	15.8	32	10	2.5	0.8	0.7	2.8	0.42
470925	<0.5	0.9	4.9	9	<5	0.6	<0.2	<0.5	<0.2	<0.05
470926	0.7	1.4	2.6	6	<5	0.7	0.3	<0.5	0.9	0.13
470927	1.3	<0.2	90.5	150	48	5.0	2.0	<0.5	0.7	0.11
470928	<0.5	2.1	224.0	327	92	10.8	4.2	<0.5	1.8	0.28
470929	<0.5	<0.2	8.5	20	10	3.1	1.5	<0.5	3.1	0.46
470930	<0.5	<0.2	24.5	30	<5	1.6	1.2	<0.5	1.1	0.15
470931	<0.5	1.0	32.1	40	11	2.0	0.7	<0.5	1.1	0.16
470932	<0.5	0.4	5.6	14	6	1.5	1.1	0.7	1.3	0.20
470933	<0.5	<0.2	3.0	7	5	1.2	0.5	<0.5	1.2	0.18
470934	<0.5	2.1	8.6	23	15	3.3	1.1	<0.5	2.5	0.37
470935	<0.5	2.1	35.1	64	25	3.9	1.1	0.9	2.0	0.30
470936	<0.5	0.4	3.2	9	<5	1.3	1.0	<0.5	1.1	0.17
470937	<0.5	<0.2	5.3	11	5	1.9	0.8	<0.5	1.8	0.26
470938	<0.5	<0.2	4.0	9	8	1.7	0.8	<0.5	1.8	0.26
470939	1.5	1.5	6.6	12	6	1.5	0.7	<0.5	1.6	0.24
470940	<0.5	1.6	8.9	20	14	1.5	0.5	<0.5	1.3	0.20
470941	<0.5	<0.2	4.5	7	<5	0.6	0.3	<0.5	0.8	0.12
470942	<0.5	4.1	13.2	30	16	3.5	0.9	<0.5	3.5	0.55
470943	<0.5	0.6	4.6	10	<5	0.7	0.3	<0.5	1.5	0.26
470944	<0.5	1.3	7.0	15	<5	1.2	0.4	<0.5	0.4	0.07
470945	<0.5	<0.2	13.8	33	24	9.1	4.6	1.3	2.3	0.33
470946	0.7	2.4	8.1	18	7	1.4	0.3	<0.5	0.5	0.08
470947	2.3	3.6	15.1	36	14	3.0	0.6	<0.5	0.7	0.13
470948	<0.5	2.7	7.1	10	<5	0.7	<0.2	<0.5	0.3	<0.05
470949	0.9	25.1	26.7	52	11	2.6	0.9	<0.5	0.5	0.08
470950	<0.5	3.5	8.3	13	<5	0.7	<0.2	<0.5	0.3	<0.05

Table 2. *Rock samples: analytical results*

GGU no.	U ppm	Th ppm	La ppm	Ce ppm	Nd ppm	Sm ppm	Eu ppm	Tb ppm	Yb ppm	Lu ppm
470951	1.1	1.5	8.3	16	6	1.6	0.8	<0.5	1.0	0.17
470952	1.0	0.9	12.2	24	7	2.2	0.7	0.5	1.4	0.20
470953	1.2	3.5	14.1	30	12	2.6	1.2	<0.5	2.3	0.35
470954	<0.5	3.0	10.9	20	6	2.0	0.9	<0.5	1.2	0.19
470955	<0.5	1.3	8.1	16	7	2.1	0.7	<0.5	1.1	0.18
470956	0.9	5.8	14.7	29	15	2.7	0.6	0.5	1.9	0.31
470957	<0.5	0.5	4.9	12	9	1.9	0.6	0.7	1.0	0.15
470958	<0.5	1.1	21.4	30	<5	1.7	<0.2	<0.5	0.4	0.06
470959	<0.5	1.8	11.6	21	<5	1.3	0.5	<0.5	0.9	0.15
470960	2.7	8.3	25.9	51	16	4.1	2.0	0.6	3.1	0.46
470961	2.0	7.6	17.4	32	13	3.1	1.1	0.6	2.6	0.40
470962	1.2	1.9	16.8	31	11	2.2	1.1	<0.5	0.8	0.14
470963	<0.5	4.2	13.1	26	12	2.8	0.3	<0.5	0.8	0.12
470964	3.3	15.7	29.2	51	17	4.2	0.9	<0.5	1.7	0.26
470965	1.5	3.6	7.7	18	5	2.5	0.9	0.6	4.4	0.70
470966	1.6	3.8	15.2	35	15	3.8	1.4	0.7	1.5	0.24
470967	1.1	4.0	16.0	32	13	2.5	0.5	0.6	3.6	0.53
470968	1.3	9.1	34.9	63	18	3.9	1.0	<0.5	2.3	0.35
470969	1.7	4.3	22.3	41	15	2.6	0.8	<0.5	4.0	0.60
470970	4.0	2.9	19.6	33	11	1.4	0.8	<0.5	1.1	0.16
470971	<0.5	0.6	56.0	92	38	8.4	2.3	1.3	2.1	0.31
Samples	71	71	71	71	71	71	71	71	71	71
Minimum	<0.5	<0.2	2.6	3	<5	0.6	<0.2	<0.5	<0.2	<0.05
Maximum	4.6	25.1	224.0	327	92	15.0	9.9	11.0	10.7	1.60

Table 2. *Rock samples: analytical results*

GGU no.	Al pct	Na pct	K pct	Ca pct	P pct	Mg pct	Fe pct	Ti pct	V ppm	Mn ppm
470901	0.85	0.03	0.29	10.00	0.006	2.96	6.60	0.02	16	3445
470902	0.30	0.03	0.06	6.67	0.003	5.24	9.14	<0.01	18	13671
470903	0.59	0.03	0.13	7.93	0.006	1.57	10.80	0.01	<2	3306
470904	4.32	1.11	1.51	2.11	0.096	4.07	8.01	1.19	329	771
470905	0.63	0.05	0.09	1.16	0.005	0.39	9.48	0.02	19	526
470906	1.86	0.51	1.09	0.11	0.025	0.12	4.93	0.05	5	31
470907	5.78	1.53	1.18	4.36	0.037	2.74	8.67	1.01	365	785
470908	8.77	2.66	1.20	3.61	0.036	1.35	5.52	0.69	197	458
470909	4.59	1.88	0.94	4.98	0.061	2.91	10.00	1.24	407	1289
470910	4.48	1.54	0.78	5.82	0.059	2.88	12.00	1.21	390	1437
470911	3.88	1.70	0.64	5.21	0.049	2.34	11.80	1.28	406	1282
470912	0.91	0.14	0.17	1.61	0.015	0.98	3.72	0.20	67	378
470913	4.59	1.24	0.69	6.00	0.056	2.92	12.40	1.55	488	1714
470914	5.25	0.83	0.45	5.77	0.034	3.84	11.30	1.12	440	1862
470915	1.47	0.09	1.74	0.05	0.010	0.21	0.60	0.10	14	41
470916	3.32	0.20	0.04	14.73	0.036	1.70	12.10	0.53	373	994
470917	3.53	0.18	0.06	14.69	0.034	1.45	12.90	0.44	421	725
470918	4.77	0.27	3.05	3.72	0.043	7.97	5.64	0.47	332	1388
470919	0.65	0.14	0.04	12.83	0.006	0.35	3.98	0.05	152	417
470920	3.00	0.04	1.90	0.11	0.019	1.94	1.47	0.16	166	99
470921	3.01	0.06	2.30	0.19	0.052	1.41	1.18	0.25	86	118
470922	2.22	0.60	3.58	8.27	0.028	1.27	4.94	0.26	136	1166
470923	5.76	1.64	3.77	4.06	0.045	5.82	7.81	0.55	306	1494
470924	3.22	1.12	1.29	5.84	0.021	4.30	8.85	0.28	245	2238
470925	0.65	0.10	0.37	0.37	0.012	0.18	0.93	0.02	21	144
470926	1.12	0.04	0.65	0.03	0.006	0.98	0.91	0.08	49	52
470927	2.20	1.03	0.24	22.57	0.011	0.33	9.56	0.09	322	383
470928	3.69	0.10	0.06	8.94	0.048	0.66	31.80	0.35	572	383
470929	3.13	1.10	0.28	13.27	0.070	1.18	10.70	1.13	633	1296
470930	2.29	0.08	2.10	6.24	0.031	0.86	27.30	0.48	319	346
470931	2.91	0.77	1.47	11.09	0.025	0.92	18.80	0.22	451	817
470932	4.10	0.20	0.14	16.64	0.029	1.01	11.90	0.44	321	827
470933	3.93	0.20	<0.01	18.21	0.029	1.02	7.51	0.45	268	524
470934	6.43	4.95	0.49	2.91	0.043	4.53	5.26	0.65	285	919
470935	5.74	5.15	0.14	3.20	0.059	3.01	11.00	0.51	401	1027
470936	3.98	0.15	0.14	16.55	0.027	1.07	8.92	0.40	448	484
470937	4.20	1.34	1.23	9.17	0.042	2.19	12.20	0.58	359	983
470938	4.72	0.80	2.77	8.70	0.032	4.03	9.05	0.57	357	1310
470939	3.48	3.07	0.04	3.14	0.013	2.27	21.90	0.26	332	924
470940	3.90	5.72	0.03	0.56	0.030	0.13	10.60	0.33	137	225
470941	0.66	0.48	0.02	0.28	0.001	<0.01	28.20	0.01	312	110
470942	3.54	4.21	0.95	2.27	0.079	0.66	16.50	0.52	239	849
470943	0.89	0.36	0.10	0.59	0.015	0.69	1.86	0.18	75	184
470944	0.45	0.02	0.13	3.60	0.011	0.43	1.40	0.06	11	1367
470945	0.79	0.03	0.02	12.73	0.006	1.72	2.03	0.09	24	2765
470946	0.80	0.02	0.62	1.13	0.010	0.12	0.54	0.05	8	345
470947	0.51	0.01	0.23	0.05	0.014	<0.01	10.00	0.05	10	492
470948	0.56	0.28	<0.01	0.03	0.007	0.21	0.82	0.03	9	30
470949	1.11	0.42	0.18	0.06	0.025	0.16	1.80	0.09	30	56
470950	0.79	0.40	0.05	0.04	0.009	0.17	1.90	0.03	14	39

Table 2. *Rock samples: analytical results*

GGU no.	Al pct	Na pct	K pct	Ca pct	P pct	Mg pct	Fe pct	Ti pct	V ppm	Mn ppm
470951	2.62	0.03	0.03	1.53	0.109	1.84	15.20	0.15	40	896
470952	2.34	0.11	0.08	2.39	0.154	1.63	16.00	0.12	28	2005
470953	2.88	0.05	0.23	2.30	0.142	1.41	15.40	0.13	50	2521
470954	3.33	0.33	0.74	3.27	0.091	1.46	15.30	0.17	48	1301
470955	2.48	0.05	0.07	2.81	0.091	1.78	18.60	0.13	28	1713
470956	3.63	0.64	1.28	1.29	0.066	1.73	8.55	0.27	93	1618
470957	3.12	0.01	0.04	1.65	0.071	1.15	17.00	0.15	43	1518
470958	2.89	1.32	2.85	0.97	0.024	0.80	2.91	0.19	51	219
470959	3.91	0.12	0.26	1.69	0.010	8.40	14.10	0.38	660	1874
470960	3.27	0.28	0.40	2.23	0.111	2.00	15.10	0.25	97	4088
470961	2.56	0.10	0.09	3.04	0.104	1.38	20.00	0.22	64	3542
470962	4.63	0.81	0.67	3.35	0.064	2.64	6.82	0.61	155	1112
470963	2.45	0.24	0.22	1.75	0.136	1.90	14.10	0.18	36	1609
470964	3.39	0.70	0.83	1.79	0.088	2.04	10.30	0.27	97	2424
470965	2.84	0.05	<0.01	2.42	0.041	1.15	17.20	0.31	59	4415
470966	1.53	0.05	0.03	5.12	0.189	2.76	7.88	0.05	11	3606
470967	2.96	1.02	0.28	0.91	0.022	1.09	9.92	0.07	46	2710
470968	4.35	1.91	0.78	1.67	0.034	1.12	5.40	0.21	63	1202
470969	4.17	1.23	0.80	1.43	0.069	1.75	6.51	0.34	92	1415
470970	3.87	1.55	2.66	0.57	0.047	0.46	2.60	0.09	27	931
470971	1.19	0.03	0.67	23.64	0.007	2.85	1.94	0.01	5	6649
Samples	71	71	71	71	71	71	71	71	70	71
Minimum	0.30	0.01	<0.01	0.03	0.001	<0.01	0.54	<0.01	<2	30
Maximum	8.77	5.72	3.77	23.64	0.189	8.40	31.80	1.55	660	13671

Table 3. *Stream sediment sample list*

GGU no.	Longitude	Latitude	Altitude metres	-0.1 mm fraction gramme	Analysis gramme
502851	77.5155	-67.9525	18	29.0	6.1
502852	77.5181	-67.9582	69	15.0	5.5
502853	77.5200	-67.9660	85	12.8	5.9
502854	77.5225	-67.9714	124	7.8	5.9
502855	77.5271	-67.9854	214	13.9	6.0
502856	77.5306	-68.0080	206	5.2	4.4
502857	77.5294	-68.0091	256	5.8	4.7
502858	77.5516	-67.8496	153	92.8	6.1
502859	77.4402	-72.1118	28	69.3	6.3
502860	77.4402	-72.1118	28	70.9	6.1
502861	77.4414	-72.0895	100	103.8	6.2
502862	77.4343	-72.0558	95	73.4	6.2
502863	77.4371	-72.0597	137	33.6	5.8
502864	77.4389	-72.1142	132	64.6	6.0
502865	77.4221	-72.1686	257	23.9	6.1
502866	77.4214	-72.1708	249	17.5	5.9
502867	77.4206	-72.1702	232	25.1	6.0
502868	77.4193	-72.1675	217	23.0	5.8
502869	77.3410	-71.6095	135	24.2	6.0
502870	77.3434	-71.6115	155	4.0	3.3
502871	77.3297	-71.6175	107	53.6	5.9
502872	77.3291	-71.6254	207	58.2	6.1
502873	77.3280	-71.6313	287	18.9	6.2
502874	77.3279	-71.5446	19	1.7	1.1
502875	77.3310	-71.5469	33	4.2	3.2
502876	77.3332	-71.5472	115	7.9	5.8
502877	77.5188	-67.6612	29	7.6	5.6
502878	77.5210	-67.6318	28	1.5	0.9
502879	77.5318	-67.7717	84	5.9	4.9
502880	77.5200	-67.6635	114	9.6	5.4

Table 4. *Stream sediment samples: analytical results*

Element	Detection limit		Analytical method	Element	Detection limit		Analytical method
Ag	0.3	ppm	ICP	Mn	1	ppm	ICP
Au	2	ppb	INAA	Mo	1	ppm	ICP
Al	0.01	pct	ICP	Na	0.01	pct	INAA
As	1	ppm	INAA	Nd	5	ppm	INAA
Ba	50	ppm	INAA	Ni	1	ppm	ICP
Be	1	ppm	ICP	P	0.001	pct	ICP
Bi	2	ppm	ICP	Pb	3	ppm	ICP
Br	0.5	ppm	INAA	Rb	15	ppm	INAA
Ca	0.01	pct	ICP	S	0.001	pct	ICP
Cd	0.3	ppm	ICP	Sb	0.1	ppm	INAA
Ce	3	ppm	INAA	Sc	0.1	ppm	INAA
Co	1	ppm	INAA	Se	3	ppm	INAA
Cr	5	ppm	INAA	Sm	0.1	ppm	INAA
Cs	1	ppm	INAA	Sn	0.01	pct	INAA
Cu	1	ppm	ICP	Sr	0.5	ppm	ICP
Eu	0.2	ppm	INAA	Ta	1	ppm	INAA
Fe	0.01	pct	INAA	Tb	1	ppm	INAA
Hf	1	ppm	INAA	Th	0.2	ppm	INAA
Hg	1	ppm	INAA	Ti	0.01	pct	ICP
Ir	5	ppb	INAA	U	0.5	ppm	INAA
K	0.01	pct	ICP	V	2	ppm	ICP
La	0.5	ppm	INAA	W	1	ppm	INAA
Lu	0.05	ppm	INAA	Y	1	ppm	ICP
Mg	0.01	pct	ICP	Yb	0.2	ppm	INAA
				Zn	1	ppm	ICP

Analysis by Activation Laboratories Ltd., Ontario, Canada.

Analytical methods:
INAA: Instrumental neutron activation
ICP: Inductively coupled plasma emission spectrometry

Table 4. *Stream sediment samples: analytical results*

GGU no.	Au ppb	Ag ppm	Ir ppb	As ppm	Sb ppm	Se ppm	Hg ppm	W ppm	Fe pct	S pct
502851	<2	0.6	<5	<0.5	0.4	<3	<1	<1	4.48	<0.001
502852	5	0.8	<5	2.2	<0.1	<3	<1	<1	5.35	<0.001
502853	<2	0.7	<5	1.7	<0.1	<3	<1	<1	4.91	<0.001
502854	<2	1.7	<5	1.4	<0.1	<3	<1	<1	5.47	<0.001
502855	6	0.8	<5	<0.5	0.2	<3	1	<1	3.62	<0.001
502856	<2	1.4	<5	<0.5	<0.1	<3	<1	<1	3.62	0.002
502857	97	1.4	<5	2.6	0.3	<3	<1	<1	3.23	0.003
502858	<2	<0.3	<5	2.3	<0.1	<3	<1	<1	5.63	0.048
502859	3	0.4	<5	3.9	<0.1	<3	<1	<1	4.53	<0.001
502860	<2	0.4	<5	5.2	0.4	<3	<1	<1	4.70	<0.001
502861	<2	0.8	<5	3.5	<0.1	<3	<1	<1	5.71	<0.001
502862	<2	1.0	<5	<0.5	0.4	<3	<1	<1	4.88	<0.001
502863	<2	0.7	<5	2.9	<0.1	<3	<1	2	4.96	<0.001
502864	<2	0.3	<5	4.7	<0.1	<3	<1	<1	4.30	<0.001
502865	<2	0.7	<5	3.0	0.3	<3	<1	<1	2.73	<0.001
502866	16	0.5	<5	4.6	<0.1	<3	<1	2	3.23	<0.001
502867	<2	0.7	<5	2.0	<0.1	<3	<1	<1	2.23	<0.001
502868	<2	0.5	<5	2.2	<0.1	<3	<1	<1	4.73	<0.001
502869	57	1.3	<5	3.1	0.4	<3	<1	<1	3.36	0.026
502870	49	1.4	<5	4.5	0.5	<3	<1	<1	3.04	0.073
502871	<2	0.8	<5	2.8	<0.1	<3	<1	<1	5.64	0.060
502872	6	0.9	<5	3.6	0.3	<3	<1	<1	5.26	0.076
502873	<2	0.9	<5	3.2	0.4	<3	<1	<1	6.75	0.032
502874	<2	0.6	<5	2.5	0.4	<3	<1	<1	10.00	<0.001
502875	<2	0.5	<5	2.9	0.5	<3	<1	<1	10.20	<0.001
502876	15	0.5	<5	2.1	<0.1	<3	<1	<1	8.42	<0.001
502877	<2	<0.3	<5	3.1	<0.1	<3	<1	<1	5.85	0.042
502878	<2	<0.3	<5	<0.5	0.2	<3	<1	<1	10.20	0.028
502879	<2	<0.3	<5	2.0	0.4	<3	<1	<1	6.11	0.033
502880	<2	0.3	<5	1.5	<0.1	<3	<1	<1	6.24	0.041
Samples	30	30	30	30	30	30	30	30	30	30
Minimum	<2	<0.3	<5	<0.5	<0.1	<3	<1	<1	2.23	<0.001
Maximum	97	1.7	<5	5.2	0.5	<3	1	2	10.20	0.076
Median	<2	0.7	<5	2.6	<0.1	<3	<1	<1	4.94	<0.001

Table 4. *Stream sediment samples: analytical results*

GGU no.	Cu ppm	Pb ppm	Zn ppm	Ba ppm	Cd ppm	Bi ppm	Mo ppm	Ni ppm	Co ppm	Cr ppm
502851	27	7	21	<50	<0.3	<2	<1	49	23	104
502852	31	10	22	260	0.8	<2	3	58	24	123
502853	25	12	25	<50	0.7	<2	2	53	24	142
502854	29	13	25	420	0.6	<2	1	58	27	152
502855	22	12	30	370	0.4	<2	1	36	14	89
502856	17	17	31	430	0.8	<2	2	22	12	84
502857	14	16	26	400	0.7	<2	<1	20	9	70
502858	344	23	98	450	1.0	<2	4	104	30	172
502859	30	17	41	720	0.7	<2	<1	47	21	99
502860	29	17	38	680	0.4	<2	2	44	21	107
502861	45	23	40	780	0.8	<2	1	60	26	150
502862	60	25	45	580	1.1	<2	1	64	27	144
502863	40	22	39	560	0.6	<2	3	55	22	133
502864	29	21	31	500	0.7	<2	2	39	19	93
502865	28	18	23	390	0.9	<2	2	23	11	51
502866	24	15	24	480	0.6	<2	<1	26	13	59
502867	19	13	23	130	0.6	<2	<1	19	10	35
502868	82	22	47	630	0.9	<2	1	39	18	37
502869	30	34	34	3200	1.8	<2	<1	28	15	40
502870	25	29	38	4400	1.2	<2	<1	35	18	67
502871	23	16	14	3400	1.4	<2	<1	51	25	99
502872	22	19	12	4100	1.3	<2	2	50	25	92
502873	24	19	15	2400	1.4	<2	<1	59	29	120
502874	115	65	100	500	2.9	<2	<1	78	40	159
502875	92	60	88	500	2.1	<2	<1	71	41	144
502876	108	78	84	570	3.5	<2	2	70	36	117
502877	87	60	233	850	1.3	<2	5	157	54	224
502878	102	43	170	760	1.2	<2	4	137	65	174
502879	69	31	138	580	1.4	<2	1	106	40	173
502880	71	48	194	650	0.8	<2	3	136	53	192
Samples	30	30	30	30	30	30	30	30	30	30
Minimum	14	7	12	<50	<0.3	<2	<1	19	9	35
Maximum	344	78	233	4400	3.5	<2	5	157	65	224
Median	30	20	36	560	0.9	<2	1	52	24	112

Table 4. *Stream sediment samples: analytical results*

GGU no.	Ta ppm	Sn pct	Be ppm	Br ppm	Rb ppm	Sr ppm	Sc ppm	Cs ppm	Hf ppm	Y ppm
502851	<0.5	<0.01	2	3.0	39	131	19.0	<1	13	16
502852	1.5	<0.01	2	<0.5	45	136	21.2	<1	13	18
502853	<0.5	<0.01	2	5.4	44	146	21.0	<1	12	16
502854	2.0	<0.02	2	4.5	67	150	23.8	<1	22	22
502855	<0.5	<0.01	2	6.8	68	166	13.8	2	13	18
502856	<0.5	<0.01	2	9.3	33	172	12.5	<1	23	24
502857	<0.5	<0.01	1	4.8	27	159	11.6	<1	25	23
502858	2.2	<0.01	2	16.8	37	88	19.2	5	11	31
502859	<0.5	<0.01	2	3.4	107	52	17.1	6	7	20
502860	<0.5	<0.01	2	3.6	102	50	16.4	5	8	20
502861	<0.5	<0.01	2	2.5	111	40	21.1	7	11	22
502862	<0.5	<0.01	2	4.4	77	39	18.4	4	12	23
502863	1.6	<0.01	2	3.8	71	36	17.9	3	9	21
502864	<0.5	<0.01	2	<0.5	86	45	14.7	5	6	19
502865	<0.5	<0.01	2	3.0	66	54	9.0	3	10	14
502866	<0.5	<0.01	2	2.7	70	51	10.9	3	7	16
502867	1.6	<0.01	1	3.5	47	55	7.3	3	11	12
502868	<0.5	<0.01	2	2.4	<15	115	12.9	<1	13	24
502869	2.5	<0.01	4	4.5	127	133	9.5	2	23	28
502870	3.7	<0.01	4	2.3	157	156	11.8	3	25	41
502871	<0.5	<0.01	3	<0.5	62	55	15.7	2	13	18
502872	<0.5	<0.01	3	2.9	73	68	14.9	2	14	18
502873	<0.5	<0.01	3	<0.5	77	54	19.0	4	14	21
502874	<0.5	<0.01	6	6.4	60	144	28.1	2	20	21
502875	3.5	<0.01	6	5.0	<15	143	27.2	<1	12	17
502876	<0.5	<0.01	8	4.1	50	144	23.6	<1	19	30
502877	<0.5	<0.02	3	25.2	80	168	16.2	5	6	26
502878	<0.5	<0.01	3	42.6	95	176	21.2	1	10	30
502879	<0.5	<0.01	3	33.1	122	235	17.5	3	8	26
502880	<0.5	<0.01	3	20.8	124	191	16.6	2	9	24
Samples	30	30	30	30	30	30	30	30	30	30
Minimum	<0.5	<0.01	1	<0.5	<15	36	7.3	<1	6	12
Maximum	3.7	<0.01	8	42.6	157	235	28.1	7	25	41
Median	<0.5	<0.01	2	4.5	71	132	16.9	3	12	21

Table 4. *Stream sediment samples: analytical results*

GGU no.	U ppm	Th ppm	La ppm	Ce ppm	Nd ppm	Sm ppm	Eu ppm	Tb ppm	Yb ppm	Lu ppm
502851	3.1	7.2	21.5	47	18	3.4	0.8	<0.5	2.4	0.36
502852	2.5	6.9	21.4	45	16	3.7	1.1	<0.5	2.1	0.31
502853	1.8	8.9	24.5	56	19	3.9	0.9	0.6	2.0	0.30
502854	4.3	11.9	29.8	68	23	4.7	1.2	<0.5	2.6	0.41
502855	2.1	11.7	33.1	67	18	4.7	1.1	<0.5	2.2	0.34
502856	4.2	19.8	47.7	95	41	7.0	1.6	<0.5	3.3	0.50
502857	4.0	21.7	41.3	99	37	6.5	1.2	<0.5	3.7	0.55
502858	7.9	29.6	103.0	196	79	12.9	1.7	1.2	2.2	0.33
502859	3.4	6.9	29.4	61	25	4.8	1.0	<0.5	2.5	0.37
502860	5.2	6.7	29.0	65	24	4.8	1.0	<0.5	2.8	0.42
502861	3.8	7.3	26.7	61	21	4.7	1.2	<0.5	2.9	0.44
502862	3.8	7.4	28.1	67	22	4.5	1.1	<0.5	2.3	0.35
502863	3.5	5.5	24.4	57	12	4.1	1.2	<0.5	2.5	0.39
502864	3.5	5.7	27.7	63	19	4.6	1.2	0.7	2.5	0.39
502865	3.6	6.7	23.0	55	21	3.5	1.0	<0.5	2.0	0.30
502866	4.7	6.7	23.8	55	16	3.8	1.0	<0.5	1.9	0.28
502867	3.9	6.0	19.3	44	20	3.2	1.0	<0.5	1.9	0.28
502868	3.8	5.8	27.2	64	30	6.7	1.8	0.6	2.6	0.39
502869	4.1	11.4	37.8	89	31	8.8	2.1	<0.5	3.7	0.58
502870	6.4	15.1	41.2	109	39	9.2	2.2	1.2	3.5	0.53
502871	3.7	8.4	24.4	57	23	4.1	1.4	<0.5	2.0	0.31
502872	5.2	8.5	25.4	57	20	4.6	1.3	<0.5	2.4	0.36
502873	4.4	9.4	27.9	63	24	5.1	1.4	<0.5	2.6	0.40
502874	2.3	8.0	28.6	59	26	7.7	2.0	1.0	3.7	0.55
502875	2.9	6.4	27.8	68	26	7.0	1.6	0.6	3.2	0.48
502876	2.6	7.0	25.4	61	30	6.6	1.9	0.9	3.3	0.51
502877	3.2	15.1	60.0	132	38	7.7	1.2	<0.5	1.8	0.29
502878	8.2	22.9	84.0	160	58	13.1	2.0	0.8	3.1	0.47
502879	2.4	21.8	90.9	200	53	11.2	1.9	<0.5	1.4	0.21
502880	2.6	19.3	74.7	165	56	9.0	1.3	<0.5	1.7	0.25
Samples	30	30	30	30	30	30	30	30	30	30
Minimum	1.8	5.5	19.5	44	12	3.2	0.8	<0.5	1.4	0.21
Maximum	8.2	29.6	103.0	200	79	13.1	2.2	1.2	3.7	0.58
Median	3.8	8.2	28.0	64	24	4.8	1.2	0.8	2.5	0.38

Table 4. *Stream sediment samples: analytical results*

GGU no.	Al pct	Na pct	K pct	Ca pct	P pct	Mg pct	Ti pct	V ppm	Mn ppm
502851	3.90	0.54	1.39	1.43	0.029	1.75	0.37	115	416
502852	4.16	0.65	1.46	1.71	0.038	1.93	0.39	126	448
502853	4.10	0.82	1.21	2.01	0.036	2.13	0.36	121	416
502854	4.35	0.87	1.15	2.48	0.037	2.41	0.41	137	501
502855	3.65	0.72	1.09	1.26	0.040	1.11	0.36	91	389
502856	3.39	0.76	1.09	0.88	0.051	0.69	0.39	72	386
502857	2.49	0.56	0.78	0.77	0.049	0.57	0.37	67	362
502858	7.61	0.78	1.97	1.30	0.086	1.96	0.53	167	752
502859	4.26	0.41	3.97	1.67	0.045	2.73	0.45	127	1003
502860	3.91	0.41	2.96	1.97	0.045	2.77	0.44	127	1075
502861	4.22	0.38	3.21	2.02	0.045	3.40	0.54	161	1257
502862	4.37	0.51	3.20	0.55	0.045	2.78	0.54	159	1028
502863	3.85	0.39	2.95	1.11	0.040	2.63	0.49	150	1141
502864	3.48	0.27	2.86	2.16	0.045	2.52	0.46	119	1202
502865	2.59	0.15	1.84	0.46	0.031	0.85	0.35	72	517
502866	2.73	0.17	2.05	0.62	0.032	1.08	0.33	86	655
502867	1.79	0.17	1.02	0.31	0.030	0.61	0.38	64	299
502868	2.66	0.49	1.01	1.40	0.072	1.28	0.59	99	764
502869	3.97	0.29	3.11	0.71	0.097	0.83	0.97	114	497
502870	6.75	0.29	4.22	0.57	0.094	1.15	0.81	94	384
502871	3.56	0.09	1.93	0.22	0.026	0.70	0.66	172	524
502872	3.64	0.11	1.95	0.23	0.029	0.67	0.64	151	471
502873	4.32	0.09	2.40	0.19	0.025	0.78	0.74	198	606
502874	3.93	1.04	1.20	3.08	0.065	2.29	1.81	250	1472
502875	3.64	1.08	1.05	2.96	0.050	2.11	1.63	207	1376
502876	5.58	0.95	1.44	2.79	0.072	2.26	2.46	316	1529
502877	10.47	1.04	2.95	1.10	0.100	2.67	0.50	165	904
502878	6.20	1.40	1.93	1.76	0.223	2.68	0.61	165	1296
502879	8.88	1.52	2.51	1.55	0.150	2.31	0.57	152	967
502880	9.55	1.41	2.48	1.31	0.100	2.24	0.50	154	876
Samples	30	30	30	30	30	30	30	30	30
Minimum	1.79	0.09	0.78	0.19	0.029	0.57	0.33	64	362
Maximum	10.47	1.52	4.22	3.08	0.223	3.40	2.46	316	1529
Median	3.95	0.53	1.94	1.30	0.045	2.04	0.50	132	704

Table 5. *Heavy mineral concentrate list*

GGU no.	Latitude	Longitude	Altitude metre	-1.0 mm fraction litre	Preconc. gramme	Conc. gramme	Analysis gramme
501851	77.5154	-67.9523	15	6	122.9	24.9	16.6
501852	77.4402	-72.1116	17	6	95.1	7.2	4.4
501853	77.3279	-71.5446	17	4	83.7	80.5	56.6
501854	77.5318	-67.7718	89	4	118.0	95.0	48.1
501855	77.5190	-67.6616	94	2	151.7	114.8	51.1
501856	77.5210	-67.6315	38	2	73.2	60.8	45.3

Note: Concentrates were produced in the GEUS sediment laboratory by heavy liquid separation (d=2.82) of the preconcentrates from field panning of 12 l active stream sediments.

Table 6. *Heavy mineral concentrates: analytical values*

Element	Detection limit		Analytical method	Element	Detection limit		Analytical method
Ag	0.2	ppm	ICP	Mn	1	ppm	ICP
Au	5	ppb	INAA	Mo	2	ppm	ICP
As	2	ppm	INAA	Na	0.05	pct	INAA
Ba	200	ppm	INAA	Nd	10	ppm	INAA
Br	5	ppm	INAA	Ni	1	ppm	ICP
Ca	1	pct	INAA	Pb	2	ppm	ICP
Cd	0.5	ppm	ICP	Rb	50	ppm	INAA
Ce	3	ppm	INAA	S	0.001	pct	ICP
Co	5	ppm	INAA	Sb	0.2	ppm	INAA
Cr	10	ppm	INAA	Sc	0.1	ppm	INAA
Cs	2	ppm	INAA	Se	20	ppm	INAA
Cu	1	ppm	ICP	Sm	0.1	ppm	INAA
Eu	0.2	ppm	INAA	Sr	0.2	ppm	ICP
Fe	0.02	pct	INAA	Ta	1	ppm	INAA
Hf	1	ppm	INAA	Tb	2	ppm	INAA
Hg	5	ppm	INAA	Th	0.5	ppm	INAA
Ir	50	ppb	INAA	U	1	ppm	INAA
La	1	ppm	INAA	W	4	ppm	INAA
Lu	0.05	ppm	INAA	Yb	0.2	ppm	INAA
				Zn	1	ppm	ICP

Analysis by Activation Laboratories Ltd., Ontario, Canada.

Analytical methods:
INAA: Instrumental neutron activation
ICP: Inductively coupled plasma emission spectrometry

Table 6. *Heavy mineral concentrates: analytical values*

GGU no.	Au ppb	Ag ppm	Ir ppb	As ppm	Sb ppm	Se ppm	Hg ppm	W ppm	Fe pct	S pct
501851	<5	0.6	<50	12	0.8	<20	<5	<4	34.1	0.002
501852	<5	0.4	<50	<2	<0.2	<20	<5	<4	20.4	0.078
501853	<5	1.1	<50	<2	<0.2	<20	<5	<4	33.5	0.001
501854	<5	<0.2	<50	2	<0.2	<20	<5	6	27.7	0.013
501855	14	0.3	<50	<2	<0.2	<20	<5	<4	19.3	0.019
501856	<5	0.4	<50	<2	0.2	<20	<5	5	24.4	0.012
Samples	6	6	6	6	6	6	6	6	6	6
Minimum	<5	<0.2	<50	<2	<0.2	<20	<5	<4	19.3	0.001
Maximum	14	1.1	<50	12	0.8	<20	<5	6	34.1	0.078

Table 6. *Heavy mineral concentrates: analytical values*

GGU no.	Cu ppm	Pb ppm	Zn ppm	Ba ppm	Cd ppm	Mo ppm	Ni ppm	Co ppm	Cr ppm	Ta ppm
501851	60	<2	165	600	0.6	<2	73	58	213	1
501852	69	11	93	5800	<0.5	3	55	42	620	<1
501853	76	10	367	<200	0.6	<2	162	70	270	4
501854	10	6	40	<200	<0.5	<2	30	39	372	<1
501855	27	9	77	<200	<0.5	3	61	40	432	<1
501856	16	10	108	250	<0.5	<2	39	44	438	2
Samples	6	6	6	6	6	6	6	6	6	6
Minimum	10	<2	40	<200	<0.5	<2	30	39	213	<1
Maximum	76	11	367	5800	0.6	3	162	70	620	4

Table 6. *Heavy mineral concentrates: analytical values*

GGU no.	Br ppm	Rb ppm	Sr ppm	Sc ppm	Cs ppm	Hf ppm	Na pct	Ca pct	Mn ppm
501851	10	<50	<0.2	42.6	<2	23	0.31	1	1171
501852	<5	<50	<0.2	46.2	<2	23	0.86	3	1279
501853	7	<50	<0.2	37.4	<2	8	0.24	3	1086
501854	6	<50	<0.2	96.4	<2	16	0.13	<1	1037
501855	<5	<50	<0.2	81.0	<2	3	0.07	2	839
501856	5	<50	<0.2	87.7	2	5	0.13	1	1260
Samples	6	6	6	6	6	6	6	6	6
Minimum	<5	<50	<0.2	37.4	<2	3	0.07	<1	839
Maximum	10	<50	<0.2	96.4	2	23	0.86	3	1279

Table 6. *Heavy mineral concentrates: analytical values*

GGU no.	U ppm	Th ppm	La ppm	Ce ppm	Nd ppm	Sm ppm	Eu ppm	Tb ppm	Yb ppm	Lu ppm
501851	3.8	19.8	30	56	15	6.4	1.7	<2	7.5	1.18
501852	6.3	8.1	42	88	21	5.7	2.0	<2	5.3	0.80
501853	<0.5	0.7	7	16	<10	2.5	1.1	<2	1.4	0.22
501854	4.1	64.7	150	255	73	20.5	1.3	4	13.3	2.10
501855	1.1	15.4	36	65	17	6.2	0.3	3	8.1	1.23
501856	3.2	37.6	82	144	50	13.6	1.0	3	9.1	1.41
Samples	6	6	6	6	6	6	6	6	6	6
Minimum	<0.5	0.7	7	16	<10	2.5	0.3	<2	1.4	0.22
Maximum	6.3	64.7	150	255	73	20.5	2.0	4	13.3	2.10