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Reconnaissance and exploration for gold and base metals in the area between Arsuk and Neria Fjords, South-West Greenland. Work performed 1971 to 1985: Results and discussion

Peter Erfurt

December 1990

GRØNLANDS GEOLOGISKE UNDERSØGELSE
The Geological Survey of Greenland
ØSTER VOLDGADE 10, 1350 KØBENHAVN K, DANMARK

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Reconnaissance and exploration for gold and base metals in the area between Arsuk and Neria Fjords, South-West Greenland. Work performed 1971 to 1985: Results and discussion.

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ABSTRACT

In the area between Arsuk and Neria Fjords, a weakly metamorphosed Proterozoic "greenstone" belt unconformably overlies Archean gneisses and greenstones. The supracrustal rocks comprise three groups of metavolcanics and metasediments. In general, syngenetic mineralisation in both the Archean and Proterozoic supracrustal rocks may be termed iron-formation. Sulphide, oxide and silicate facies BIF occurs, the latter type only in Proterozoic rocks.

Stratabound gold and sulphide mineralisation associated with carbonatised volcanic rocks occurs in the Archean Tartoq Group. Spatially related to this syngenetic mineralisation, quartz veins with gold and sulphides are found. The veins represent classically epigenetic mineralisation.

This report presents the results of reconnaissance and exploration in the supracrustal rocks of the area by three exploration companies plus the Geological Survey of Greenland (GGU). The investigations of the individual companies are described along with the results of mapping, diamond drilling, sampling and a geophysical survey. Sample analyses for Au, As, Cu, Zn, Pb, Ba, Ag and Ni are presented, along with a short description of each sample. The highest gold value recorded is 19.4 ppm over 2.5 m (chip sample).

The discussion compares the geological development of the Tartoq Group with that of the Timmins area, Ontario. It is concluded that the Tartoq Group greenstone belt has a potential for economic gold deposits. Further exploration is suggested. The Proterozoic supracrustal rocks may have a potential for massive sulphide or placer gold occurrences.

CONTENTS

1. INTRODUCTION

This report presents the results of reconnaissance and exploration for gold and base metals in the Precambrian supracrustal rocks of the Sermiligârssuk, Midternæs and Grænseland areas of South-West Greenland (roughly the area between Arsuk and Neria fjords).
The investigations focused on gold-copper showings in the Archean volcanics of the Tartoq Group. This supracrustal belt outcrops in several areas along Sermiligârssuk fjord (Fig. 1). Reconnaissance has also been performed on rocks of the Proterozoic Ketilidian mobile belt to the east and south-east of the Tartoq Group rocks.

The report is split into three parts. Part I is a general view of the geology and mineral occurrences in the area plus a summary of the exploration history. Part II comprises a summary of the combined investigation results, which is the basis of a discussion of the geological development and mineralisation potential of the investigated rocks (particularly the Tartoq Group). The third part of the report comprise three appendices:
Appendix 1 is a description of the investigation procedures of the individual companies.
Appendix 2 presents the investigation results obtained by the participation of several companies.
Appendix 3 comprises plates and a map showing analyses for Au, As, Cu, Zn, Pb, Ba, Ag and Ni and short rock descriptions of each sample as well as sample localities.

PART I. GEOLOGICAL SETTING AND EXPLORATION HISTORY

2. REGIONAL GEOLOGY (Fig. 1)

The area between Arsuk Fjord and Neria is underlain by Archean amphibolite facies rocks, consisting mostly of quartz dioritic to granodioritic biotite and biotite-hornblende gneisses that have been strongly and repeatedly deformed (Allaart, 1976).

Within the gneisses infolded segments of supracrustal rocks occur, outcropping as several areas around Sermiligârssuk fjord. These rocks, termed the Tartoq Group are presumed to be the remnants of a single large supracrustal belt (Appel & Secher,1984). They have been metamorphosed under amphibolite facies conditions and suffered several phases of deformation. As a result of this, the contact relationships between the gneisses and supracrustals are complex, and the age relationships are not clear (Appel & Secher, 1984). The Tartoq Group is presumed to be Archean (Bridgwater et al., 1976). Two different types of contacts are developed (Appel & Secher, 1984). The sharp tectonic contacts seen in the area north of Sermiligârssuk Fjord may be either thrusts or faults. This type of contact is locally superimposed on the second type, which consists of up to 250 m wide gradational zones with gneiss veins concordantly intercalated with layers of supracrustal rocks. In earlier work on the area such borders were described as migmatite fronts. At several localities, however, gneissic rocks display clear intrusive contacts, and apparently at least some of the orthogneisses were emplaced after the deposition of the Tartoq Group (Kalsbeek et al., 1990).

On Midternæs (Fig. 1), supracrustal rocks of the Proterozoic Ketilidian mobile belt unconformably overlie the gneisses and the Tartoq Group. The supracrustals extend southwards as a belt in Grænseland along the margin of the Inland Ice. The rocks on Midternæs and part of the type area in Grænseland are virtually unmetamorphosed and weakly deformed. They rest directly on a roughly peneplained surface of Archean basement. In southern Grænseland the unconformity is modified by thrusting.

A late Ketilidian granite complex consisting of two biotite granite stocks and emplaced into Archean gneiss occurs at Pyramide Fjeld.

2.1 THE TARTOQ GROUP SUPRACRUSTAL ROCKS

The Tartoq Group was described by Higgins & Bondesen (1966), Higgins (1968) and summarised by Berthelsen & Henriksen (1975) and Bridgwater et al. (1976). The supracrustal rocks have been strongly deformed and metamorphosed, and consequently most primary facing criteria have been obliterated. A type section 2000 m thick in the Nûluk area (about 30 km^2 of volcanic rocks) on the south side of Sermiligârssuk Fjord is described by Berthelsen & Henriksen (1975). A detailed stratigraphy is difficult to establish (Appel, 1984). Fig. 2 (Modified from Greenex A/S 1984 report) is an attempt to give a gross stratigraphy of the rocks, which consist largely of basic volcanic rocks interlayered with quartz-rich units, minor calcareous layers and ultrabasic bodies. Two volcanic cycles can be recognised in the westerly dipping rock assemblage in the Nûluk area.

The structurally lower cycle consists of amphibolitic greenschists and greenstones as well as dark chlorite schists interlayered with quartz-sericite schists. The latter include rusty brown weathering carbonate schists with talc and chlorite as well as carbonate and quartz, and pale, sometimes banded micaceous or talc-bearing schists. Individual carbonate schist units are up to

70 metres thick, but many thin out laterally to form lenses.

The carbonate schists, along with massive dolomite and magnetite-rich units occur approximately within the axial zone of a major syncline closing in the area. The whole cycle is terminated by a 60-70 m thick rhyolite unit exhibiting sheared contacts with the surrounding rock. A carbonate schist is developed at the contact. Towards Sermiligârssuk Fjord the rhyolote unit and carbonate schist are isoclinally folded (Greenex A/S 1983-84 reports).

Similar units are described by Higgins (1968) from the Iterdlak area, where supracrustals of undetermined thickness cover approximately 25 km^2. Intermediate and acid(quartz-sericite schists) volcanics are folded into a major syncline overturned to the south-east and plunging 30-40 degrees to the south-west. Several carbonate schist units occupy the axial zone of the fold (Greenex A/S 1984 report). The area further comprises dolomite units and a highly deformed quartz pebble conglomerate.

In general, relict primary textures suggests that the amphibolitic greenschists represent a mixed suite of pillow lavas and pyroclastics with some gabbroic sills. The pillow lavas are oversaturated tholeiites with quartz and hypersthene in the norm (Berthelsen & Henriksen, 1975). The chlorite greenschists are believed to represent andesite pyroclastics (Greenex A/S 1983-84 reports). Ultrabasic rocks occur as partly discordant up to 25 m wide sills and rows of lenses and pods. They are serpentinised and schistose, and consist of serpentine, talc, chlorite, carbonate and magnetite concentrations.

The quartz-sericite schists were formerly interpreted as metasediments (e.g. by Higgins, 1968), but an origin as acid volcanic rocks has now been proposed (Renzy Mines Ltd., 1975 report). These rocks occur primarily in the upper part of the lower sequence and are characterised by widespread carbonatisation (Renzy Mines LTD. report, 1975; Greenex A/S report, 1983). The quartz-pebble conglomerate described by Higgins (1968) may be of volcaniclastic origin.

The upper volcanic sequence, at least 1000 m thick, (cycle 2 on Fig. 2) consists of chlorite-amphibole schists and greenstones, representing basic volcanic flows and shallow intrusives. Locally, well preserved quartz-tholeiitic pillow lavas occur. The shape of the lava pillows at places suggests that the succesion is right way up. Pyroclastics and carbonatisation seems absent from the upper cycle.

A simplified structural model of the Tartoq Group is a major regional composite synform, overturned to the southeast, and trending ENE (Allaart, 1976). This synform seems to close in the Nûluk area on the south side of

Sermiligârssuk (Fig. 1). The outcrop areas flanking both sides of Sermiligârssuk represent tight to isoclinal parasitic folds on the major structure (Greenex A/S 1984 report).

2.2 THE KETILIDIAN SUPRACRUSTAL ROCKS

The Ketilidian supracrustal rocks on Midternæs have been described by Higgins (1970), and the corresponding rocks of Grænseland by Bondesen (1970).
Fig. 3 presents the stratigraphy of the Ketilidian rocks of Midternæs and Grænseland.

The supracrustal rocks comprise a more than 5000 m thick pile of sediments and volcanics intruded by numerous gabbro sills. The sequence has been divided into two major groups, the lower 120-750 m thick sedimentary Vallen Group and the upper mainly volcanic Sortis Group that is c. 4800 m thick.

The Vallen Group

The lower Zigzagland Formation is dominated by clastic and dolomitic sediments. In central Grænseland, the basal unconformity is modified by a deep carbonatisation of the gneiss surface, related to the dolomites of the Zigzagland Formation. A conglomerate, the Ore-Conglomerate member, in the upper part of the formation consists of cherty quartzite and gneiss pebbles in a dominantly magnetite and pyrite matrix. The Zigzagland Fm. is considered to have been deposited in a shallow basin and shelf type environment.

The overlying Blåis Fm. is an expression of transgression, a regional deepening of the Ketilidian Sea involving intracratonic basins or fault-bounded troughs. Sediments are siltstones and greywackes. In Grænseland a turbidite exhibits graded bedding and contains chert fragments.
The uppermost Grænsesø Fm. represents a change to a predominanly euxinic, low-energy environment with alternating deposition of dolomites, graphitic and pyritic shales.

The Sortis Group

This unit contains c. 5 % sediments. The Foselv Fm. consists of pillow lavas with thin interlayered bands of graphitic shales, dolomite and anthracite.
The Rendesten Fm. comprises pelites, semipelites and psammites. Locally pillow lavas are present, such as in the Perledal complex on Midternæs. Widespread volcanic activity is represented by basic and locally felsic pyroclastic rocks, comprising agglomerates, well bedded tuffs and lapili tuffs.
The Qernertoq Fm., outcropping only on Midternæs consists almost entirely of thick pillow flows, with a few intercalated sediments.

At all levels the Sortis Group is intruded by gabbroic sills.
Sills and lavas of the Group are tholeiitic with a low K_2O-content. On a

silica-alkali variation diagram the gabbroic sills plot in the same fields as Hawaiian tholeiitic basalts, and gabbro intrusions from the Ahr Lake area of the Labrador Trough on the Canadian Shield (Bondesen, 1970).
The general sedimentary evolution in the Labrador Trough (1800-1600 m.y.) is comparable to that of the Ketilidian sequence (deformation age about 1840-1770 m.y.). Iron-formation exists in both suites, and Appel (1974) compares the geological evolution of the Ketilidian rocks and those of the Labrador Trough.

3. MINERALISATION IN THE TARTOQ GROUP

Mineralisation in the Tartoq Group is of two main types:
1) iron-formation, and
2) disseminated sulphides.
Iron-formation (IF), outcrops in several areas that have been described by Appel (1984) and Appel & Secher (1984). Locally, these deposits have been mobilised into epigenetic occurrences. Noble and base metal mineralisation associated with quartz veins and lenses seems connected to this scenario.

Disseminated sulphides are mainly pyrite with chalcopyrite and pyrrhotite; in the greenschists the sulphide content averages less than 1 %. The disseminations occasionally grade into massive lenses parallel to foliation. Small discordant pyrite veins rarely exceeding 5 cm in width are traceable for a few metres along strike. Up to 10 % disseminated pyrite occurs locally in the carbonate schists. Some of these rocks also contain disseminated magnetite.

Fig. 4 shows the location of IF within the Tartoq Group. Banded iron-formation (BIF) is very similar to Precambrian IF known worldwide. Oxide facies BIF is found in the northern part of the Iterdlak outcrop area. Well developed alternating quartz and magnetite bands range from a few mm to 1 cm in thickness. Within the oxide facies BIF thin horizons of sulphide facies rock occur which consist of thin bands of massive pyrite alternating with quartz bands locally rich in fuchsite. The exposed width of the entire BIF is about 50 m. Strong isoclinal folding caused repetition of horizons so that the original thickness of the BIF was probably less. The strike length is about 50 m. Towards the north this BIF is limited by a fold closure, towards the south by erosion.

Sulphide facies IF in the central part of the Iterdlak area (the West Valley sulphide showing, see App. 2, this report) comprises alternating pyritic rock-chert layering. The pyritic layers range from a few cm to 0.5 m in width, while the chert layers rarely exceed 10 cm in width. The latter often contain high amounts of fuchsite, which is also seen locally as scattered grains in the pyrite-rich layers. The mineralisation outcrops close to a secondary fold on the major structure and covers an area of 100 m x 150 m, but appears to be open to both the north and south. Although exposure is limited, the sulphides are clearly concentrated in a dilatant zone formed during folding. Original thickness is estimated at 5 m maximum (Greenex A/S 1983-84 reports).

An unusual type of sulphide facies IF is seen in the coastal area of Iterdlak. It consists of a very rusty sequence of mica schist with lenses and thin layers of massive pyrite and quartz. The pyrite-quartz bodies are up to 5 cm wide, 20 to 30 cm long and are arranged parallel to the rusty schists. The whole sequence is about 5 m wide and can be traced at intervals for 100 m.

Another type of sulphide facies IF seen in the Nûluk area is described by Appel & Secher (1984). The IF comprises a unit of gold-bearing arsenopyrite-pyrite-quartz layers. These are associated with groups of thin tennantite-mineralised lensoid quartz veins. Also, abundant quartz-chalcopyrite-pyrite veins occur in the area.

Similar gold-bearing arsenopyrite-pyrite horizons in Zimbabwe-Rhodesia was interpreted by Fripp (1976) as representing a mixed sulphide-carbonate facies IF. The gold mineralisation of the Tartoq Group is found in greenschist and carbonate schist. Massive arsenopyrite-pyrite associated with quartz and ankerite is found as a concordant double layer enclosed in, and separated by, a few metres of schist. The sulphide content is 50-75 % by volume, with equal proportions of arsenopyrite and pyrite. The thickness of each layer is about 50 cm, pinching and swelling along strike. The mineralised horizons can be traced for at least 1.4 km along strike with strongly weathered rusty surfaces.

The tennantite mineralised veins are found only in the vicinity of the arsenopyrite-pyrite horizons. The sulphide content may reach 5 % but is generally below 1 %. Minor sulphides include chalchopyrite and pyrite. Malachite and azurite stainings are common.

The chalcopyrite-bearing veins are the most frequent. Chalcopyrite and associated pyrite occurs as irregular clusters scattered in the veins, generally amounting to less than 1 %. Brecciation of quartz and sulphides is common, as well as stainings by secondary minerals.

Gold occurs as 1-15 μ sized inclusions in arsenopyrite, tennantite and chalcopyrite respectively (Appel & Secher, 1984). The fineness of the gold decreases outwards from the arsenopyrite-pyrite layers where gold has a fineness of c. 990, over a fineness in the tennantite veins of c. 720 to c. 500 in the chalcopyrite veins.

Appel & Secher (1984) conclude that the gold-bearing arsenopyrite-pyrite layers are of syngenetic submarine exhalative origin, whereas the gold-bearing tennantite and chalcopyrite-rich quartz veins were formed during metamorphism. Under temperature conditions of c. 500 °C extensive mobilisation presumably took place. The least mobile elements such as As were only partly mobilised, and only migrated short distances. The mobilised arsenic, copper and sulphur reacted to form tennantite in zones of weakness close to the arsenopyrite-pyrite layers. Copper which is highly mobile migrated further to precipitate with quartz as veins. Silver is easier mobilised than gold, and precipitates later. This is demonstrated by the trend in fineness of the gold particles, the fineness being highest in the syngenetic mineralisation and decreasing away from this, in the epigenetic mineralisation.

3.1 MINERALISATION IN THE KETILIDIAN SUPRACRUSTAL ROCKS

Vallen Group

The Ore-Conglomerate Member in Grænseland is notable for the high content of opaque minerals in the matrix, mainly magnetite. The opaque mineral proportion of the matrix varies vertically, being highest at the base (up to 70 %), decreasing upwards and amounting to 50 % about 3 m from the top. Generally, the top metre is without ore minerals. Magnetite content also decreases laterally north and southwards from the highest concentration just south of Lake Vallen (Fig. 1). South of Lake Lappesø the matrix gradually changes character. Instead of being magnetite dominated, the ore mineral content becomes pyritic. The opaques show a tendency to migrate into fissures.
The matrix is considered largely of secondary origin, perhaps with a genetic relation to magnetite concentrations in sandstone of the underlying Varved Shale Member. These are believed to be heavy mineral (paleoplacer) deposits (Bondesen, 1970).

Sortis Group

Iron-formation is found in the Rendesten Formation on Midternæs (Appel, 1974). It is observed at two localities, on Nuna qernertoq and "Nuna 810" (on some maps referred to as Erdmuths Nunatak), just south of the main Midternæs area. On Nuna qernertoq the IF occurs between a thin pyroclastic division of the Rendesten Fm. and thick pillow lavas of the Qernertoq Fm. It is at least 15 m wide and hundreds of metres long. Overburden obscures the true width of the IF.

On "Nuna 810" two horizons of IF were found separated by a gabbro sill of 80 m width. The northernmost IF is 4 m wide, the other 100 m, strike length of both is at least several hundred metres.

The iron-formations consist of up to 1x0.5 m sized chert lenses embedded in a finely laminated shale rock. The dominating mineral of the latter is an iron

silicate which constitutes about 80 % of the rock. The iron silicate is mainly greenalite, but on Nuna Qernertoq minnesotaite constitutes about 9 % vol. of the rock. The lamination of the shale is due to variations in the content of iron silicate and other constituents.
These are quartz, siderite and magnetite, the latter comprising about 10 % vol. of the rock. Very small quantities of fine-grained sulphides are also found. Pyrite and pyrrhotite along with chalcopyrite, sphalerite and pentlandite occur as inclusions in magnetite grains.

Copper mineralisation is found at several locations in the Sortis Group. Sulphides (chalcopyrite, pyrite, pyrrhotite) are found in sedimentary horizons between pillow lava flows on Midternæs, and in pyroclastic rocks in Grænseland.

Table 1. Summary of exploration history.

PARTICIPANTS	YEAR 19-	ACTIVITY
GGU	50's-60's 83, 85-86	Systematic regional mapping programme. Reconnaissance sampling in Sermiligârssuk area.
Renzy Mines Ltd. - Cominco	70	Exploration concession covering the area between Ivigtut and Frederikshåb, SW-Greenland.
	71	Field work in 19 sub-areas of the concession. Programme partly funded by Cominco. Au-Cu mineralisation discovered in the Tartoq Group.
	72-73	Limited follow-up work.
	74	Sampling, prospecting and mapping - joint Renzy Mines-Cominco operation in the Tartoq Group and supracrustals of Midternæs and Grænseland. Project cancelled.
Greenex A/S - Cominco	82	Non-exclusive prospecting licence covering all known exposures of Tartoq Group rocks in the Ivigtut-Frederikshåb area.
	83	Greenex and Cominco commenced sampling in the Nûluk area. Encouraging returns, for example a sulphide-quartz-carbonate lens sampled over 270 m strike length returned values from 2.5 ppm Au over 1.5 m to 4 ppm Au over 4 m.
	84	Exclusive exploration concession covering all known auriferous showings in the Sermiligârssuk area. Geological mapping, rock-, chip-, grab-, and stream sediment geochemical sampling in most of the Tartoq Group. 1:1000 scale geological mapping and shallow diamond drilling in the Nûluk area.
	85	Geophysical programme (VLF, HLEM) in the Nûluk area.
	86	Greenex A/S concluded that the gold-bearing horizons were too discontinuous to be of interest to the company. The concession was given up.

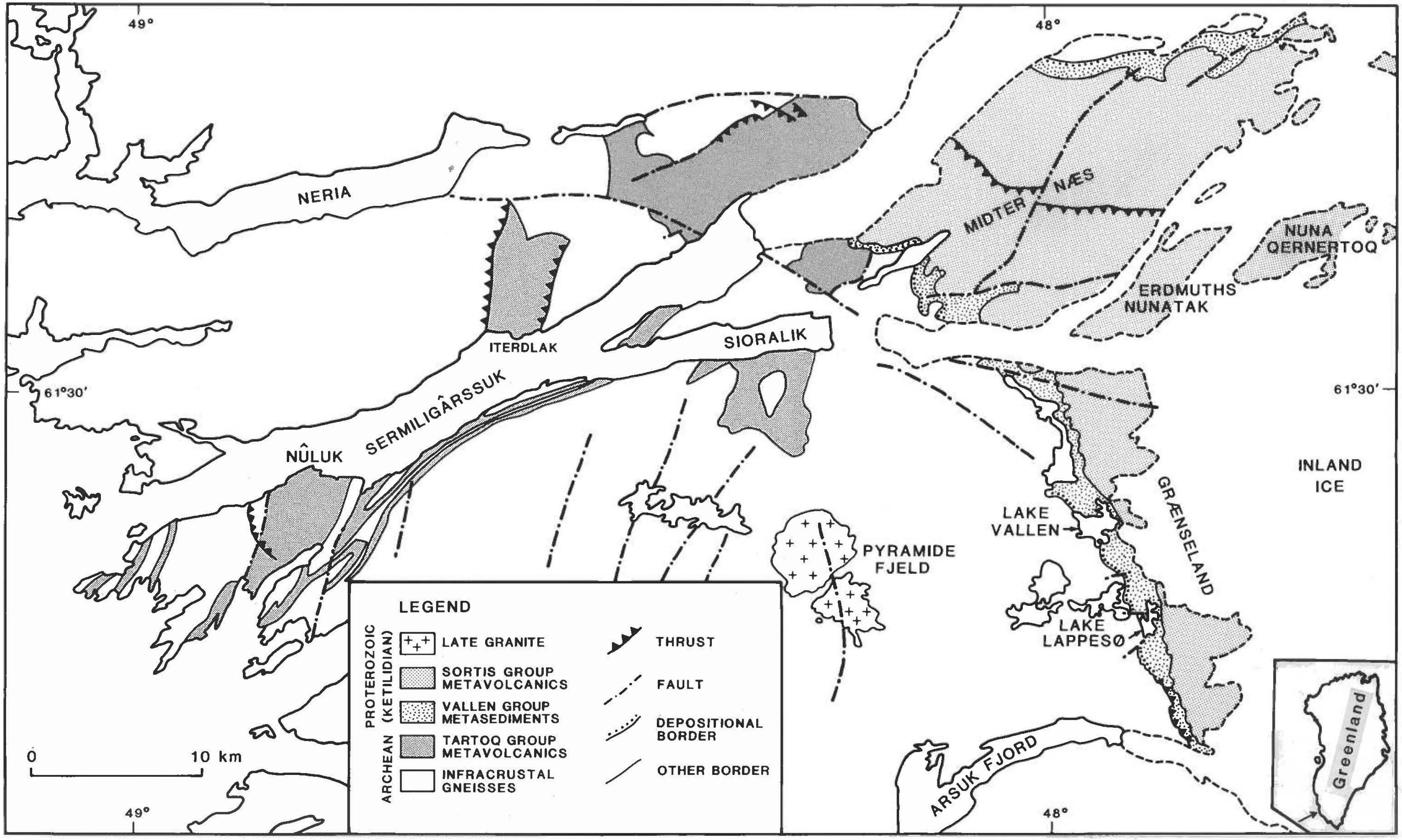

Fig. 1. Simplified geological map of the area between Arsuk Fjord and Neria. Modified from Windley et al. (1966)

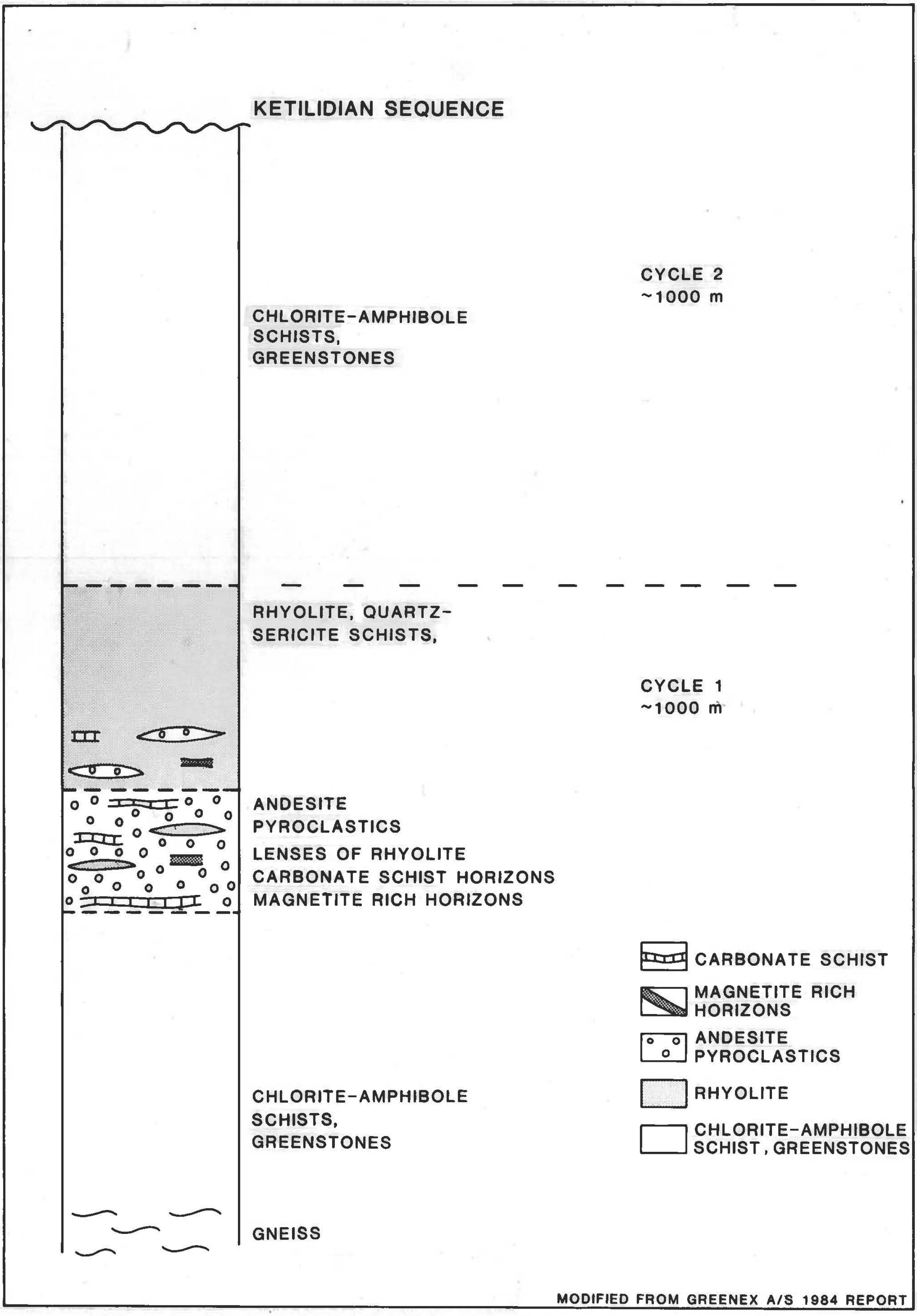

Fig. 2. Gross stratigraphy of the Tartoq Group rocks.

MIDTERNÆS		GRÆNSELAND	
Thick pillow lavas	Qernertoq Formation		SORTIS GROUP
Lavas and sediments including pyroclastics 4800 m with c. 5 % sediments	Rendesten Formation	Banded semipelites and pelites (500 m) Pelites, semipelites (100 m) or bedded psammites with pelites and greywackes (300 m) Pyroclastics (200 m) Semipelites, graded greywackes (200 or pelites, pyroclastics (400 m) Pyroclastics (0-1000 m) Dolomites and pelites (0-100 m)	
Pillow lava (100-900 m) with thin sediments	Foselv Formation	Upper Pillow Member (700 m) Anthracite- Carbonaceous shale Member (1-3) m Lower Pillow Member (300 m)	
Principally lime-stone with shales and thin quartzites	Grænsesø Formation	Cherty quartzite, pelite, dolomite Massive dolomite Carbonaceous pelites 20-100 m	
Shales, semipelites and greywackes (with calcareous bands, cherty quartzite, arkose) 50-700 m	Blåis Formation	Rock unit with strong facies variations (greywackes, semipelites-banded shales and slates, finely laminated pelites, interbedded shales and slates	VALLEN GROUP
Calcareous shales, sandstones (35 m) Quartzites and sand-stones (0-100 m) Conglomerate (0-4m)	Upper Zigzagland Formation	Dolomite Shale Member (0-150 m) Banded Quartzite Member (3-140 m) Ore-Conglomerate Member (1-10 m)	
	Lower Zigzagland Formation	Rusty Dolomite Member (0-8 m) Varved Shale Member (2-10 m) Lower Dolomite Member (3 m) Residual deposits on sub-Ketilidian surface	
Unconformity			

Fig. 3. Stratigraphy of the Ketilidian rocks of Midternæs and Grænseland. After Allaart (1976).

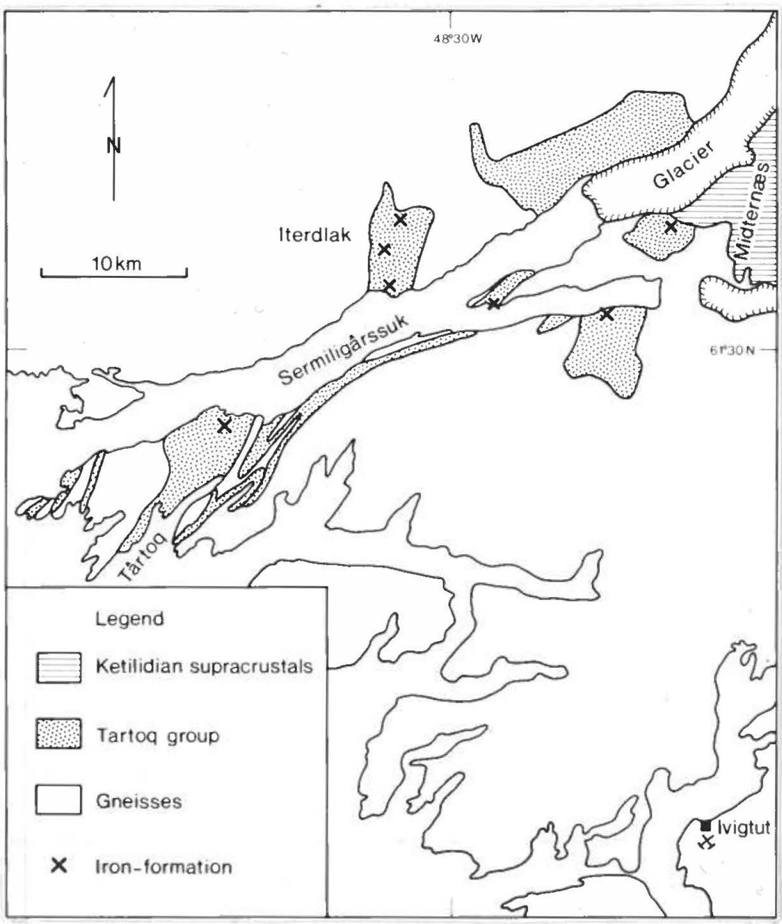

Fig. 4. Locations of iron-formations in the Tartoq Group. Appel (1984).

PART II. SUMMARY AND DISCUSSION

4. SUMMARY OF RESULTS

Appendices 2 and 3 provide the documentation of this summary. Figures II.1 to II.7 are found in Appendix 2. They comprise simplified geological maps of some of the areas investigated by the exploration companies and present best value chip sample returns for gold. Also the results of drilling and the geophysical survey are shown.

4.1 TARTOQ GROUP

The greenschists and greenstones are interpreted as representing metamorphosed basic to intermediate volcanic rocks, originally deposited as basaltic pillow flows, andesite pyroclastics and some gabbroic sills. The quartz-sericite schists are interpreted as metamorphosed acid volcanic rocks, as for example rhyolite tuff in the Nûluk area.

Serpentinised ultramafic rocks occurring as apparently conformable horizons, as well as pods, lenses and layers are abundant in the Tartoq Group, but seem concentrated in the eastern areas (North Midternæs, Midternæs, Sioralik, see Fig. II.1). They were probably emplaced as flows and/or minor shallow intrusions. A locality with peridotite is reported in the North Midternæs area.

Up to several thousands of metres long carbonate schist horizons are present in most of the Tartoq Group outcrop areas, commonly as conformable stratiform layers. They are stratabound in the sense that they mainly occur in the uppermost part of the presumed lower volcanic cycle, i.e. with andesite pyroclastic and acid volcanic rocks over a thickness of about 400 metres. Inside this zone however, the individual carbonate schist horizons may cut lithological contacts, as in the North Midternæs area where carbonate schist horizons are found to cut greenstone-pyroclastic rock and greenstone-acid volcanic rock contacts.

None of the literature available goes into great detail about the nature of carbonate minerals present in the schists, but ankerite and calcite are mentioned. In the Nûluk and North Midternæs areas massive dolomite occurs in proximity of the carbonate schists, in Nûluk as lenses of c. 150 x 20 m and in North Midternæs as larger bodies up to 200 x 200 m in size. Carbonate schist horizons are most common in the Nûluk, Iterdlak and North Midternæs areas, in the latter carbonate schist horizons up to 300 m wide and about 2 km long occur along with smaller outcrops. In other Tartoq Group areas carbonate schist is less well developed.

The following main types of mineralisation are found in the Tartoq Group:
1) Pronounced sulphide and oxide facies banded iron formation.
2a) Stratabound disseminated to massive sulphides associated with carbonate schist. Massive sulphides may occur as layers with ankerite, quartz, chert and fuchsite.
2b) Disseminated to massive sulphides in greenschist, greenstone and quartz-sericite schist.
3) Quartz and quartz-carbonate veins and lenses with sulphides.

Basically, all four types of mineralisation may carry anomalous amounts of gold, and locally the term gold mineralisation is applicable.

Type 1): The ore mineral parageneses comprise pyrite in the sulphide facies BIF and magnetite with occasional subordinate pyrite in the oxide facies BIF. Occurrences of BIF are most common in the Iterdlak area, where both sulphide and oxide facies are found, but also seem to be developed in the Midternæs area (Appendix 2) and Sioralik (GGU sample 288811 and fig. 4). Fuchsite is common in the West Valley sulphide facies BIF of the Iterdlak area, where gold concentrations above 500 ppb were found in some samples.
Type 2a): This type of mineralisation is common in most carbonate schist horizons. The sulphide parageneses apparently are simple and occurrences restricted to pyrite or arsenopyrite-pyrite. Raised concentrations of Zn, Ni and Cu (up to several 1000 ppm) in some arsenopyrite-pyrite samples however, locally suggest a more complicated paragenetic sequence as does elevated gold and silver contents.
Most abundant is pyritic carbonate schist, with disseminated pyrite locally grading into massive mineralisation. In the Nûluk area massive pyrite-arsenopyrite associated with quartz, ankerite and occasional fuchsite is found as 0.1-0.6 m thick layers in carbonate schist and andesite pyroclastics. Pyrite-arsenopyrite mineralisation hosted in carbonate schist is also found in the North Midternæs area, where it occurs with chert.

In the Nûluk area, type 2a) mineralisation often carries gold, assay results from mineralised horizons range from 1 to 15 ppm Au. Gold grains occur as inclusions in both sulphides of the pyrite-arsenopyrite layers and in part of the pyritic carbonate schists where it is uncertain whether the gold is located in the pyrite or occurs as free gold.

In the North Midternæs area gold concentrations above 500 ppb are associated with quartz or ankerite in pyritic carbonate schist.

Most pyritic carbonate schist in the above-mentioned areas as well as in the other Tartoq Group areas such as Iterdlak, where relatively large carbo-

nate schist horizons occur, do not seem to carry gold in significant amounts.
Type 2b): This type is ubiquitous in all Tartoq Group areas. Sulphides are mostly pyrite and pyrrhotite, occasionally with minor chalcopyrite. Samples (603 and 1172) from the Nûluk area returned 13.5 ppm Au, but they were taken from a 200 m long quartz-pyrite band in andesite adjacent to a carbonate schist horizon and are considered belonging to type 2a). In other areas gold analyses from type 2b) mineralisation are at places anomalous, the highest being 862 ppb Au in rusty quartz-sericite schist on Midternæs.
Essentially type 2b) is similar to type 2a), the differences being the nature of the host rock, the smaller size of type 2b) ocurrences, and that this type in contrast to type 2a) may carry disseminated chalcopyrite but apparently not arsenopyrite.
Type 3): Quartz veins and lenses with 1-10 % sulphides are found in most areas, the sulphide mineralisation often being restricted to pyrite, but with pyrite-chalcopyrite or chalcopyrite also constituting common parageneses, often with malachite staining.
In the Nûluk area, the quartz veins and lenses mineralised with pyrite-chalcopyrite or tennantite are spatially related to the gold-bearing pyrite-arsenopyrite layers of type 2a) in the sense that tennantite veins occur conformably in the immediate vicinity of pyrite-arsenopyrite layers, and that pyrite-chalcopyrite veins are grouped more irregularly around, and more distant from, these. Gold is found as inclusions both in chalcopyrite and tennantite, samples assay up to 10 ppm Au.

Up to 19 ppm gold over 2.5 m is carried in pyrite mineralised quartz veins and bands in the Nûluk area. Again the samples taken from such veins and bands in the main area of carbonate schist horizons, are considered to represent type 2a) mineralisation.

Location of gold mineralisation. Gold values in excess of 500 ppb were found in all areas except Sioralik, but apart from the Nûluk area no sampling of in situ material have returned values above 1 ppm Au. A stream sediment and a pyrite-quartz float sample from North Midternæs returned respectively 1500 and 5660 ppb Au. An overwiev of the results in the Nûluk area is presented on figures II.2 a, II.3 and II.5 a,b,c.

Diamond drilling in the Nûluk area suggests a weak down-dip continuity of the gold-mineralised sulphide bands in the carbonate schist horizons. Only in holes N1, N3 and partly in N9 were significantly high results obtained; viz. in N1 4818 ppb Au over 2.5 m, in N3 1128 ppb Au over 2 m and in N9 535 ppb Au over 2.5 m.

Geophysical survey. The VLF-HLEM conductor axes to the north of the known pyrite-arsenopyrite bands and layers of the carbonate schist zone in the Nûluk area remain to be explained.

4.2 KETILIDIAN SUPRACRUSTAL ROCKS

Apart from a more thorough description of mineralisation in the Ketilides of Midternæs and Grænseland, the investigations presented in this report did not introduce any important changes regarding lithology or structure of the supracrustal pile. No significant gold values were returned from samples of Ketilidian rocks. Minor base metal mineralisation of the following types were located:

1) 1-10 % disseminated pyrite, pyrrhotite and occasional chalcopyrite occur in several volcanic and sedimentary rock units.
2) Type 1) locally grades into small pockets of massive pyrite, pyrrhotite and minor chalcopyrite. These occurrences are always found in the vicinity of gabbro sills intruding the Sortis Group.
3) A stratabound dolomite-hosted lead-zinc-silver showing in the lower Vallen Group.
4) The Ore-Conglomerate Member of the lower Vallen Group, an oligomict conglomerate with a dominantly magnetite matrix in which Fe-Ti oxides or pyrite locally are important constituents.

Type 1): No significant gold or base metal concentrations were encountered.

Type 2): This mineralisation occurs in pyroclastic rocks of south-eastern Grænseland and in pillow lava interflow sedimentary horizons in the Perledal Valley of north-western Midternæs. A float sample from the Perledal Valley returned 0.25 % Cu. The few gold assay returns were insignificant.

Type 3): The mineralisation appears to be related to quartz net veining in a dolomite unit occurring immediately above the Ketilidian unconformity on western Midternæs.

Type 4): Gold analyses returned 5-10 ppb Au.

5. DISCUSSION

This discussion presents a simple interpretation of the results and as far as is possible places the mineralisation within a geological framework. For the Tartoq Group, this is attempted by comparison with the Timmins area in the Abitibi Greenstone Belt of Ontario, Canada.

Main emphasis is placed on the Tartoq Group rocks, but an interpretation of the evolution of Ketilidian mineralisation is also carried out, along with an assessment of economic potential.

5.1 GEOLOGICAL EVOLUTION OF THE TARTOQ GROUP

The gold mineralised arsenopyrite-pyrite layers with quartz and ankerite were described in section 3 as representing a mixed sulphide-carbonate facies iron-formation. That is, a mineralisation of submarine exhalative origin. This involves the concept that the carbonate schist layers are in fact chemically precipitated or altered (carbonatised) volcanic rocks. Most mineralisation in the Tartoq Group appears to be of syngenetic (synvolcanic) origin. Only the mineralised veins (type 3) are typically epigenetic.

In essence, gold and sulphide mineralisation is associated with relatively thin, stratiform carbonatised horizons. These are commonly conformable, but may crosscut stratigraphy. Formation of the carbonatised horizons is conside-red to predate tectonic deformation, since they are affected by folding in a manner similar to that of the other rock units. A quartz vein system, within places mineralised with gold and sulphides, is spatially related to the carbo-nate horizons. It is difficult to establish a good stratigraphic sequence, but the carbonatisation appears to be related in space and time to the upper part of the volcanic cycle commencing with basic pilow lavas and terminating with intermediate and acid pyroclastic rocks. The Tartoq Group rocks comprise many of the elements of a hypothetical "typical" Archean greenstone belt, from ultramafic rocks over tholeiitic basalts and calc-alkaline volcanics to banded iron formation. Clastic sediments seem absent, possibly reflecting a relatively deep level of erosion.

Some of the difficulty in interpreting the rocks lies in the lack of detai-led knowledge of the extent and manner of tectonic rearrangement of the stra-tigraphy in the individual outcrop areas. Indirectly however, and with a view to mineralisation potential, this problem can be approached by means of comparison. Much of the Tartoq Group stratigraphy, and especially the carbonatised horizons and accompanying mineralisation bears a striking resemblance to the Timmins area, Ontario.

5.1.1 SUMMARY OF THE GEOLOGY AND MINERALISATION IN THE TIMMINS AREA

Within the volcanic stratigraphy of the Timmins area, a variety of stratabound and cross-cutting carbonate zones occur in association with major exhalative vents. Away from these centres two stratabound carbonate members persist. The two units, the Lower and Upper Carbonate Members are distinct and mappable along strike for over 20 km (see Fig. 5). The Lower Carbonate Member is associated with komatiitic ultramafic flows and tuff, the Upper Carbonate Member comprises carbonatised tholeiitic massive and pillowed basalt, tuff and chemical sedimentary carbonate.

In addition to the main carbonate members, several thin (<5 m) stratabound ankeritic horizons as well as irregular cross-cutting carbonate alteration is found in and near fossil vent areas. The cross-cutting alteration type has mineral assemblages similar to those found in the main carbonate members, but contain predominanatly dolomite instead of ankerite (Karvinen, 1981).

There is a close spatial and chronological association between gold deposits and the two carbonate members. These are associated with irregular bodies of quartz-feldspar porphyry ranging from lenses 1-10 metres in thickness to larger bodies a mile across. The smaller bodies (interpreted as felsic crystal tuff) are concentrated in and near the Lower Carbonate Member and occur at several stratigraphic levels up to the Upper Carbonate Member at fossil vent areas.

Gold deposits. Gold occurs as native metal or in sulphides, mainly in systems of quartz-ankerite "veins" but also in pyrite-rich carbonatised rocks that contain no veins. In general "Each gold-bearing unit consists of two components: A carbonate-rich rock which may be a sedimentary rock or an altered volcanic rock, and a quartz vein system which has a direct spatial relationship with the carbonate unit. Carbonatisation of volcanic rocks predates the first tectonic deformation,.....quartz veins postdate the carbonatisation event" (Roberts, 1981).

The following types of gold mineralisation are recognised (Karvinen, 1981):

1) Continuous stratiform and stratabound bodies of quartz-ankerite with tourmaline, pinching and swelling along strike and characterized by cross-cutting veins.

2) Massive siliceous carbonate rock with 5-20 % pyrite and minor quartz-carbonate stringers.

3) Breccia bodies within fossil vents where mineralisation occurs as disseminated pyrite in matrix material or as pyritic quartz-carbonate stringer vein systems.

Vents are identified by breccia, agglomerate, cross-cutting alteration zones and pyrite-quartz stringers. Proximity to vent areas is indicated by felsic porphyry bodies and high density of thin, stratabound ankeritic horizons. Mineral and trace element zoning is indicative of a discharge zone of hydrothermal solutions.

4) The metamorphogenetic ores, are gold-bearing quartz veins with minor amounts of carbonate, classically epigenetic in character. The average thickness is 3 m (up to 30 m) and length are up to several hundred metres. Veins transgress primary volcanic structures and contacts between carbonatised rock and volcaniclastic sediments.

Economic concentrations of gold appear to be localised in three principal geological environments: a) major exhalative vent areas (where deposits are concentrated); b) structurally deformed zones of the carbonate members; and c) metamorphogenetic veins at contacts of carbonatised volcanic rocks and volcaniclastic sedimentary rocks.

Formation. Karvinen (1981) favours a series of processes entirely related to volcanic activity in explaining the formation of syngenetic gold deposits. Important here is the conclusion that concordant and discordant carbonate-rich rocks formed during periods of submarine-exhalative hydrothermal activity centered at several major vents.

5.1.2 COMPARISON OF THE TARTOQ GROUP GREENSTONE BELT AND THE TIMMINS AREA

The area of greenstones (with gold deposits) around Timmins is comparable in size to the Tartoq Group greenstone belt (see Figures 1 and 5), but of course the Timmins area itself is but a part of a much larger supracrustal rock sequence, the Abitibi greenstone belt. The relatively small outcrops of the Tartoq rocks, however, does not exclude the possibility of economic gold deposits. The Tartoq Group possibly represents the remnants of a once more widespread supracrustal cover. There are signs of some of the outcrop areas having been transported. Providing conditions at some time during the build-up of the volcanic sequence were favourable for the formation of gold deposits, the possibility of such existing in the Tartoq belt should be equal to that of other greenstone belts - per unit rock volume provided the mineralised part of the stratigraphy was not removed by erosion. In this case, the quetion of how much original stratigraphy is preserved largely depend on deformation. That is, to what extent tectonic movement left the appropriate levels of the volcanic pile as part of the volume of rock presently constituting the Tartoq Group.

The existence of gold mineralisation in the Tartoq Group has been demonstrated. Gold occurs in the Nûluk area associated with carbonate horizons resembling the Upper and Lower Carbonate Members of the Timmins area. The mineralisation types are to a large extent similar to those of the Timmins area, and in fact the gold mineralisation in the Nûluk area may be characterised using the expression of Roberts (1981) quoted in section 5.1.1 concerning the gold-bearing units of the Timmins area.

The lithology of the Tartoq Group in many aspects resembles that of the Timmins area, as does type and morphology of alteration and associated mineralisation. From this literature study, it is clear, however, that a close resemblance in geological framework exists. Put in another way, the Tartoq Group is likely to be the result of geological processes similar to those that led to the formation of the Timmins area supracrustals, which constitute a "typical" greenstone belt possessing known economic gold deposits.

Under the assumption that the gross stratigraphy of the Tartoq Group shown on Fig. 2 is valid, a provisional sequence of events may be suggested: During submarine basaltic volcanism, a sequence of tholeiitic pillow lavas were deposited. Some of the ultramafic rocks may represent the base of the tholeiitic activity but their stratigraphic position is uncertain. The build-up of pillow flows then ceased, contemporaneous with the onset of exhalative activity. During this hydrothermal phase the carbonate rocks were formed, by alteration of the volcanics on the sea-floor. The hydrothermal exhalative flows not only resulted in carbonatisation and formation of dolomite bodies, but also in the formation of sulphide and gold mineralisation. Circulating seawaters liberated gold and other trace elements from within the volcanic pile, and deposited them as syngenetic mineralisation at the sea-floor. Mineralisation extended over a relatively large area, shifting Eh-pH conditions and relative sulphur activity produced facies changes resulting in both oxide and sulphide occurrences. Sulphide facies mineralisation dominated, and variations in the intensity of exhalative activity produced different kinds of mineralisation ranging from disseminated pyrite ocurrences to BIF and stratiform quartz-ankerite layers with massive pyrite-arsenopyrite.

Gold is associated with areas of relatively more intense exhalative activity. Waning exhalative activity continued during the subsequent onset of explosive volcanism. Lapilli tuffs of andesitic composition were laid down and the cycle terminated with an eruption producing rhyolite tuff. This was followed by the eventual onset of a new phase of extrusion of basaltic flows, forming the upper volcanic cycle.

Subsequent to volcanic activity, the area underwent tectonic deformation. Gold and other elements were remobilised from the synvolcanic occurrences, migrated to zones of weakness forming quartz veins with sulphides and gold.

5.1.3 ECONOMIC GOLD POTENTIAL OF THE TARTOQ GROUP - PROPOSED FUTURE WORK

It is apparent from previous chapters that the distribution pattern of known mineralisation and the gold assays, changed relatively little during the years 1971-1985. This seems to establish the reliability of the results obtained. It further suggests however, that the potential for further mineralisation in the Nûluk and Iterdlak areas is low. The unexplained northern VLF-HLEM anomaly in the Nûluk area seems to coincide with a magnetite-rich horizon (see figures II.4 and II.6). Magnetite is a relatively good conductor, and a dissemination of this mineral within a rock can make this a better conductor (Parasnis, 1979). Another matter of speculation is the size or extent of the mineralised and altered horizons. These are described in somewhat different terms in text and figures of individual reports. This probably reflect the different geologists viewpoints and detail of the work undertaken.

If the known gold occurrence in the Nûluk area is deemed sub-economic due to lack of down-dip continuation of the mineralised strata, other possibilities exist. In this respect, it is appropriate to quote from the exploration guidelines for the Timmins area set up by Karvinen (1981):

"1) Stratabound carbonate horizons serve as important indicators of volcanic hydrothermal exhalative activity. If they are anomalously rich in gold or associated trace elements, economic concentrations should be explored for by locating fossil vents, structurally complex areas or facies changes into volcaniclastic sedimentary rocks.

2) ...., gold-bearing sulphide-type orebodies in carbonates can be detected by using conventional geophysical techniques; however the other types of mineralisation could easily be missed, even by diamond drilling. In such cases .... geochemical surveys may prove to be useful."

The possibility of locating fossil vents may warrant a further investigation of the Nûluk area and a more detailed exploration around the West Valley sulphide showing in the Iterdlak area.

The most interesting area regarding potential economic gold mineralisation is North Midternæs. It is the largest and least understood Tartoq outcrop (56 km^2) and apparently structurally very complex. Greenex A/S presents an unfinished 1:10000 scale geological map of the area in its 1984 report. Carbonatised horizons are common, some of them cross-cutting lithology. Anomalous gold values exist in the carbonates, a float and a silt sample returned gold values above 1 ppm.

Future work should include a very detailed stream sediment sampling programme, along with detailed mapping aiming towards the location of fossil exhalative vents. Furthermore, the establishment of a detailed stratigraphic column for the entire Tartoq Group will be useful. This necessitates a more detailed understanding of the structural geological pattern of the greenstone belt. Whole rock chemical analyses of the different rock types will provide a better understanding of the original geological environment. For example, it would be interesting to establish whether or not the ultramafic rocks are of komatiitic composition. Peridotite has been reported from North Midternæs.

5.2 INTERPRETATION OF MINERALISATION IN THE KETILIDIAN SUPRACRUSTAL ROCKS

The largest volume of mineralisation in this part of the Ketilidian supracrustal rocks is of syngenetic origin, with minor remobilisation of elements during basic intrusion and tectonic deformation.

Exhalative activity of relatively minor intensity but wide areal extent was intermittent during the mafic volcanism that led to formation of the Sortis Group. It was associated with both pillow lava extrusion and explosive activity producing pyroclastic material. The mineralisation itself is hosted in interflow sedimentary horizons and sediments flanking pyroclastic rocks, suggesting that the results of the submarine exhalations were best preserved during periods of waning magmatic activity.

Minor epigenetic occurrences of very different kinds are found. The magnetite matrix of the Ore-Conglomerate Member in central Grænseland is believed to be the result of metamorphic rearrangement of an original black sands placer deposit. It is possible via diagenesis and incipient burial metamorphism to mobilise iron and titanium of heavy minerals such as ilmenite, if the redox-potential in the sediment is negative. An oxidizing environment, however, will tend to mobilise titanium and leave iron as residual hematite (Erfurt, 1988).

The dolomite hosted lead-zinc-silver showing in the Zigzagland Formation is probably of epigenetic origin. The dolomite unit itself may be an evaporite or sedimentary exhalative rock. The mineralisation is associated with quartz veining throughout the dolomite, and is possibly a result of fracturing during deformation and subsequent infilling by quartz and sulphides mobilised by the tectonic movement. The showing is found in an area of relatively intense deformation compared to that of the other Ketilidian rocks north of Arsuk Fjord.

Gabbro sill intrusion in the Sortis Group resulted in the mobilisation of iron and copper from the syngenetic sulphide occurrences. Pyrrhotite and chalcopyrite were concentrated as pockets of near massive mineralisation proximal to the gabbro intrusions.

5.2.1 ECONOMIC MINERAL POTENTIAL ON MIDTERNÆS AND IN GRÆNSELAND

Gold mineralisation has not been located and the base metal occurrences found are of limited extent. The probability of discovering epigenetic mineralisation of larger extent seems low. The reason for this is the limited deformation and very low grade metamorphism of the rocks, i.e. the possibility of mobilising metals, and of metamorphism-induced hydrothermal activity is remote. South of Arsuk Fjord, the increasing intensity of orogenetic phenomena of all types has led to a better mineralisation potential in the Ketilidian rocks of this area (Erfurt & Lind, 1990). The largest potential for locating economic occurrences lie in the syngenetic mineralisation, i.e. in the possible existence of volcanogenic massive sulphide deposits.

Still another possibility is the existence of placer gold with the Ore-Conglomerate Member of the lower part of the Vallen Group. No gold has been returned from limited sampling in the central Grænseland area. Most of the conglomerate seems to be of residual character or locally derived, and the existence of a fossil placer deposit cannot be ruled out. The magnetite matrix of the conglomerate is probably of secondary origin, and related to paleoplacer deposits in sandstones of the underlying Varved Shale Member. This heavy mineral occurrence may contain placer gold.

6. ACKNOWLEDGEMENTS

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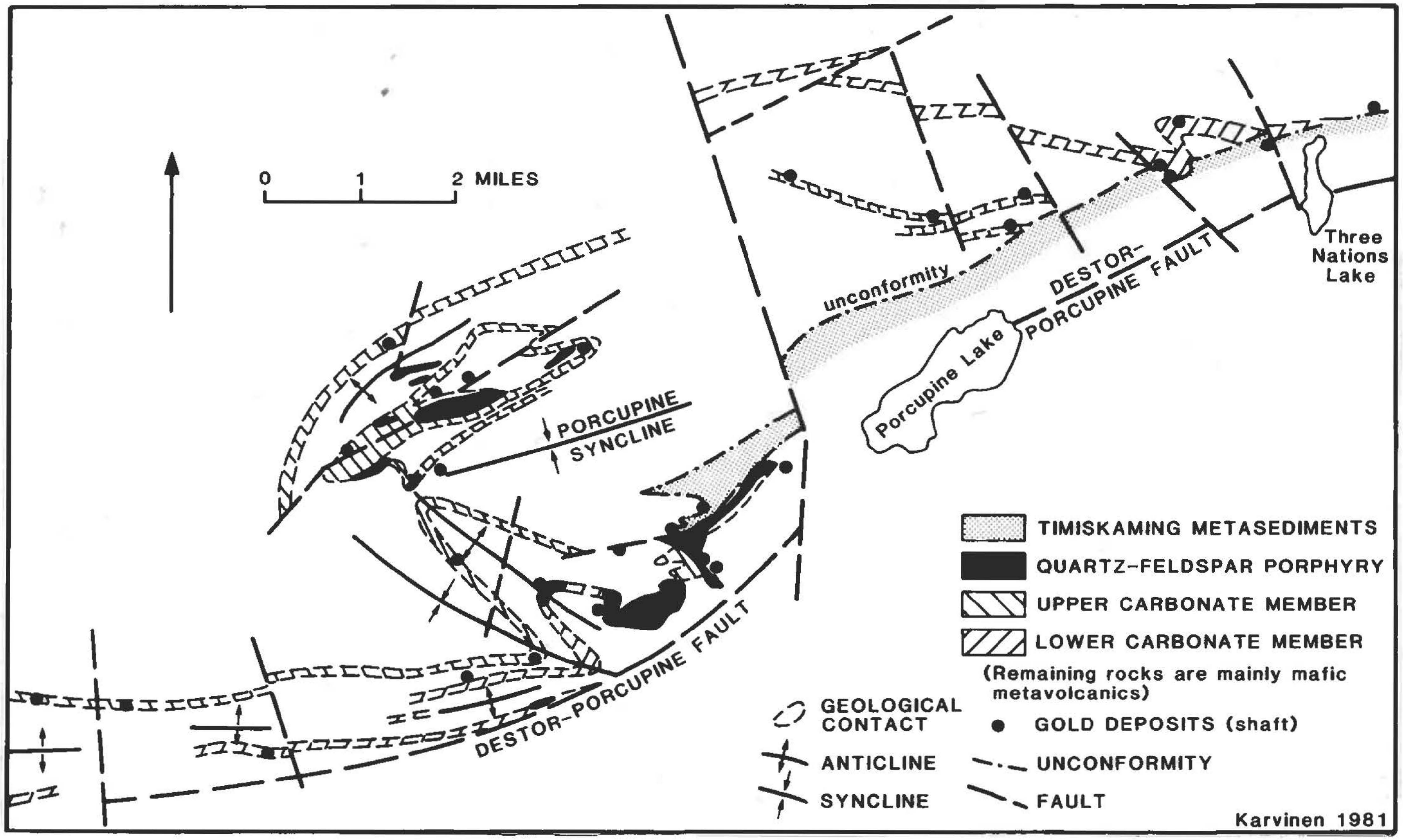


Fig. 5. Distribution of carbonate-rich rocks, porphyries, and gold deposits, Timmins area.

7. REFERENCES

Allaart, J.H. 1976: Ketilidian mobile belt in South Greenland. In Escher, A. & Watt, W.S. (ed.) Geology of Greenland, 120-151. Copenhagen: Geol. Surv. Greenland.

Appel, P.W.U. 1974: On an unmetamorphosed iron-formation in the early Precambrian of South-west Greenland. Miner. Deposita 9, 75-82.

Appel, P.W.U. 1984: An iron-formation in the Precambrian Tartoq Group, South-West Greenland. Rapp. Grønlands geol. Unders. 120, 74-78.

Appel, P.W.U. & Secher, K. 1984: On a gold mineralization in the Precambrian Tartoq Group, South-west Greenland. J. geol. Soc. Lond. 141, 273-278.

Berthelsen, A. & Henriksen, N. 1975: Geological map of Greenland 1: 100 000. Ivigtut 61 V.1 Syd; descriptive text. Geol. Surv. Greenland, 169 pp.

Bondesen, E. 1970: The stratigraphy and deformation of the Precambrian rocks of the Grænseland area, South-West Greenland. Bull. Grønlands geol. Unders. 86, 210 pp. (also Meddr Grønland 185, 1).

Bridgwater, D., Keto, L., McGregor, V.R. & Myers, J.S. 1976: Archaean gneiss complex of Greenland. In Escher, A. & Watt, W.S. (ed.) Geology of Greenland, 18-75. Copenhagen: Geol. Surv. Greenland.

Erfurt, P. 1988: A petrological and economic investigation of some paleoplacer deposits on the Varanger Peninsula, North Norway. Unpubl. thesis, University of Aarhus, Denmark. English abstract.

Erfurt, P. & Lind, M. 1990: Reconnaissance for noble and base metals in the Ivigtut-Kobberminebugt area, South Greenland: analytical results. Open File Ser. Grønlands geol. Unders. 90/7, 14 pp. + appendix.

Fripp, R.E.P. 1976: Stratabound gold deposits in Archean Banded Iron-Formation, Rhodesia. Econ. Geol. 71, 58-75.

Higgins, A.K. 1968: The Tartoq Group on Nuna qaqortoq and in the Iterdlak area, South-West Greenland. Rapp. Grønlands geol. Unders. 17, 17 pp.

Higgins, A.K. 1970: The stratigraphy and structure of the Ketilidian rocks of Midternæs, South-west Greenland. Bull. Grønlands geol. Unders. 87, 96 pp. (also Meddr Grønland 189, 2).

Higgins, A.K. & Bondesen, E. 1966: Supracrustals of pre-Ketilidian age (the Tartoq Group) and their relationships with Ketilidian supracrustals in the Ivigtut region, South-west Greenland. Rapp. Grønlands geol. Unders. 8, 43 pp.

Kalsbeek, F., Larsen, L.M. & Bondam, J. 1990: Geological Map of Greenland 1: 500 000. South Greenland sheet 1, descriptive text. Geol. Surv. Greenland.

Karvinen, W.O. 1981: Geology and evolution of gold deposits, Timmins area, Ontario; p. 29-46 In Genesis of Archean, Volcanic-hosted gold deposits, Symposium held at the University of Waterloo, March 7, 1980, Ontario Geological Survey, MP97, 175 pp.

Parasnis, D.S. 1979: Principles of applied geophysics, 3rd. edition, p. 129. London: Chapman and Hall.

Roberts, R.G. 1981: The volcanic-tectonic setting of gold deposits in the Timmins area, Ontario; p. 16-28 In Genesis of Archean, volcanic-hosted gold deposits, Symposium held at the University of Waterloo, March 7, 1980, Ontario Geological Survey, MP97, 175 pp.

COMPANY REPORTS - MISCELLANEOUS

All exploration reports mentioned in this report are available for inspection at GGU's headquarters in Copenhagen or can be requested from GGU against payment of copying costs.

Reports from Renzy Mines Ltd.:
Investigations on the Frederikshaab exploration concession of Renzy Mines Ltd. from 1971-1975. 4 reports.

Reports from Greenex A/S:
Frederikshaab prospecting licence: Report on sampling and prospecting in the Sermiligârssuk Fjord area, South-west Greenland. 1983.

Sermiligârssuk exploration concession: Report on geological field work carried out in the Sermiligârssuk Fjord area, South-west Greenland, July-August 1984. Submitted February 1985.

Report on Horizontal-Loop Electromagnetic Survey at Sermiligârssuk Fjord, SW Greenland for Greenex A/S. June-July 1985. By Brian S. Williams, BWL Geophysics, U.K.

APPENDIX 1:
Investigation procedures.

1. FIELD INVESTIGATIONS FROM 1971 to 1974

The 1971 investigations delineated the Tartoq Group rocks outcropping around Sermiligârssuk Fjord and the Ketilidian rocks of Midternæs and Grænseland as interesting sub-areas, with regard to further exploration. The main targets were noble and base metals. Also, kimberlitic rocks had been reported within the concession area, and prospecting in 1971 resulted in the recovery of 8 microscopic diamonds from dykes on Midternæs and sills in the Pyramidefjeld Granite complex. However, no further diamonds were found during exploration in the following years.

In 1971 329 rock- and 3 pan samples were collected, of which 90 were analysed. The reconnaissance consisted largely of traversing with occasional detailed mapping, including some trenching in the Iterdlak area (samples 1836-1837, 1840, 1842) and on Midternæs.

In 1972 limited follow-up work was conducted, consisting mostly of prospecting and trenching (samples 1309-1313) in the Perledal Valley on Midternæs (Fig. II.2d), where low-grade copper mineralisation had been found in 1971. Visual helicopter examinations for gossans were made over about 75 km^2 of Midternæs, centered on Perledal. These, followed by ground traversing were extended over Erdmuths Nunatak and Nuna Qernertoq. On the former a rusty pyroclastic area was examined and trenched.

The Nûluk area was prospected for gold. Two arsenopyrite showings were trenched for 4 metres across the mineralised zones (samples 268-273 and 290-297). A total of 153 rock- and chip samples were collected.

In 1973 no field work was undertaken. 1974 reconnaissance work was carried out by Cominco personnel. After an aereal reconnaissance more detailed ground work, including mapping, was performed in all supracrustal areas between Neria and Arsuk Fjords.

2. EXPLORATION 1983-1985

Over a period of 14 days in August 1983 investigations were conducted in the six areas of outcrops of Tartoq Group (Fig. II.1).
149 chip and 22 grab samples were collected. Chip samples were 4-5 kg in size, taken with hammer and chisel perpendicular to schistosity.

From July 5 to August 28 1984 geological mapping and sampling was conducted, mostly in rocks of the Tartoq Group. At Nûluk three 800 m x 600 m slope corrected grids were laid out and mapped at 1: 1000 scale. The grids were centered on auriferous quartz-pyrite veins in sheared carbonate schists located in 1983. Further sampling in the Nûluk area outside the grids was carried out, mostly across carbonatised horizons within the 300-400 m thick sequence where andesite pyroclastics occur.
The other Tartoq group outcrop areas were mapped and sampled.

1984 diamond drilling

23 short angled holes, totalling 460 m, were drilled at Nûluk using a Smit-Winkie drill. The objective was to obtain uncontaminated fresh samples of potentially auriferous sulphides down dip from showings previously sampled in 1983, in order to confirm grades and down dip continuity. All holes were drilled at 45 to 50 degrees of dip to the southeast to intersect the rock units at approximately right angles. For location of drill holes and a summary of results see Figures II.4; II.5 a,b and Table II.1

1985 geophysics

19 lines of reconnaissance Horizontal-loop Electromagnetic (HLEM) surveying, 200 m apart, were used to evaluate the Nûluk area, that was thought to be a major syncline. The isoclinally folded greenstones contain narrow gold-bearing horizons, and the implication was that the latter might form thicker sections in the fold closures. These thicker sections might give an electromagnetic response. An additional 5 intermediate lines were surveyed between the reconnaissance lines; all 24 lines were also surveyed with
Very Low frequency EM (VLF). HLEM measurements were made using different transmitter/receiver coil separations and different signal frequencies in order to vary detail of mapping and depth penetration. Topography corrections were carried out, coils were attempted co-planar. The HLEM survey was carried out using the Apex Max-Min II. Frequencies used were 3555, 1777 and 444 Hz. VLF data were measured with a Geonics EM-16. The transmitter used was JXZ in Norway which produced the best along strike angle. All geophysical surveying was made over an area of ca. 3300 x 900 m between Sermiligârssuk and Tartoq Fjords (see Fig. II.6).

APPENDIX 2:
Exploration activities 1971-1986 - results, documentation.

Fig. II.1 is a location map for the individual supracrustal outcrops treated in the following.

1. RENZY MINES LTD. RECONNAISSANCE EXPLORATION (company reports 1971-75)

The conclusion drawn from the 1971-74 work was that significant concentrations of gold mineralisation could be considered of limited extent and they were declared uninteresting in relation to gold prices at the time. Subsequently the prospect was abandoned except for some very limited laboratory work done until 1977.

1.1 RESULTS

The results of the work performed from 1971-74 are summarised below. Sample localities and analyses are shown on Map 1 and Plate 1 in Appendix 3. Fig. II.2 a-d summarize the geology and some sample results in areas that were given special attention.

1.1.1 TARTOQ GROUP

Nûluk (fig. II.2 a).
A 350-400 m thick carbonatisation zone exists in connection with intermediate and acid pyroclastics as numerous carbonate schist horizons, and as coarse pyroclastic fragments in carbonate matrix.

Disseminated pyrite mineralisation is widely distributed throughout the carbonatised zone, and this zone of carbonatisation/pyritisation can be followed for 4-5 km from Sermiligârssuk Fjord to the south. In general, pyrite occurs only in small amounts, but in a number of places zones of intense pyrite-arsenopyrite mineralisation occurs with quartz as layers or lenses. Zones of chalcopyrite mineralisation are found. The mineralised zones are from 0.15-0.5 m wide and extend for 2-3 km along strike. Several of these zones were found during 1971 to 1974. Gold assays varied from about 1 to 15 ppm. The abovementioned occurrences are seen by Renzy Mines Ltd. as forming small discontinuous pods present at different levels in the carbonatised zone. Local concentrations of gold are associated with disseminated pyrite zones in carbonate schist and in carbonate-rich coarse pyroclastics. Again, only limited mineralisation is indicated, believed to be of volcanic exhalative origin.

Gold assays varied from nil to 10 ppm. At the base of the sequence at Sermiligârssuk short, discontinuous gash veins with pyrite, chalcopyrite and arsenopyrite are present. Samples assayed 15-135 ppb Au.

Iterdlak (fig. II.2 b).

The most significant mineralisation found in the Iterdlak area is a massive pyrite body located on the western limb of a syncline overturned to the southeast and having an axis plunging 30-40 degrees to the southwest. This mineralisation, referred to as the West Valley sulphide showing, comprises a conformable lens of banded massive and near massive sulphides associated with banded chert and black argillaceous sediments. It occurs at the contact between andesitic schists forming the structural footwall, and a 200 feet thick carbonate schist unit, itself being bounded by andesitic rocks.

It strikes north-south, dips 30-55 degrees to the west and has a maximum true thickness of 170 feet and a strike length of at least 1800 feet which is considerably more than stated by Appel (1984) and Greenex A/S (1984),see p 10.

Grab sampling from the main part of the sulphide zone returned gold values from 60 to 550 ppb, unfortunately the sample sites are not being indicated on any map.

Outcrops of a folded banded magnetite IF occur about 1 mile to the north along the projected strike of the sulphide showing. There were no anomalous base metal values in stream sediment samples of this area. Conformable pyritic showings associated with carbonate schists and cherts were found on the north shore of Sermiligârssuk Fjord, in the axial area of the regional syncline. All were barren.

All other areas of Tartoq Group rocks around Sermiligârssuk Fjord.

Reconnaissance exploration revealed disseminated pyrite in chlorite schists, disseminated pyrite-pyrrhotite in rhyolite tuffs and pyrite-chalcopyrite in quartz veins as well as magnetite and/or pyrite gossans in quartz sericite schists and rusty outcrops in general. No significant gold or base metal values were detected.

1.1.2 KETILIDIAN SUPRACRUSTAL ROCKS

Grænseland (fig. II.2 c).

Ore-Conglomerate Member.

Between the lakes Vallen and Lappesø the Ore-Conglomerate Mb. has a thickness ranging from 6 to 10 m. The boulders and pebbles with long axes between 1 and 40 cm consist of grey or white cherty quartzite. They are rounded to subrounded, with occasional more ellipsoidal to flattened shapes found.

In this area, the matrix is dominated by magnetite, with pyrite, hematite and

occasional ilmenite as minor constituents (Bondesen, 1970).
Assay results from 19 samples show background gold values of 5-10 ppb. The cherty quartzite pebbles of the Ore-conglomerate Mb. seem to be partly of residual origin and partly deposited after short transport by wave action.
The potential for alluvial gold is probably very low and this is supported by the assays.

Pyroclastic rocks

Located in southeastern Grænseland, these are exposed over a length of 6.5 km. True thickness of the pyroclastics and associated sediments which are split into a number of separate segments by diabase-gabbro sills, is in the order of 400 metres. Sheared black and purple pyritic slates, cherts and argillites form the base of the sequence and are overlain by finely laminated tuffs and minor cherts. There is a progressive interbanding of thicker lapilli tuffs representing the major facies of this assemblage-up sequence. It consists almost entirely of lapilli sized andesite fragments in a tuffaceous matrix of the same composition. Typically, the pyroclastic sequence is overlain by fine laminated siltstones and cherts. Two insignificant sized showings of pyrrhotite and chalcopyrite were noticed within the pyroclastics. In both showings the mineralisation occurs at the contact with a gabbro-diabase sill.

Midternæs (fig. II.2 d)

Attention was focused on the copper showings of the Perledal area and on several areas of pyroclastic material and associated sediments.

Erdmuths Nunatak

Examination and trenching of the prominent rusty fold zone varying from 2 to 40 m in width, and extending for several km across black shales and pyroclastics yielded no significant results. The mineralisation consists of up to 10 % stratabound pyrrhotite with rare chalcopyrite in extremely fine crosscutting veinlets. Disseminated pyrite is present in fine-grained flanking sediments (chert and carbonaceous material) of the pyroclastic rocks.

Perledal

This is a broad steep-sided valley in the western part of Midternæs, cut through a thick pile of the volcanics. Boulders of siltstone, graphitic argillite and chert mineralised with pyrite, pyrrhotite and chalcopyrite were discovered along the 6-7 km length of the valley in 1971. Apparently the boulders were derived from a number of interflow sedimentary horizons in the basaltic pillow lavas that are cut by diabase-gabbro sills.

Eleven of these sedimentary horizons occurring at different stratigraphic levels were examined in 1974. They can be traced for distances of up to 1.5 km, in places are up to 16 m thick and consist of black shales, siltstones, cherts and occasionally dirty limestones. Sulphide mineralisation consisting mainly of pyrite and pyrrhotite is fairly widespread within these horizons, but seldom exceeds 5 % by volume. Chalcopyrite is found only with pyrrhotite, and only where the horizons are cut by gently discordant transgressive diabase-gabbro sills. The occurrences comprise pockets of near-massive mineralisation which play out within a few metres of the intrusive. They are regarded as having no economic significance.

Pyroclastic rocks

Pyroclastic rocks of intermediate and acid composition occur at similar levels within the upper part of the volcanic sequence in several parts of Midternæs. No mineralisation has been found.

2. GREENEX A/S EXPLORATION (company reports 1983-1985)

Sample localities are shown on Map 1 and in Plate 2 of Appendix 3. The results of the work carried out from 1983 to 1985 are described below.

2.1 NÛLUK AREA

The most encouraging gold values consistently came from massive arsenopyrite-pyrite lenses or pyritic quartz-carbonate layers, lenses and veins hosted by carbonate schists. In particular, an extensive carbonatised zone (c. 4.5 km long x 70 m thick) comprising several rusty carbonate schist units up to 15 m thick is located in central Nûluk (Fig. II.3) In this zone the three 1: 1000 scale mapped grids were centered and the diamond drilling was carried out (Table II.1 presents a summary of the Nûluk drilling results). No work was undertaken in the upper volcanic cycle, comprising greenschists and greenstones (Fig. 2).

Fig II.3 shows a summary of results of the 1983 sampling presenting the best values returned from the chip samples (g/t over metres). Samples 1191-1200 were taken along a 270 m strike length of a conformable pyritic quartz horizon. Samples 1184-1189 were taken along the length of a mineralisation consisting of several thin arsenopyrite-pyrite horizons, and sample 1182 from a massive arsenopyrite-pyrite horizon traceable for 60 m. Sample 1172 was collected in the vicinity of grab samples 22-24 from 1974 (see fig. II.2 a). Samples 1176-1178 were taken over 25 m strike length of a pyritic quartz layer in carbonate schist, and sample 1168 across two 15-20 cm thick pyrite horizons in a quartz-carbonate veined carbonate schist.

Sample 1201 of rusty felsic tuffs and 1108 of pyritic carbonate schist was taken outside the main carbonatised zone. Both of these samples are from just below the rhyolite-andesite contact. The terrain here is incised and exposure limited.

Fig. II.4 shows a downscaled version of the 1984 Greenex A/S geological map of the Nûluk area, with the locations of the three 1: 1000 grid map areas (see Fig. II.5 a,b,c) marked. Analyses of 1983 and 1984 chip samples (g/t Au over m) and 1984 drill cores (best value g/t Au over m) are shown.

Grid 1 is centered on a 300 m long quartz-pyrite lens in carbonate schist (Fig. II.5 a). In 1983 samples 1194-1200 were taken here. Of the 1984 samples with values exceeding 1 g/t Au, the most interesting was chip sample 769 which returned 14.2 ppm Au over 2.5 m. It was taken over a massive sulphide zone 35 m south of the quartz-pyrite lens. 365 m to the west of sample 769, chip sample 766 asssayed 1.5 g/t Au over 2.0 m of similar material.

The remaining 1984 samples returning above 1 ppm Au were grab samples from the main carbonatised zone (752: 15.8 g/t Au, 771: 13.0 g/t Au, 770: 5.0 g/t Au, 757: 3.2 g/t Au, 758: 2.4 g/t Au).

All the above samples except 766 fall in the well exposed c. 300 x 100 m zone of carbonate schist shown on Fig. II.5 a, in which individual sulphide zones are numerous but thin and discontinuous. Drilling returned significant values from holes N3 (1.7 ppm Au over 1.0 m) and N1 (5 ppm Au over 2.5 m, including 12.3 ppm Au over 0.5 m).

Grid 2 is centered on the beach showing located on the south side of Sermiligârssuk (Fig. II.5 b). The showing is a conformable double layer of arsenopyrite-pyrite traceable for 70 m. Each layer has a maximum thickness of 30 cm. The mineralisation is hosted in sheared andesite volcanics.
A further 100 m along strike, to the south-west of the showing, six 10-20 cm sulphide lenses can be traced for 50 m. The best value returned was 8.6 ppm Au over 0.6 m (1983 sample 1182). A core sample from hole N9 with 1.6 ppm Au over 0.5 m was the only significant 1984 result.

Grid 3 is centered some 3 km inland from Sermiligârssuk Fjord (Fig. II.5 c). Gold mineralisation is associated with a pyritic quartz layer in carbonate schist. 1984 grab sampling returned a best value of 13.7 ppm Au (sample 603). Grab sample 605 (1984) returned 1.1 ppm Au. Chip sample 24530 (1984) gave 9.53 ppm Au over 1.0 m. This mineralisation comprises a pyritic quartz layer 200 m to the north-west of the main carbonatised zone. None of the drill holes returned significant values.

HLEM-VLF results

Fig. II.6 shows the estimated positions of interpreted HLEM-VLF conductor axes plotted from a 1: 5000 scale topographical contour map presented in the 1985 geophysics report of BWL Geophysics. There are three VLF conductor axes:
VLF-1: strong and coinciding with the coastline,
VLF-2: weak to moderate, coinciding with the known and drilled mineralisation, and
VLF-3: strong and located north of the known mineralisation.
The two HLEM conductor axes are very weak. One is coinciding with VLF-1, the other with part of VLF-3.

The report concludes that anomalies coinciding with the coastline may be due to a sea-water indurated coastparallel fault zone. VLF-2 appears to reflect the gold-bearing sulphide horizons.
The coinciding HLEM and VLF-3 axes were not tested further. The HLEM anomalies

are mainly weak and out-of-phase at all coil separations. The implication is that the source is a poor conductor, and that conductivity does not increase with depth.

2.2 ITERDLAK AREA (see fig.II.2 b)

The highest gold value returned from the West Valley sulphide showing was 0.93 ppm (see Fig. II.7).

In the folded banded magnetite iron formation 1.5 km to the north along the projected strike of the West Valley showing, several grab samples were taken, one reported to assay 1.8 ppm. However, these samples are of uncertain location and are consequently not shown on the map.

2.3 NORTH MIDTERNÆS (sample locations and results in Appendix 3)

The largest outcrop, about 56 km^2, of Tartoq Group volcanics is the North Midternæs area (see Fig.II.1). The western limit of this area is marked by a major transcurrent fault. Most of the area is underlain by chlorite-amphibole schist. Quartz-sericite and carbonate schists are less common than at Nûluk, but carbonate schist horizons up to 300 m thick and 2 km long occur. A large anticline-syncline structure is defined by acid volcanics and siliceous dolomite horizons. Other notable markers are a number of orange weathering ultramafic pods and lenses with alteration rims of talc-magnetite schist.

A 1983 stream sediment sample (G 26) taken from a river gulley along a major fault zone returned 1.5 ppm Au. 1984 prospecting upstream of G 26 revealed a magnetite-rich horizon with a 30 cm thick pyrite lens to the footwall. Samples were anomalous but below 1 ppm Au. Sample 807 consisting of pyritic quartz float material returned 5.6 ppm Au. Similar outcrop material was not observed in the vicinity but sample 1480, also consisting of pyritic quartz float material returned 6.1 ppm Au. The sample however, is of uncertain location and not shown on Map 1 in Appendix 3.

2.4 MIDTERNÆS (sample locations and results in Appendix 3)

The Tartoq Group on Midternæs cover 12 km^2 (see fig. II.1). To the south-east it terminates against a regional transcurrent fault, and to the north-east the group is unconformably overlain by the Proterozoic Ketilidian sequence. Chlorite-amphibole schists with minor carbonate schist horizons pass upwards into a 50 m thick structurally repeated quartz-sericite schist sequence. Apparently conformable ultramafic horizons and talc-magnetite schists are interlayered with the quartz-sericite units. Chlorite-amphibole schists with minor acid volcanics complete the succesion, which is isoclinally folded and sheared along a NW-SE trend.

Sampling of pyritic acid volcanics, jasper and magnetite-rich horizons returned a highest assay of 862 ppb Au (sample 10742). Samples were also taken from the Ketilidian sequence immediately above the unconformity (rusty basal conglomerate and gossanous shale), but failed to provide encouraging signs of placer gold or base metal mineralisation. A stratabound lead-zinc-silver showing hosted by dolomite units in the Zigzagland Fm. of the Vallen Group was located in 1983 (samples G 44 to G 47). The mineralisation appears to be related to quartz net veining througout the dolomite. It was traced discontinuously for 300 m along strike.

Sample	Pb %	Zn ppm	Ag ppm	Cu ppm
G 44	14.2	1140	410	30
G 45	13.0	860	520	27
G 46	0.176	1600	21	7900
G 47	14.0	22	1210	61

2.5 SIORALIK (sample locations and results in Appendix 3)

The Sioralik belt of volcanics covers an area of 16 km^2 on the south side of Sermiligârssuk (Fig. II.1). It consists of amphibolite facies rocks in which two thin acid to intermediate cycles can be recognised, folded into a south plunging and eastwards overturned anticline. Underlying granodiorite gneiss is exposed at the core of the anticline.

The two thin volcanic cycles consist of greenschist with pyritic horizons and quartz-sericite schists. The volcanics are cut by ultramafic pods and layers, as well as dykes of several phases. 1983 and 1984 sampling did not return any interestingly high values.

2.6 WEST MIDTERNÆS (sample locations and results in Appendix 3)

The area of interest comprises 2.5 km^2 of volcanics outcropping between Sioralik and Sermiligârssuk (Fig. II.1). The rocks are chlorite schists with minor felsic and carbonatided horizons, as well as magnetite-rich horizons in intensely folded zones. In 1983 a grab sample of pyritic schist (G 55) returned values of:

Sample	Pb ppm	Zn %	Cu ppm	Ag ppm	Au ppb
G 55	388	1.6	4700	2	25

1984 sampling returned a single anomalous grab sample (24593) of 727 ppb Au.

3. GGU RECONNAISSANCE

In 1983, GGU performed a reconnaissance for noble and base metals in the Sermiligârssuk-Midternæs area. In 1985 some work was done in connection with the Greenex A/S exploration programme, and in 1986 some samples were taken during helicopter reconnaissance. On Midternæs, the reconnaissance covered both Tartoq Group rocks and rocks of the lower part of the Ketilidian sequence. 148 grab samples were analysed; sample locations and analyses are shown on Map 1 and Plate 3 of Appendix 3.

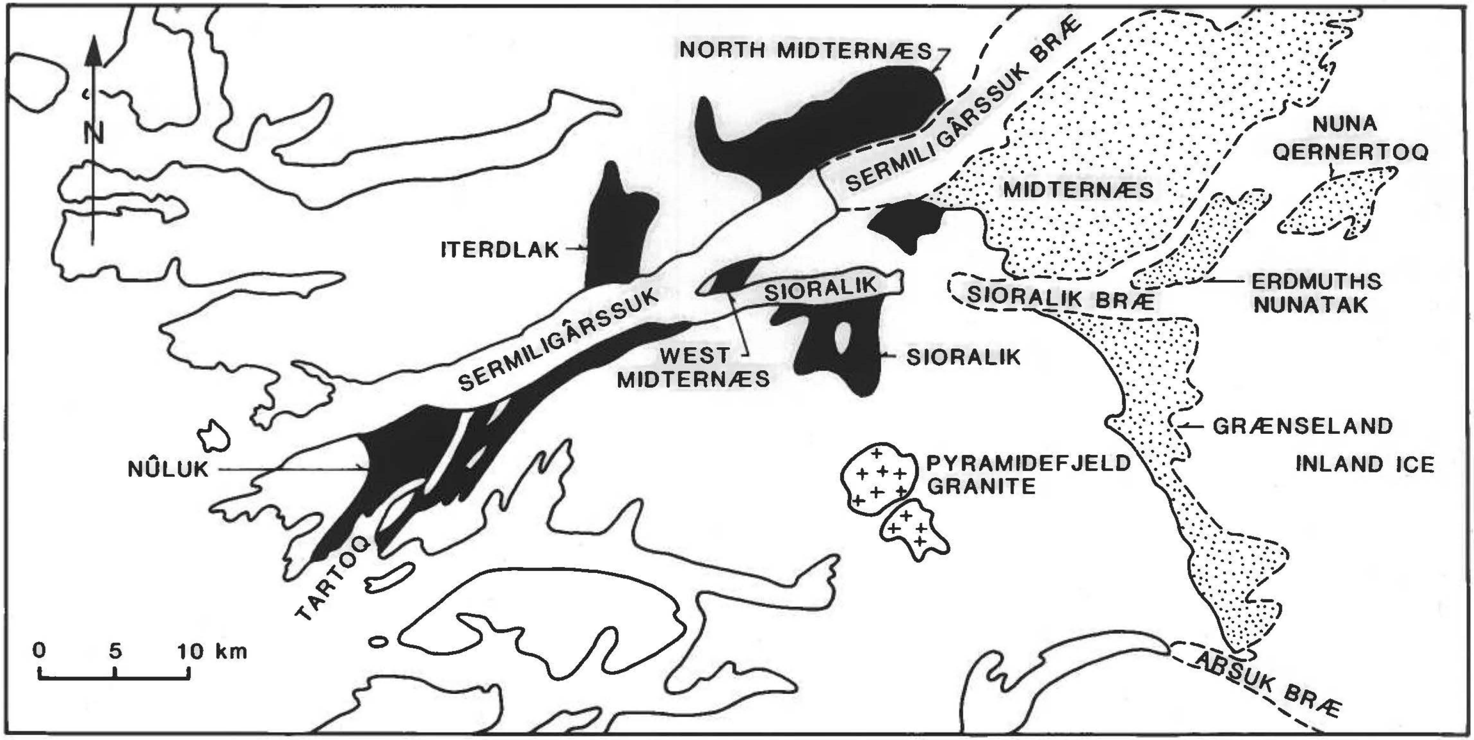
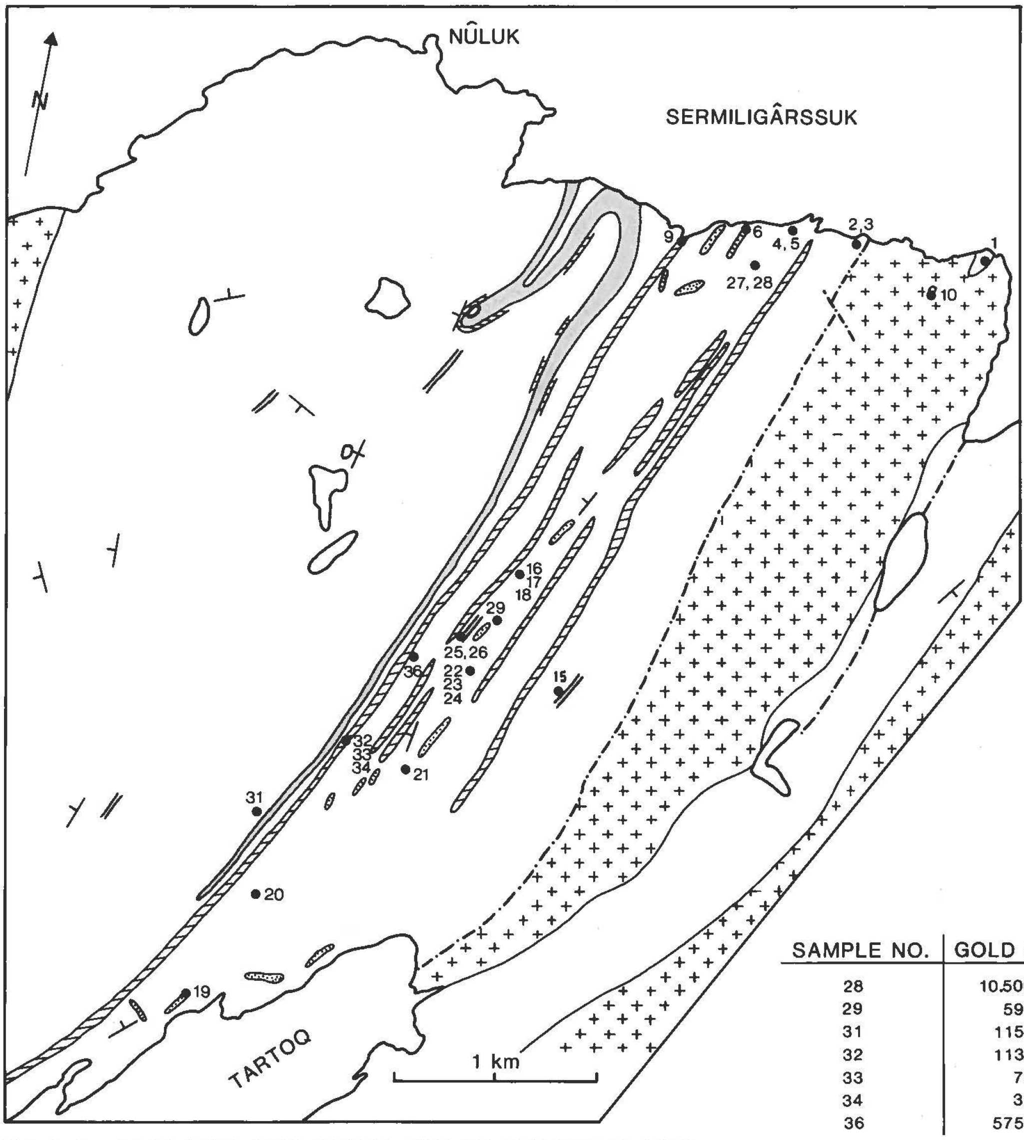


FIG. II. 1 LOCATION MAP-AREAS. TARTOQ GROUP SUPRACRUSTALS IN BLACK. KETILIDIAN SUPRACRUSTALS DOTTED.

x



SAMPLE NO.	GOLD (ppb)
1	105
2	135
3	15
4	35
5	1450
6	4250
9	115
10	50
15	65
16	5
17	5
18	10
19	10.000
20	10
21	3500
22	15.000
23	15.000
24	3500
25	20
26	1800
27	15.000

SAMPLE NO.	GOLD (ppb)
28	10.500
29	590
31	1150
32	1130
33	75
34	35
36	5750

FIG. II. 2a. SIMPLIFIED GEOLOGICAL MAP OF THE NULUK AREA. MODIFIED FROM RENZY MINES LTD. REPORTS 1972, 1975

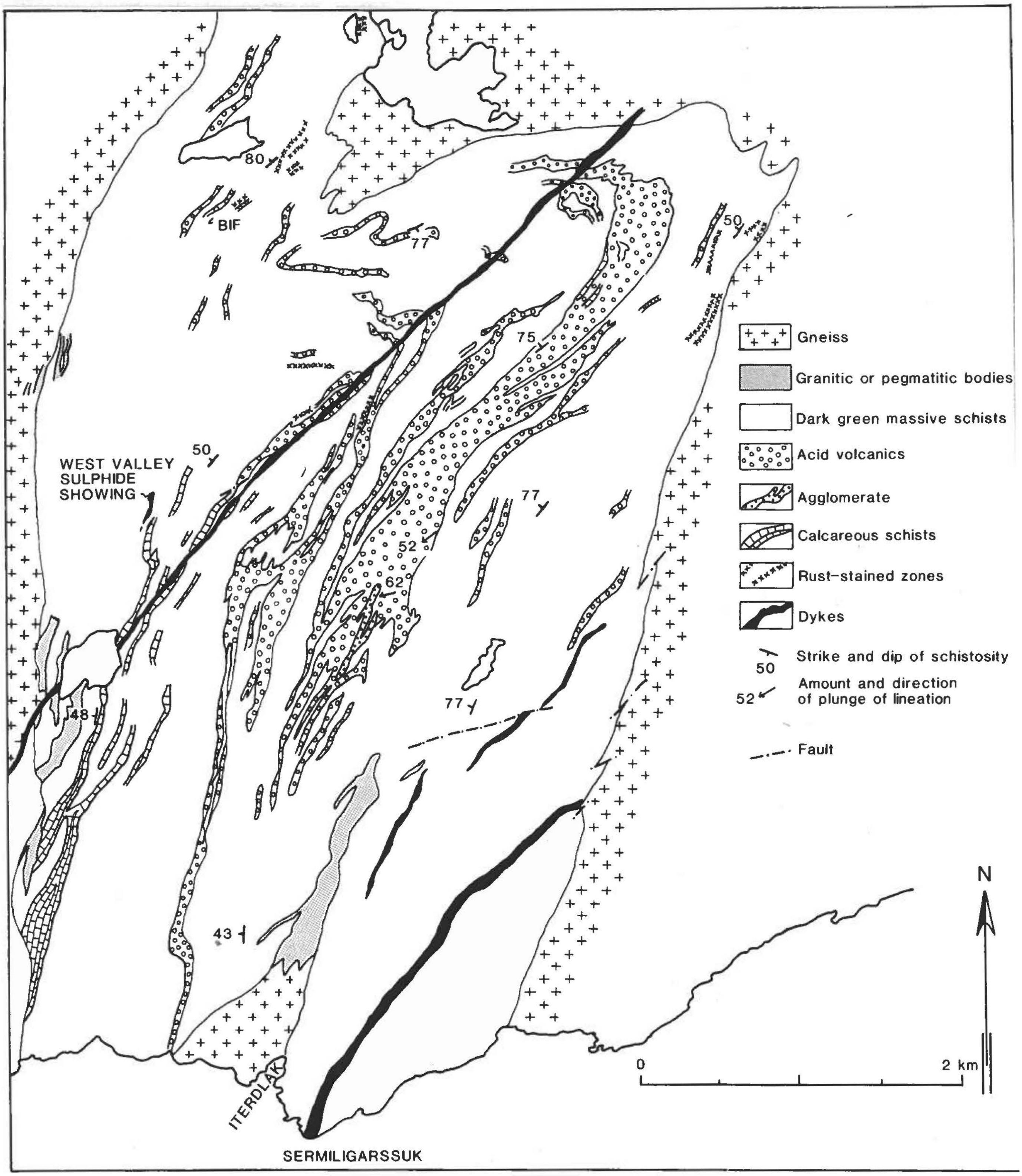
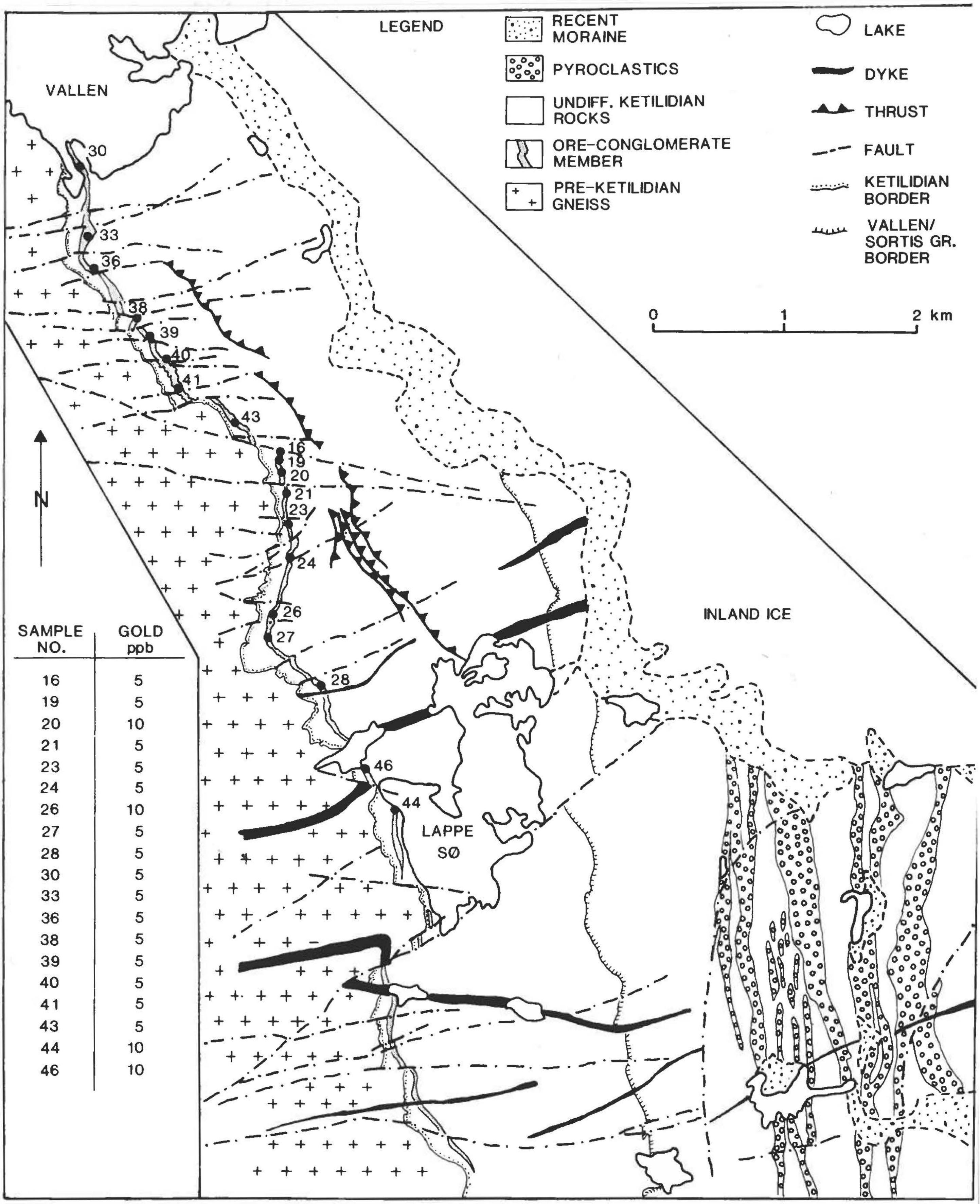


FIG. II. 2b. SIMPLIFIED GEOLOGICAL MAP OF THE ITERDLAK AREA. MODIFIED FROM HIGGINS (1968)



SAMPLE NO.	GOLD ppb
16	5
19	5
20	10
21	5
23	5
24	5
26	10
27	5
28	5
30	5
33	5
36	5
38	5
39	5
40	5
41	5
43	5
44	10
46	10

FIG. II. 2c. SIMPLIFIED GEOLOGICAL MAP OF THE CENTRAL GRÆNSELAND AREA. MODIFIED FROM BONDESEN (1970)

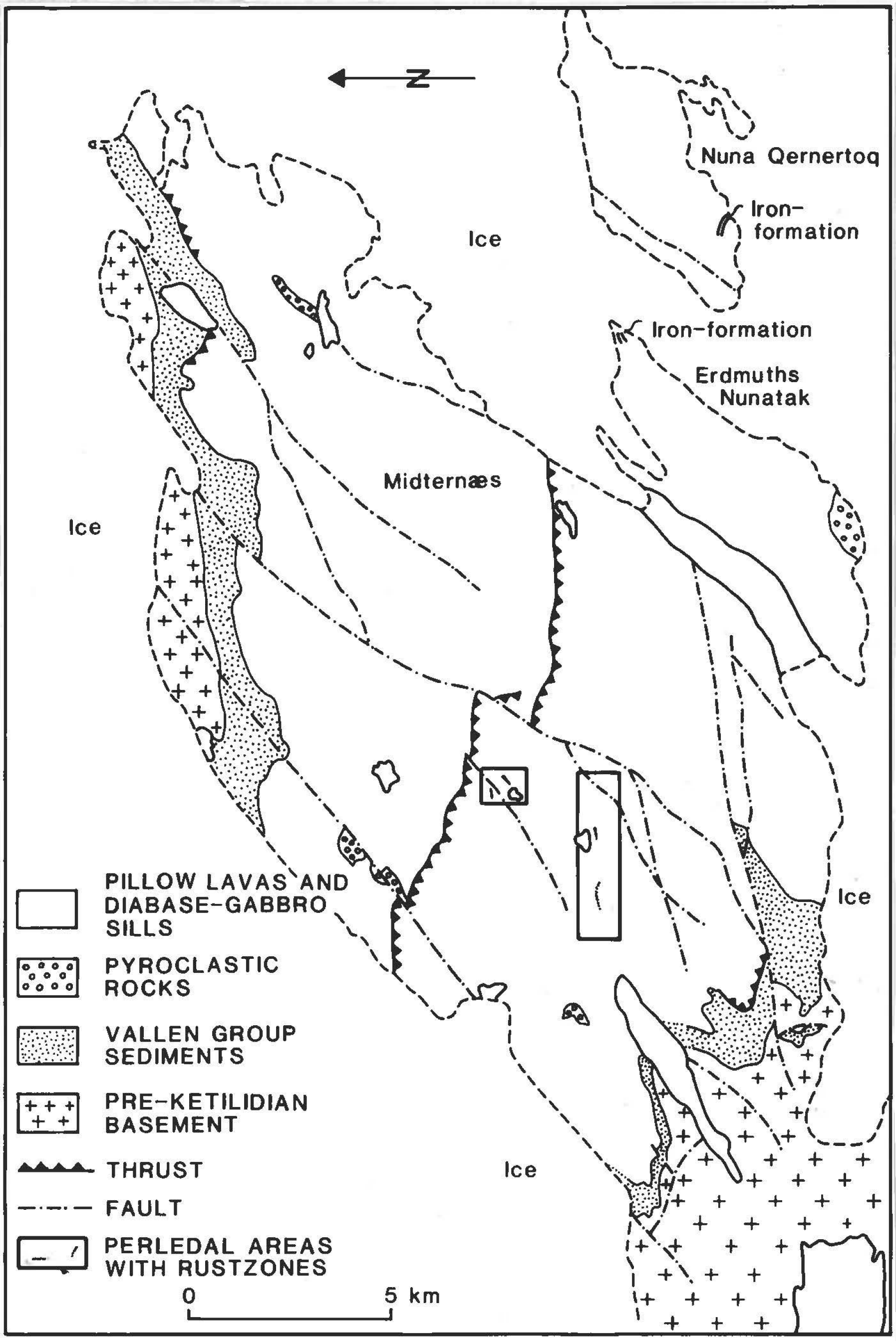
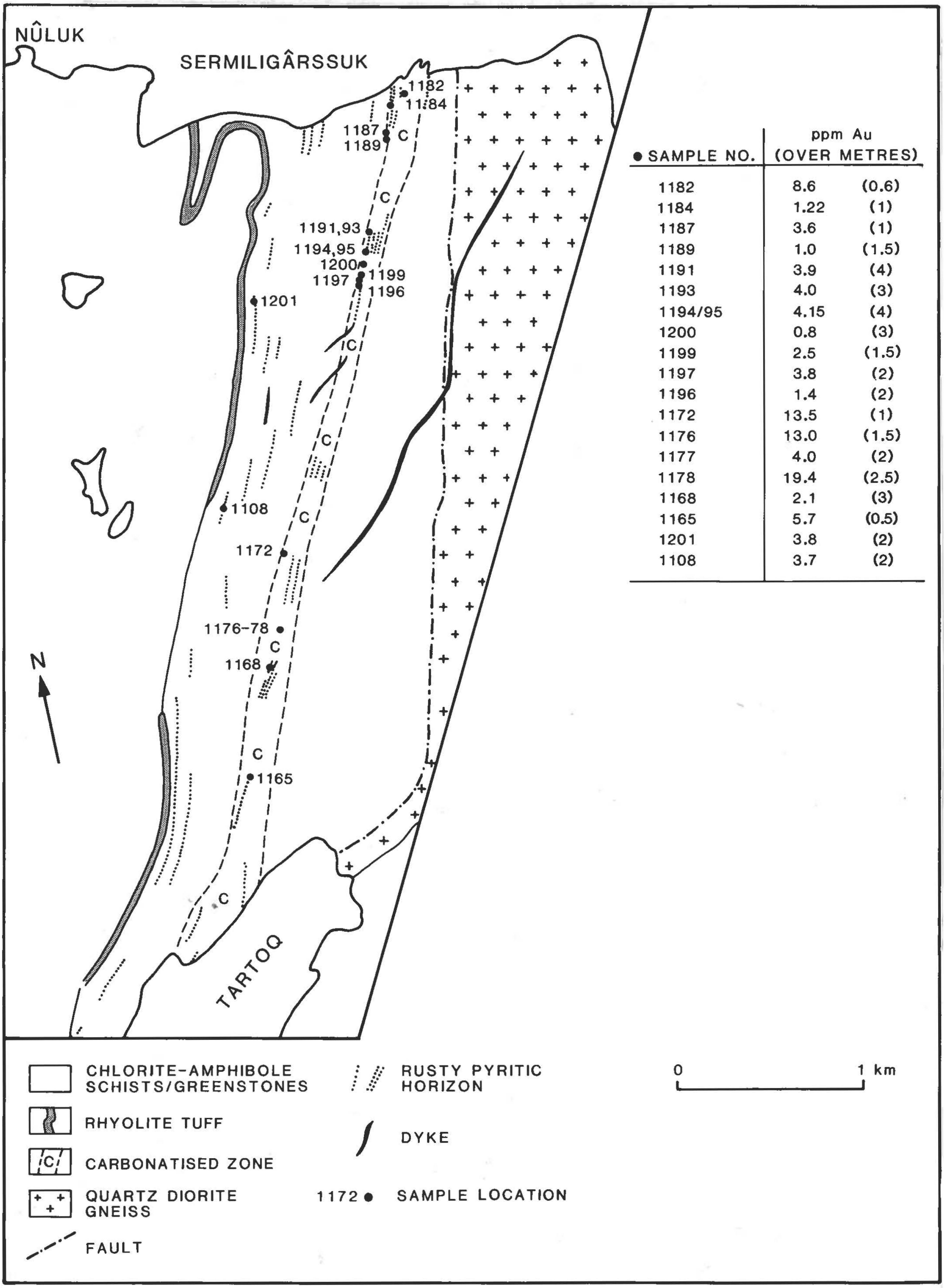


Fig. II. 2d. Simplified geological map of the Midternæs area. Modified from Appel (1974)



● SAMPLE NO.	ppm Au	(OVER METRES)
1182	8.6	(0.6)
1184	1.22	(1)
1187	3.6	(1)
1189	1.0	(1.5)
1191	3.9	(4)
1193	4.0	(3)
1194/95	4.15	(4)
1200	0.8	(3)
1199	2.5	(1.5)
1197	3.8	(2)
1196	1.4	(2)
1172	13.5	(1)
1176	13.0	(1.5)
1177	4.0	(2)
1178	19.4	(2.5)
1168	2.1	(3)
1165	5.7	(0.5)
1201	3.8	(2)
1108	3.7	(2)

FIG.II.3. SIMPLIFIED GEOLOGICAL MAP OF THE NULUK AREA. GREENEX A/S 1983 CHIP SAMPLING BEST VALUES (BLACK DOTS) MODIFIED FROM GREENEX A/S 1983 REPORT.

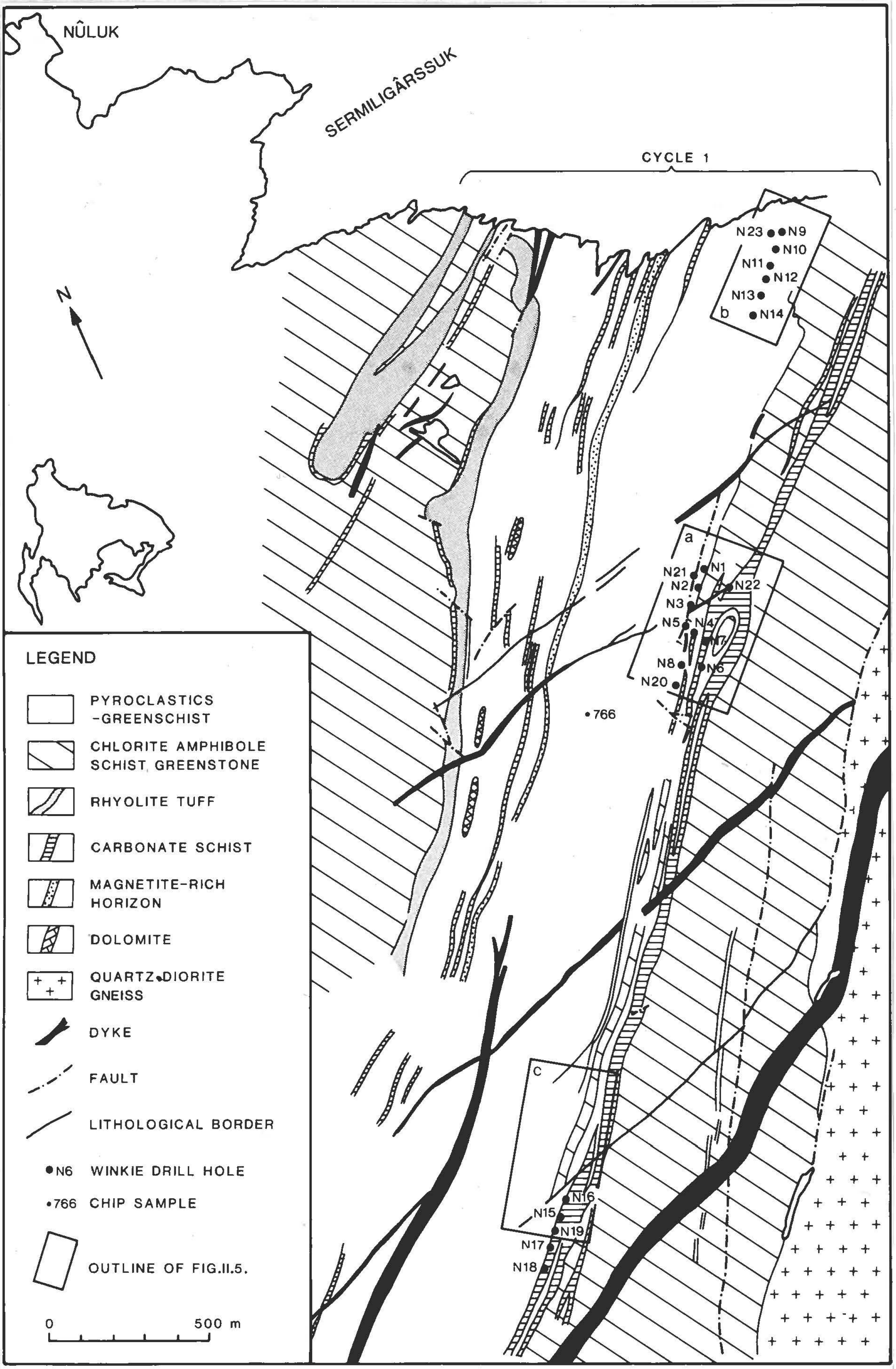


FIG.II.4. GEOLOGICAL MAP OF THE NULUK AREA.
MODIFIED FROM GREENEX A/S 1984 REPORT.

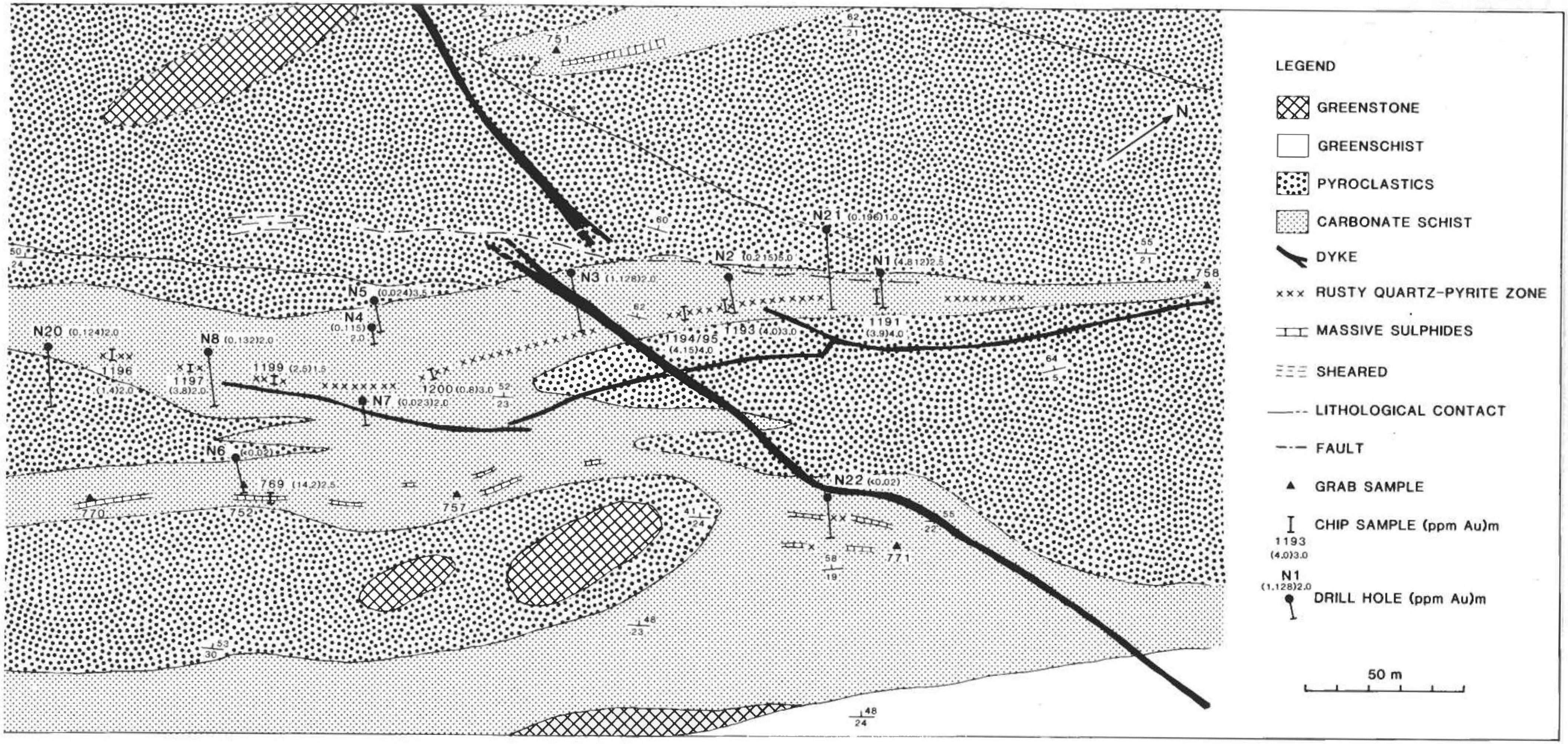


FIG. II. 5a. GEOLOGICAL MAP WITH SAMLING RESULTS, GRID 1.

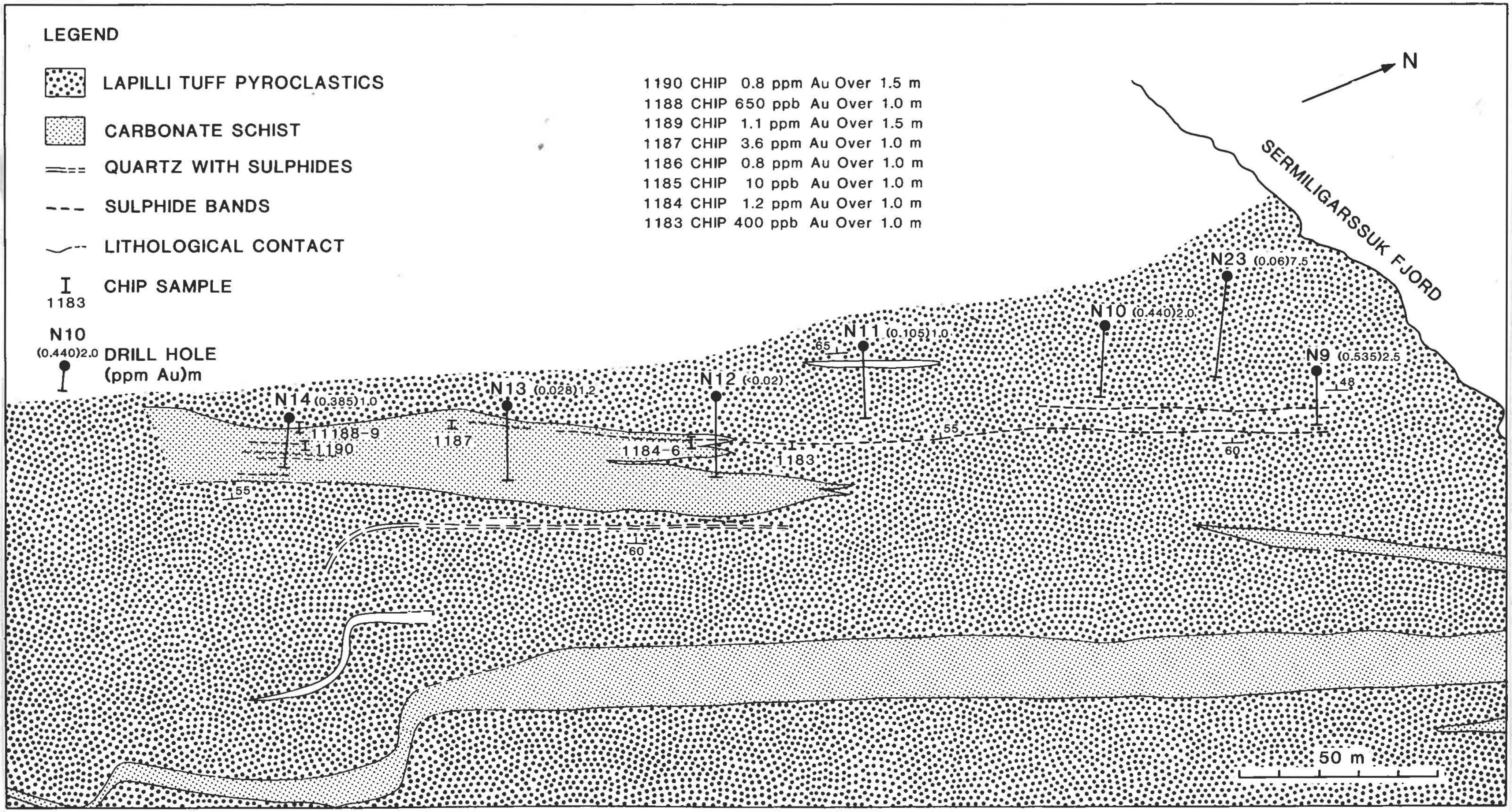
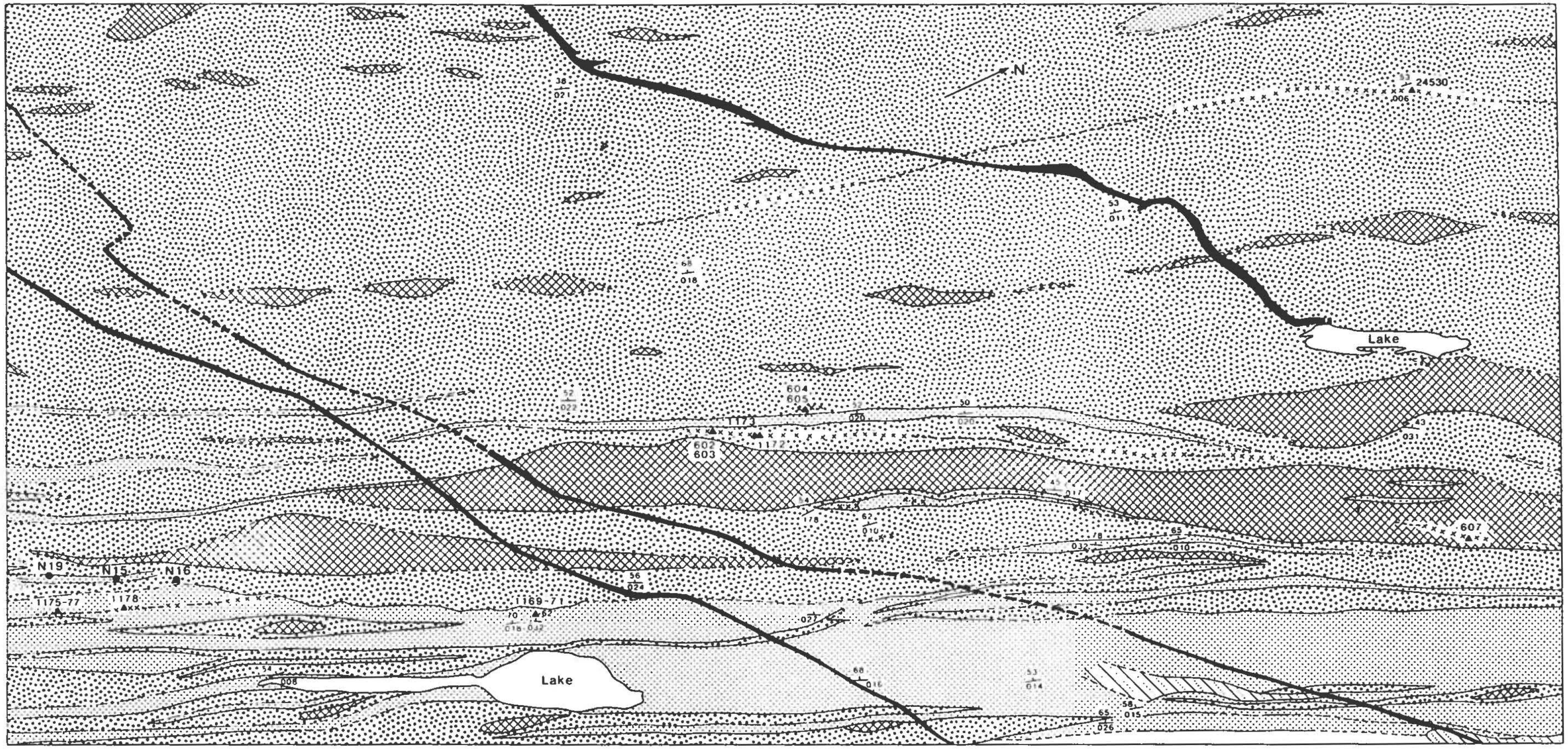


FIG. II. 5b. GEOLOGICAL MAP WITH SAMPLING RESULTS, GRID 2.



50 m

LEGENDE

- GREENSTONE
- GREENSCHIST
- PYROCLASTIC ROCKS
- CARBONATE SCHIST
- ALLUIVIUM
- DYKE
- RUSTY QUARTZ- PYRITE ZONE
- LITHOLOGICAL BORDER
- STRIKE/DIP OF SCHISTOSITY/LAYERING
- 1983 AND 1984 SAMPLES

FIG. II. 5c. GEOLOGICAL MAP WITH SAMPLING RESULTS, GRID 3.

1983-1984 CHIP SAMPLES
(ppm Au) over m

1175	(0.03)1.5		
1176	(13.0)1.5	1172	(13.5)1.0
1177	(4.0)2.0	1173	(0.28)1.0
1178	(19.4)2.5	602	(0.42)(1.0)
1169	<10ppb	604	(0.70)(1.1.0)
1170	<10ppb	607	(0.16)(1.0)
1171	(0.06)1.0	24530	(9.53)(1.0)

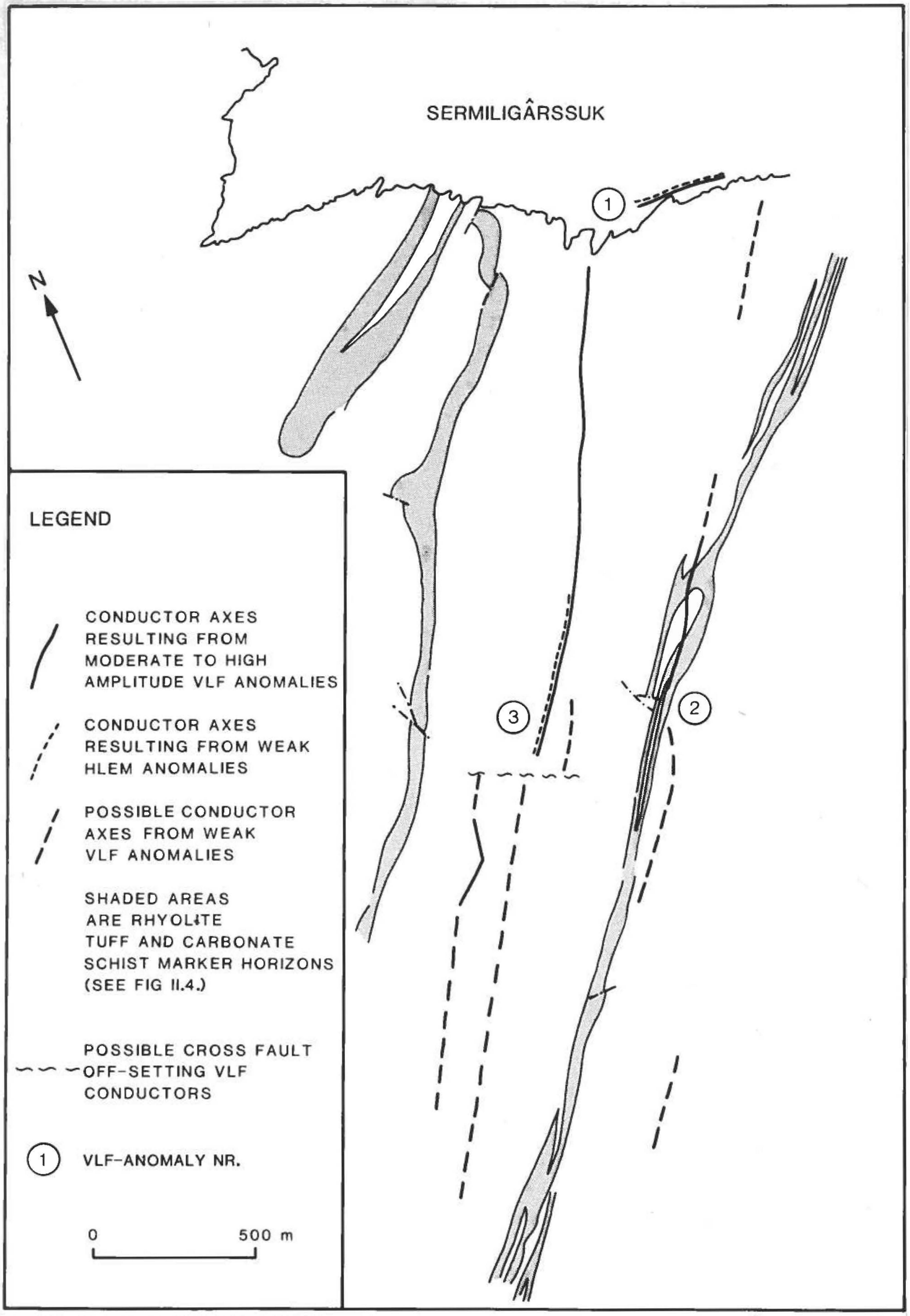
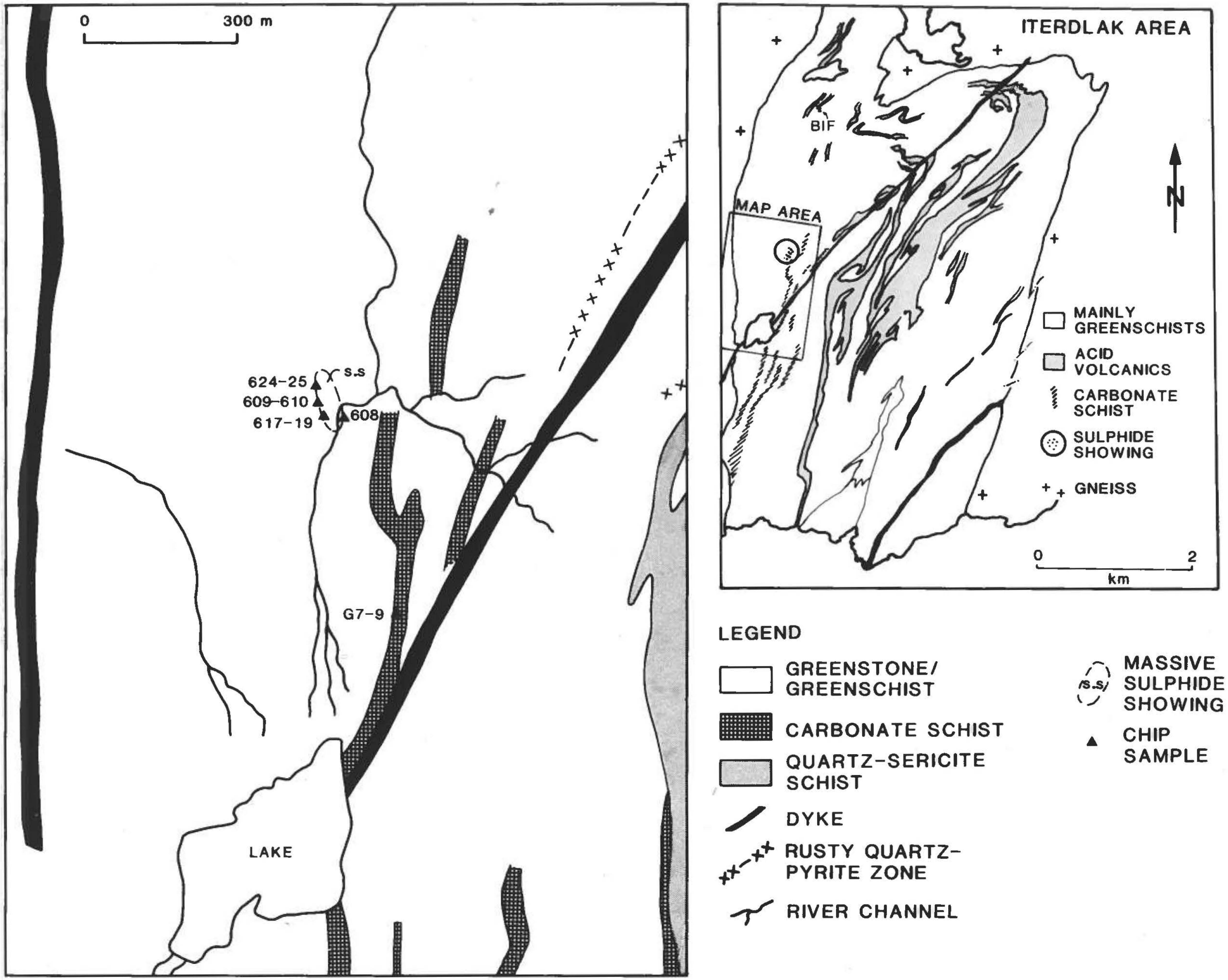


FIG. II.6. SKETCH MAP OF VLF AND HLEM SURVEY RESULTS IN THE NÛLUK AREA



1983-1984
CHIP SAMPLES
(ppm Au) over m

608 (0.10) 1.0
609 (0.50) 1.0
617 (0.19) 1.5
618 (0.06) 1.5
619 (0.33) 1.5
624 (0.93) 1.0
625 (0.83) 1.0
G7 (0.17) 1.0
G8 (0.06) 2.0
G9 (0.80) 1.0

FIG. II. 7. BEST CHIP SAMPLE RETURNS, ITERDLAK AREA
S.S. WEST VALLEY SULPHIDE SHOWING.

APPENDIX 3:

Sample analysis and detection limits.

Renzy Mines Ltd. samples: analysed by X-Ray Laboratories Ltd., Ontario, Canada. Lower detection limits not stated.

Greenex A/S samples: analysed by Caleb-Brett Laboratories, Liverpool, U.K.
Au-analyses: The sample was crushed to -60 mesh, then a 250 gm. split was homogenised and pulverised to -150 mesh. 50 gms. of this fine fraction was roasted to burn off sulphides and digested in aqua regia. The solvent was then extracted with MIBK and the sample analysed by atomic absorption (AA).
1983 fire assay checks (by Alex Stewart) show consisted upgrading of values by 15-20 %. Standard AA analyses were used for the remaining elements.
Lower detection limits when stated:

1983	Au	Ag	As	1984	Au
	10 ppb	1 ppm	1 ppm		20 ppb

GGU samples: analysed by GGU, Bondar-Clegg & Co. Ltd., Ontario, Canada, and VTT (Technical Research Centre of Finland). Methods:
X-ray fluorescence (GGU). Instrumental neutron activation analysis (VTT and Bondar-Clegg & Co. Ltd.). Lower detection limits:

GGU:	Cu	Zn	Ba	Ni
	25 ppm	5 ppm	50 ppm	5 ppm

Bondar-Clegg:	Au	As	Zn	Ba	Ag	Ni
	5 ppb	1 ppm	200 ppm	100 ppm	5 ppm	20 ppm

VTT: not stated.

PLATE 1. ANALYSIS RESULTS WITH SHORT ROCK DESCRIPTIONS - RENZY MINES LTD.-COMINCO.
Only samples given with numerical analysis values are presented. Most values recalculated from oz./ton (1 oz = 31.1 g, e.g. 0.08 oz./t = 2488 ppb., 1 oz./t = 3110 ppb).
Py=pyrite, aspy=arsenopyrite, ph=pyrrhotite, cp=chalcopyrite, Ma=malachite. Chip=chipsample, all others grab samples.

AREA	SAMPLE	DESCRIPTION	Au (ppb)	Cu (ppm)	Ag (ppm)	Ni (ppm)
	1743	Rustzone, 50-75 % py-aspy over 0.3 m.	4976			
NÛLUK	1744	----------------"-----------------.	4354			
	1747	Rustzone, 50-75 % py-aspy over 0.15 m.	3110			
	1752	Greenschist. 50-75 % py-aspy over 0.1 m.	8708			
	1753	Greenschist. 50-75 % py-aspy over 0.4 m.	7464			
	1754	Quartz vein. 1-5 % cp over 0.15 m.	8708	15700		100
	1756	Greenschist. 1-5 % cp, py over 0.3 m.		1100		
	268	Rusty greenschist, 5 % py-aspy. Chip.	2488			
	269	Greenstone with calcite. 30-50 % py-aspy. Chip.	2488			
	270	----------------------"---------------------.	2488			
	271	Greenstone with calcite. 30-50 % py-aspy. Chip.	2488			
	272	Greenstone with calcite. 50 % py-aspy. Chip.	2488			
	273	Greenstone. 10-15 % py-aspy. Chip.	2488			
	290	Greenstone. Chip.	0			
	291	--------"-------.	0			
	292	--------"-------.	0			
	293	--------"-------.	0			

294	Greenstone. Chip.	622		
295	Greenstone with calcite. 50-75 % py-aspy. Chip.	622		
296	Greenstone. 5-10 % py. Chip.	622		
297	Greenstone. Chip.	622		
1708	Greenschist, 5-10 % py over 5 m.	5598		
1735	Quartz lens. 1-5 % py over 0.5 m.	622		
1736	Quartz vein. 1-5 % cp, ma, py over 0.3 m.	622	3100	
1737	Quartz vein. 1 % cp,py over 0.2 m.	311	2300	
1738	Greenschist. 1-5 % py over 0.5 m.	311		
1739	Quartz vein. 5-10 % py over 0.3 m.	311		
1740	Quartz vein. 1-5 % cp,py over 0.5 m.	4354	3900	
1750	Quartz vein. 1-5 % cp,ma over 1 m.		1900	
1	Quartz vein, 1 m.	105		0
2	Pyritic quartz vein.	135		0
3	Quartz vein with py,cp.	15		0
4	Pyritic zone in carbonate schist.	35		0
5	Quartz with py in carbonate schist.	1450		0
6	Massive py-aspy over 0.5 m. "Renzy showing".	4250		2.8
9	0.2 m py-band in carbonate schist.	115		0

10	Amphibolite with disseminated py.	50	0
15	Gossan adjacent to narrow rhyolite horizon.	65	0
16	5 m carbonate schist.	5	0
17	----------"---------.	5	0
18	5 m carbonate schist.	10	0
19	Disseminated py in carbonatised agglomerate associated with carbonate schist.	10000	0
20	Carbonate schist.	10	0
21	Pyritic carbonate schist.	3500	0
22	0.1 m massive py-aspy in quartz vein in chlorite schist.	15000	13
23	---------------------------"---------------------------.	15000	10
24	0.1 m massive py-aspy in quartz vein in chlorite schist.	3500	0
25	0.2 m gossan zone in carbonatised agglomerate-tuff contact.	20	0
26	Leached massive pyrite 5 m from 25.	1800	0
27	0.6 m massive py-aspy in quartz.	15000	2
28	---------------"---------------.	10500	1.5
29	0.2 m pyritic horizon in carbonate schist.	590	0
31	Quartz-carbonate gash vein in basic agglomerate.	1150	0
32	10 m rusty carbonate schist horizon. Samples over 3.3 m.	1130	0
33	--------------------------"----------------------------.	75	0

	34	10 m rusty carbonate schist horizon. Samples over 3.3 m.	35		0
	36	Pyritic carbonate schist.	5750		0
ITERDLAK	211	Py float.	311		
	1728	Greenstone. 1-5 % py over 1 m.	0	200	
	1836	Schist with py.	311		
	1837	-------"-------.	0		
	1840	-------"------.	0		
	1842	Schist with py.	622		
SIORALIK	3	Pyritic horizons in quartz-sericite schist.	<5		
	6	-------------------"--------------------.	<5		
	10	-------------------"--------------------.	<5		
	12	-------------------"--------------------.	<5		
	13	-------------------"--------------------.	<5		
	15	Pyritic horizons in quartz-sericite schist.	<5		
	786	Rustzone, 5-10 % cp. Float.		2200	
	792	Schist, 1-5 % py over 2 m.		300	
WEST MIDTERNÆS	1713	Quartz vein with 1-5 % py over 0.2 m.		400	
	1715	Greenschist. 1-5 % cp over 1 m.		700	

	1718	Quartz vein with 1-5 % cp, ma, py over 0.4 m.	311		
	1724	Greenstone, 1 % py over 1 m.		300	
	1726	Quartz vein with 1-5 % cp,ma over 0.2 m.	311	10000	8
	1806	Greenschist, 5-10 % py over 1 m.		700	
MIDTERNÆS Tartoq Gr.	6	Greenstone-rhyolite tuff contact.	105		
	22	Pyritic horizons or ironstones in rusty schists.	<5		
	26	-----------------------"----------------------.	40		
	27	-----------------------"----------------------.	10		
	28	-----------------------"----------------------.	10		
	35	-----------------------"----------------------.	10		
	44	-----------------------"----------------------.	<5		
	57	-----------------------"----------------------.	5		
	59	-----------------------"----------------------.	<5		
	60	-----------------------"----------------------.	<5		
	61	-----------------------"----------------------.	<5		
	68	-----------------------"----------------------.	20		
	69	-----------------------"----------------------.	10		
	77	-----------------------"----------------------.	140		
	90	Pyritic horizons or ironstones in rusty schists.	15		

MIDTERNÆS Ketilidian rocks outside Perledal	676	Gabbro, 1-5 % cp,ma over 1 m.		1600	200
	679	Gabbro, 1-5 % sulphides.		300	
	680	------------"----------.		300	
	681	Gabbro, 1-5 % sulphides.		100	
	718	Conglomerate with 1-5 % cp,py,ma over 2 m.		600	
	1366	Gossan.		300	
ERDMUTHS NUNATAK	243	Shale, 5-10 % py. Float.		1100	
	244	Tuff, 30-50 % py. Float.		200	
	246	Tuff breccia, 1-5 % ph.		100	
	1314	Shale, 5-10 % ph over 3 m.		200	
	1315	Shale, 5-10 % ph over 10 m.		100	
MIDTERNÆS Perledal.	232	Black shale, 5-15 % ph,cp. Float.		700	200
	234	Shale, 5-10 % ph,cp. Float.		300	
	238	Black shale, 5-10 % ph,cp. Float.	0	300	
	794	Siltstone, 1 % cp. Float.		200	
	795	Shale, 1-5 % cp over 1.2 m.		500	
	939	Rustzone, 50-75 % cp over 1 m.	310	1000	
	940	Rustzone, 50-75 % cp. Float.		2500	

942	Rustzone, 10-15 % cp over 1 m.	900
944	Rustzone, 10-15 % cp. Float.	400
945	-------------"-------------.	400
1309-1313	5-10 % cp,ph over 0.8 m. Shale.	200
1321	5-10 % ph,cp over 3-5 m. Shale.	100
1322	---------------"--------------.	600
1502	Lava. 20-30 % ph,cp. Float.	1700
1601	Siltstone, 5-10 % cp. Float.	500
1606	Lava, 1-5 % cp over 1 m.	300
1607	Lava? with 10-15 % cp. Float.	600
1608	Rustzone, 1 % cp over 1 m.	100
1616	Siltstone, 1 % cp over 1 m.	1200
1619	Siltstone, 1 % cp over 1 m.	400
1768	Siltstone, 1-5 % cp,py. Float.	600
1769	Siltstone, 1-5 % py. Float.	300
1772	Siltstone, 1-5 % py,cp. Float.	400
1851	Siltstone, 1-5 % cp. Float.	1200

GRÆNSELAND	16	Conglomerate with magnetite matrix.	<5	
	19	----------------"-----------------.	<5	
	20	----------------"-----------------.	10	
	21	----------------"-----------------.	5	
	23 -24	----------------"-----------------.	<5	
	26	----------------"-----------------.	10	
	27 -28	----------------"-----------------.	<5	
	30	----------------"-----------------.	<5	
	33	----------------"-----------------.	<5	
	36	----------------"-----------------.	<5	
	38 -41	----------------"-----------------.	<5	
	43	----------------"-----------------.	<5	
	44	----------------"-----------------.	10	
	46	Conglomerate with magnetite matrix.	10	
	712	Lava. 5 % py. Float.		400

PLATE 2. ANALYSIS RESULTS WITH SHORT ROCK DESCRIPTIONS - GREENEX A/S-COMINCO.
For 1984 samples only values >20 ppb (lower detection limit) were given. Chip(1.0)= chip sample over m. All other samples were grab samples. FW=footwall, HW=hangingwall. Py=pyrite, ph=pyrrhotite, aspy=arsenopyrite, cp=chalcopyrite, ga=galena, mt=magnetite, ma=malachite. Carb.=carbonate. NB!: * denotes Fire Assay ppm values for gold.

AREA	SAMPLE	DESCRIPTION	Au (ppb)	As (ppm)	Cu (ppm)	Zn (ppm)	Pb (ppm)	Ag (ppm)
NÛLUK	1151	Orange pyritic ankerite horizon. Chip(1.3).	<10	176				
	1152	Carbonatised chlorite-sericite schist. Chip(2.7).	<10	191				
	1153	Pale green crenulated chlorite schist. Chip(2.7).	<10	183				
	1154	——————————"——————————. Chip(2.4).	<10	63				
	1155	——————————"——————————. Chip(0.4).	<10	6				
	1156	Gossan zone with sericite schist. Chip(1.5).	<10	167				
	1157	Rusty py-zone in unaltered andesite pyroclastics. Chip(2.0).	<10	205				
	1158	Carbonatised horizon. FW andesite pyroclastics, HW acid volcanics. Chip(3.0).	<10	119				
	1159	10-15 cm pyritic quartz zone in carb. schist. Chip(2.0).	120	56				
	1160	Pyritic carbonate schist. Chip(3.0).	40	42				
	1161	10 cm py-zone in carbonate-sericite schist. Chip(3.5).	500	174				
	1162	Chlorite-amphibole schist, HW to 1163. Chip(1.0).	<10	140	50			1
	1163	Pyritic zone, minor Cu-staining. Chip(1.0)	150	297	690			1
	1164	Andesite pyroclastics, footwall to 1163. Chip(1.0).	<10	166	376			<1

1165	Pyritic carbonate schist. Chip(0.5).	5700	352	4600	3
1166	Quartz-carbonate lenses in carb. schist. Chip(1.0).	<10	18		
1167	Pyritic carbonate schist, FW to 166.	30	8		
*1168	2 x 15-20 cm py-quartz zones in schist, chip(3.0).	2.1ppm	183		<1
1169	Carb. schist, chip(1.0).	<10	39		
1170	——————"——————.	<10	52		
1171	25-30 cm pyritic acid volcanic lens in carb. schist. Chip(1.0).	60	61		
*1172	Pyritic zone in andesite volcanics. Chip(1.0).	13.5ppm	<10000		
1173	Minor py in unaltered andesite, chip(1.0).	280	2130		
1175	Carbonate schist, HW to 1178. Chip(1.5).	30	40	34	<1
*1176	Pyritic quartz carbonate. Chip(1.5)	14.3ppm	222	360	1
1177	Carb. sericite schist 1 m + py-quartz carb. 1m. Chip(2.0).	4000	213	135	<1
*1178	Pyritic quartz vein. Chip(2.5).	19.4ppm	684	540	4
1179	Felsic tuff with py. Chip(2.0).	100	15		
1180	————————"————————.	80	9		
1181	1 m quartz-carb. schist + 1 m pyritic carb. schist. Chip(2.0).	250	57	102	<1
*1182	Massive py. HW/FW unaltered andesite. Chip(0.6).	8.6ppm	>10000	87	1
1183	40 cm semi-massive banded py-aspy. "Renzy Showing". Chip(1.0).	400	>10000	104	<1

1184	25 cm massive py in fine grained green tuff. "Renzy Showing". Chip(1.0).	1220	>10000	450	1
1185	Thin pyritic quartz lenses in basic-intermediate tuff. Chip(1.0).	<10	306	200	<1
*1186	20 cm massive py-aspy and sulphosalts in basic tuffs. "Renzy" extension. Chip(1.0)	0.8ppm	>10000	470	<1
1187	"Renzy" extension. 1-2 cm py-carb. lenses + 20 cm massive py. Chip(1.0).	3600	>10000	630	2
1188	HW to 1189. Weak carbonatised horizon, minor disseminated sulphides. Chip(1.0).	650	5210	500	<1
*1189	2 x 10 cm py-aspy layers in carb. schist. Chip(1.5).	1.1ppm	>10000	840	2
*1190	FW to 1189. Rusty carb. schist. 1 x 20 cm + 1 x 5 cm sulphide layers. Chip(1.5).	0.8ppm	>10000	203	<1
1191	Quartz-py in carb. schist. Chip(4.0).	3900	>10000	45	<1
1192	FW to 1191. Rusty carb. schist. Chip(1.0).	25	594	74	<1
1193	Quartz-py in carb. schist. Chip(3.0).	4000	>10000	188	1
*1194	FW to 1195. quartz-py in carb. schist. Chip(2.0).	6.6ppm	>10000	75	<1
1195	15 cm quartz + minor sulphides in carb. schist. Chip(2.0).	2800	273		
1196	1-15 cm py-quartz horizon in carb. schist. Chip(2.0).	1380	6240		
1197	20 cm massive py in carb. schist, chip(2.0).	3800	>10000	58	1
1198	FW to 1199. 1 m carb. schist, 1 m quartz-py. Chip(2.0).	20	>10000		<1

1199	Py-quartz horizon, chip(1.5).	2450	5320		<1
1200	60 cm quartz horizon in carb. schist. Chip(3.0).	730	383		
1201	Rusty felsic tuffs. Chip(2.0).	3800	222	58	1
1202	Rusty felsic horizon. Chip(1.0).	70	378		
1203	FW to 1202. Py-carbonate agglomerate.	20	323		
1104	Acid volcanics, chip(2.0).	40	<1		
1105	Pyritic carb. schist. Chip(2.0).	40	<1	126	
1106	Pyritic carb. schist. Chip(4.0).	<10	330	58	
1107	Pyritic carb. schist. Chip(2.0).	80	271	36	
1108	——————————"——————————.	3700	231		
1109	Py-cemented breccia, float.	15	409	56	<1
1110	Pyritic carb. schist. Chip(3.0).	60	389		
1111	Pyritic carb. schist. Chip(2.0).	10	71		
1112	Pyritic acid volcanics, chip(2.1).	50	139		
1113	Pyritic carb. schist. Chip(1.2).	35	271	74	
1114	Pyritic carb. schist. Chip(4.0).	<10	139	62	
1117	Rusty acid volcanics, chip(2.6).	<10	3		
1118	Quartz veins in chlorite schist. Chip(1.5).	<10	<1		
1119	Carbonate schist, chip(4.2).	<10	6	60	

1120	————"————, chip(3.1).	15	25	52
1121	————"————, chip(6.0).	25		
1122	————"————, chip(2.05).	80	12	
1123	————"————, chip(5.0).	<10	12	27
1124	————"————, chip(1.6).	<10	9	
1125	————"————, chip(1.2).	150	5	80
1127	Chip(1.1).	<10	90	
1128	Chip(2.0).	<10	83	
751	Disseminated sulphides over max. 0.5 m.	298		
* 752	Disseminated to massive py-aspy layer, max. 0.5 m.	15.8ppm		
753	Massive greenstone with 4 x 0.5 m rusty quartz zone.	264		
754	Disseminated sulphides in carbonate schist.	971		
755	2-3 m x 15 m weathered zone of massive sulphides in greenschist.	3960		
756	Medium grained greenstone in greenschist.	54		
757	Rusty zone 0.5 m x 2-3 m, with ma.	3277		
758	10-15 cm rusty band in sheared carb. schist.	2353		
759	Sheared rusty carb. schist with 30-40 cm massive quartz. Chip (2.0).	33		
766	15-20 cm massive sulphides in greenschist. Chip(2.0).	1551		

	767	10-30 cm x 75 m py-bands in greenschist.	157			
	768	20 cm x 75 m sulphide zone in sheared carb. schist.	1481			
	* 769	Massive sulphide zone in carb. schist. Chip(2.5).	14.2ppm			
	770	20-30 cm rust zone in carbonate schist.	4245			
	* 771	Disseminated to massive sulphides flanking quartz (0.5-1 x 8 m). in carbonate schist.	13.0ppm			
	602	Quartz-py in pyroclasitc rock, chip(1.0).	421			
	* 603	Py-zone in pyroclastic rock, sample of massive sulphides from 602.	13.7ppm			
	604	Py-zone in pyroclastic rock adjacent to carbonate schist. Chip(1.0).	696			
	605	Py-mineralisation from 604.	1107			
	607	30 cm py-zone in pyroclastic rock adjacent to carb. schist. Chip(1.0).	163			
	*24530	Quartz vein with 2 % py,cp. Chip(1.0).	9.53ppm			
	24925	Pyritic quartz vein in carbonate schist.	43			
ITERDLAK	G4	Pyritic carbonate schist. Chip(1.0).	15	306		<1
	G5	Semi-massive sulphides. Chip(0.2).	<10	286	150	2
	G6	Py-zone in chlorite-sericite schist. Chip (2.0).	25	246		
	G7	>30 cm gossanous sulphides, carbonaceous. Chip(1.0).	170	200		
	G8	Banded py-chert, bands 0.5 cm. Chip(2.0).	60	427	44	<1

* G9	Py-chert, chip(1.0).	0.8ppm	207		
G10	Pyritic carbonaceous chert.	60	255		
G12	Siliceous gossan zone, chip(3.0).	<10	<1		
G13	Py-cemented breccia.	<10	2		
G14	Py-chert horizon, chip(3.0).	<10	<1		
G15	————————"————————.	<10	7		
G17	Rusty metasediments, chip(3.0).	<10	<1		
*G18	Pyritic metasiltstone. Several discontinuous py-lenses. Chip(2.0).	0.4ppm	238	80	1
G19	HW greenschist, FW scree at sea level. Chip(2.0).	40	255	83	1
G20	Strike extension G18/G19, chip(3.0).	<10	284	74	<1
G21	Pyritic horizon in carbonate schist.	20	128	180	
G22	Carbonate-sericite schist. Chip (1.0).	<10	80	132	
G24	Carbonate schist. Chip(2.0).	<10	67	75	
G25	—————"—————. Chip(1.0).	<10	24	96	
1129	Rusty carbonate schist. Chip(8.0).	<10	<1		
1130	———————"——————. Chip(4.0).	<10	45		
1133	———————"——————. Chip(5.0).	15	<1		
1134	———————"——————. Chip(4.5).	<10	<1		
1135	———————"——————. Chip(2.5).	<10	81		

1136	----------"---------. Chip(1.2).	10	73		
1137	----------"---------. Chip(6.0).	80	189		
1138	----------"---------. Chip(3.8).	<10	64		
1139	Rusty carbonate schist. Chip(5.6).	40	167		
1140	Rusty schist, chip(2.0).	25	106	570	
1141	-----"----, chip(6.4).	<10	47		
1142	Rusty silicified schist.	<10	<1	107	
1143	Rusty schist, chip(2.5).	<10	<1		
1144	Rusty schist with py, chip(6.0).	<10	224	42	<1
1145	---------"--------, chip(7.5).	<10	121	133	
1146	Rusty schist, chip(1.0).	<10	132		
1147	------"---, chip(5.1).	<10	249		
1148	Shear zone, chip(0.2).	15	246	80	
1149	Rust zone, chip(0.5).	<10	67		
1150	---"---, chip(0.9).	<10	242		
K01	Rust zone, chip(4.0).	<10	32		
K02	---"---, chip(2.0).	<10	13		
K03	---"---, chip(2.5).	<10	24		
K04	---"---, chip(1.2).	<10	32	78	

K05	Rust zone, chip(2.0).	<10	72	88
555	Py, cp in greenschist close to dyke.	486		
564	Py in BIF.	35		
566	BIF with Cu-staining.	72		
582	Quartz in carbonate schist. Chip(1.5).	23		
584	Pyritic quartz in carbonate schist.	28		
589	Ankerite-dolomite with disseminated py. Chip(2.0).	28		
608	Pyritic quartz vein in pyroclastics, mineralisation associated with isoclinal folding. Chip(1.0).	103		
609	Iron-stained chert, chip(1.0).	509		
610	Pyritic banded chert. Total sulphides 5%. Chip(1.5).	432		
617	Rusty chert in carbonate schist. Chip(1.5).	185		
618	Isoclinal parasitic fold in chert, no visible sulphides. Chip(1.5).	59		
619	Up to 20% py in chert. Same locality as 617/618. Chip(1.5).	333		
624	Chert with 5% py, chip(1.5).	928		
625	15 cm pyritic chert band in carb. schist. Chip(1.0).	833		
629	Chert in rusty pyroclastic rock.	105		
702	Rusty zone in greenschist.	28		
748	Disseminated py in carbonate schist.	330		

	1452	Rusty sheared contact between pyroclastic rock and grey schist. Chip(0.5).	34			
	1453	1-2 m x 75 m pyritic quartz in pyroclastic rock.	27			
NORTH MIDTERNÆS	G26	NB! STREAM SEDIMENT (SILT) SAMPLE.	1500	>10000		
	G48	Carbonate-sericite-chlorite schist. Chip(1.5).	<10	42		
	G49	Py-mt-carbonate schist. Chip(3.0).	<10	306		
	G50	Mt-(py)-carbonate schist.	<10	75		
	G51	Pyritic chert, chip(2.0).	20	>10000		
	G52	Py-aspy chert.	<10	2150		
	G53	Py-aspy chert hosted in carbonate schist.	220	>10000		
	K10	Carbonate schist, chip(2.0).	<10	9		
	K11	————————"———————, chip(1.5).	<10	<1		
	K12	————————"———————, chip(2.5).	<10	5	14	
	K13	————————"———————.	<10	592	5	<1
	K25	Carbonate schist, chip(1.0).	<10	4	61	
	K28	Ultramafic rock.	<10	70	10	<1
	K30	———————"———————.	<10	6		
	592	Rusty fuchsitic greenstone.	26			
	596	————————————"—————————————.	169			

597	————————"————————. Chip(1.5).	33
598	Rusty fuchsitic greenstone.	28
599	Rusty schist with quartz zone, chip(2.5).	36
600	—————————"—————————.	25
807	Py-quartz float.	5660
808	25-30 % py in chlorite schist, float.	169
810	Quartz-ankerite-py-(cp) in carb. schist.	877
811	Minor disseminated py in fine-grained leucocratic dyke. Chip(0.5).	51
814	Rust zone of limited strike adjacent to dyke.	52
817A	30 cm py-cp-quartz in pyroclastics, limited strike.	446
818	5 m rusty acid volcanics in pyroclastic rock, < 3% sulphides. Chip(3.0).	28
820	Sulphides associated with folded carbonate schist, area 20 m wide x 80 m long.	72
825	Pyritic quartz pods in carbonate schist.	740
827	Heavy disseminated py in greenschist.	67
829	Pyritic quartz in carb. schist. 30 cm sulphides concentrated on minor fold.	166
831	Thin pyritic quartz horizon in pyroclastics in FW to carbonate schist.	92
832	Extension 831. 20 cm sulphide horizon.	803

839	Rusty pyritic greenschist, chip(1.0).	28
840	10-15 % py float close to major quartz unit.	27
1471	Rusty pyritic pyroclastic rock.	67
1475	Pyritic quartz vein.	345
1476	Minor rust associated with quartz lens in carbonate schist. Chip(2.0).	88
1485	30 cm Cu-stained quartz boulder. Float at dyke contact.	125
1490	Pyritic quartz in carbonate schist, chip(2.0).	26
1491	Pyritic quartz in pyroclastic rock.	351
1495	Pyritic greenschist.	25
1500	Minor py-bands in greenschist.	34
10714	Quartz vein with py,cp,limonite in pyroclastic rock.	120
10715	Pyritic quartz in carbonate schist.	390
10720	Disseminated pyrite in carbonate schist, chip(1.5).	313
10723	Quartz rock overlying carbonate schist.	45
10725	Rusty zone flanking carbonate schist.	29
10726	Rusty "quartzite" in greenstone.	284
10727	——————"——————.	27
24801	Disseminated py in pyroclastics.	35

	24803	Disseminated py in greenstone, chip(4.0).	44					
	24804	Pyritic quartz in greenschist.	245					
	24805	————————"————————.	153					
	24806	Rusty shearzone in pyroclastics, chip(0.5).	77					
	24807	Minor py flanking quartz vein in pyroclastic rock.	81					
	24808	Disseminated py in carbonate schist.	35					
	24809	30 cm py on sheared contact, chip(0.5).	37					
	24810	Pyritic greenstone.	35					
	24816	Py-quartz in carbonate schist.	27					
	24823	Rusty pyritic zone in acid volcanics.	56					
MIDTERNÆS	G36	Carbonate-sericite-mt schist.	30	13				
	G37	Carbonate-sericite schist, chip(2.0).	<10	3	42			<1
	G38	Pyritic schist.	25	142				
	G40	Rusty pyritic zone.	230	3050				
	G41	Pyritic carbonate schist.	<10	18				
	G42	Py-cemented gossan.	<10	41				
	G43	Ankerite horizon, 3-4 % sulphides.	<10	9				
	G44	Sphalerite-rich float.	91	23	30	1140	14.2%	410
	G45	Ga-rich float.	147	28	27	860	13.0%	520
	G46	Cu-rich float.	<10	103	7900	1600	0.176%	21

G44-G47:
Samples from Ketilidian rocks. Pb-values in %.

	G47	Ga-rich float.	109	37	61	22	14.0%	1210
	K20	Rusty schist, chip(1.5).	<10	<1				
	K21	Carbonate schist, chip(3.0).	<10	6				
	K22	--------"-------, chip(1.5).	25	4				
	K23	--------"-------, chip(3.0).	<10	297				
	K24	Quartzite.	<10	23				
	10741	Dolomitic talc-garnet schist in rhyolite.	581					
	10742	Rusty quartz-sericite schist bordering ultramafic horizon.	862					
	10835	0.4 m x 40 m long rusty zone ± cp in pyroclastics. Co-staining?	74					
SIORALIK	G30	Rusty metasediments, 1-2 % sulphides.	<10	150				
	G31	Pyritic quartz lens.	<10	19				
	G32	---------"---------.	<10	23				
	G33	Massive and semi-massive py-ph float.	<10	<1				
	G34	Pyritic rust zone	<10	31				
	K14	Pyritic schist, chip(2.0).	<10	125				
	K15	Pyritic siltstone, chip(1.8).	<10	31				
	K18	Rusty schist, chip(1.5).	<10	6				
	K19	>20 m rust horizon.	<10	<1				

	24845	Rusty pyritic acid volcanics.	46					
WEST MIDTERNÆS	G55	Siliceous rusty metasediments, visible py,cp.	25	43	4700	1.61%	388	2
	K31	Rusty metasediments, chip(2.1).	<10	<1				
	K32	----------"----------, chip(1.5).	<10	<1				
	24593	Grab sample, no description.	727					

PLATE 3. ANALYSIS RESULTS WITH SHORT ROCK DESCRIPTIONS - GGU.

Blank space indicates sample not analysed for this element, 0 indicates value below detection limit. Py=pyrite, aspy=arsenopyrite, cp=chalcopyrite, ph=pyrrhotite, mt=magnetite, ma=malachite. □ Analysed by Bondar-Clegg & Co. LTD, ■ Analysed by GGU. All other samples analysed by VTT, except for Cu-analyses (GGU).

AREA	SAMPLE	DESCRIPTION	Au(ppb)	As	Cu	(ppm) Zn	Ba	Ag	Ni
MIDTERNÆS	288708	Quartzite with ma+Co - staining on joints.	7	326		149	447	9.3	151
	288709	Quartzite with ma.	7	50		80	319	4.7	32
	288710	Quartzite with <1 % py.	4	62		63	52	5.2	36
	288711	Quartzite with 1-5 % py.			0	0	0		0
	288712	Arkose with 1-5 % aspy.	15	1890	9	126	147	12.6	53
	■288717	Quartzite with carbonates.			0	0	0		0
	288718	Rusty Greenschist.	5	10		66	368	7	49
	288719	Greenschist.	4	9		62	293	7.4	48
	■288720	Greenstone with 1-5 % py, uppermost Tartoq Group.			0	0	0		0
	288721	Quartzitic greenstone (?) from contact Tartoq Group/ Vallen Group.	2	3		62	344	4	31
	■288723	Vallen Group conglomerate, <1 % py.			0	0	0		0
	■288724	Quartzite, <1 % py+green mineral. Vallen Group.			0	0	0		0
	288726	Green quartzite, lowermost Vallen Group.	3	2		60	285	3.9	16
	■288727	Quartzite, Vallen Group			0	0	0		0
	288729	Quartzite near bottom of Vallen Group.	2	99		121	205	6.5	40
	288730	Ketilidian basal conglomerate with 1-5 % mt.	3	9		63	168	4.2	25

288731	Ketilidian basal conglomerate with ma and limonite. Sampled immediately above 730.	18	47	516	73		4.7	83
288732	Quartzite with quartz vein.	2	8		84	84	4.5	29
288734	Rusty greenstone, Tartoq Gr. 1% py,cp.	3	2		301	65	8.4	352
288735	Mt-rich greenstone from 0.5 m layer. Tartoq Gr.	26	249		611	68	7.8	845
288736	Fresh greenstone, near top of Tartoq Gr.	1	87		232	46	5.5	392
288737	Quartzitic horizon/lens in Tartoq Gr. rocks near contact to Vallen Gr. 1-5 % cp.	170	1570	7190	155	142	18.1	167
■288738	Carbonate schist, Vallen Gr.			0	0	0		0
■288739	Quartzite, Vallen Gr., < 1% py.			0	0	0		0
288740	Shale, Vallen Gr.	5	42		353	59	6.7	23
■288741	Shale, Vallen Gr., < 1% py.			0	0	0		0
288743	Rustzone in Tartoq Gr. greenstone, 5-10 % sulphides.	25	144		45	60	7.2	206
288745	Rustzone in Tartoq Gr. greenschist, 1-5 % py.	13	272		92	60	5.9	99
288746	Quartzitic greenstone, Tartoq Gr., 5-10 % py.	58	464	84	87	73	6.7	305
288747	Tartoq Gr. quartzitic rock, rustzone, 5-10 % py.	12	134	14	56	24	4.2	89
288748	——————————"——————————.	9	109		67	45	4.8	33
288749	Quartzitic gneiss below Ketilidian unconformity.	3	3		112	866	5.6	36
288750	Gneiss-conglomerate transition (unconformity).	4	6		116	673	6.0	40
288751	Ketilidian basal conglomerate. < 1% py.	3	3		76	381	2.6	27

	■288752	Quartzite, lowermost Vallen Gr.			0	0	0		0
	■288753	Quartzite, Vallen Gr.			0	0	0		0
	288756	Black quartzite, Vallen Gr. Top of sequence just below limestone/shale unit.	3	2		76	101	4.0	25
	■288757	Rusty black shale, Vallen Gr.			0	0	0		0
	288759	Carbonate layer from black shale, Vallen Gr.	2	5		55	31	2.0	9
	288762	Carbonate from black shale, Vallen Gr. < 1% py.	2	4		39	27	2.7	18
	288763	Fine-grained arkose, Vallen Gr. (Blåis Fm.).	3	2		68	467	3.7	24
	288764	Coarse-grained arkose, Blåis Fm.	4	3		89	563	4.8	32
WEST MIDTERNÆS	288766	Homogenous greenstone.	4	1		103	594	5.5	39
	288767	Rustzone in greenstone. 1-5 % py,cp.	6	1		105	535	5.7	40
	288769	Massive greenstone with carbonate streaks.	4	2		89	383	5.6	77
	288775	Quartzitic gneiss.	1	2		100	868	4.9	32
	288776	Rustzone in foliated greenstone, < 1% py,cp,ph on joints and fissures.	5	0		85	49	5.6	114
	288777	Foliated greenstone.	4	0		100	47	5.6	71
	288780	Quartz streak with 1-5 % py from greenstone.	7	1	0	98	58	5.0	39
	288781	Fresh greenschist.	4	1		405	44	2.8	77
	288782	Rustzone in greenschist, 1-5 % py.	4	1		130	47	5.5	125
	288784A	Quartz streak with 10-20 % py,ph.	10	1		5400	376	7.1	1290

■288784B	———————————"———————————.			752	6665	652		1502
288787	Quartzitic greenstone with 5-10 % ph,py.	14	1		8600	920	6.7	553
288790	Greenstone.	4	0		246	188	5.5	138
288793	Talc-carbonate layer.	3	1		58	37	4.0	186
288794	————————"————————.	4	1		89	43	5.1	131
288796	Rusty greenschist, < 1% py.	4	2		246	266	4.5	246
288799	Greenstone.	4	2		238	190	5.3	74
288819	Greenstone.	3	2		72	100	4.0	28
288820	Greenstone.	3	1		149	75	4.0	716
288821	Quartz vein in greenstone, occasional cp.	644	5		2420	52	99.3	876
288823	Dark shale with 1-5 % ph.	6	32		946	74	3.9	147
288824	Dark greenstone in shale outcrop, 5-10 % ph.	38	830		1780	43	5.5	212
288825	Greenschist.	5	34		361	49	5.0	303
288826	Greenschist, 1-5 % ph.	7	61		65	1200	4.2	267
288827	Chlorite from rustzone in greenschist.	4	75		35	1010	3.8	152
288828	Dark greenschist with 20-30 % massive py.	12	9		188	199	5.1	429
288829	Greenstone with calcite streaks.	4	2		133	44	4.6	130
288830	Quartz lens from greenstone. Occasional cp.	30	5		20	25	2.7	100

SIORALIK	288800	Rusty greenstone from shearzone, 1-5 % py.	4	2		102	495	5.3	105
	288801	Greenstone.	4	4		92	292	5.2	111
	288808	Amphibolitic greenstone.	4	1		115	332	4.6	15
	288809	Sulphide mass in amphibolitic greenstone, 10-20 % ph.	114	4	2575	106	393	6.3	262
	288811	Quartz-mt-banded greenstone.	72	7		106	26	2.1	28
	288812	Amphibolitic greenstone, <1 % ph.	3	1		93	201	1.9	33
	288813	Sulphide-quartz mass in amphibolitic greenstone, 5-10 % ph.	7	2		92	46	6.5	324
	288814	Greenstone, 10-15 % ph,cp.	49	54		128	45	5.3	305
	288815	Quartzitic greenstone, 1-5 % ph.	4	3		108	235	4.0	95
	288816	Quartzitic rock, 1-5 % ph.	4	4		300	538	4.8	199
	288818	Amphibolitic greenstone.	4	3		66	98	4.2	159
NÛLUK	288834	Greenstone.	32	103		73	45	4.6	56
	288835	Greenstone.	10	36		49	42	4.0	47
	288836	Py-aspy layer.	564	230		16900	5390	935	6230
	288837	Greenstone.	13	22		92	48	4.7	76
	288838	Greenstone.	14	285		190	47	4.6	64
	288839	Greenstone.	12	173		157	95	9.2	71
	288840	Py-aspy layer.	4120	56000	289	661	984	37.1	415

288841	Greenstone.	15	107		80	47	5.0	38
288842	Greenstone.	6	74		81	46	4.9	99
288843	Py-aspy layer.	3160	72600	1592	1660	1230	46.5	527
288848	Greenstone.	5	315		70	51	5.0	470
288851	Schist from flank of py-aspy layer.	21	67		116	93	7.5	124
288854	Greenstone.	5	13		138	74	7.7	205
288857	Quartz vein in schist, 5-10 % fahlore, ma.	7290	12100	52850	1440	524	48.2	361
288858	Schist with < 1% py-crystals.	12	96		69	53	4.5	91
288860	Greenstone, < 1% py.	10	14		65	26	4.0	79
288861	Greenstone.	4	15		83	43	4.6	74
288862	Greenstone with carbonate net-veining.	4	17		45	40	4.2	106
288863	Greenstone.	3	6		25	37	3.9	113
288864	Greenstone.	106	12		58	38	4.0	127
288865	Greenstone.	4	12		60	38	4.1	464
288866	Crenulated talc schist.	5	178		107	370	3.7	119
288867	10 cm py-layer in talc schist. >50 % py in layer.	47	509		71	57	5.0	211
288870	Greenstone, < 1% py.	4	2		61	42	4.5	101
288872	Greenstone with hornblende spots.	4	4		70	50	4.6	67
288874	Greenstone.	4	2		72	43	4.5	106

	288876	Talc-quartzite.	3	24		94	483	5.0	22
	288877	Fine-grained greenstone with cp-spots.	15	15	565	84	45	5.1	75
	288878	Greenstone.	4	5		79	152	6.2	110
	288879	Calcite-quartz vein with 20-30 % cp,ph.	10300	68	41250	657	70	47.5	1170
	288880	Chloritised greenstone.	4	8		125	94	6.9	231
	288881	Greenstone.	7	6		108	105	6.3	89
	288884	Greenschist.	6	14		100	56	6.4	207
	288887	Talc-carbonate schist.	13	9	47	96	29	5.7	126
	288888	Greenschist with carbonate veins.	9	33		93	48	5.5	124
	288889	Greenstone.	3	1		125	38	6.6	88
SOUTHERN NÛLUK - TARTOQ FJORD	288890	Quartz vein with cp.	101	1		47	36	3.1	21
	288891	Greenschist.	2	3		185	48	5.6	44
	288892	Greenschist.	11	2		96	27	5.2	362
	288893	Greenstone.	17	1		119	37	6.0	126
	288895	Greenstone.	3	1		90	35	5.5	79
	288896	Greenstone.	4	4		97	73	5.8	53
	288897	Greenstone, gneissified.	3	1		106	554	5.2	34
	288898	Greenstone with gneiss streaks, from thrust zone.	4	3		138	53	3.4	66

TARTOQ GROUP ROCKS – SEVERAL AREAS	□343005	Greenschist with 5-10 % cp,ph.	390	3		320	110	26.0	160
	343006	Greenschist with mt.	8	3	179	97	289	0.0	1200
	■343007	Greenschist.			95	139	260		1520
	■343009	Greenschist.			30	60	554		5
	■343011	Talc-carbonate schist.			10	16	540		9
	□343013	Shaly greenschist with cp,ma,quartz lens.	440	220		290	0	24.0	460
	■343147	Greenstone, 1-5 % py.			31	52	158		155
	■343150	Peridotite.			51	94	108		2169
	■343179	Amphibolite.			331	87	235		174
	■343180	Greenstone.			65	95	431		190
	■343183	Greenschist with carbonates.			131	169	210		95
	■343184	Amphibolitic greenstone.			46	67	361		57
	■343187	Coarse-grained peridotite.			80	111	72		2935

Map 1. GGU samples with no analyses; shown on map 1; Midternæs - Sioralik.

288713 Arkose with galena in joints.

288714 Arkose with green silicate.

288715 Coarse-grained arkose with <1 % py.

288716 Kimberlite, float.

288722 Conglomerate, Vallen Group.

288725 Basal conglomerate, Vallen Group. Scattered py crystals.

288728 Conglomerate, Vallen Group.

288733 Coase-grained sandstone with clasts of shale with cp, ma.

288742 Greenstone, Tartoq Group. Rustzone - 5-10 % py, aspy?

288744 Greenschist, Tartoq Group. Rustzone - 5-10 % py, aspy?

288754 Quartzite, Vallen Group.

288755 Quartzite, Vallen Group. Quartz veins with galena. Float.

288758 Rusty black shale with carbonate veins.

288760 Rusty bituminous shale.

288761 Graphite schist from shearzone in black shale.

288765 Brecciated arkose. Quartz veins with py.

288768 Sheared greenstone.

288770 Rustzone in greenstone, 1-5 % py.

288771 Hematite slickenside in Tartoq Group greenstone.

288772 Quartzitic gneiss with py in cracks.

288773 Rustzone in contact greenstone/quartzitic gneiss. 5-10 % cp.

288774 Layered greenstone. 0.5 m from quartzitic gneiss (288773).

288778 Greenstone.

288779 Quartz-calcite vein, 1-5 % py.

288783 Banded magnetite-greenstone with carbonates, py.

288785 Quartz streak with 10-20 % ph + cp.

288786 Quartzitic greenstone with 5-10 % ph + py.

288788 --------------------"--------------------.

288789 Quartz streak with 1-5 % ph + py.

288791 Talc from talc-carbonate layer.

288792 Quartz vein from talc-greenstone. <1 % cp with ma + azurite.

288795 Quartzite lens with graphite and 1-5 % py.

288797 Rusty black schist with 1-5 % py.

288798 Quartz streak with 5-10 % py + ph.

288802 Gneiss/pegmatite with black mineral.

288803 Greenstone.

288804 Quartz lens with sphalerite.

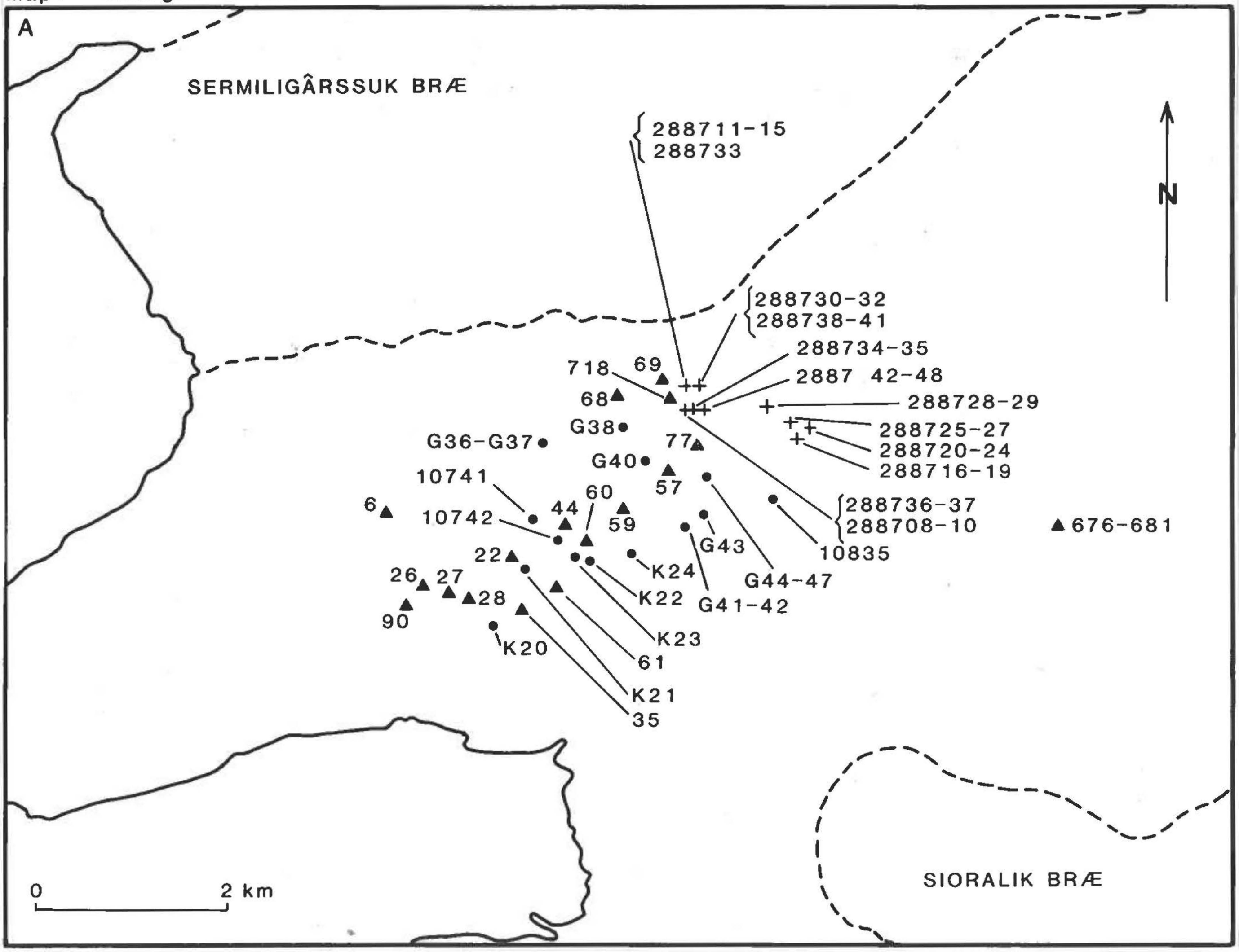
288805 Carbonate-opal rock from quartz lens in greenstone.

288806	Vein in greenstone with carbonate, fluorite, epidote, baryte?
288807	Massive carbonate vein in greenstone.
288810	Quartz lens in greenstone, 5-10 % ph + cp.
288817	Quartzitic rock, 1-5 % ph.
288822	Quartz-calcite vein in greenstone, cp spots.
288831	Quartz streaks in greenstone, cp spots.
288832	Quartz vein with cp spots.
288833	Quartz vein with py + cp spots.

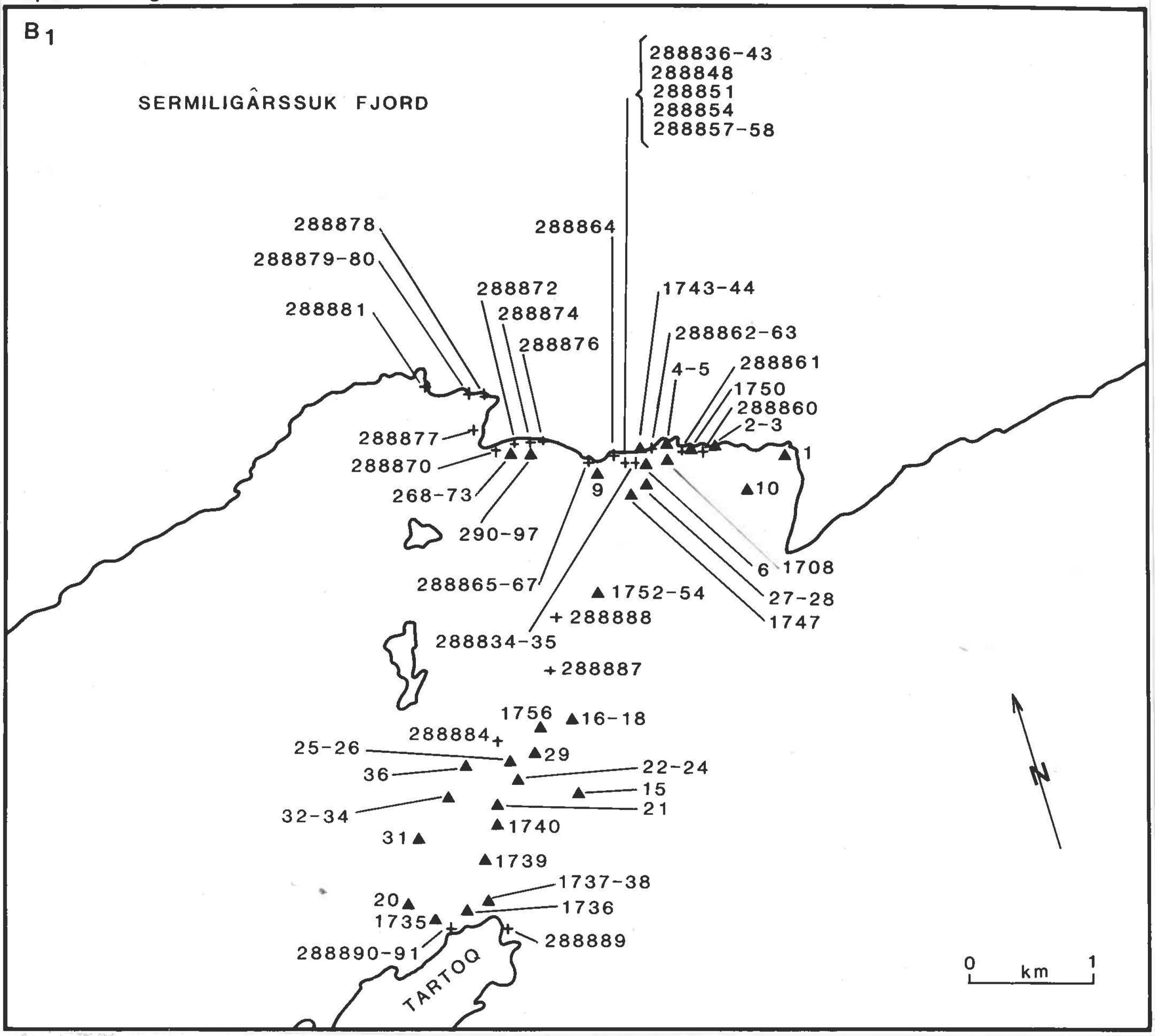
MAP 1


61° 45'00"
61° 30'00"
61° 15'00"
48° 45'00"
47° 45'00"
A WESTERN PART OF MIDERNÆS.
ENLARGED MAP SECTION
B NÛLUK ENLARGED MAP SECTION 1 & 2
B1 RENZY MINES - GGU SAMPLES
B2 GREENEX SAMPLES
LEGEND - MAP 1
LOCATION MAP-ROCK SAMPLES
1 : 100 000
× GGU SAMPLE
▲ RENZY MINES Ltd. SAMPLE
• GREENEX A/S SAMPLE
A,B DENSE SAMPLED AREAS - ENLARGED MAP SECTIONS
0 1 2 3 4 5 km
N

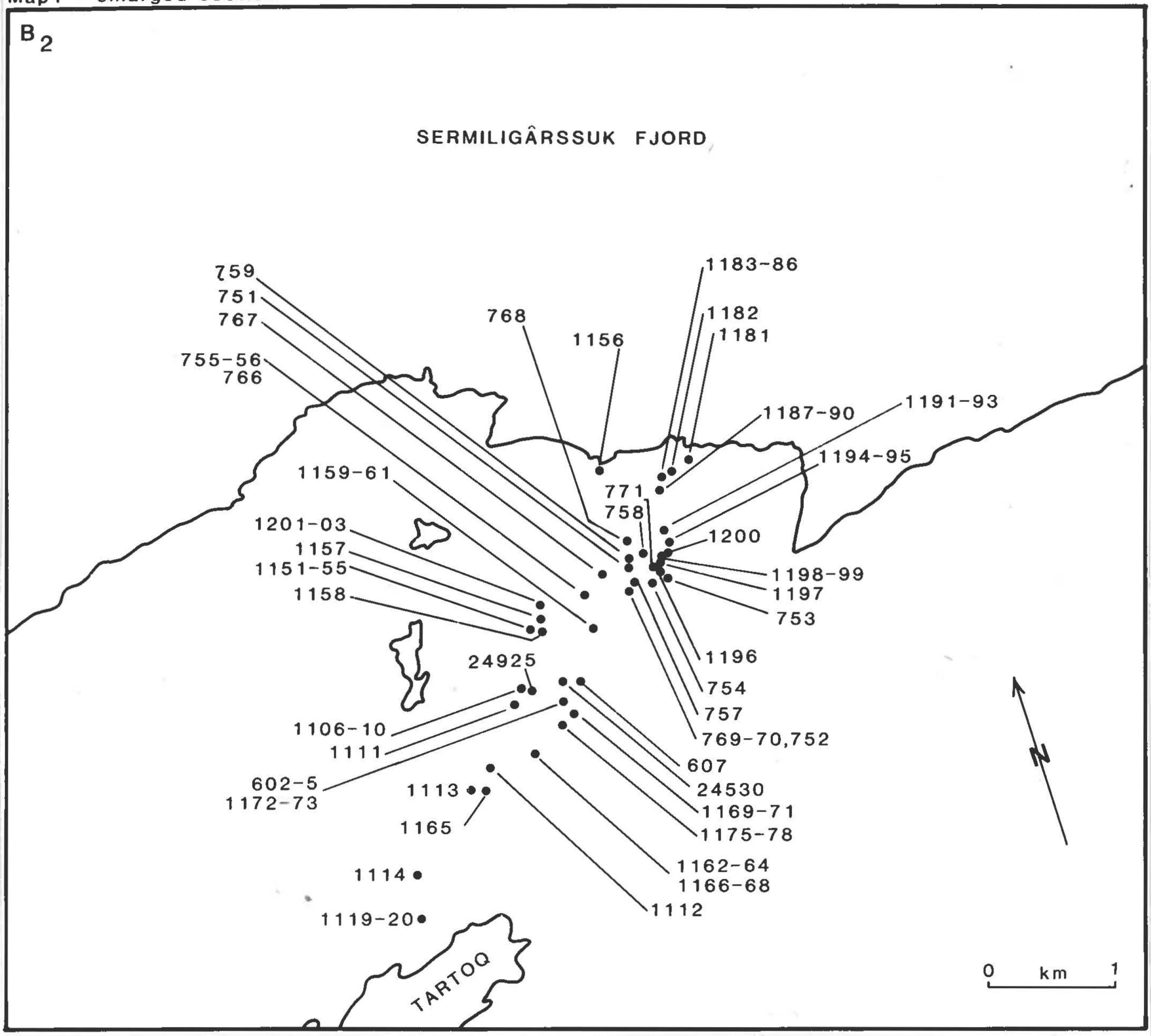
Map 1 - enlarged section



Map 1 - enlarged section



Map 1 - enlarged section



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