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KARRAT GROUP RECONNAISSANCE PROGRAMME

MARMORILIK AREA, WEST GREENLAND

(Period : May 1979 - May 1980)

May 1980

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Confidentiality expired
May 1985
(forundersøgelseskoncession 1978)

1. SUMMARY

(a) The Karrat Group of Proterozoic metasediments forms the time equivalent distal basin of the Marmorilik carbonate Formation which hosts the Black Angel ore body. The Karrat Reconnaissance Programme was carried out to locate possible stratabound massive zinc, copper, lead sulphide deposits within the metaclastics of the Karrat Group where previous work had suggested frequent and laterally extensive cherty graphitic iron sulphide sheets within the meta pelites and meta greywackes of the area. Previously collected pyrrhotite rich samples had assayed up to 0.41% copper and 0.5% zinc.

A concession area and non exclusive permit covering part of this formation bounded by latitudes 71°15' and 72°30' north is jointly held by A/S Cominco (85%) and Greenex A/S (15%) and is valid until 31st December, 1980.

The programme area measures 135 x 50 kilometres and is dissected by numerous large fjord systems whose walls rise abruptly to heights in excess of 2000 m. The geological reconnaissance consisted of visual examination of cliff faces for gossans, routine talus and shore line prospecting, detailed examination of accessible sulphide bands, moraine prospecting, and traversing and prospecting in inland valleys. Stratigraphic sections were examined where possible. Talus prospecting and visual examination has been responsible for all of the sulphide showings located to date in the Marmorilik Formation Carbonates. The geological programme was supplemented by a stream geochemistry programme. Stream heavies, analyzed for 15 elements, and stream silts analyzed for 12 elements, were collected on most accessible drainage systems.

Extensive examination and sampling of the cherty or graphitic sulphide bands suggests there is no economic potential for copper or zinc deposits. Sporadic samples with visible chalcopyrite do exist, but do not exceed 1% copper. The highest zinc values encountered were 0.57% zinc. Cherty sulphide deposits capping a newly identified sequence of komatiitic to andesitic volcanic complex contain up to 0.3% copper and 0.44% zinc. An occurrence of molybdenite related to peraluminous granite pegmatites was discovered but appears to have no economic significance.

(b) The results of the geochemical stream survey show numerous multi element and single element anomalies for the elements copper, lead, zinc, molybdenum, tin and barium. The most interesting copper, zinc anomaly is flanked by a barium anomaly located on the carbonate black shale fringe immediately north-west of Marmorilik on the northern drainage of Alfred Wegeners Halvo. Sporadic molybdenum, tin, tungsten anomalies are rated as second priority. Geochemical and prospecting follow up of a number of these geochemical anomalies is recommended and examination of the volcanic exhalite potential for possible massive sulphide deposits.

In conclusion, several ancilliary exploration targest have been defined, but the original target of massive ore deposition in metasedimentary sulphide sheets has been largely negated in the work to date.

2. INTRODUCTION

(a) Objectives

The Karrat Group reconnaissance programme was conducted over some 6,700 square km in the area immediately North of the Greenex A/S Black Angel Mine in Western Greenland. Previous work around Marmorilik has suggested that the fine grained Nukavsak Formation clastics of the Karrat Group were the basinal equivalents to the pericratonic platform carbonates of the Marmorlik Formation, and could conceivably host an age equivalent orebody in a different facies setting.

The programme was therefore designed to examine the poorly documented but apparently widespread cherty sulphide and graphitic sulphide horizons (Pyrrhotite, Pyrite, trace Chalcopyrite, quartz and graphite) that occur in the basal and lower portions of the clastic basin. Copper and zinc contents of these sulphides horizons were known to be locally anomalous, maximum values of 0.41% Cu, 0.5% Zn having been previously reported.

As the Karrat Programme was a reconnaissance (recce) programme in virtually virgin territory, the following exploration analogues were considered:

1) Black Angel Type carbonate hosted ores.

2) Volcanogenic massive sulphides, after the identification of a new differentiated volcanic complex at the base of the Nukavsak Formation.

3) Sulphide formations similar to those in the metaclastic (greywacke-quartzite) rocks of the Upper Proterozoic in the Appalachians of the U.S.A. These extensive sulphides formations are almost everywhere barren in base metals but do locally contain substantial copper-zinc orebodies (e.g. Ducktown, Tennessee; Oreknob, North Caroline). They have endured a complex metamorphic history but seem to be derived from the remobilization of sedimentary sulphides.

4) Black shale hosted zinc-lead deposits in the upper portions of the Nukavsak Formation, which consist of microturbidites and black or grey shales.

5) Fahlbands - elongated schistose zones impregnated with iron sulphides - are not uncommon in the Precambrian of Norway, and locally produce cobalt (Co), lead (Pb), zinc (Zn) and copper (Cu). The famous Kongsberg silver mines occur in fahlbands where, it is believed, the strata bound sulphides were able to precipitate silver from fluids circulating into vein structures. (Bugge 1979)

6) The mineral potential of the Proterozoic Proven granite and its complex pegmatites.

7) The kimberlite potential.

8) Base and precious metal potential of the rusty pyritic bands within the meta-sedimentary Umanak gneiss.

(b) Ownership and Location

The Karrat Project area in West Greenland, and the non-exclusive exploration permit held by Cominco Ltd. is bounded by 72°30'N latitude to the north, 71°15'N to the south, 54°W longitude to the west and 51°W to the east (Plate 1). The permit is valid for all mineral products apart from oil, gas, coal, uranium and thorium. On January 18, 1980, the Danish government approved the transferral of the Cominco prospecting license for the Karrat Area to A/S Cominco (wholly owned by Cominco) and Greenex A/S. Any further exploration in the permit area will be conducted on an 85% A/S Cominco, 15% Greenex A/S basis. The Greenex A/S exclusive exploration concession and utilization concession lie adjacent to the south.

The Karrat non-exclusive exploration concession expires December 31, 1980. Reporting requirements demand that a report on all geological, geophysical and other exploration carried out in any given year be submitted to the Danish Government, together with an evaluation of the results.

Charter Consolidated also holds a non-exclusive prospecting license covering all the Karrat area, and a larger portion of ground to the north and west.

The limits of the permit area, and the boundaries of the programme area are shown in Plate 1.

(c) Access and Topography

The Karrat Project area, covering some 6,750 km^2, Encompasses some of the most spectacular and rugged alpine scenery of Greenland. Five major fjord systems, each 30 to 60 km long by 4 to 8 km across, radiate up to the inland ice cap. The fjord bounded peninsulas and large islands rise abruptly from sea level to 1600 - 2000 m. Permanent snow fields exist above 1300 - 1500 m, giving rise to numerous small glacier tongues reaching close to, or descending to sea level. The Rinks glacier is particularly active and has been recorded to move at rates of 28 m/day. Kangigdleq Fjord is ice clogged much of the year.

Coastal and fjord wall exposure is excellent above the talus slopes and cones.

Access is entirely by boat to coastal exposures, or by helicopter to hinterland areas. There are a number of broad shallow valleys formed by glacial retreat which provide limited foot access to the interior.

3. PREVIOUS EXPLORATION

Karrat Group Area

1962 - 1963 Mapping at a scale of 1:100,000 was carried by Henderson and Pulvertaft of the G.G.U.

1970 At the request of N. Anderson acting on behalf of New Quebec Mining and Exploration Ltd., J.C. Sproule and Associates Ltd. made a photogeological study of an area north of Greenex between latitudes 71°00' to 72°10' north and longitudes 53°00' west, easterly to the ice cap. Reference is made to a literature description only of pyrrhotite with trace chalcopyrite in phyllitic schists on the Svartenhuk Peninsula. The Marmorilik carbonates of course were the main search target.

1971 Niels Anderson prospecting for Gronlands Efterforsknings Minecompagni A/S - (GEMCO) located some Marmorilik type mineralization in glacial float at the foot of Kangerdlagssuag Glacier.

A concession between 71°00'N and 72°12'N was granted to GEMCO for a period expiring on Dec. 31, 1975. The date of issue is not stated. 1973-11-16

1972 J.C. Sproule updated the 1970 photogeological study for Ponderay Exploration Company Ltd. stressing the Marmorilik Pb/Zn occurrences. A reconnaissance programme was also carried out by J.C. Sproule over the whole area.

In August 1975 Anderson was granted the right by GEMCO to prospect and explore the concession and approached COMINCO about the property. No agreement was finalized, however it was agreed that Cominco would examine parts of the concession during the field season after work was completed on the Greenex programme. Four days work was carried out. Recommendations at that time were negative, and nothing further was done on the property.

The GEMCO permit expired Dec. 31, 1975.

1977 Recent development of the shale basin exploration model and the occurrence of large tonnage stratiform base metal deposits in basins of similar age worldwide led to a re-appraisal of this area and a brief Cominco examination was made during September 1977. This resulted in a work proposal and the subsequent application for a non-exclusive exploration permit.

1978 A reconnaissance trip in the Karrat Group was carried out by R.A. Gannicott and F. Pedersen between Agust 8 - 12. Numerous sulphide samples were taken from talus, glacial float and outcrop some of which returned anomalous Cu (580 - 1360 ppm) and Zn (2050 - 4500 ppm) values.

1979 Charter Consolidated carried out a helicopter supported kimberlite reconnaissance in the Karrat area, and to the north and west on the Svartenhuk Peninsula, for the Diapros syndicate. their programme, during the months of July and August, was directed at bulk heavy mineral of the major stream systems with field processing of all samples.

The Karrat Programme describe below was carried out between June 26 and August 25, 1979.

4. EXPLORATION

(a) Reconnaissance Method

In a period of two months an area of 135 x 50 km (6,750 km^2) was evaluated. In the past, shore line prospecting and visual examination of cliffs has been responsible for the discovery of all the showings in the Marmorilik Formation - the Black Angel, Agpat, Uvkussigsat and Tributary showings - that have warranted drill testing. As a result, examination of gossan talus, and the outcropping sulphides themselves where accessible, formed the major part of the Karrat Programme. Concurrent with the geological recce, a geochemical heavy mineral and stream silt sampling programme was undertaken.

(i) Geology The quality of the 100,000 scale maps of Hendersen and Pulvertaft is considered very good. The combination of extreme exposure on 2000 m fjord walls, lack of vegetation, and talus, recent glacial polishing, relatively simple gneiss dome and large recumbant isoclinal fold-nappe structures, three dimensional geology and photo interpretation, have resulted in a high quality base map.

In the 7 major fjord systems, the shore line and cliff wall geology was verified by observation from sea level. Cliff side gossans located by binocular were intensively investigated in talus or outcrop. Systematically, all talus slopes were walked out and prospected. Outwash alluvial fans and lateral and terminal moraines were checked carefully.

Five helicopter supported fly camps and several helicopter supported traverses supplemented the mother ship home base and rubber boats used for local transport.

(ii) Geochemistry along the fjord shore lines heavy mineral samples (3 - 5 kg) were taken from the available drainage (outwash fans and cones, talus gullies, glacier outwash) though this was locally impossible early in the season (frozen talus cones) or at the end of the season (dry cones). Much of the drainage is under the talus. Silt samples were taken on traverses, and where heavy mineral samples were not available. A total of 177 heavies and 234 silts were collected.

Extensive rock sampling was conducted on the cherty sulphide, graphitic sulphide, and sulphide shale units. One hundred and thirty three samples were analysed for Cu, Pb, Zn, Co, Ni and Mo.

(b) <u>Programme Chronology</u>

The staffing consisted of two geologists and two summer field assistants.

MAY: Review of available literature, previous reports, preparation of base maps, air photos, charter boat arrangements, shipment of equipment.

JUNE 26 - JULY 18: Recce of Kangerdluarssuk Fjord, Upernivik Island, Kangerdlugssuaq Fjord, Karrat Island, Qeqertarssuaq Island from the boat Aglantha.

JULY 19 - AUGUST 2: Helicopter supported fly camps.

AUGUST 3 - 26: Recce of Uvkusigssat Fjord, Ingia Fjord, Kangigdleg Fjord, some fly camps, some follow up of the previously surveyed area to the south based on boat Hanne Gitte.

LATE AUGUST: Some helicopter supported traverses on the south fringe of the Karrat Group.

The ship assisted recce required 6 weeks, the helicopter supported recce required 2 weeks.

5. GEOLOGY

(a) Regional Geology - The Rinkian Mobile Belt

The west coast of Greenland, between Disko Island (70°N) and Kraulshavn (74°N) - a distance of some 500 km - consists of a belt complex of Archean basement (Umanak gneisses) and Aphebian (Proterozoic I (Geotimes Dec. 1979)) supra-crustals with a ENE to east trend. This major structural unit is termed the Rinkian mobile belt,now distinguished from the Nagssugtoqidian belt to the south (Escher and Pulvertaft 1976). The Rinkian belt is itself divided into three structural units.

The Ata Sund (70°N) area in the south is dominated by a very large gneiss dome surrounded by a rim syncline of two formations; an unconformable lower formation consisting mainly of quartzite and mica schist, and an upper formation consisting of meta volcanics (basalt-andesite-felsite) and interlayered semi-pelite schists. Local calc silicates and marbles are present.

The central unit extending from Umanak (71°) to the vicinity of Proven, (72°30') is the most important in the context of the report as it includes the metaclastic and metacarbonate sediments of the Proterozoic Karrat group which lie unconformably on Archean gneissic basement. The structure is characterized by large recumbent nappes and basement gneiss domes.

The northerly limit of this central belt is blurred by the intrusion of the Proven charnockite granite and its attendant granulite facies regional metamorphism.

Recent mapping by Escher (pers. comm.) suggests that Karrat type lithologies and structures extend in the northern unit as far north as the Steenstrup glacier at 75°N.

Radiometric K-Ar age dates point to a prevalent thermal event at 1870 - 1680 m.y. Depositional ages for the Karrat group, by analogy in part with Canadian examples, are estimated to be 2100 - 2200 m.y. or older (Moore 1977).

Considerable correlation and revision of the Archean and Proterozoic stratigraphy of Western Greenland remains to be done, and will probably result in depositional correlation of the Ketilidian of SW Greenland, the Ata Sund area, the Karrat Group, and much of the Proterozoic geology of Baffin Island. nåh!

(b) Regional Structure

The structure reveals itself as a rather simple pattern of basement Archean gneiss domes emplaced upwards into the Karrat Group metasediments. The Karrat Group, exposed along the margins of the domes, show overturned folds and nappe structures. The axial directions and vergence of the overfolds are consistent with gravity induced folds sliding off the buoyant gneiss domes. (Escher and Pulvertaft 1976) (Figs. 1,2)

Nappe development around the gneiss domes was probably initiated by metamorphic dehydration reactions in lower greenschist conditions which resulted in high pore fluid pressures and allowed gravity sliding (at depths of 4 - 5 km) off the slopes of the gneiss domes. (Ayrton, 1980)

The upper greenschist and lower amphibolite facies metamorphism in the lower Karrat Group post dates the major nappe and dome development, for micas and amphiboles show no deformation. Regional gneissosity or axial plane cleavages are not developed in the Karrat metasediments.

6. STRATIGRAPHY

The stratigraphy of the Karrat Programme area is summarized in Table 1, and diagrammatically in the form of a palinspastic reconstruction, in Plate 2. Detailed descriptions of specific locations are found in Appendix 1.

(a) Umanak Gneiss

The Umanak gneiss underlies the karrat Group with a stratigraphic unconformity. However, as a result of gneissic deformation, the contacts of Umanak gneiss are now invariably tectonically parallel and conformable to the basal Qeqertarssuaq Formation (south of Nugatsiaq). The Archean (?) Umanak Gneiss is largely of metasedimentary origin and contains several recognizable formations within it - the Nunatak Formation of basic and intermediate volcanics south of Marmorilik, and the amphibolitic Sermikavask Formation on Alfred Wegener Halvo. The gneiss is chiefly of medium to fine grained granodioritic composition (quartz, feldspar, biotite ± Chlorite with 10 - 15% mafics and weathers pale grey. Migmatite, lit par lit banding, quartz segregations, mafic gneiss bands, and disrupted amphibolites are frequent. The gneiss is rarely nebulitic. Micaceous schist bands, frequently pyritic, are encountered. Porphyritic gneisses occur south of Marmorilik.

In general, the gneisses seem derived from granitized, migmatized metasedimentary material, with some limited granitic plutonism.

(b) The Karrat Group

This consists of four major formations, illustrating a platform and shelf to deep basin sedimentary transition. The Marmorilik Formation, dominated by marbles and thin pelite bands formed in a pericratonic setting. The deeper basin is represented by a thick basal quartzite and pelite (the

Qeqertarssuaq Formation), an extensive agglomeratic and pillow breccia volcanic sheet of Komatiite composition (the newly described Kangigdleg Formation), overlain by a thick sequence (± 5000 m) of greywacke, turbidite, calcareous turbidite, siltstone and shale (Nukavsak Formation). There is no Proterozoic stratigraphy younger than the Nukavsak Formation.

(b) i. Qeqertarssuaq Formation

This unit of undifferentiated quartzite and semi pelite (i.e.sandy siltstone) with rare local calcsilicate or marble bands is well developed north of a line passing east-west through Nugatsiaq. Its thickness varies from 50 m or less to as much as 2,000 m. Conglomerate bands are not encountered and although it is stratigraphically unconformable on the Umanak gneiss, the basal contact is now structurally conformable. South of Nugatsiaq, the Qeqertassuaq Formation is represented as a thin (2 - 10 m) pelitic sandstone intervening between the Umanak Gneiss and impure amphibole-biotite bearing metaclastics of the Nukavsak Formation. The Qeqertarssuaq Formation is overlain, north of the Nugatsiaq line, by 50 - 600 m of basic volcanics. It is curious that the area of major quartzite-semi pelite deposition corresponds exactly with that of the major volcanic development, and that both of these formations are virtually absent south of the Nugatsiaq line. (Plate 2)

Sulphide bearing schists are not infrequent along Kangigdleq Fjord within the formation. These occur as pyrrhotite bearing black shales, pyrrhotitic (po) cherty siltstones, pyritic quartz biotite schists, cherty pyritic limestones and rare 1 - 1½ m beds of Po rich graphitic cherts. Their distribution is marked out on Plates 3 to 6. These sulphide bearing units were examined and sampled during the course of the recce programme and returned universally low base and precious metal contents.

The metamorphism is lower amphibolite grade (garnet, staurolite, amphibole with local sillimanite, chiastolite).

The Qeqertarssuaq formation evolved as a wedge of coarse and fine clastics peripheral to a rather pereplained stable craton but is not necessarily the age equivalent to the thin quartzite member at the base of the marmorilik Formation.

(b) ii. Kangigdleq Formation

The basic to intermediate volcanics, which outcrop over an area of 50 x 60 km, are sufficiently distinctive, homogeneous and stratigraphically extensive to warrant formational status. They are limited to the area north of a line passing through Nugatsiaq. the formational name of Kangigdleq Formation is unofficially introduced here to describe them in their area of maximum development. The Kangigdleq Formation has sharp basal and upper contacts with the Qeqertarrsuaq and Nukavask Formation.

The volcanic nature was recognized for the first time, and had previously (Henderson and Pulvertaft, (1976); Escher and Pulvertaft, (1976)) been identified as hornblende schist and amphibolite of largely sedimentary origin. It was assigned to the upper part of the Qeqertarrssuaq Formation.

The volcanics form a sheet varying form 25 - 75 m thick (along Ingia Fjord, northern end of Kangerdlugssuaq Fjord) to ± 250 m (Umiamako Nuna) to an estimated 400 - 600 m on the east side' of Kangigdleq Fjord. The sheet seems to taper quite regularly away from its thickest point. The Qeqertarssuaq Formation along Kangigdleq Fjord is not infrequently cut by folded metabasic dykes interpreted as feeders. No local edifices are apparent. In terms of thickness versus lateral extent, a multiple vent eruption seems inescapable. In outcrop, the volcanics are dominantly agglomeratic, tuffacerous or pillow-flow breccias with little or no thick flow or well pillowed material. The fragments are very commonly vesicular, and fragment size ranges from 1 - 50 cm. they are frequently highly carbonated - especially carbonate cemented tuffs interbedded with the coarser fragmentals.

Whole rock analyses (Table 2) prove the volcanics to be a differentiated sequence extending from basaltic komatiites, through magnesium tholeiites, to limited amounts of andesitic or spilitic material. This is discussed more extensively in the section dealing with lithogeochemistry. Rare andesitic flows occur within the agglomerates. No rhyolites were encountered.

Metamorphically the basalts are within the greenschist facies showing evidence of retrograde metamorphism. In composition they range from tremolite-chlorite-albite-epidote rocks with relict clinopyroxene and magnetite, through tremolite-actinolite-biotite schists to retrograded hornblende-plagioclase gneisses.

In the area between Kangerdlugssuaq Fjord and Johannes glacier, a second amphibolite band, some 50 - 100 m thick, occurs within the Nukavsak Formation 250 m above the major amphibolitic (volcanic) band. It occasionally has a gossanous zone above it, and is thought to represent a second basic volcanic horizon. this may also be present above the NW side of the Puatdlarsiviup valley. Access to this unit is difficult.

To the south of the Nugatsiaq line volcanics are absent, but the basal Nukavsak frequently contains an amphibole bearing quartz-feldspar-biotite gneiss or schist While carbonates are present, and para amphibolitic gneisses quite certain, there may be a dispersed mafic tuff component in many of these impure sediments.

The upper contact of the volcanics with the Nukavsak Formation commonly outcrops at + 1,000 m above sea level, and is rarely accessible.

Perhaps 50% of the linear length of the Kangigdleq - Nukavsak Formation contact appears to be visibly marked by a semi-persistent gossan band, believed either to be ankeritic carbonate, pyrrhotite bearing chert or massive pyrrhotite. These units are seen in outcrop along the contact. Access to this contact was extremely limited due to topography.

(b) iii. Nukavsak Formation

These reddish brown weathering meta sediments of the Karrart Group dominate the geology of the area, and are host to the frequent pyrrhotite-chert, pyrrhotite-graphite-chert and pyrrhotite bearing black shales that were the economic stimulus for this programme. These units occur throughout the Nukavsak Formation and are described separately in section 7. They appear to be progressive variations of cherty sulphide iron formation and sulphide rich black shales. The Nukavsak Formation progressively changes both laterally away from the Marmorilik platform, and vertically upwards in the basin. The lower Nukavsak formation consists of peripheral platform limestones and black shales; basin edge limestones, greywackes, proximal turbidites, siltstones and shales. Very detailed structural and stratigraphic studies were however not warranted beyond that of the model presented in Plate 2. The top of the Proterozoic Nukavsak Formation sequence is not present. Local Cretaceous sandstones, tertiary basalt flows and/or Quaternary glaical deposits and icecap unconformably overlie the Nukavsak formation.

North of the"Nugatsiaqline", the Nukavsak overlies a thickening wedge of Kangigdleq volcanics as previously described. South of this line it overlies the Umanak gneisses and the basal beds include a thin (2 - 10m) pelitic quartzite in some cases, and, in others near the Marmorilik Formation, a thin impersistent carbonate wedge tapering to the north. This basal unit should not be confused with some deep water limestones or local carbonate lenses which occur elsewhere in the lower Nukavsak Formation.

(b) iv. Marmorilik Formation

The type section of Marmorilik Formation is not exposed in the area under consideration but is thought to be the lateral time equivalent platform carbonate succession of the basinal Nukavsak Formation. The black pelite unit, in excess of 400 - 500 m thick, which overlies the Marmorilik Formation, is interpreted to be in fact the Nukavsak Formation (Plate 2). The transition from shelf at Marmorilik to basin is not well preserved because of the 8 km wide gap formed by the Alfred Wegener Peninsula basement - topographic high.

Intertonguing of Marmorilik carbonates and basinal sediments can however be seen on Den Sorte Nunatak and Kangerluarssup Sermia.

(c) Proven Granite

The syntectonic Proven charnokite granite is not actually encountered in Uvkusigssat Fjord. However the fjord is fringed by areas of granite veining, stoped blocks, and some pegmatites which intrude into the Karrat Group. This granitic activity is encountered in the extreme northern part of the field area and around the Pangnertoq gneiss dome.

In the best exposure north of Qaersorssuag the cliff faces show 50% granite veining over a cliff height of ± 900 m. Metamorphic grades - generally of greenschist facies in the vicinity of Ingia Fjord - increase rapidly towards the north to middle-upper amphibolite in the area of granitic activity.

The change in metamorphism is accompanied by a change in colour of Karrat lithologies from reddish brown to grey.

Complex and simple pegmatites seem to be confined to a NNW trending zone 10 - 20 km wide which extends southerly along Uvkusigssat fjord. They can be traced for ± 100 km from the Proven granite. Elsewhere the Karrat group is free of pegmatitic material containing only quartz veins and segregations. On Karrat Island, the pegmatites are ptygmatically folded suggesting similar ages and association to the Proven granite.

The pegmatites are peraluminous in character, consisting of quartz, two feldspars, biotite, muscovite, tourmaline with or without pink garnet. Occasional traces of MoS_2 occur for a distance of several 100's metres opposite Karrat Island (see chapter 8). The pegmatites seem free of Beryllium, lithium and uranium mineralization.

(d) Post Proterozoic Geology

(d) i. Cretaceous sandstones (Odum and Koch 1955)

Very limited amounts of Mesezoic sediment outcrop on the SW sides of Qequertarssuag and Upernivik Islands. On Qeqertarssuaq, these Cretaceous sandstones occupy an area of 2x4 km, on Upernivik, 8x5 km. These sandstones outcrop or form low, lying beds near the shore line where they are covered by extensive moraine or talus veneer. On Qeqertarssuaq Island the sandstones have been cut by Tertiary basalts and flows. The Cretaceous consists of quartz sandstones, usually yellow white, locally conglomeratic. The sandstones may be variably shaly, argillaceous or micaceous. They are infrequently carbonaceous, containing plant remains and/or organic films throughout their 200 m thickness. Cross bedding and ripple marks are common.

(d) ii. Tertiary Basalts

South of 72° in the present field area, the Karrat Group and Umanak Gneiss are cut by NNW trending diabase and gabbro dykes, as much as 50 or 100 m thick. Some single dykes are traceable in excess of 130 km. Along Uvkusigssat Fjord north of 72° and at elevation 1600 m, the Karrat meta sediments are unconformably overlain by Tertiary (50 - 65 m.y.) flows erupting from the lower feeder dykes. The flows are 100 - 400 m thick, flat lying to gently westward dipping (5 - 7°) and consist of magnesian basalt, vesicular flows now highly zeolitic in places (Clarke 1976).

(d) iii. Lamprophyres

On nearby Ubekent Island, a swarm of ± 100 m. kersantite-comptonite-monchiquite dykes trends NNW and cuts the late volcanics. (Clarke and Pedersen 1976) The dykes contain basement xenoliths, clinopyroxene megacrysts, and dunite and spinel harzburgite xenoliths. They are dated by K/Ar techniques at 30 - 40 m.y.

During the coastline recce of the Karrat Group programme frequent boulders and occasional dykes of lamprophyre or mica peridotite were found similar to Ubekent Island. Many of these lamprophyres are xenolithic carrying olivine, clinopyroxene, orthopyroxene and spinel.

Samples 529, 530, 684, 547, 548, 789 and 812 were thin sectioned and proven to be monchiquites and fourchites.

(d) iv. Ultramatic Intrusions

Within the basal Karrat group are a number of totally serpentinized or talc-tremolite bodies of ultramatic composition. Good examples are found on the NE corner of Qeqertarssuaq Island. Several bodies are found in Puatdlarsiviup valley. Dimensionally they are ovoid 50 x 300 m and resemble alpine type pods. Relict igneous textures are not preserved. The age of these ultra mafics is not apparent from geological relations.

7. THE BARREN SULPHIDE UNITS

(a) Type and Distribution

Three gross divisions were established for the sediment hosted sulphide bearing lithologies present within the Nukavsak formation.

(a) i. Cherty sulphide iron formations comprised dominantly of chert , with abundant pyrrhotite ($\pm$ pyrite) and variable graphite content. These are best developed in the lower 500 - 600 m of the Nukavsak Formation, sporadically in the Qeqertarssuaq Formation, and are evident just above the Kangigdleq Formation. There are multiple bands, with several bands showing prominent thicknesses (5 - 10 m) and long strike extent (5 - 10 km).

(a) ii. Graphitic sulphide formations composed of graphitic metasediments with abundant pyrrhotite ($\pm$ pyrite) and a lesser amount of chert. This unit is intermediate between type (i) described above and type (iii) described below It may occur in conjunction with type (i) or type (iii) or occur by itself. It is in actuality a pyrrhotite rich ($>$ 20%) black shale, typically quite thick (2 - 5 m) and may be extensive. It is, however, not a cherty sulphide iron formation as is type (i). Type (ii) shows no preference to a particular stratigraphic level of the Nukavsak Formation.

(a) iii. Pyrrhotite ($<$ 3%) Bearing Black Shales. The pyrrhotite may frequently be locally remobilized to form pyrrhotite rich bands. Type (iii) shows ubiquitous development throughout the Nukavsak Formation, but is perhaps more prevalent in the middle-upper turbidite siltstones where they occur as thin (0.3 - 2 m) black shale intervals.

The positions of known sulphide bearing lithologies are shown on Plates 3 - 6, subdivided as to sulphide band type. The Plates also show the relative abundance and lithology type of sulphide bearing boulders in talus or moraine deposits. These Plates present a summary of stratigraphic distribution, frequency, lateral extent, relationship of sulphide bands with respect to the base of the Nukavsak Formation, the geographical distribution, and the inter association of types (i), (ii) and (iii). It is evident that the cherty sulphide formations where they do not directly overlie the Kangigleq volcanics are confined to the basin edge between Alfred Wegeners Halvo and the southern limit of the volcanics. Cherty sulphide iron formations are not abundant in the Nukavsak stratigraphy above the volcanics, and are scarcely present along Uvkusigssat Fjord or northern Ingia Fjord.

(b) Description and Mineralogy

The mineralogy of the sulphide rich units is primarily quartz, graphite, pyrrhotite, pyrite, biotite, chlorite, amphibole, feldspar and traces of chalcopyrite. It was found that the presence of visible chalcopyrite corresponds with ± 700 - 1000 ppm copper. Pyrrhotite is by far the most abundant iron sulphide. The ground mass pyrrhotite surrounds rounded breccia fragments of pyrrhotite, and is often altered to marcasite along grain boundaries and fractures. Pyrite occurs as euhedral to subhedral porphyroblasts suggesting a late origin in the paragenetic sequence. Chalcopyrite occurs either as small interstitial anhedral grains between pyrrhotite grains or its alteration products, or is entirely surrounded by pyrite porphyroblasts.

There is no indication of the presence of sphalerite, bornite, covellite, galena, magnetite, hematite, iron carbonate or high-iron silicates.

(b) i. Cherty Sulphide Iron Formations This unit consists of cherty bands (>75%) interbedded with pyrrhotite-graphite-quartz breccia that define the association. The breccia consists of 30 - 60% matrix pyrrhotite, is aphanitic to fine grained massive, dull bronze to steel grey in colour depending on recrystallization, and contains sub angular to rounded graphite coated clasts or oblate pills of cherty siltstone, chert or quartz. The clasts range from a few mm to 1 - 2 cm. Abundant graphite forms schlieren in the matrix. Occasionally massive steel grey pyrrhotite forms 100% of hand specimens. The graphite coated "pills" are frequently composed of recrystallized glassy silica. Pyrrhotite is almost always greatly in excess of pyrite, but rare examples of coarse grained pyritic cherty breccia do exist. Cpy is rare, never exceeding 3% with only 1% of samples (or less) containing visible cpy.

The unit seems to have formerly been a laminated pyrrhotite-graphite cherty siltsone or chert. The brecciated nature is probably the physical response, during deformation, between brittle silica, plastic sulphides, and graphite lubricant. (See also Vokes 1969)

(b) ii. Graphitic Sulphide Formation These are essentially non siliceous rocks, consisting of 10 - 40% remobilized pyrrhotite as anastamosing veins, blobs and stringers, later brecciated but dominantly following the schistosity. The pyrrhotite is hosted by graphite rich schists with abundant chlorite and actinolite and quartz. Schlieren of graphite are ubiquitous. The host rock must initially have been an organic rich, pyrrhotite rich shale. The pyrrhotite is generally dull bronze or grey bronze. Pyrite is less frequent but shows more recrystallization to clotted porphyroblasts of coarse, angular nature. Traces of cpy are rare.

(b) iii. Pyrrhotite Bearing Black Shales Over several tens of cms to 1 - 5 m, contorted, folded and brecciated black shales and lesser black siltstone units contain 1 - 5% pyrrhotite (± pyrite). There is local remobilization of pyrrhotite into shear zones accompanied by deformed graphite rich schists. The pyrrhotite in these instances may be highly recrystallized. Small amounts of pyrrhotite may also occur as filaments, tiny blobs and coalesced clots in black essentially non graphitic siltstones. These black shale bands may be up to 10 - 15 m thick in the lower and middle Nukavsak Formation, and are commonly repeated every 5 - 30 m.

(c) Stratigraphy and Extent

Several very extensive cherty pyrrhotite bands of type (a) are recognized which deserve individual comment. These are located within the lowermost 800 m of the Nukavsak Formation, and generally south of Kangigdleq Fjord.

(c) i. Kangerdlugssuakavsak This cherty pyrrhotite-graphite sequence is the first sulphide sheet in the basal Nukavsak and lies 400 - 500 m above unconformity. It can be traced for a strike length of 24 km. A second thinner band of similar type lies some 100 - 150 m stratigraphically higher. The major band, 12 m thick, overlies flaggy red brown mica schists. The type section consists of 2.5 m of pyrrhotite-graphite milled cherty breccia, 1 m of iron stained schists, 3 m of pyrrhotite-graphite-chert breccia, 0.5 m of banded pyrrhotite-chert, 4 m of dark grey cherty with disseminated pyrrhotite, and 0.3 m of graphite rich schist overlain by flaggy rust schists.

(c) ii. An impressive exposure 30 m thick of folded and thickened pyrrhotite-graphite chert, containing large fragments of disrupted chert, occurs on the north side of Kangerdlugssuaq Fjord. This sulphide unit, with a footwall of compact siltstones, lies 300 m above the unconformity and can be traced for 2 or 3 km along strike. A second sulphide band is regionally present 50 m above the unconformity but is only on the order of 3 - 4 m? thick, composed of chert with 25 - 40 cm bands of pyrrhotite breccia.

(c) iii. An exposure of chert-pyrrhotite sulphide formation on Inukavsait Fjord outcrops for a length of 10 - 12 km, is 15 - 20 m thick, and lies 50 - 100 m above the unconformity. It is exposed on both sides of a syncline bounded by gneiss domes. This implies a third dimension of 3 - 4 km.

(c) iv. Opposite the north-east corner of Karrat Island a laterally continuous horizon of pyrrhotite-graphite-chert breccia, 3 - 4 m thick, lies 110 m above the unconformity. Footwall lithologies consists of thin bedded schists with tremolitic lenses. The band consists of 2 - 2½ m of breccia rich in pyrrhotite and highly contorted, and 1½ m of thin-bedded quartz chert and cherty shale with traces of pyrrhotite. (Sample site 690.) Two narrow sulphide bands in the lower 50 m of the Nukavsak Formation which outcrop 6 km distant are not present in this section.

8. MINERALIZATION

No significant base metal mineralization was encountered during the field period, and subsequent lithogeochemical studies have revealed no substantial metal concentrations. Traces of molybdenum, copper and zinc have been encountered. These are described below.

(a) Molybdenum

(a) i. Despite the traces of molybdenum found in the barren sulphide sheets within the Nukavsak Formation (values up to 500 ppm molybdenum) no molybdenite (MoS_2) was seen in these lithologies, likely due to the near impossibility of distinguishing trace MoS_2 from graphite. These sulphide sheets have no molybdenum potential.

(a) ii. Traces of molybdenite (MoS_2) in granite were found at two locations. A simple coarse flake of MoS_2 in a homogeneous white non altered granite was found on Uvkusigssat Fjord, 3 km south of the Qinga delta. Stream heavy results from an adjacent sample give $<$ 2 ppm molybdenum. The granite is likely to be derived from a sheeted dyke phase of the Proven Granite. A single boulder with traces of MoS_2 in leucogranite gneiss was found in the lateral moraine on the north side of Kangerdluarssup Sermia. Neither location has any economic potential.

(a) iii. A swarm of peraluminous granite pegmatite dykes cuts Umanak Gniess and Karrat Group lithologies opposite Karrat Island, centered 2.5 km north-west of the Akuliaruseq headland. Traces of MoS_2 are present in the pegmatites in outcrop and talus along 800 m of shoreline and to elevations of more than 600 m. The width of best mineralization is 300 m. No MoS_2 is present on Karrat Island.

The pegmatites are composed of quartz-muscovite-biotite-feldspar-garnet $\pm$ tourmaline are commonly zoned with quartz rich centres, and, are associated with quartz veins. They are generally hosted within biotite rich schists of the Umanak Gneiss and occur as shoots, dykes, masses and bifurcating dykes. Smaller veins, 1 - 2 m across, are commonly folded. Larger masses, 5 - 15 m across, may extend vertically and horizontally for greater than 100 m. Pegmatites constitute at best 30% of the 300 m zone of best outcrop where the coastline transects the pegmatites at right angles. (Barren pegmatite veins in the adjacent area to the north-east may achieve 50 - 60 m thickness.)

Molybdenite is found commonly within 30 cm of the margins of the veins especially where the pegmatite selvage is rich in biotite, and as rare flakes in the host biotite rich on amphibolitic schists within 40 cms of the pegmatite dyke margin. Clots of MoS_2 rarely occur in the pegmatite interior. Occasionally a muscovitic alteration of the dyke walls has been noted. Three or four thin sheeted dykes are sometimes present over a 10 m width with traces of MoS_2 on all margins. Normal margin grades are 0.1 - 0.5% MoS_2 over 4 - 5 cm. All pegmatites are greater than 1 m thick. There is no tungsten, uranium, tin or copper associated with the molybdenum.

This occurrence is judged to have no economic significance. Stream sampling in the area proved negative.

(b) Copper

No economically significant copper mineralization was encountered. Traces of chalcopyrite are not uncommon in the cherty and graphitic iron sulphide formations. The four most copper rich samples (> 2,500 ppm) are described as follows regardless of provenance.

(b) i. 701A contains ± 1% copper and 380 ppm zinc and is located on the north side of Kangerdlagssuaq Fjord. This moraine boulder is a typical pyrrhotite breccia containing graphite coated pills of quartz (25 - 30% pyrrhotite) and disseminated specks of chalcopyrite (cpy). It occurs with a rich selection of other boulders of similar and diverse type all of which are essentially barren in copper. Inland traversing and heavy mineral sampling revealed no further copper concentrations.

(b) ii. 704 contains 0.74% copper and 315 ppm zinc. It is an unusual pyrrhotite-biotite rich quartzo feldspathic gneissic schist with 2 - 3% chalcopyrite as ribbons, laminae and streaks. It appears to be Umanak gneiss and occurs as a single fragment in moraine, just below the ice cap. Prospecting failed to reveal the source, or any other similar float. Coincidentally, it lies 3 km NE of sample 701A.

(b) iii. 968C contains 5050 ppm copper and 960 ppm zinc. It is nearly identical in hand specimen to 701A. One other adjacent sample, some few hundred metres distant contains 2400 ppm copper, 1400 ppm zinc and 240 ppm molybdenum.

(b) iv. 765 contains 3050 ppm copper and 4400 ppm zinc. It occurs as a moraine boulder in glacial outwash in the Puatdlarsiviup valley, east of Ingia Fjord. Higher up this tributary valley the volcanics outcrop and are visibly overlain by cherty gossans. The sample consists of 50 - 75% pyrrhotite with shreds and wisps of chlorite-tremolite, quartz and trace chalcopyrite and contains no graphite. The boulder occurs in association with chlorite, and chlorite ankerite boulders of volcanic origin. Its distinctive composition, chloritic rather than graphitic matrix, and probably derivation from the sulphide zone immediately overlying the volcanics deserves further attention. Several other samples with a 1:1 ratio of base metals, but lower total abundance, are also of probable volcanic cherty sulphide origin (e.g. 874A, 771B, 705, 664).

(c) Zinc

The highest levels of zinc recorded are 5000 - 6000 ppm, with numerous samples in the range 2000 - 5000 ppm. Sample 697 (5,500 ppm zinc, 250 ppm copper) is typical. It is a pyrrhotite-graphite breccia band some 30 - 40 cm thick within a one metre band of pyrrhotite bearing silica banded black shale. Graphite beds separate the upper and lower boundaries of the fine

fine grained clastic host. The horizon can be traced 100 - 200 m along strike.

Sample 727 with 3800 ppm zinc and 340 ppm copper is typical of the pyrrhotite-quartz-graphite rolled breccia.

9. LITHOCHEMISTRY

(a) The Kangigdleq Volcanics

Nine representative samples of lithologies form the Kangigdleq volcanics were analysed for whole rock elements, as was a single sample from Nunataq Formation.

The single analysis of the amphibolite from the Archean Nunataq Formation, enclosed within the Umanak Gneiss, suggests that the Nunataq Formation is indeed a metavolcanic complex. The lower metabasaltic portion of the formation is a typical tholeiite of probably calc alkaline character now metamorphosed to middle amphibolite facies. Considerable amounts of intermediate volcanic material and minor dacite are present but were not analyzed.

The Proterozoic Kangigdleq Volcanics prove to be a differentiated sequence ranging from true basaltic komatiites (in the sense of Naldrett and Arndt (1975)) through to magnesium tholeiites, tholeiites and andesites. The whole rock analyses are listed in Table 2. Four samples are basaltic komatiites with 15 - 20% MgO, 6.5 - 9% Al_2O_3, and uniformly high Mg/Mg + Fe of 0.75 - 0.70. Two samples are magnesian tholeiites (10 - 12% MgO), and two samples are tholeiites (5 - 7% MgO). The greatest chemical differentiation is represented by an andesite (55% SiO_2, 3% MgO) that shows strong alkali enrichment but no iron enrichment. Although an insubstantial number of magmatic differentiates were chosen for analysis, the differentation trend of the suite seems to be of a calc alkaline tholeiite type. All of the suite is characterized by high titanium and titanium enrichment, strong sodium enrichment and no iron enrichment. Volumetrically, the suite is dominated by basaltic komatiites and magnesian tholeiites.

It seems likely that the pods of ultramafic material i.e. serpentinite-talc rock (not analyzed) found along the Puatdlarsiviup valley and on Qeqertarssuaq Island represent magmatic cumulates from the source magma of these komatiite flows.

In terms of rock chemistry and geological setting, the Kangigdleq volcanics are very similar to the descriptions of some Proterozoic volcanic belts peripheral to Archean cratons of the Canadian shield. Komatiite and basaltic komatiite flows have been reported from the Committee Fold Belt on Baffin Island and Melville Peninsula, from the Cape Smith-Wakeham Bay Belt, and from the Labrador Trough (Moore 1977). The Committee, Fox and Dorset Fold Belts on Baffin Island contain substantial amounts of mafic and intermediate flows and pyroclastics with subordinate dacite and rhyolite.

Schau (1977) describes a situation similar to the Karrat Group. Komatiite flows and sills SW of Melville Peninsula in the Committee Fold belt are interlayered with Proterozoic sedimentary quartzites typical of a stable craton. However, in the Karrat Group, the very fluid mafic flows were suceeded by tectonic instability and the development of a large clastic basin. The Karrat Group presents yet another instance of komatiites lying on an ensialic basement.

(b) Sulphide Units of the Nukavsak Group

The multiple, laterally extensive stratabound sulphide rich cherty and graphitic units, and pyrrhotite bearing black shales of the Nukavsak Group constituted the major exploration target in the Karrat Group. Due to the very limited access, much of the direct observation was limited to scree, talus cone, alluvial fan and lateral or terminal moraine deposits. Base metal presence was sought a) directly by talus or outcrop examination, b) by collecting an extensive suite of random samples and any weakly copper mineralized samples for lab analysis and c) indirectly through the collection of stream heavy and stream silt samples.

Approximately 134 iron sulphide bearing samples were analyzed for copper, lead, zinc, cobalt and nickel; 79 samples were analyzed for molybdenum. The statistical data for a representative suit of these samples is summarized in Table 3. Analyser mangler!

(b) i. Gold and silver

The precious metals were not examined in the sulphide units directly, but rather were evaluated by the stream/heavy silt programme discussed below. Earlier test samples show the silver content of 11 samples to be typical of sulphide rich black shales. There is no silver - base metal correlation. Gill (1975) assayed a suite of pyrrhotite-pyrite bearing lithologies and rusty Umanak gneisses for gold and found values for 5 to 45 ppb with a single maximum of 100 ppb.

(b) ii. Nickel and cobalt

Cobalt shows a strong maxima at 55 - 60 ppm, while nickel shows a broad maxima between 600 - 1200 ppm with a mean value of 975 ppm. These essentially non chalcophile elements show a strong enrichment over normal black shales (non sulphide bearing) but are perhaps typical of syngenetic sulphide deposits. In some instances of remobilized pyrrhotite it is highly likely that nickel and cobalt have been scavenged from host pelites.

Nickel and cobalt show a rather strong inter element correlation. The inexact knowledge of sample (talus) derivation in the stratigraphy does not permit recognition of anomalous regional nickel, cobalt contents of specific sulphide sheets, but the raw nickel, cobalt data show no geographic clustering of either high or low values.

Nickel and cobalt were chosen to discriminate those copper, zinc stream silt and heavy anomalies derived from barren sulphide sheets, from those copper, zinc stream anomalies perhaps related to sulphide ore deposits. This crude filtering technique is described in the section dealing with stream geochemistry.

(b) iii. Molybdenum

As discussed below, there are several molybdenum silt anomalies in the project area (substantiated by stream heavies where taken). Molybdenum values in sulphide rock samples show a range of 2 - 490 ppm and a strong maximum at 65 ppm, though 23% of the samples are greater than 100 ppm. Molybdenite is not visible in any specimen. Vire and Tourtelot (1970) have found mean values of up to 300 ppm molybdenum in some black shale sets which contain only traces of sulphides. Molybdenum in the Nukavsak sulphide sheets is erratic, not preferentially distributed with respect to area or source bed, and is assigned no economic significance. Molybdenum is regarded as a primary absorbed constituent of the black clays, perhaps now remobilized during metamorphosis, scavenged by the sulphur. It is presumed to be present as traces of MoS_2 within the graphite-sulphide units.

Trace MoS_2 is a common constituent of massive stratiform pyrrhotite lenses in the high grade metasediments of Grenville stratigraphy in Canada. This appears separate and distinct from molybdenum bearing fahlbands such as southern Norway where disseminated iron sulphides have been remobilized from or into amphibolites, concomittantly leaching or remobilizing molybdenum from basement rocks (Bugge 1978).

(b) iv. Lead

Lead shows a range of 5 - 283 ppm and a mean of 39 ppm; only 6% of samples are greater than 100 ppm. The lead contents are typical of black shales and barren syngenetic sulphide deposits.

(b) v. Copper and zinc

Copper and zinc are the two most chalcophile elements and show a large range of values. Copper ranges from 36 - 5050 ppm with a mean of 467 ppm, omitting two values of 0.74 and 1.0%. Zinc ranges from 19 - 5700 ppm with a mean of 975 ppm. The presence of visible copper sulphides (cpy) in hand specimen corresponds to the 700 - 1000 ppm copper level.

These maximum copper, zinc values correspond closely with the best values found by Cominco in the 1978 (0.14% copper, 0.45% zinc) preliminary work.

Copper-zinc rock plots reveal a strong bipolar separation, high copper and zinc being mutually exclusive. The copper zinc correlation coefficient is low. A zinc and a copper rich group emerge (Fig. 3). Sulphide units with a direct volcanic association do not show the extremes of zinc rich, copper poor (or vice versa) nature shown by some sedimentary associated sulphides.

The whole rock contents of copper and zinc show neither a regional zinc, copper grouping of high values within a restricted area, nor a zinc, copper grouping of high values associated with any particular sulphide sheet. Thus no unique sheet, or specific section of stratigraphy would inherently warrant a more detailed examination for possible economic grades of copper or zinc.

The copper-zinc sulphide rock data presented in Fig. 3 show one unique sample with both high copper (3050 ppm) and high zinc (4400 ppm) contents. This is a chlorite bearing pyrrhotite rich rock of bovious volcanic association (see Mineralization). This single sample (number 765) may point to a class of zinc, copper enriched iron sulphide formation of volcanic exhalite type. In the absence of encouragement from the sediment hosted sulphide formations, the sulphide formations directly overlying the volcanic formation emerge as the only potential sulphide ore type.

In conclusion, the group of sulphide rich samples contains several subjective populations (1) the cherty pyrrhotite association, (2) the graphitic pyrrhotite association, (3) the pyrrhotite rich black shale and (4) the volcanic association. The lithogeochem data show no interesting results from groups (1) to (3). Group (4), which is intrinsically more interesting, is confirmed as such by the occasional sample with anomalous base metal values.

(c) Ankerite - Chlorite Metavolcanics

The extensive gossanous bands commonly overlying the Kangigdleq volcanic unit of basaltic komatiites and mganesian cholerites is locally revealed to consist of banded or schistose ankerite - chlorite - epidote - actinolite rock, or schist stuffed with ankerite. Commonly these schists are crenulated (millimetre scale banding) and resemble carbonate cemented tuffs. Limestones or cherts may overlie the ankerite rich schists. Examples of these ankerite tuffs are well developed in the Puatalarsiviup Valley (776, 768, 780, 787).

These ankerite tuffs were thought to have a potential for gold exhalite mineralization of the Kirkland Lake type and a number of samples were analyzed for gold and base metals. They typically contain less than 10 ppb gold, less than 0.4 ppm silver, 10 - 70 ppm copper, 4 - 96 ppm lead and 10 - 400 ppm zinc. No gold anomalies have been recorded in gold heavies from drainage coming off the volcanic package. It is concluded that there is no gold potential within these ankerite zones.

10. STREAM GEOCHEMISTRY PROGRAMME

(a) Introduction

In such a large area - 6,700 km^2 of which 60% is high plateau hinterland - only a reconaissance geochemistry programme and subsequent follow up can provide a rapid appraisal of the economic potential. In this arctic alpine environment, most of the weathering is mechanical rahter than chemical, and there is little opportunity for metal absorption to the silt size fraction of the sample. The detrital rock component heavy fraction should give a strong enhancement of any base or precious metal mineralization, especially in the larger streams. For this reason, heavy mineral sampling was chosen as an adjunct to conventional silt sampling. In actuality, anomaly contrasts for metals such as copper and zinc proved quite similar from both silts and heavies, perhaps indicating that weathering is wholly mechanical.

Heavy mineral samples were taken on major and minor drainage - e.g. alluvial fans, stream cones, major talus rills, glacier margin streams, stream tributaries, and small active streams - wherever these were accessible on the coastline, or in low lying river valleys. The spacing on the coastline is generally 1 to maximum 5 kms. Drainage basins range from 1 - 50 kms^2. Major braided rivers with source areas of several 100 km^2 were avoided. Samples were mainly confined to streams draining the Karrat Group, and not much attention was paid to the gneissic basement.

Much of the area is not amenable to stream sampling because:
(1) in early summer some talus cones are snow covered to sea level and no sample can be obtained,
(2) in late summer there is no active run off, or sediment is absent in the blocky rock talus cones,
(3) much of the area is cliff bounded with direct spill to the fjords rather than stream development,
(4) in much of the area drainage runs within rather than over the talus,
(5) fjord ice or icebergs prohibit access to the shore line.

At a crude estimate, only 30 - 40% of the available Karrat Group outcrop was and could be sampled in the heavy mineral programme. Sample locations of heavy mineral samples and supplementary silts are shown on Plates 7, 8 and 9.

(b) Heavy Mineral Programme

A total of 177 heavy mineral samples were collected. Because there is little natural concentration in some of the streams, bulk samples of 3 - 5 kg. were taken. These were sieved in the field to - 1 mm., and split in the lab to a silt fraction (- 80 mesh) and a heavy fraction. The heavy fraction was examined for kimberlite indicator minerals. The heavy mineral samples were analysed for copper, lead, zinc, iron, manganese, cobalt, nickel, silver, gold, arsenic, molybdenum, tungsten, uranium, barium and tin.

A summary of the geochemical statistics for the 15 elements sought in the heavy mineral programme is presented in Table 4. Table 6B shows the correlation matrices for the 7 elements copper, lead, zinc, cobalt, nickel, manganese and iron. As expected from lithogeochemical studies of the sulphide formations, there exist strong positive copper-zinc, copper-iron, zinc-iron, cobalt-nickel correlations (0.81 - 0.86). Manganese (0.25 - 0.48) and lead (0.29 - 0.73) show the weakest correlations with cobalt-iron (0.53) and nickel-iron (0.53) relations also weak.

Zinc, nickel, cobalt and iron all show dual populations with a strong separation which correlates with the presence or absence of sulphide sheets in the stratigraphy. Copper exhibits a more complex relationship which will be dealt with below. Other elements present either single populations, or some uncertainty because of their low abundance.

The discussion below describes each element in turn including recommendations for follow up. These follow up anomalies are summarized in Table 9. A similar treatment of silts follows. As mentioned above, anomaly contrasts for silts and heavies are commonly quite similar.

As the distance between adjacent samples is commonly on the order of 3 kms, all isolated anomalies are worthy of follow up but gain value only if they are substantiated by adjacent samples.

(b) i. Zinc

Zinc ranges from 28 - 1140 ppm and is strongly bimodal with maxima at 140 and 300 ppm, most likely related to rock distribution and sulphide distribution. The threshold is calculated at 728 ppm. Taking 700 ppm as a cut off, there are 14 anomalous samples. The samples listed in Table 7A were screened, rejecting any samples where iron or nickel were in excess of their threshold. Samples 512 - 517 survive and deserve follow up, as does sample 662. The samples listed in Table 7B have zinc values from 500 - 700 ppm (i.e. mean($\bar{x}$)+ one standard deviation) and were filtered using the same one standard deviation. Samples 557, 650 and 654 should be followed up on a second priority.

Sample set 512 - 517 is perhaps the most interesting. These five adjacent samples on the north side of Alfred Wegeners Halvo are zinc anomalous, and are flanked to the west by four barium anomalous streams (518,520, 521, 523). The streams contain frequent boulders of pyrrhotite-pyrite bearing black shale, and some graphitic sulphide formation but these may not explain the high zinc, low iron stream values.

Priority follow up is recommended here for both the zinc and barium source.

Samples with anomalous zinc but characterized by high iron and/or nickel-cobalt are likely to be barren sulphide bands but in some instance should be verified. For example, sample 594 is a multi element molybdenum anomaly with above threshold copper, silver, zinc, arsenic, iron and nickel. Sample 593, adjacent to this should also be verified.

(b) ii. Copper

Copper is ubiquitous in the sulphide iron formations, and these sulphide bands must form the largest copper contributor to the streams. Sporadic copper values in rock in excess of 5000 ppm are noted, but most sulphide bands run 400 - 600 ppm.

Copper in stream heavies ranges from 41 - 1020 ppm with a mean of 247 and a threshold of 651 and shows a negatively skewed distribution. Copper forms one large low population (130 ppm) and a less distinct smaller population (15% of samples) centred at 600 ppm. The copper-zinc correlation coefficient in stream heavies is very high at 0.85. Thus most high copper samples correlated with high zinc, and these were discussed in the zinc section and Table 7. Those copper samples with values between 500 and 650 ppm copper are listed in Table 8. From this list, only two samples seem deserving of attention - samples 596 and 654.

(b) iii. Barium

Barium is a useful pathfinder for base metal deposits, especially of the black shale hosted variety that might be expected to occur within the Karrat Basin. Barium shows a range from 80 to 1430 ppm. Although the geometric mean is approximately 400 ppm, barium shows a very broad distribution between 100 and 800 ppm with no sharp maximum. Values in excess of 950 ppm (9 samples) are considered enriched. None of the 10 most barium rich samples shows a positive correlation with base metals. Coincident values of zinc , lead (copper) iron and manganese are all very close to their arithmetic means.

Four adjacent samples (518, 520 - 1, 523) along 8 km of the north side of Alfred Wegeners Halvo show anomolous barium, and are flanked to the east by marginally anomalous zinc, lead, copper results (514, 515, 517). Samples 514 and 515 have passed the copper, zinc, nickel, cobalt silt screening test for barren sulphide formation contribution and are deemed to have a possibility of zinc sulphides at source. The lateral coincidence of zinc, barium stream anomalies in this area should deserve first priority investigation.

Two other adjacent samples (582-3) contain anomalous barium but low base metals. These samples deserve second priority follow up.

(b) iv. Lead

Unlike zinc, lead shows a broad single maximum at approximately 20 ppm, ranging from 2 to 112 ppm. the threshold is approximately 56 ppm. Within the sulphide sheets, lead ranges from 5 - 283 ppm with a mean and standard deviation of 39 ppm. The average black shale contains 20 - 50 ppm lead. Four significantly anomalous lead values are noted (594, 645, 649, 714). 714?
The first three samples are multi element zinc, copper, lead anomalies with high iron, nickel and cobalt considered in the zinc section. The sample sites contain considerable sulphide boulders and barren sulphide outcrop above. Sample 714 is a multi element lead, tungsten anomaly but with very low associated base and ferrous metals. Abundant carbonate blocks in the area may testify to some carbonate related galena mineralization.

(b) v. Iron, manganese, cobalt and nickel

The primary exploration targets within the Karrat Group are deposits of copper, zinc, lead strata bound sulphides either similar to the barren sulphide sheets (i.e. representing local base metal enrichment) or of a different genre. Two deposit types can be imagined:
(1) high zinc, copper accompanied by high iron, nickel, cobalt as an indicator of base metal mineralized iron formation (e.g. the Oreknob or Ducktown type with 60% pyrrhotite, 30% pyrite, 4% chalcopyrite, 4% zinc sulphide 2% magnetite) and
(2) high zinc, lead accompanied by lower iron, nickel cobalt, copper as an indicator of strata bound argillaceous hosted massive sulphides (i.e. Sullivan or McArthur river 15 - 20% iron, 6 - 20% Zn S, 1 - 6% lead, 0.5% copper, plus or minus barium).

It is necessary to remove by some filtering technique the ubiquitous geochemical signature of the marginally copper, zinc enriched barren sulphide sheets in order to discriminate higher zinc, lead, copper sources of possible economic significance.

In the section dealing with lithogeochemistry the non sulphide-graphite formations have been characterized by their copper, lead, zinc, nickel, cobalt, silver and molybdenum contents. the most distinctive trace element of these pyrrhotite rich iron formations is their high nickel content ($\bar{x}$ = 994 ppm) and moderate cobalt content ($\bar{x}$ = 59 ppm). An examination of the data compiled by Mercer (1976) on minor elements in metal deposits within sedimentary rocks (especially the stratiform deposits in argillaceous rocks of type (2) above) show that nickel contents of ore are on the order of 0 - 110 ppm, cobalt contents perhaps 10 - 40 ppm. Thus nickel would appear to be the best discriminant for base metal barren sulphide sheets. Deposits of type (1) above can only be recognized by their higher zinc, copper values as there is no unique trace element (enriched or depleted with respect to barren sulphide formation) known.

The absolute iron content of the sample gives an indication of the potential contribution of detrital pyrrhotite and pyrite. Iron shows a strong bimodal distribution in stream heavies with maxima at 5.5% a,d 14.5%. Conversely, iron in stream silts shows a single maximum at 3.3%. It is suggested that the higher iron population in stream heavies represents the pyrrhotite, pyrite contribution while the lower iron population in heavies and the single iron silt population reflect the iron silicate-oxide-sulphide material ubiquitously derived from greywackes and shales.

Manganese in both heavies and silts shows a positively skewed single maximum. The manganese-iron correlation in heavies and silts is poor (0.35 and 0.53 respectively) and there are no anomalous manganese heavies (T = 1240 ppm).

Nickel in stream heavies shows a bimodal distribution with maxima at approximately 100 and 180 ppm, probably reflecting the parallel distribution of iron. The nickel threshold is 320 ppm. Three samples exceed 350 ppm. Sample 593 (383 ppm) is marked by high iron, cobalt, copper and zinc, and abundant boulders of cherty pyrrhotite iron formation were recorded at the sample sight. Samples 763 and 900 (487 and 513 ppm respectively) are adjacent to one another on the west side of Uvkusigssat Fjord. They are characterized by low to very low iron (i.e. high nickel/iron ratio) and low base metals. Only black shale lithologies with trace pyrrhotite are recorded at the sample site. Drainage originates from the Tertiary plateau basalts to the west and the geochemistry probably reflects some nickel sulphides at source. Elsewhere along Uvkusigssat Fjord the Tertiary basalts give no response. These two localities are recommended for follow up.

Cobalt as well shows a dual population in stream heavies with maxima at 21 and 33 ppm. The threshold of 81 ppm is exceeded by 10 samples. The cobalt-manganese and cobalt-iron correlation coefficients differ significantly (0.79 versus 0.50). The highest cobalt values correlate with the highest manganese values and moderately high iron, suggesting a possible cobaltian manganese oxide phase in the stream source area.

The cobalt, nickel, iron and manganese data sets form a basis for interpreting the zinc, lead, copper data.

(b) vi. Molybdenum

It has already been pointed out that the sulphide-graphite formations may contain anomalous molybdenum concentrations (mean 65 ppm, std. dev. 77 ppm), and that black shales themselves may contain high molybdenum. The potential molybdenum deposit types (pegmatite, falhband, etc.) have been discussed. Molybdenum in stream heavies ranges from 2 to 75 ppm and the threshold is set at 40 ppm.

Four sample sites are recommended for follow up (second priority): 514 (Mo 75 ppm) concomitant with zinc, barium follow up in the area, 659 (65 ppm Mo), 571 and 594 (50 and 51 Mo respectively).

There is no evident relation of molybdenum with tungsten or tin. If the follow up of stream silt samples 824 - 829 for molybdenum proves encouraging, other molybdenum heavies in excess of threshold might be considered for further attention.

(b) vii. Tungsten

Tungsten ranges from 2 to 40 ppm with an arithmetic mean of 6.9 and a threshold of 20 ppm. Five samples with tungsten in excess of 25 ppm are selected for re-investigation (second priority).

- 762 and 763 with 40 ppm tungsten each, and adjacent to one another. These samples come from an area in proximity to the Proven granite and its pegmatites.
- 581 (40 ppm tungsten)

- 714 (35 ppm tungsten)
- 939 (40 ppm tungsten) with coincident tin.

(b) viii. Tin

Tin was analyzed in stream heavies because of the known presence of some complex pegmatites related to the Proven granite. Tin values range from 5 to 70 ppm. The threshold is estimated as 30 ppm, making some 7 samples of 176 anomalous. Correlation with the commonly associated elements tungsten and molybdenum is poor. Second priority investigation of samples 939 (tin 70, tungsten 40), 730 (tin 56) and 673 (tin 59, molybdenum 47) is suggested. Tin does not show an assoication with base metals or known sulphide bands. Cassiterite could be expected to survive long transport distances in this arctic alpine environment.

§ Rare metal pegmatites and greissens are not expected to be present, so the moderate tin, tungsten, molybdenum correlation is mildly suprising for the anomalous samples.

(b) ix. Arsenic

Arsenic as chosen for analysis because it is a pathfinder for gold deposits and the cobalt-nickel-silver type vein deposits. Arsenic ranges from 2 to 994 ppm with an arithmetic mean of 90 ppm and a threshold of 390 ppm. Seven samples are recognized as anomalous (424 - 994 ppm). No arsenic-gold relationship exists. Above threshold arsenic correlates well with above threshold copper (> 81 ppm), nickel (> 320 ppm) and high iron. Arsenic would thus appear to be a minor component of iron sulphide formations. Two samples (645, 762) correlate with above threshold copper, zinc, silver, cobalt, nickel and iron and deserve second priority follow up attention. Sample 762 is also tungesten anomalous; there are no known sulphide formations in this area. Conversely sample 645 drains an extensive sulphide band which may be of cobalt-arsenic-silver fahlband type at this locality.

(b) x. Silver

Silver values in stream havies range from 0.4 to 2.3 ppm. The mean is 0.4 ppm and the threshold is set at 1 ppm. Silver contents of the barren sulphide-graphite formations are known to range from 1.2 - 9 ppm. Stream heavy values for silver in excess of threshold have a strong positive correlation with above threshold zinc and iron, a moderate correlation with copper, lead and nickel, and essentially negative or poor correlations with arsenic and cobalt. This would suggest that much of the low silver value is derived from the barren sheets of iron sulphide. Several multi element anomalies contain anomalous silver and have already been recommended for follow up (e.g. 514, 515, 517, 594, 762). None of the silver results deserve follow up on the basis of silver values alone.

(b) xi. Gold

Gold values in stream heavies range from 10 ppb (76% of samples) to 160 ppb. An approximate threshold for gold is 40 ppb, and only four samples equal or exceed this value. Although samples 760 and 900 contain respectively 160 and 100 ppb gold the yield ratios of heavy mineral samples were very low - on the order of 18 - 23 g/litre. Both samples come from the west side of Uvkusigssat Fjord where little is known of the geology. Minor quartz veining is present. These two sample locations are recommended for second priority follow up.

(c) Silt Programme

Silt samples. Silts totalled 231, both split from the heavy mineral and collected independently where heavies were impossible to obtain or on traverses in river valleys. they were analyzed for copper, lead, zinc, cobalt, nickel, iron, manganese, arsenic, antimony, silver, molybdenum and uranium. In one locality of East Greenland, silts have been shown to be of more value in defining some types of copper mineralization than were stream heavies (Stendal (1979)). Conversely, on the south side of Kangerdlugssuaq Fjord many streams are filled with silt flour from mechanical breakdown of argillite and shale, and the heavy mineral data is preferred here.

A summary of the geochemical statistics for the 12 elements sought in the silt fraction of stream samples is given in Table 5. Table 6A presents the correlation matrix for the 7 elements, copper, lead, zinc, cobalt, nickel, manganese and iron in 230 silt samples. Correlation coefficients in the stream heavies and greater than silt samples for the same element pairs, except for the cases of manganese and cobalt.

The discussion below describes each element in turn and makes recommendations for follow up. These silt anomalies are summarized in Table 11.

(c) i. Copper

Copper in stream silts ranges from 13 to 265 ppm, with an arithmetic mean of 71.5 ppm and a nominal threshold of 143 ppm. Copper shows an essentially normal distribution with an apparent single population. Ten percent of samples are in excess of threshold. Copper shows high correlation coefficients with zinc, cobalt, nickel (0.74 - 0.77), moderate correlation with iron (0.64), and low correlation with lead and manganese (0.45 - 0.54). None the less, the anomalous copper values are all associated with substantial iron. The stratiform sulphide lithologies are characterized by a strong copper maximum at 200 - 300 ppm copper, and a broad nickel maximum at 700 - 900 ppm nickel. Assuming mechanical dispersion and no metal absorption on to silts, the copper anomalies of 150 - 265 ppm are difficult to explain. The copper-nickel in silts correlation coefficient is quite high at 0.76. On the assumption that potential base metal deposits will not be characterized by high nickel, truly anomalous samples are chosen as those with copper in excess of 107 ($\bar{x}$ + one std. dev. = 107), and nickel less than 100 ($\bar{x}$ + ore std. dev. = 98). These are listed in Table 10.

(c) ii. <u>Zinc</u>

Zinc in silt samples ranges from 8 to 620 ppm with a mean of 104.5 ppm and a threshold of 247 ppm. Zinc forms a single population. Only four samples are in excess of threshold (2%). The zinc-manganese correlation coefficient is only moderate (0.63) but the highest zinc values are paired with the highest manganese values, suggesting that there is a manganese scavenging process in operation. Similarily, high zinc is associated with appreciable iron values reflecting most probably the sulphide iron formation source.

In a fashion similar to that used for copper, the zinc anomalies are chosen as those in excess of $\bar{x}$ + one std. dev. (175) and less than $\bar{x}$ + one std. dev. for nickel (100). These are listed in Table 10.

The eleven silt samples recommended for follow up are the common copper, zinc anomalous silts listed in Table 10. Five of these are multi element silts (e.g. uranium, molybdenum, copper, zinc). the six copper, zinc silt anomalies are not substantiated by the equivalent heavies, but do none the less warrant follow up.

(c) iii. <u>Lead</u>

Lead ranges from 1 to 70 ppm with a mean of 6.5 ppm and a nominal threshold of 21 ppm. Some 4.5% of samples are anomalous. Lead is strongly negatively skewed. The highest lead values are accompanied by moderately high manganese and iron. there are strong discrepancies between two analytical batches, the second smaller batch, (25% of population) containing virtually all of the anomalous samples. Only sample 665, and the previously discussed samples 825 - 829 (molybdenum, lead anomalous) are recommended for any follow up.

(c) iii. <u>Molybdenum</u>

Molybdenum shows a range from 2 to 70 ppm, and the threshold is set at 14 ppm. Four samples are anomolous. Moderate molybdenum values are recorded in samples 512 - 515, areas already recommended for zinc follow up. Just to the north of this area, a sequence of 6 silt samples (825 - 830) range from 10 - 70 ppm, pointing to a broad molybdenum anomalous area. The presence of trace amounts of molybdenum in the sulphide sheets has already been noted, and an extensive band of sulphides runs across the drainage basin of these 6 consecutive silts. This is the probably explanation for the molybdenum stream anomaly, and many of the stream silts are marked by high copper, zinc contents further suggestive of a sulphide sheet source. these anomalies do, none the less, warrant follow up. Two other isolated samples (No. 562 (15 ppm) and 659 (23 ppm)) are noted as anomalous, and are tentatively suggested for second priority follow up after samples 512 - 515 have been checked.

(c) iv. <u>Silver</u>

All silver values are non anomalous.

(c) v. Iron and manganese

The correlation between these elements is low at 0.52. Both iron and manganese form apparent single populations with a normal distribution, centred at 3.3% and 347 ppm respectively. Cumulative probability plots reveal, however, five distinct iron and four distinct manganese populations. The lower two iron populations, and the lowest manganese population each account for 90% of the total population and have a moderately high correlation. the remaining small populations (10% of data set) are more disparate. The total population correlation coefficients listed in Table 6A show that much of the zinc, cobalt nickel variance is accounted for by manganese, while copper variance is mainly accounted for by iron.

(c) vi. Nickel and cobalt

Cobalt forms essentially a single population centred at 16 ppm, and little information can be extracted from the raw cobalt data or its elemental relationships. Some 95% of the nickel data fall into a single population whose upper limit is marked by the threshold value of 137 ppm. Above this is a discrete anomalous population of 9 samples, ranging from 140 to 249 ppm marked by high manganese, iron. Many of these high nickel values are marked also by near threshold levels of zinc and copper (or cobalt). Where samples are taken below outcropping barren sulphide sheets, nickel abundances are frequently on the order of 115 - 240 ppm (e.g. Nos. 825 - 829). The element relations that nickel shows suggest no major NiS mineralization. The two heavy mineral samples recommended for nickel follow up (763, 900) contain low nickel abundances in the silt fraction. No nickel or cobalt directed follow up is recommended on the basis of silt geochemistry. Some high nickel values originate from drainage coming off the komatiitic basalts (e.g. 946 - 249 ppm), probably reflecting nickel inherent in magnesian basalts.

(c) vii. Antimony

All antimony values are below the limit of detection. Even the high arsenic values show no anomalous antimony.

(c) viii. Arsenic

Arsenic ranges from 2 to 189 ppm with a mean of 22 and a threshold of 67 ppm. Arsenic forms a broad sngle population, with 13% of samples being anomalous. Those arsenic values in excess of threshold show infrequent correlation with copper, zinc, iron, cobalt and nickel - hence the affiliation of arsenic is difficult to determine. The single markedly anomalous sample of 189 is marked by high abundances of this group and should be followed up as a type example (sample 810). Prominent sulphide bands are noted above sample 810.

(d) Kimberlite Indicator Check

As previously mentioned, the Karrat Group area was regarded as a potential kimberlite host area. This is suggested by:

(1) the known presence in west and south-west Greenland of Mesozoic and late Pre-Cambrian kimberlites,

(2) the presence of a Swarm of lamprophyre dykes on Ubekent Island dated at 30 - 40 m.y. cutting Lower Paleogene (Tertiary) basalts,

(3) the setting of these primitive picritic basalts, their deep derivations (30 kb) and their relation to the development of the Baffin Sea,

(4) lengthy feeder dyke swarms of Tertiary basalt and lapmrophyre parallel to the coast.

The 1977 stream heavy alluvial samples were examined for kimberlite indicator minerals (chromian diposide, pyrope and olivine) after processing in heavy liquid. The sample weight collected (3 - 5 kg), the sample volume processed (300 - 450 ml, rarely 600 - 900 ml) and the resulting sample aliquot (15 - 50 g) are probably not adequate for many of the larger stream systems. Only four samples contained indicators.

Sample 546 - one grain of chrome diopside. this sample coincides with known lamprophyre dykes. Rock samples of these (547, 548) were petrographically identified as monchiquite and fourchite, so this is the likely source of the pyroxene.

Samples 572 and 577 contained respectively one grain each of purple garnet and chrome diopside. These samples drain a common height of land and have a common source area. Lamprophyres are not recorded in outcrop or talus.

Sample 589 contained one grain of chrome diopside, but has a large source area. Lamprophyre dykes may extend from the 546 sample area across the fjord to the 589 sample area. Follow up is not suggested.

11. FINANCE

Expenditures are as follows:

	DKR
Consultant fees and salaries:	351,654
Mobilization and demobilization:	76,692
Equipment/supplies:	50,141
Helicopter:	33,000
Boat rental:	187,650
Assaying:	74,857
	773,994
Administration fees:	38,133
1979 Total	812,127

Since the application to the government to restructure the concession between A/S Cominco and Greenex A/S was pending, costs were distributed as follows:

A/S Cominco (85%)	690,308
Greenex A/S (15%)	121,819
Total = DKR	812,127

12. CONCLUSIONS AND RECOMMENDATIONS

During the programme, four iron sulphide assemblages were recognized of which three occur within metaclastic rocks of the Karrat Formation and one along the contact between volcanics and overlying sediments. These are:

a) cherty sulphide iron formations with or without a graphite association,

b) pyrrhotite/graphite bearing black metasediments,

c) black shales with minor pyrrhotite,

d) cherty pyrrhotite iron formation at the contact between the Karrat sediments and underlying volcanics.

No significant amounts of copper, zinc or other base metal mineralization were encountered in any of the four units where sampled. However, the volcanics of type (a) represent a volcanic formation of differentiated komatiite-andesite character which may hold potential for copper-zinc type deposits. Extensive areas of sulphide gossan capping these volcanics have been noted, but require helicopter follow up if warranted. Such a volcanic assemblage could hold a nickel-copper potential which as of the moment is undefined. No targets, however, have been indicated from the geochemical work to date.

The geological reconnaissance has indicated the absence of carbonates of Marmorilik type throughout the recce area, except on the northern side of Alfred Wegeners Halvo where the carbonate black shale transition takes place. Some stream geochemistry encouragement in this portion of the Karrat paleobasin supports a recommendation that shale hosted sulphide bodies should be sought in this area.

Small amounts of molybdenum mineralization associated with granite pegmatites was the only mineralization encountered during the programme. This is judged to be of no economic significance.

Stream geochemical sampling including silts and heavy mineral sampling yielded no outstanding anomalies but did suggest several areas of moderate base metal anomalies worth field checks. The most interesting is a copper-zinc anomaly mentioned above which is flanked by barium values on the carbonate - black shale facies front north-west of Marmorilik on the northern drainage of Alfred Wegeners Halvo. Other anomalies for checking are specified in the tables.

It is recommended that in 1980 some field checking be done over the specified anomalies and that subsequent follow up will depend on the results of this prospecting and geochemical detailing.

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14. LIST OF ATTACHMENTS

APPENDIX 1

The following represents detailed and general descriptions of individual sections and occurrences in the various stratigraphic units encountered during the project.

(A). Karrat Group

i. Qeqertarssuaq Formation

Along the Kangigdleq Fjord the lower few hundred metres of Qeqertarssuaq consist of interbanded orthoquartzites, quartzitic grey gneiss and semi pelitic schists with rare carbonate horizons. Sulphide bearing (Po, Py) schists are not infrequent. The scale of interbanding varies from 1 - 50 m.

On the south side of Kangigdleq Fjord, the upper few hundred metres of Qeqertarssuaq Formation comprises grey hornblende schist, lesser pelite and infrequent quartzite.

Near Puatdlarsiviup on Ingia Fjord, there are a few thin lapilli tuff bands within para-amphibolites and impure quartzites below the Kangigdleq Formation.

ii. Kangigdleq Formation

From observed outcrops several types of transition are evident along the upper contact of the volcanics and the Nukavsak Formation. these are as follows:

1) North-west side of Puatdlarsiviup Qorua. Some 35 m of massive homogeneous dark green amphibole-chlorite metavolcanic schist and 10 m of finely gneissic amphibole- plagioclase-quartz schists pass through a 1 m transition zone of chlorite-biotite-quartz-plagioclase schists (mafic tuffs). This is followed by 1.5 m of pure white banded chert, 0.5 m of shale laminated chert, and then by basal Nukavsak dark grey brown indurated laminated siltstones.

2) North-east side of Puatdlarsiviup Qorua. Some 30 m of actinolite-chlorite schist and retrograded chlorite-epidote schists, commonly laminated or microbanded and folded represent the volcanics. These are overlain by 1.5 - 2 m of green chlorite fragmentals mixed with appreciable dolomite and ankerite and a few 3 - 4 cm cherty bands. Carbonate fills vesicules, and forms the ground mass. Above the carbonate (volcanic limestone?) is 10 - 50 cm of yellow stained mildly pyritic grey banded white chert and then fine grained dark grey siltstones of monotonous upward extent. The chert may locally contain up to 50% pyrrhotite over 0.5 - 1.0 m, but its development is quite sporadic. Equivalent carbonate rich fragmentals occur along Ingia and Puatdlarsiviup, along the west side of Kangigdleq Fjord, and near Tinumanikavsa on the south side of Kangigdleq Fjord. The Johannes Isbrae morain e contains chlorite-actinolite meta-volcanics with frequent ankerite filling vesicules and shear zones. Iron carbonates are common

within the mafic tuffs on Umiamak Nuna, but the upper contact is not exposed.

3) Towards the north end of Ingia Fjord, chlorite-tremolite schists with relict agglomeratic fragments are overlain directly by dirty amphibolitic banded sediments and dark grey banded siltstones.

4) On the north side of Kanglugssuaq Fjord some 5 km from the glacier the following transition is evident. A thick ± 50 - 75 m volcanic amphibolite passes through a transitional 2 - 5 m band of chlorite-biotite-amphibolite metatuffs(?) and is succeeded by 3 m of banded cherty or siliceous siltstone with occasional 25 - 30 cm brecciated pyrrhotite bands, then a 2 m pyrrhotitic chert unit, a 1 m pyrrhotite-graphite chert unit and followed by Nukavsak meta grey wacke. Of the total 10 m section, 2 - 3 m is sulphide dominant (see Photo 11). This unit of pyrrhotite-graphite-chert is extensively developed in this area, up to and along Johannes Isbrae.

iii. Nukavsak Formation

The contact relations and basal Nukavsak stratigraphy are as follow:

1) Contacts with Kangigdleq volcanics are described in the previous section.

2) Contacts with Qeqertarssuaq Formation (sensa stricto) is marked by intervening Kangigdeq volcanics or, south of the Nugatsiaq line a Qeqertarssuaq representative of thin (2 - 10 m) quartzite semipelite may be present. This may be best assigned to lowermost Nukavsak.

3) Contacts with the Umanak gneisses:

a) Kangerdlugssuakavsak. Above the Umanak Gneiss and its tectonically parallel unconformable contact, the lowermost 100 m of Nukavsak Formation comprise dark to reddish brown flaggy bedded quartz-feldspar-biotite-actinolite gneisses and lesser schists (microgneisses, microquartzites, discontinuous quartz-feldspar amphibolites, rare calcitic bands). These are followed by quartz-feldspar- mica schists (siltstone, psammitic siltstones, meta-argillite) and then by banded flysch or turbidite, rare arkose and grey wacke. The first major sulphide interval comes in 600 m above the base. Within the lower 50 m there are local 1 - 3 m non-extensive white to grey marble bands.

b) Niaqornanguaq Point on Inukavsait. Umanak Gneiss is overlain by a few metres of quartz-feldspar-biotite sillimanite schists followed by a one metre banded amphibolite-plagioclase gneiss, and then a further 40 m of varying quartz-feldspar-biotite schists with occasional sillimanite, occasional fine graphite flakes and a few 1 - 2 m quartzite bands. Some 40 - 50 m above the base is a refolded pyrrhotitic cherty graphitic iron formation varying from 15 to 20 m thick. This seems to pass laterally into a unit of graphite free pyrrhotitic chert and banded pyrrhotite rich quartz-feldspar mica -biotite schist.

c) North side of Kangerdlugssuaq Fjord (52°09'W). Migmatitic grey Umanak Gneiss underlies non migmatitic coarse grained mesocratic biotite schists with occasional calcareous recessive weathering bands of the basal Nukavsak (± 30 m) followed by another 30 m of fine grained biotite rich schist with calc silicate bands. This is followed by quartz-feldspar- mica -biotite schist, and then perhaps 250 m of mixed banded siltstone and calcareous schist (calc turbidite). Perhaps 320 m above the unconformity occurs the first major, extensive sulphide-chert unit.

d) Opposite Karrat Island (Akuliaruseq). Some 10m of rusty amphibolite (ortho? para?) with sandstone bands overlie the Umanak gneiss, followed by a thick (50 m) sequence of laminated and banded amphibolite. Above the amphibolite, the Nukavsak forms an impure gneissic metaclastic for some 10's of metres, and then a siliceous marble and chert unit appears (3 beds each of 2 - 3 m). The marbles are underlain by a thick pale grey banded chert, and overlain by several 10's of metres of amphibole bearing greywackes and mica schists.

e) Eight kilometres to the north-west of d), at Satukujoq the basement gneiss passes through thin bedded flaggy metasediments with a few tremolite bands, into a monotonous 90 m section of thin-beded quartz-feldspar-biotite schists with amphibolite, garnet and/or biotite. A 2½ m massive pyrrhotite breccia suddenly occurs 110 m above the unconformity followed by 1½ m of cherty quartz-feldspar-biotite shale. This is overlain by further Nukavsak metapelites and thin turbidites.

f) Kangerdluarssup qingua (east end of Kangerdluarssuk Fjord). A basal unit of grey green amphibolitic metasediment lies directly on Umanak Gneiss. This unit is ± 20 m thick and typically contains tremolitic or vague calcareous bands of a few cms in its upper few metres. It is succeeded by 100 m of thin-bedded dirty grey siltstones with some mudstone laminae with a few intercalated rusty amphibolitic bands (para amphibolite). An 80 m unit of sandy siltstone follows this unit. Some 200 m above the unconformity, fissile shaly micaceous units begin to predominate over sandy siltstone, and then black graphitic siltstones and grey siltstones make their appearance. This gross sequence of fining upwards shows occasional setbacks with some coarse influxes of sandstone or silty sandstone which indicate a rejuvenation of source area rather than turbidite greywackes.

g) Tornit Point, Kangerdluarssuk Fjord. Three kilometres south-east of Tornit Point, basal Nukavsak lies on veined agmatitic banded gneiss which contains rare amphibolitic bands cut by pegmatite. The lowermost Nukavsak consists of 50 m of dark green banded and folded amphibolite of a remarkably homogeneous colour index, cut by frequent quartz and pegmatite veins. The derivation of the amphibolite is not obvious. In its upper 5 m are found intercalated carbonate bands, then a rapid transition over 1 m (shaly marble) to 5 - 7 m of banded tremolite-talc-dolomite and banded white dolomite with impure chert bands. The carbonates pass into ± 7 m of pyritic chert with rare carbonate bands. These are finally succeeded by banded granular quartz-feldspar - quartz-feldspar-biotite siltstones and greywackes (cut by quartz-feldspar- Mica -tourmaline pegmatites).

iv. The Marmorilik Formation

Two sections illustrate the distal intertonguing of Marmorilik carbonates with the Nukavsak Formation.

1) Den Sorte Nunatak. 1270 m asl, 27 km 030° from Marmorilik into the inland ice (71°20'North, 51°56' West). A small nunatak 2 km to the west shows an incomplete basal section. Umanak gneiss at the unconformity shows a horizon of several metres of altered clay like gneiss succeeded by 1 - 2 m of grey quartzite, the upper 0.5 m of which is dolomitic and contains some pyritic bands. Above this is 3 - 4 m of algal stromatolitic dolomite containing silt bands, dessication features and intraformational breccias. these are quickly succeeded by dark grey massive dolomites (5 m), very dark grey argillites (10 m), grey quartzites (8 m) and then a thick sequence of black argillites with ± 10% silt free grey limestone bands of 2 - 3 m thickness. This latter unit, in excess of 70 m thick, passes under the ice cap.

2) Kangerdluarssup Sermia. An appreciable thickness of carbonate is developed on the east side of the glacier. The stratigraphy is complicated by nappe structures and later high angle thrusts developed in the Karrat Group. The Umanak Gneiss is overlain by a thin (1 - 2 m) cherty quartzite unit followed by a 10 - 25 m unit comprising thin marble bands of 2 - 3 m, silicified black shale, pyritic black shale with as much as 50% pyrite over 8 - 10 m, and chert bands. These 4 lithologies alternate over the 10 - 25 m thickness of the unit. Pyrite is present as nodules, as disseminations, and as buckshot massive pyrite in pelite. This basal unit is overlain by 75 - 100 m of grey limestone marble with intercalated shale bands. The carbonate content is in excess of 60%. Tremolite marbles locally form distinctive horizons, as do cherty units. Quartzites, and phyllitic quartzites some 50 m thick overlie the carbonates, and are succeeded by turbidites (interbanded greywacke and dark pelites).

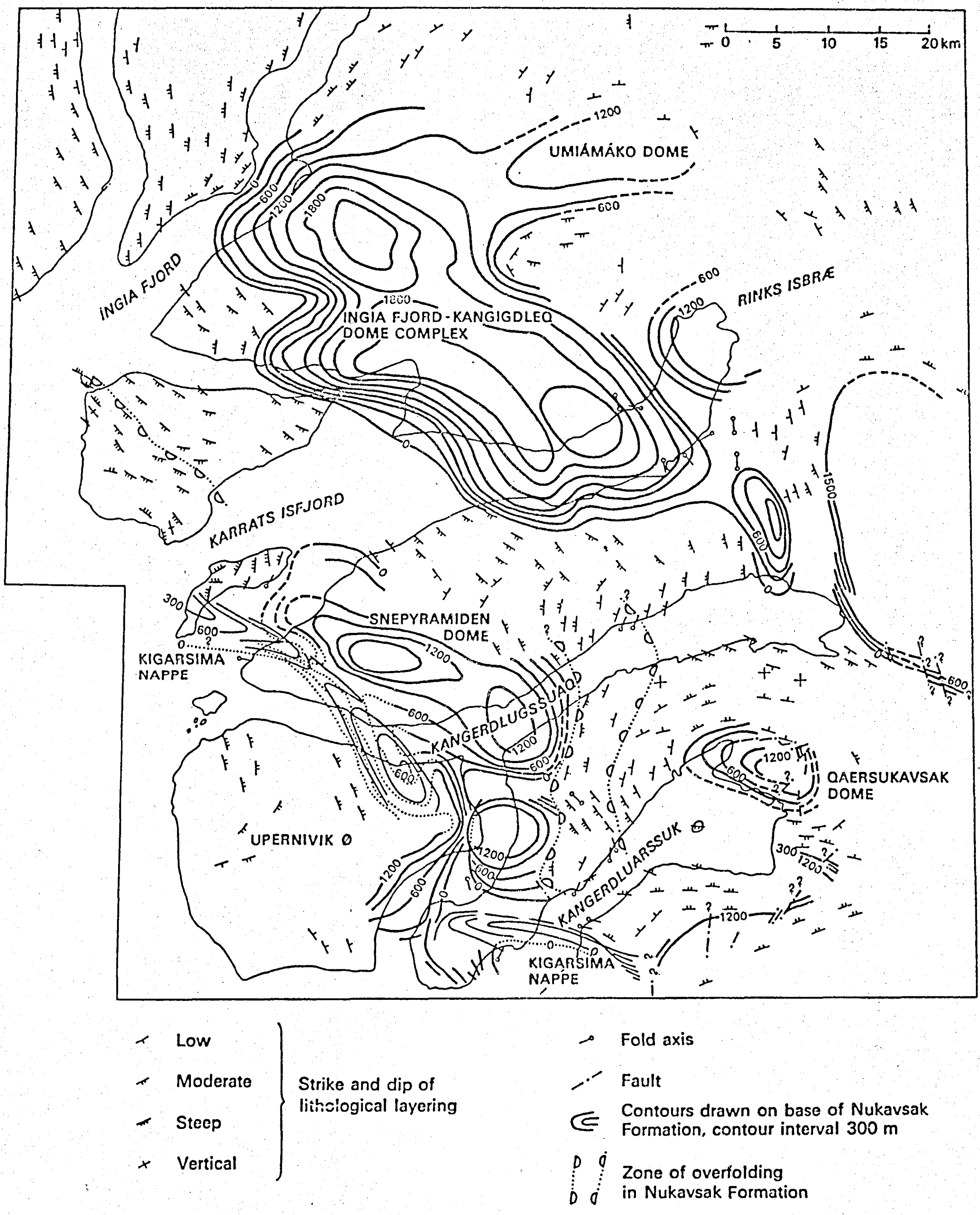


Fig. 1 Simplified structural map of the central part of the Umanak - Rinks Isbrae area, showing structural contours for the base of the Nukavsak Formation (from Escher and Pulvertaft 1976).

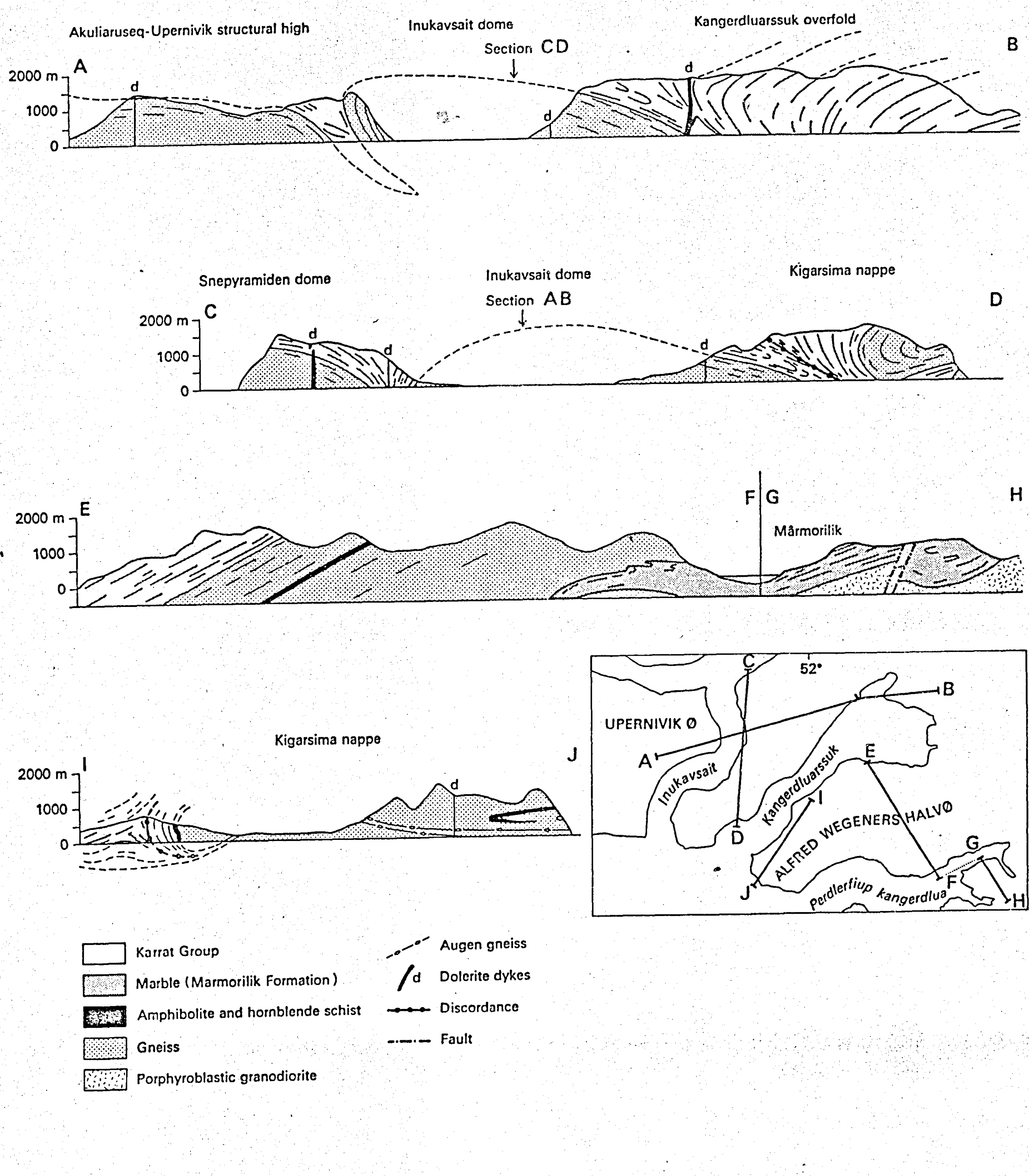
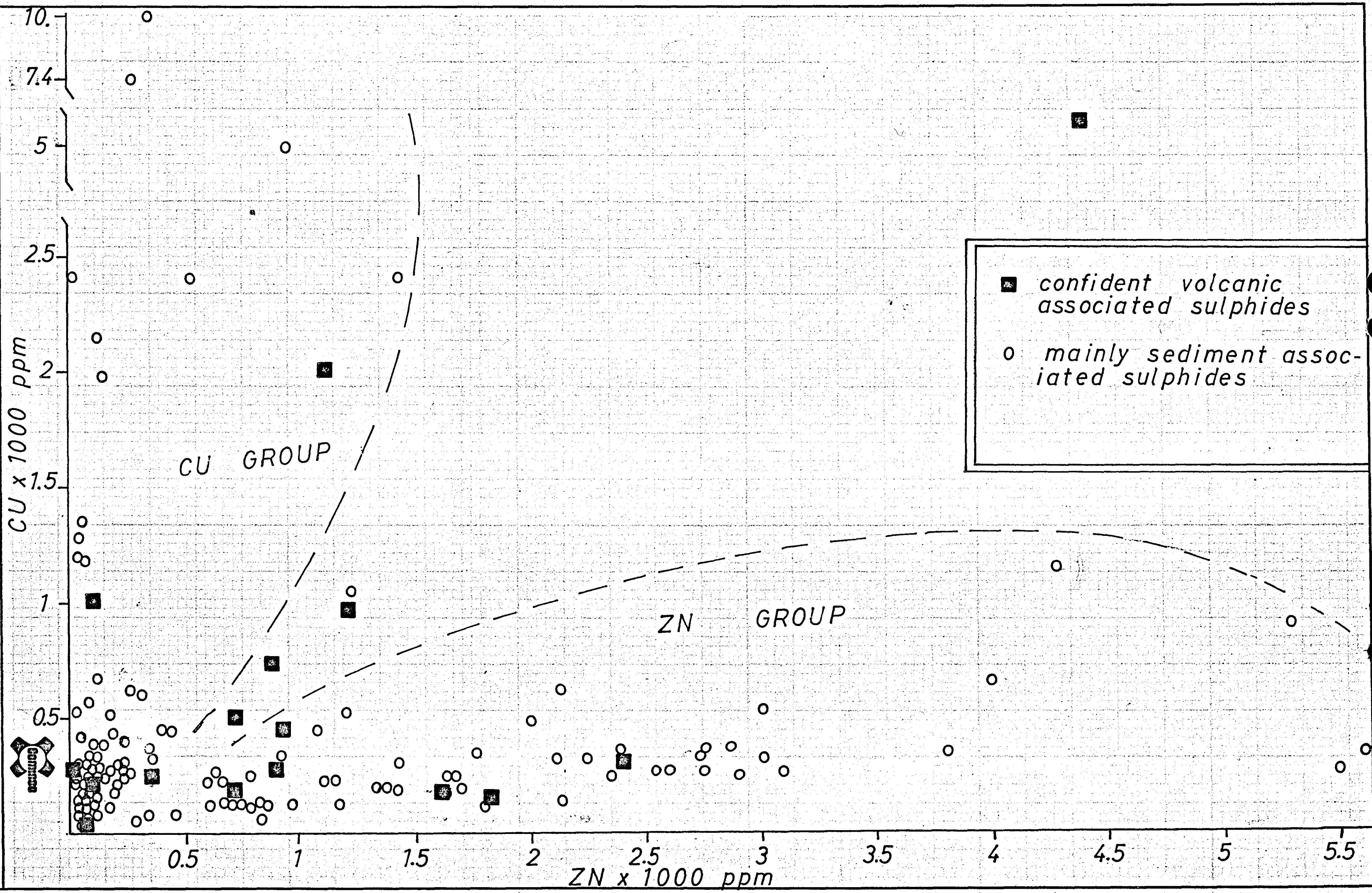


Fig. 2 Representative cross sections through the central part of the Umanak - Rinks Isbrae area. Horizontal and vertical scales are the same. The Marmorilik Formation can be shown to terminate in an overturned syncline in section E-F, and to be laterally equivalent to Karrat lithologies (after Escher and Pulvertaft 1976).



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CU-ZN DISTRIBUTION IN SULPHIDE LITHOLOGIES OF THE KARRAT GROUP

Date: 22 4 80

Plate: FIG. 3

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210-0610

TABLE 1 STRATIGRAPHY OF THE KARRAT GROUP

in the programme area.

substantially revised from Henderson and Pulvertaft (1967)

	KANGIGDLEQ FJORD	KANGERDLUARSSUK FJORD	KANGERDLUARSSUP SERMIA AND DEN SORTE NUNATAK	MARMORILIK
Lower Proterozoic KARRAT SUPERGROUP	NUKAVSAK FM 5000 m ? black shale siltstone fine turbidite turbidite greywacke	NUKAVSAK FM 5000 m siltstone turbidite greywacke	NUKAVSAK FM ? black pelite siltstone	NUKAVSAK FM > 500 m black pelite
	KANGIGDLEQ FM 50 – 600 ? m komatiitic to basic volcanics	± 1000 m calc turbidite blackshale siltstone turbidite		MARMORILIK FM ± 1300 m dolostone limestone pelite interbeds
	QEQERTARRSSUAQ FM 100 – 2000 m quartzite, pelite	± 100 m ortho and para amphibolite limestone, pelite	MARMORILIK FM ± 100 – 200 m limestone, interdigitated black shale	
			pelite, chert ± 30 m	quartzite 50 m
		unconformity		
Archean	UMANAK GNEISS			

Table 2 Whole rock Analyses of Kangigdleq and Nunatak Formation Volcanics

Sample No:	875	746	744	754	800	730	786	777	779	797
SiO_2	39.62	47.47	43.14	45.57	33.69	45.39	50.46	44.98	52.96	47.47
TiO_2	1.38	1.28	1.93	1.67	1.26	2.12	2.37	2.88	1.21	1.48
Al_2O_3	6.78	6.79	8.36	8.77	6.06	10.56	10.15	12.64	15.61	15.00
$Fe_2O^*_3$	11.09	11.23	12.52	11.55	7.33	12.45	10.32	10.78	10.31	12.21
MnO	0.08	0.05	0.05	0.02	0.10	0.03	0.05	0.10	0.10	0.04
MgO	18.30	18.29	18.65	15.17	10.35	10.77	6.46	5.48	2.90	6.57
CaO	11.37	10.64	8.98	11.41	22.39	12.91	13.10	11.07	3.82	11.27
Na_2O	0.66	1.05	0.87	1.37	1.24	1.96	1.47	3.66	6.75	1.58
K_2O	0.01	0.15	0.10	0.22	0.20	0.45	0.47	0.77	0.70	0.30
P_2O_5	0.12	0.12	0.19	0.19	0.22	0.25	0.31	0.35	0.35	0.15
L O I	5.86	0.08	1.27	0.28	12.98	0.01	0.75	3.28	0.27	0.54
Total	96.41	98.33	97.39	97.47	96.53	98.25	97.01	97.09	96.02	97.93
Cu ppm	38	66	32	77	81	64	50	2	177	63
Pb	<4	<4	<4	<4	<4	<4	<4	4	11	<4
Zn	30	34	38	19	14	16	26	41	90	17
Mn	607	400	417	127	807	238	445	700	750	307
Mg/Mg + Fe	.746	.744	.726	.700	.694	.607	.527	.447	.334	.489

* Total iron as Fe O

Kangigdleq Formation	875	Fragmental Unit	North end of Ingia Fjord
	746	Fragment in Agglomerate	Northwest of Putdlarsivik
	744	Schistose Agglomerate	Northwest of Putdlarsivik
	754	Amph-Chl-Ep schist	Puatdlarsiviup Valley
	800	Chl-calcite volcanic fragmental	south side of Kangigdleq Fjord
	730	Amphibolite	South end of Ingia Fjord
	786	Chl lapilli tuff	North side of Kangigdleq Fjord
	777	Dyke	Umiamako Nuna
	779	Andesite Band	Umiamako Nuna
Nunataq Formation	797	Massive Amphibolite	

Kangigdleq Fm metavolcanics – analyses

Table 3 Geochemistry of Karrat Group Sulphide-Graphite-Chert Unit (sulphide rich members).

ELEMENT	n	min	max	x̄ (all values in ppm)	σ	sea water[2]	enrichment factor[4]	avg black shale[3]	median 95th[3]
Ag	11	1.2	9	6.3	-	0.04	157	1	2
Co	113	5	410	59.2	53	0.15?	393	10	15
Cu	111[1]	36	5050	467	555	0.25	2220	70	150
Ni	113	307	2800	994	445	0.6	741	50	100
Mo	79	2	490	65.2	77.3	10	7.7	10	50
Pb	113	5	283	38.8	38.6	0.03	1286	20	50
Zn	113	19	5700	975	1265	3.0	421	< 300	500

1) excludes two values at 7,400 and 10,000 ppm Cu

2) HOLLAND H. D. 1979 ECON. GEOL v 74 p. 1676 - 1680
KHARKAR ET AL 1968 GEOCHEM COSMO. ACTA v 32 p. 285 - 298

3) VINE AND TOURTELOT 1970 ECON. GEOL. v 65 p. 253 - 272
average black shale = median of median of 20 sets
median 95th = median of 95th percentile of 20 sets

4) x̄ divided by concentration in sea water

Table 4 Summary of Geochemical Statistics Karrat Group Heavy Mineral Samples

Element	No. of Analyses	Range	Units	Arith. Mean	(M + 2 Std. Dev.)	Geo. Mean	(M + 2 Std. Dev.)
Copper	176	1020 TO 41	ppm	247.5	(651)	187.6	(808)
Lead	176	112 TO < 4	ppm	17.4	(56)	9.5	(94)
Zinc	176	1140 TO 28	ppm	282.1	(728)	212.3	(1005)
Cobalt	175	150 TO 3	ppm	37.3	(81)	31.9	(98)
Nickel	176	513 TO 12	ppm	141.2	(320)	116.1	(421)
Silver	176	2.3 TO < .4	ppm	0.4	(1)	0.2	(0)
Iron	173	36.30 TO 2.7	%	12.28	(26.60)	10.30	(35.07)
Manganese	176	1270 TO 300	ppm	794.6	(1224)	762.8	(1380)
Arsenic	176	994 TO < 2	ppm	90.6	(390)	23.2	(1190)
Molybdenum	175	75 TO < 2	ppm	13.5	(40)	7.7	(82)
Tungsten	176	40 TO < 2	ppm	6.9	(20)	5.1	(22)
Gold	174	160 TO < 10	ppb	9.9	(40)	7.0	(26)
Uranium	175	45.0 TO < 0.1	ppm	7.1	(20)	4.7	(35)
Barium	175	1403 TO 82	ppm	465.5	(971)	398.5	(1267)
Tin	175	70 TO 4	ppm	9.6	(29)	6.6	(35)

Table 5 Summary of Geochemical Statistics Karrat Group Silt Samples

Element	No. of Analyses	Range			Units	Arith. Mean	(M + 2 Std. Dev.)	Geo. Mean	(M + 2 Std. Dev.)
Copper	231	265	TO	13	ppm	71.5	143	63.7	(169)
Lead	231	60	TO	1	ppm	6.5	21	4.4	(22)
Zinc	231	620	TO	8	ppm	104.5	247	88.0	(294)
Cobalt	231	47	TO	3	ppm	15.9	30	14.2	(39)
Nickel	231	249	TO	7	ppm	59.5	137	50.0	(162)
Silver	231	0.7	TO	<0.4	ppm	0.2	0	0.2	(0)
Iron	230	11.0	TO	0.5	%	3.27	6.01	2.98	(7.34)
Manganese	231	800	TO	52	ppm	347.3	608	319.1	(777)
Arsenic	231	189	TO	< 2	ppm	22.0	67	13.4	(116)
Antimony	231	<5	TO	<4	ppm	2.4	2	2.3	(2)
Molybdenum	230	70	TO	2	ppm	4.0	14	3.0	(10)
Uranium	231	20.0	TO	0.1	ppm	3.0	7	2.4	(8)

Table 6 Correlation Matrices for Karrat Stream Geochem Study

6a. Karrat Group Silts n = 230

	Cu	Pb	Zn	Co	Ni	Mn	Fe
Cu	1.00						
Pb	0.45	1.00					
Zn	0.77	0.51	1.00				
Co	0.74	0.43	0.75	1.00			
Ni	0.76	0.46	0.80	0.88	1.00		
Mn	0.54	0.35	0.63	0.79	0.67	1.00	
Fe	0.64	0.42	0.58	0.50	0.51	0.53	1.00

6b. Karrat Group Heavy Mineral Samples n = 172

	Cu	Pb	Zn	Co	Ni	Mn	Fe
Cu	1.00						
Pb	0.73	1.00					
Zn	0.85	0.64	1.00				
Co	0.73	0.65	0.54	1.00			
Ni	0.70	0.52	0.58	0.81	1.00		
Mn	0.25	0.29	0.31	0.48	0.46	1.00	
Fe	0.81	0.59	0.86	0.53	0.53	0.35	1.00

Table 7A List of Anomalous Zn Samples (>700 ppm).

++ very high
+ above threshold
o threshold
- below threshold

Sample No.	Zn	Cu	Pb	Fe	Co	Ni	Ag	
(T)	728	651	56	26.6	81	320	/	
512	1140	800	-	+	-	-	+	follow up
513	1090	-	-	-	-	o	-	"
514	1000	845	+	+	o	-	+	"
515	770	570	-	-	-	-	+	"
517	770	570	-	-	-	-	+	"
593	800	980	o	-	o	+	o	default high Fe, Ni
594	1000	950	+	+	o	+	+	"
645	710	670	+	o	+	+	+	"
659	1030	1020	+	++	-	-	+	"
662	750	600	-	o	o	o	+	follow up high Fe
756B	820	540	+	++	-	o	+	default high Fe
756	900	610	+	++	o	+	+	" high Fe, Ni
757	730	560	-	+	-	o	-	" high Fe
760	860	713	-	+	-	-	-	" high Fe

Table 7B List of Marginally Anomalous Zn Samples (500-700 ppm).

Sample No.	Zn	Fe	Ni	
557	500	17.0	175	follow up
650	532	17.5	215	"
654	580	23.5	174	"
665	610	21	269	default high Fe, Ni
758	540	27.8	279	"
759	540	21.7	315	"
762	610	31.0	327	"

(screened using $\overline{x}$ + one standard deviation Fe = 19.4
Ni = 230)

Table 8 List of Anomalous Cu Samples

(Range $\overline{x} + 1\sigma$ to $\overline{x} + 2\sigma$) with Zn

less than threshold

values in ppm

Sample No.	Cu	Fe	Ni	Co	
(T)	651	19	230	81	
	(2σ)	(1σ)	(1σ)	(2σ)	
596	690	-	-	-	follow up
643	530	+	+	+	NO
644	650	o	+	++	NO
645	670	++	++	++	NO
649	573	-	++	++	NO
654	533	+	-	-	follow up
665	690	+	+	+	NO
748	550	-	++	+	NO
758	590	++	+	o	NO
759	536	+	+	o	NO
762	700	++	+	+	NO

Table 9 Summary List of Heavy Mineral Anomalies

Recommended for Follow Up

Sample Number	Elements
* 512	Zn, Cu
* 513	Zn
* 514	Zn, Pb, Cu, Mo, Ag
* 515	Zn, Pb, Cu, Ag
517	Zn, Pb, Cu, Ag
518	Ba
520	Ba
521	Ba
523	Ba
557	Zn
* 571	Mo
* 572	kimberlite
* 574	Mo
* 577	kimberlite
581	W
582	Ba
583	Ba
593	Zn, Cu
* 594	Mo, Ag, Cu, Zn, As
596	Cu
645	As, Cu, Zn, Ag
650	Zn
654	Zn, Cu
* 659	Mo
662	Zn
673	Sn, Mo
714	W, Pb
730	Sn
748	Cu
* 760	Au
762	W, As, Cu, Zn, Ag
763	W, Ni
900	Au, Ni
939	Sn, W

* also an anomalous silt sample

Table 10 Cu and Zn silt anomalies

Copper			Zinc		
Sample No.	Cu(ppm)	Ni(ppm)	Sample No	Zn(ppm)	Ni(ppm)
	(>107)	(<100)		(>175)	(<100)
514	142	66	514	191	66
515	140	33	517	156	79
551	106	73	551	158	73
559	110	92	557	172	85
561	112	76	561	166	76
567	128	77	578	183	84
578	117	84	594	210	96
587	110	85	639	184	97
593	107	80	646	151	92
594	156	96	659	230	68
659	265	68	660	158	66
760	122	75	760	194	75
752	125	79	752	161	79
833	106	75	833	155	75
808	108	58	824	140	71
590	103	58	515	142	33
673	103	47	565	142	67
776	100	24	567	146	77
			662	141	70
			665	140	78

common samples
514,515,551,561,567,578,594,659,760,752,833

Table 11 Summary List of Silt Anomalies

Recommended for Follow Up

Sample Number	Elements
* 512	Mo
* 513	Mo
* 514	Mo, Cu, Zn
* 515	Mo, Cu, Zn
551	Cu, Zn
561	Cu, Zn
562	Mo
567	Cu, Zn
578	Cu, Zn
594	Cu, Zn
659	Cu, Zn
665	Pb
752	Cu, Zn
760	Cu, Zn
825	Mo, Pb
826	Mo, Pb
827	Mo, Pb
828	Mo, Pb
829	Mo, Pb
830	Mo
833	Cu, Zn

* also an anomalous heavy sample

Photo 1 The Hanne Gitte, 57' steel hulled trawler, built 1973, 270 H.P. cruises at 9.5 knots. Anchored in Karrat Isfjord - Karrat Island to left, Qaqertarssuaq Island to right. Early August, 1979.

Photo 2 Kangigdleq Fjord East of Umiamako Nuna. Johannes Brae Glacier in (behind left wall !) centre background, 18 km away, where topography rises to 2000 m. The 16 foot rubber Zodiac boats with 25 H.P. outboard motors proved to be excellent under all of the experienced conditions of ice, tide, waves and winds.

Photo 3 North side of Kangigleq Fjord. Width of photo 10 km, height 2150 m. The lower half of the cliff face is metasedimentary Umanak Gneiss overlain by $\pm$ 1200 m of Qeqertarssuaq quartzites and metapelites. Note the structural discordance of contact and Umanak Gneiss foliation. An erosional remanent of volcanic Kangigdleq Formation survives near the glacier and ice field to the right at elevation 2000 m.

Photo 4 North side of Kangerdluarssuk Fjord. Width of field, 6 km, average height 1650 m. The triangular grey-white unit to the left is Umanak Gneiss in the core of the Kigarsima nappe. Karrat Group lithologies underlie the gneiss, and form the arcuate fold in the centre and right of the photo. Some 3000 m of Nukavsak Formation clastics is exposed in this section. The axis of the nappe is approximately horizontal, east-west trending, and verging towards the north.

Photo 5 The Rinks Glacier (right) and the North corner of Kangigdleq Fjord. In the middle background 100-200 m of basic volcanics overlie the Qeqertarssuq Formation at the level of the prominant bench. A discontinuous orangy gossan forms a thin band above the volcanics. The dark overlying unit, extending from 1000-1700 m elevation is the Lower Nukavsak Formation.

Photo 6 North side of the Johannes Glacier, to the east of Kangigdleq Fjord. The dark band in the middle is ± 150 m of basic volcanic with Qeqertarssuak Formation below, Nūkavsak Formation above. A second prominent dark band exposed in the cirque to the left and passing to the cliff top on the right is another presumed volcanic interval.

Photo 7 Vesicular Basaltic pillow breccia and agglomeratic fragmental cemented by hyaloclastite and tuff material. Exposed along Ingia Fjord near Puatdlarsiviup where thickness is ± 75 m.

Photo 8 Deformed basic volcanic fragmentals and basaltic tuffs exposed on the east side of Kangigdleq Fjord between Rinks and Johannes Isbrae. Metamorphic assemblage is quartz-chlorite-biotite-actinolite-oligoclase. Estimated thickness is ± 400 m at this locality.

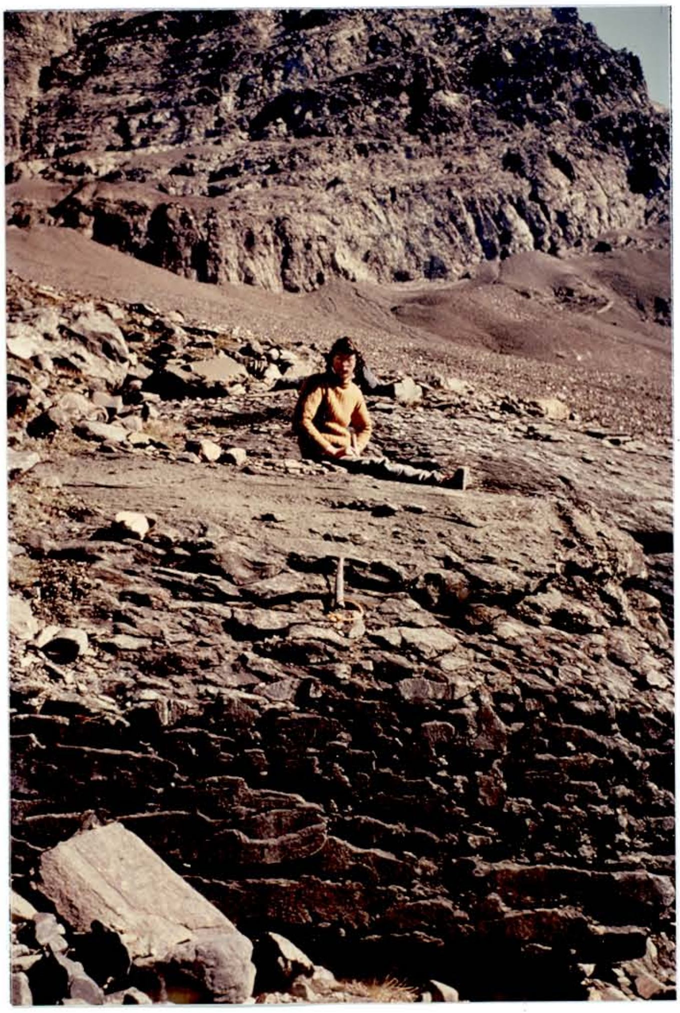

Photo 9

Transition from pillowed andesite to pillow breccia to agglomeratic and tuffaceous andesite-dacite. In the background are metasediments of the overlying Nukavsak Formation. Located on East side of Ingia Fjord near Puatdlarsiviup.

Photo 10 NE wall of Puatdlarsiviup Qorua. Height of exposure ± 1000 m. The talus is banked against Qeqertarssuaq Formation. Discontinuous lenses of meta basalts ± 75 m thick occur in the middle of the face, overlain by thin gossan bands of ankeritic tuffs and pyritic/pyrrhotitic cherts. The upper 500 m of red brown weathering rock is basal Nukavsak meta sediment.

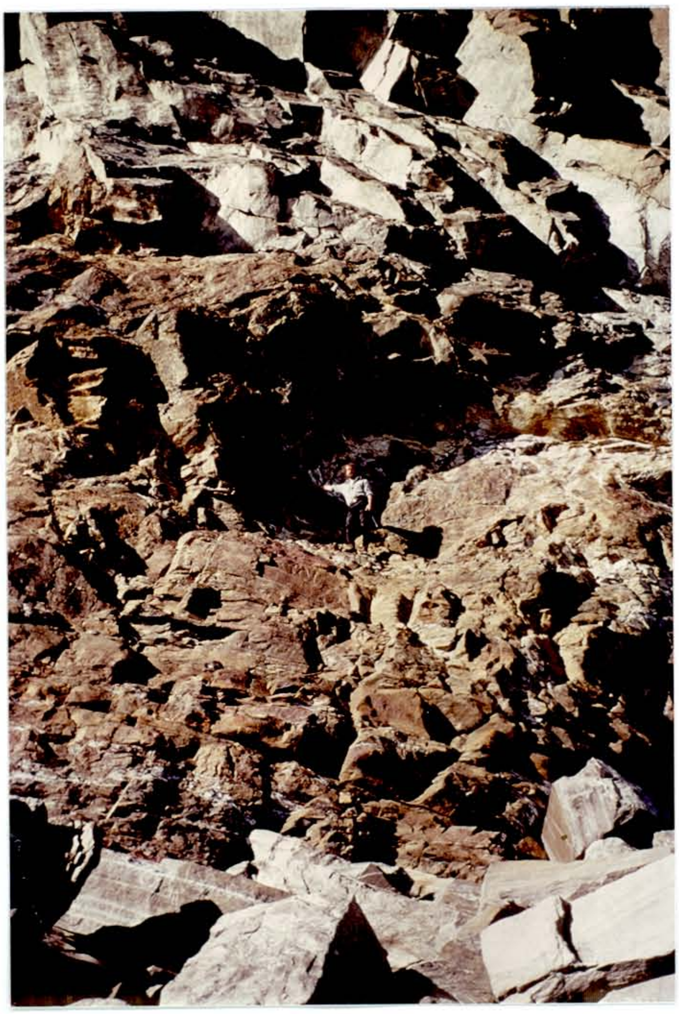

Photo 11

Ten metres of pyrrhotite bearing chert, cherty siltstone above amphibolitic metavolcanics. North side of Kangerdlugssuaq Fjord, five km east of the glacier. Amphibolite passes up to a thin chlorite-biotite transition zone, then to several metres of cherty siltstone with 25-30 cm Pyrrhotite breccia zones, a 2 m cherty Pyrrhotite unit just above the geologist, and topped by a Pyrrhotite graphite breccia unit. Of the 10 m zone, 2-3 m is pyrrhotite dominant. The hanging wall is meta grey wacke.

Photo 12 White oxide coated pyrrhotite graphite chert bands and sulphide poor chert bands intercalated with grey wacke and siltstone, outcropping near Kangerdlugssuakavsak. The thickness approaches 11 m here, 50% of which is Po breccia, 50% of which is chert with disseminated Po. This sulphide band is $\pm$ 500 m above the base of the Nukavsak Formation, and can be traced for at least 20 km.

Photo 13 A greater than 30 m thick Pyrrhotite rich graphitic chert band on the North side of Kangerdlugssuaq Fjord 28 km West of the glacier (Hammer for scale). The sulphide band, thickened by folding, consists almost exclusively of milled cherty pebbles coated by graphite in a matrix of 30-50% Po. Hanging and foot wall rocks are greywacke - siltstone. Locates $\pm$ 300 m above base of Nukavsak Formation.

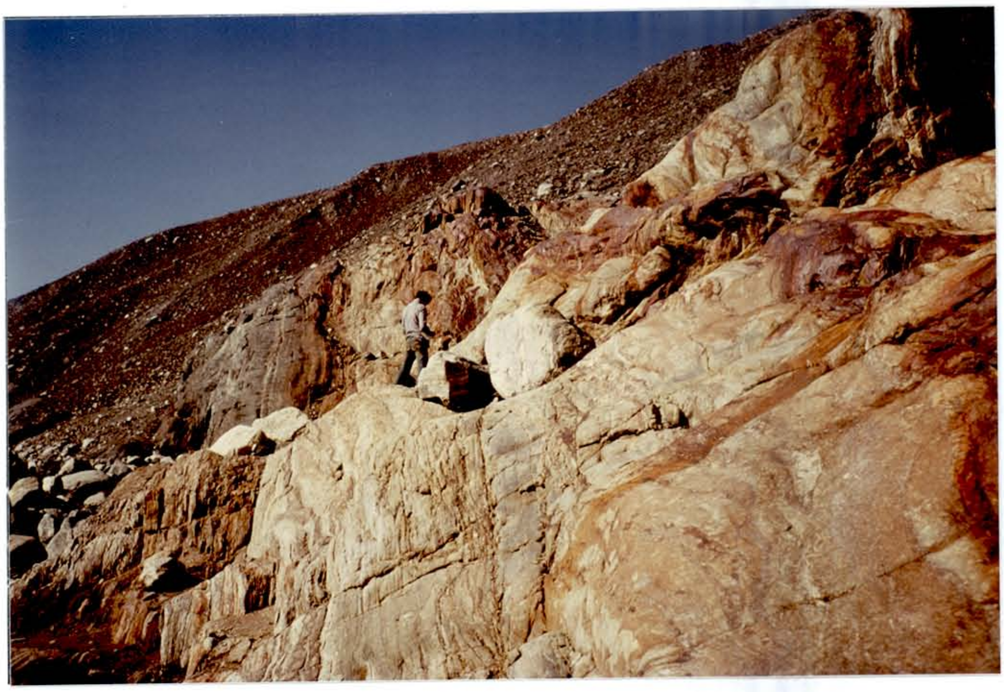

Photo 14 Fringe of Marmorilik Formation below the Nukavsak Formation, 3 km SE of Tornit point on South side of Kangerdluarssuk Fjord. Basal green amphibolites (para gneiss?) $\pm$ 50 m thick (to left) lies on Umanak Gneiss, and overlain by a transition zone then 7 m of recrystallized marble (centre), followed by cherty marble (1 m) and 7 m of chert with disseminated and massive pyrrhotite. Graphite is absent. Above the chert is QFB schist of the Lower Nukavsak.

ANALYTICAL RESULTS

NOTES

1. Prefix H79 relates to heavy mineral samples.

2. Prefix S79 relates to silt samples.

3. Uranium values : The terms of the non-exclusive exploration concession do not include uranium exploration which is reserved to the state.

   As a result, the uranium analyses which were automatically run as part of a routine laboratory procedure were not subjected to the same detailed scrutiny as the other elements.

   It is apparent from scanning that eight consecutive samples (570-577) draining the Qioqe headland appear anomalous.

   This area may prove to be of interest for follow-up by either the GGU or other interested government department.

REPORTING DATE 7 APR 1980

SAMPLE NUMBER	FIELD NUMBER	VOLUME ml	YIELD g	RATIO g/l
H80 00080	775	450	26.2	58.2
H80 00081	776	450	107.1	238.0
H80 00082	785	450	36.0	80.0
H80 00083	842	450	13.6	30.2
H80 00084	845	450	31.6	70.2
H80 00085	846	600	13.1	21.8
H80 00086	850	600	12.2	20.3
H80 00087	852	450	12.3	27.3
H80 00088	853	900	12.7	14.1
H80 00089	855	450	42.1	93.5
H80 00090	857	450	64.6	143.5
H80 00091	860	450	34.8	77.3
H80 00092	861	450	55.5	123.3
H80 00093	865	450	80.3	178.4
H80 00094	872	450	33.0	73.3
H80 00095	886	450	10.9	24.2
H80 00096	891	###	14.4	10.6
H80 00097	895	###	15.1	11.1
H80 00098	900	###	24.6	18.2
H80 00099	902	450	28.0	62.2
H80 00100	907	450	56.0	124.4
H80 00101	908	450	42.3	94.0
H80 00102	911	450	19.4	43.1
H80 00103	916	450	43.8	97.3
H80 00104	923	450	72.0	160.0
H80 00105	924	450	33.7	74.8
H80 00106	927	450	60.3	134.0
H80 00107	935	450	83.1	184.6
H80 00108	939	450	46.6	103.5
H80 00109	545	600	14.1	23.5
H80 00110	921	450	44.8	99.5

HMG yield data: 'VOL (ml)' is the approximate volume of -18 mesh material processed through heavy liquids: 'YIELD (g)' is the weight of heavies (after removal of ferromagnetics) obtained from that volume; 'RATIO (g/l)' is the yield per unit volume

REPORTING DATE 14 APR 1980

SAMPLE NUMBER	FIELD NUMBER	W ppm	Mo ppm	U ppm
H80 00080	775	5	5	4.5
H80 00081	776	<2	<2	<0.1
H80 00082	785	5	<2	3.7
H80 00083	842	8	12	5.0
H80 00084	845	2	3	1.3
H80 00085	846	10	15	5.8
H80 00086	850	8	9	6.6
H80 00087	852	8	7	5.6
H80 00088	853	10	11	5.8
H80 00089	855	3	4	2.6
H80 00090	857	<2	<2	0.6
H80 00091	860	2	<2	1.5
H80 00092	861	<2	<2	1.2
H80 00093	865	<2	2	0.7
H80 00094	872	3	4	21.0
H80 00095	886	8	9	6.7
H80 00096	891	2	10	11.0
H80 00097	895	5	7	7.0
H80 00098	900	15	2	3.0
H80 00099	902	3	<2	1.0
H80 00100	907	8	<2	0.5
H80 00101	908	6	<2	0.6
H80 00102	911	5	5	4.5
H80 00103	916	<2	<2	0.7
H80 00104	923	<2	<2	1.2
H80 00105	924	<2	<2	1.6
H80 00106	927	4	<2	9.0
H80 00107	935	8	3	3.7
H80 00108	939	40	<2	2.0
H80 00109	545	3	26	6.6
H80 00110	921	4	<2	1.6

Where analysis requested but no values shown, results are to follow

ANALYTICAL METHODS

W
K2S207 fusion/colorimetric

Mo
HNO3-HC104/colorimetric

U
HNO3/fluorimetric

565

Where analysis requested but no values shown, results are to follow

ANALYTICAL METHODS

Au
Aqua regia/solvent extr/AA

As
K2S2O7 fusion/colorimetric

Cu
Pb
Zn
Ag
Co
Ni
Fe
Mn
Aqua regia/AA

10711

SAMPLE NUMBER	FIELD NUMBER	VOLUME ml	YIELD g	RATIO g/l
H79 04475	693	750	12.5	16.6
H79 04476	696	###	20.8	12.6
H79 04477	697	450	146.2	324.8
H79 04478	698	450	78.3	174.0
H79 04479	699	450	76.5	170.0
H79 04480	700	450	44.7	99.3
H79 04481	714	450	25.3	56.2
H79 04482	728	450	10.0	22.2
H79 04483	730	450	30.1	66.8
H79 04484	733	450	74.4	165.3
H79 04485	734	450	68.3	151.7
H79 04486	735	450	63.4	140.8
H79 04487	739	450	68.0	151.1
H79 04488	747	450	13.6	30.2
H79 04489	748	450	19.0	42.2
H79 04490	756	900	12.1	13.4
H79 04491	757	900	13.3	14.7
H79 04492	758	750	13.0	17.3
H79 04493	759	600	19.0	31.6
H79 04494	760	600	13.9	23.1
H79 04495	761	750	12.1	16.1
H79 04496	762	900	12.5	13.8
H79 04497	763	750	16.0	21.3
H79 04498	772	450	33.2	73.7
H79 04499	773	450	51.6	114.6
H79 04500	774	450	48.3	107.3

HMG yield data: 'VOL (ml)' is the approximate volume of -18 mesh material processed through heavy liquids; 'YIELD (g)' is the weight of heavies (after removal of ferromagnetics) obtained from that volume; 'RATIO (g/l)' is the yield per unit volume

KARRAT JOB V80 – 0139H

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	As ppm	Co ppm	Ni ppm	Fe %	Mn ppm
H80 00080	775	114	7	182	<.4	20	<2	21	57	6.80	790
H80 00081	776	102	<4	42	<.4	20	<2	13	35	3.10	490
H80 00082	785	124	17	48	<.4	20	25	61	76	5.60	550
H80 00083	842	240	17	370	<.4	20	58	45	160	15.50	1025
H80 00084	845	74	<4	158	.4	<10	7	47	79	11.10	1170
H80 00085	846	226	24	370	<.4	<10	91	43	165	16.80	1000
H80 00086	850	220	14	220	<.4	<10	60	47	203	12.00	920
H80 00087	852	219	13	300	<.4	16	63	48	167	14.90	1068
H80 00088	853	490	21	320	.4	20	314	90	283	15.00	945
H80 00089	855	164	4	168	<.4	<10	76	38	215	8.40	840
H80 00090	857	102	<4	60	<.4	24	<2	25	157	4.35	550
H80 00091	860	124	4	80	<.4	20	36	26	104	5.10	710
H80 00092	861	128	<4	72	<.4	20	15	21	74	4.53	565
H80 00093	865	127	<4	83	<.4	<10	11	31	210	5.00	630
H80 00094	872	270	28	157	<.4	20	121	30	101	7.03	765
H80 00095	886	320	10	265	<.4	36	292	67	166	13.90	1090
H80 00096	891	350	17	250	<.4	<10	94	54	190	13.30	1125
H80 00097	895	530	13	200	<.4	<10	236	54	178	9.70	830
H80 00098	900	147	4	110	<.4	100	107	52	513	8.50	1250
H80 00099	902	151	<4	134	<.4	<10	51	38	208	8.25	1140
H80 00100	907	145	<4	70	<.4	10	57	32	134	5.50	830
H80 00101	908	180	<4	124	<.4	<10	103	47	200	6.64	746
H80 00102	911	170	10	270	<.4	<10	88	41	153	12.50	1030
H80 00103	916	131	<4	65	<.4	<10	3	25	75	5.10	750
H80 00104	923	131	<4	53	<.4	<10	25	22	67	3.95	700
H80 00105	924	150	5	95	<.4	<10	<2	20	59	5.01	835
H80 00106	927	113	11	78	<.4	<10	20	23	45	4.86	780
H80 00107	935	65	<4	101	<.4	<10	8	18	55	5.59	511
H80 00108	939	91	5	68	<.4	40	12	26	82	5.35	710
H80 00109	545	262	42	435	<.4	20	233	45	162	18.18	855
H80 00110	921	131	<4	148	<.4	<10	119	33	98	6.20	785

SAMPLE NUMBER	FIELD NUMBER	VOLUME ml	YIELD g	RATIO g/l
H79 04436	601	300	33.5	111.6
H79 04437	602	300	45.2	150.6
H79 04438	603	300	17.3	57.6
H79 04439	604	300	39.9	133.0
H79 04440	605	300	14.2	47.3
H79 04441	606	450	93.9	208.6
H79 04442	607	450	15.1	33.5
H79 04443	608	750	18.0	24.0
H79 04444	637	750	15.9	21.2
H79 04445	638	450	83.7	186.0
H79 04446	639	450	28.6	63.5
H79 04447	640	450	18.2	40.4
H79 04448	641	600	12.6	21.0
H79 04449	642	600	10.3	17.1
H79 04450	643	900	14.4	16.0
H79 04451	644	###	15.9	15.1
H79 04452	645	###	10.8	10.2
H79 04453	646	450	30.6	68.0
H79 04454	647	450	98.8	219.5
H79 04455	648	450	37.9	84.2
H79 04456	649	750	12.7	10.4
H79 04457	650	450	16.5	36.6
H79 04458	651	450	23.5	52.2
H79 04459	654	450	23.8	52.8
H79 04460	659	450	29.5	65.5
H79 04461	660	450	18.3	40.6
H79 04462	662	600	11.2	18.6
H79 04463	665	450	11.3	25.1
H79 04464	667	450	74.8	166.2
H79 04465	673	450	17.3	38.4
H79 04466	674	450	70.6	156.8
H79 04467	677	450	69.1	153.5
H79 04468	678	450	58.4	129.7
H79 04469	679	450	33.0	73.3
H79 04470	682	450	24.7	54.8
H79 04471	685	450	25.9	57.5
H79 04472	686	450	11.9	26.4
H79 04473	688	450	27.0	60.0
H79 04474	692	###	11.1	10.5

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SAMPLE NUMBER	FIELD NUMBER	VOLUME ml	YIELD g	RATIO g/l
H79 04397	562	450	29.8	66.2
H79 04398	563	450	22.7	50.4
H79 04399	564	300	22.1	73.6
H79 04400	565	300	25.6	85.3
H79 04401	566	450	15.3	34.0
H79 04402	567	450	20.3	45.1
H79 04403	568	300	13.2	44.0
H79 04404	569	450	17.3	38.4
H79 04405	570	300	31.3	104.3
H79 04406	571	300	23.8	79.3
H79 04407	572	450	14.0	31.1
H79 04408	573	300	29.3	97.6
H79 04409	574	300	23.6	78.6
H79 04410	575	300	27.5	91.6
H79 04411	576	300	31.3	104.3
H79 04412	577	300	22.4	74.6
H79 04413	578	300	19.9	66.3
H79 04414	579	300	15.8	52.6
H79 04415	580	300	26.2	87.3
H79 04416	581	300	17.0	56.6
H79 04417	582	300	28.2	94.0
H79 04418	583	300	30.9	103.0
H79 04419	584	300	23.8	79.3
H79 04420	585	450	15.3	34.0
H79 04421	586	300	26.3	87.6
H79 04422	587	300	29.1	97.0
H79 04423	588	450	42.4	94.2
H79 04424	589	300	65.4	218.0
H79 04425	590	300	11.0	36.6
H79 04426	591	###	20.0	19.0
H79 04427	592	900	18.0	20.0
H79 04428	593	600	15.6	26.0
H79 04429	594	600	13.9	23.1
H79 04430	595	750	16.6	22.1
H79 04431	596	600	20.8	34.6
H79 04432	597	300	22.8	76.0
H79 04433	598	300	24.8	82.6
H79 04434	599	300	16.9	56.3
H79 04435	600	300	63.2	210.6

KARRAT JOB V79 - 1169H

SAMPLE NUMBER	FIELD NUMBER	VOLUME ml	YIELD g	RATIO g/l
H79 04359	506	450	21.8	48.4
H79 04360	507	450	10.0	22.2
H79 04361	508	450	35.7	79.3
H79 04362	509	450	30.5	67.7
H79 04363	510	450	12.0	26.6
H79 04364	511	450	12.4	27.5
H79 04365	512	450	12.6	28.0
H79 04366	513	450	16.9	37.5
H79 04367	514	900	10.4	11.5
H79 04368	515	450	10.9	24.2
H79 04369	517	450	12.8	28.4
H79 04370	518	450	19.7	43.7
H79 04371	520	450	22.6	50.2
H79 04372	521	450	34.0	75.5
H79 04373	523	450	13.4	29.7
H79 04374	524	450	15.2	33.7
H79 04375	525	450	42.7	94.8
H79 04376	528	450	34.5	76.6
H79 04377	531	450	37.7	83.7
H79 04378	532	450	19.3	42.8
H79 04379	533	450	76.2	169.3
H79 04380	536	450	57.0	126.6
H79 04381	537	450	62.0	137.7
H79 04382	538	450	54.5	121.1
H79 04383	541	450	48.8	108.4
H79 04384	544	450	44.7	99.3
H79 04385	546	450	19.2	42.6
H79 04386	549	450	47.1	104.6
H79 04387	551	450	25.8	57.3
H79 04388	552	450	28.8	64.0
H79 04389	553	450	31.3	69.5
H79 04390	554	450	58.7	130.4
H79 04391	555	450	81.8	181.7
H79 04392	556	450	16.0	35.5
H79 04393	557	450	23.9	53.1
H79 04394	559	450	23.6	52.4
H79 04395	560	450	23.9	53.1
H79 04396	561	450	16.8	37.3

10708

ANALYTICAL METHODS

W

K2S207 fusion/colorimetric

Mo

HNO3-HClO4/colorimetric

U

HNO3/fluorimetric

SAMPLE NUMBER	FIELD NUMBER	W ppm	Mo ppm	U ppm
H79 04476	696	10	27	16.0
H79 04477	697	2	<2	2.7
H79 04478	698	3	3	2.7
H79 04479	699	4	2	3.5
H79 04480	700	10	<2	2.7
H79 04481	714	35	14	18.0
H79 04482	728	5	9	6.6
H79 04483	730	15	16	5.4
H79 04484	733	6	3	1.9
H79 04485	734	5	<2	0.6
H79 04486	735	4	<2	3.0
H79 04487	739	8	<2	2.4
H79 04488	747	7	11	6.0
H79 04489	748	8	12	2.4
H79 04490	756	6	30	14.0
H79 04491	757	15	56	14.0
H79 04492	758	10	24	15.0
H79 04493	759	10	21	7.0
H79 04494	760	6	32	13.0
H79 04495	761	17	17	13.0
H79 04496	762	40	16	9.8
H79 04497	763	40	8	5.6
H79 04498	772	4	<2	0.4
H79 04499	773	3	<2	1.8
H79 04500	774	2	<2	3.1

Where analysis requested but no values shown, results are to follow

562

SAMPLE NUMBER	FIELD NUMBER	W ppm	Mo ppm	U ppm
H79 04437	602	10	10	7.4
H79 04438	603	10	7	2.6
H79 04439	604	2	6	3.7
H79 04440	605	10	17	4.4
H79 04441	606	8	7	5.1
H79 04442	607	8	23	9.4
H79 04443	608	12	4	5.0
H79 04444	637	5	8	4.7
H79 04445	638	3	4	2.3
H79 04446	639	8	10	4.2
H79 04447	640	10	<2	4.5
H79 04448	641	8	21	8.6
H79 04449	642	8	16	8.0
H79 04450	643	12	26	17.0
H79 04451	644	10	20	12.0
H79 04452	645	6	33	17.0
H79 04453	646	3	14	9.0
H79 04454	647	4	<2	1.5
H79 04455	648	6	2	2.7
H79 04456	649	5	26	13.0
H79 04457	650	6	18	6.4
H79 04458	651	8	9	3.5
H79 04459	654	5	42	4.2
H79 04460	659	6	65	17.0
H79 04461	660	3	12	7.8
H79 04462	662	4	35	11.0
H79 04463	665	3	20	16.0
H79 04464	667	12	<2	3.2
H79 04465	673	5	47	16.0
H79 04466	674	8	7	2.4
H79 04467	677	4	21	3.4
H79 04468	678	6	5	2.4
H79 04469	679	25	4	3.8
H79 04470	682	10	29	10.0
H79 04471	685	3	3	3.2
H79 04472	686	8	10	7.6
H79 04473	688	4	3	8.2
H79 04474	692	8	11	6.4
H79 04475	693	8	22	9.2

560

SAMPLE NUMBER	FIELD NUMBER	W ppm	Mo ppm	U ppm
H79 04398	563	6	8	2.3
H79 04399	564	8	15	5.0
H79 04400	565	8	9	5.0
H79 04401	566	6	20	8.2
H79 04402	567	4	13	4.1
H79 04403	568	6	12	3.9
H79 04404	569	4	10	13.0
H79 04405	570	22	29	19.0
H79 04406	571	6	50	32.0
H79 04407	572	3	15	40.0
H79 04408	573	6	6	45.0
H79 04409	574	3	5	14.0
H79 04410	575	4	7	14.0
H79 04411	576	6	13	12.0
H79 04412	577	6	14	28.0
H79 04413	578	3	16	9.0
H79 04414	579	6	11	4.6
H79 04415	580	6	19	1.5
H79 04416	581	40	17	4.2
H79 04417	582	2	9	3.7
H79 04418	583	2	7	1.8
H79 04419	584	3	9	3.7
H79 04420	585	7	3	9.0
H79 04421	586	8	7	5.0
H79 04422	587	10	9	2.5
H79 04423	588	25	7	11.0
H79 04424	589	3	<2	4.4
H79 04425	590	12	41	7.6
H79 04426	591	8	22	9.2
H79 04427	592	6	36	15.0
H79 04428	593	6	32	14.0
H79 04429	594	8	51	34.0
H79 04430	595	4	9	9.2
H79 04431	596	4	20	14.0
H79 04432	597	4	5	3.5
H79 04433	598	8	6	3.6
H79 04434	599	5	16	4.6
H79 04435	600	2	2	15.0
H79 04436	601	5	<2	3.7

KARRAT

JOB V79 - 1169H

REPORTING DATE 14 APR 1980

SAMPLE NUMBER	FIELD NUMBER	W ppm	Mo ppm	U ppm
H79 04359	506	3	25	5.0
H79 04360	507	4	2	7.4
H79 04361	508	2	27	3.8
H79 04362	509	3	6	3.5
H79 04363	510	4	4	4.9
H79 04364	511	6	14	5.4
H79 04365	512	6	50	16.0
H79 04366	513	3	33	11.0
H79 04367	514	4	75	16.0
H79 04368	515	6	35	14.0
H79 04369	517	3	27	8.2
H79 04370	518	4	10	4.9
H79 04371	520	3	7	2.8
H79 04372	521	3	9	2.7
H79 04373	523	5	8	<0.1
H79 04374	524	6	29	6.8
H79 04375	525	2	11	3.3
H79 04376	528	2	4	2.9
H79 04377	531	2	<2	3.0
H79 04378	532	<2	2	3.4
H79 04379	533	8	8	3.1
H79 04380	536	20	9	2.1
H79 04381	537	2	9	2.9
H79 04382	538	4	7	2.1
H79 04383	541	3	10	3.3
H79 04384	544	3	18	3.8
H79 04385	546	2	5	5.6
H79 04386	549	5	6	3.8
H79 04387	551	5	18	4.0
H79 04388	552	3	18	6.0
H79 04389	553	6	24	7.2
H79 04390	554	4	11	3.0
H79 04391	555	3	19	2.2
H79 04392	556	4	18	7.4
H79 04393	557	4	24	7.4
H79 04394	559	6	20	5.6
H79 04395	560	8	17	4.1
H79 04396	561	6	26	6.0
H79 04397	562	6	54	2.5

559

10704

ANALYTICAL METHODS

Au

Aqua regia/solvent extr/AA

As

$K_2S_2O_7$ fusion/colorimetric

Cu
Pb
Zn
Ag
Co
Ni
Fe
Mn

Aqua regia/AA

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	As ppm	Co ppm	Ni ppm	Fe %	Mn ppm
H79 04476	696	474	45	388	.7	<10	158	67	238	17.65	1100
H79 04477	697	120	<4	65	<.4	<10	3	22	76	4.00	476
H79 04478	698	96	<4	77	<.4	<10	4	23	75	4.50	462
H79 04479	699	74	<4	35	<.4	20	<2	15	50	2.71	300
H79 04480	700	73	<4	48	<.4	46	<2	20	93	3.82	445
H79 04481	714	150	112	127	<.4	<10	33	30	53	6.30	755
H79 04482	728	350	21	340	.4	<10	994	105	243	15.10	1075
H79 04483	730	206	15	343	<.4	<10	64	32	167	11.95	650
H79 04484	733	97	<4	159	<.4	<10	<2	28	118	7.50	560
H79 04485	734	82	<4	35	<.4	<10	<2	16	57	2.95	335
H79 04486	735	124	<4	39	<.4	<10	<2	23	82	3.60	425
H79 04487	739	74	<4	28	<.4	<10	<2	15	58	2.80	457
H79 04488	747	247	15	342	<.4	<10	34	45	180	14.60	978
H79 04489	748	550	27	320	.9	<10	246	83	322	14.20	625
H79 04490	756	610	67	900	1.7	20	22	65	322	32.30	925
H79 04491	757	560	38	730	.8	<10	128	61	300	30.20	1050
H79 04492	758	590	33	540	.5	<10	320	67	279	27.80	965
H79 04493	759	536	14	540	.4	<10	688	66	315	21.70	924
H79 04494	760	713	42	860	.6	160	102	48	207	29.60	950
H79 04495	761	439	40	480	.9	<10	111	66	256	23.00	1080
H79 04496	762	700	46	610	1.2	<10	956	95	327	31.00	870
H79 04497	763	390	23	290	.8	<10	246	79	487	16.60	1100
H79 04498	772	127	<4	61	<.4	20	41	35	236	5.40	900
H79 04499	773	110	<4	120	<.4	22	8	27	89	6.60	975
H79 04500	774	105	<4	86	<.4	20	<2	15	39	4.20	530

Where analysis requested but no values shown, results are to follow

10703

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	As ppm	Co ppm	Ni ppm	Fe %	Mn ppm
H79 04437	602	97	4	185	<.4	<10	<2	27	118	8.57	970
H79 04438	603	120	<4	162	<.4	14	6	22	80	7.20	610
H79 04439	604	111	<4	155	<.4	<10	6	24	122	7.40	665
H79 04440	605	135	8	235	<.4	<10	2	21	82	12.90	850
H79 04441	606	160	5	150	<.4	<10	<2	28	170	6.90	653
H79 04442	607	300	58	330	.9	<10	280	48	170	19.40	785
H79 04443	608	83	19	120	<.4	<10	46	27	97	5.00	571
H79 04444	637	237	14	118	<.4	<10	351	36	97	6.61	600
H79 04445	638	155	4	154	<.4	10	95	36	236	6.60	500
H79 04446	639	175	8	220	<.4	22	65	38	178	8.00	673
H79 04447	640	61	16	85	<.4	<10	45	16	49	4.22	664
H79 04448	641	440	39	270	.4	<10	305	69	230	12.60	1070
H79 04449	642	440	56	290	.7	<10	504	88	269	14.10	1130
H79 04450	643	530	56	400	.8	<10	193	84	277	19.00	1270
H79 04451	644	650	51	300	.8	<10	217	99	299	17.50	1080
H79 04452	645	670	83	710	1.0	<10	664	150	350	24.20	1060
H79 04453	646	243	25	328	<.4	<10	60	43	140	15.50	935
H79 04454	647	65	<4	71	<.4	10	<2	24	67	4.50	600
H79 04455	648	111	<4	146	<.4	<10	34	31.	97	7.02	740
H79 04456	649	573	105	428	1.0	<10	293	94	333	16.40	1170
H79 04457	650	326	60	532	.7	<10	176	48	215	17.50	920
H79 04458	651	340	10	330	.5	<10	121	64	202	14.00	855
H79 04459	654	533	21	580	.8	<10	474	64	174	23.5	605
H79 04460	659	1020	64	1030	1.2	<10	99	52	172	36.30	515
H79 04461	660	243	25	400	<.4	<10	124	56	158	14.50	1190
H79 04462	662	600	33	750	1.2	<10	162	69	278	23.00	930
H79 04463	665	690	37	610	.8	<10	277	86	269	21.00	1000
H79 04464	667	106	5	97	<.4	<10	55	24	72	4.50	395
H79 04465	673	440	30	380	<.4	<10	28	29	120	23.00	620
H79 04466	674	115	<4	107	<.4	<10	<2	17	53	7.45	850
H79 04467	677	108	4	87	<.4	<10	<2	16	66	4.60	735
H79 04468	678	105	<4	90	<.4	<10	7	18	62	4.40	685
H79 04469	679	80	10	98	<.4	<10	61	23	66	5.20	900
H79 04470	682	460	18	360	.6	<10	156	63	273	20.00	900
H79 04471	685	218	21	129	<.4	<10	176	54	119	5.69	590
H79 04472	686	368	27	303	.5	<10	424	85	180	12.00	765
H79 04473	688	198	10	94	<.4	<10	113	38	114	5.65	460
H79 04474	692	131	28	160	<.4	<10	109	33	122	11.30	945
H79 04475	693	257	35	260	.6	<10	84	46	163	14.80	1220

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	As ppm	Co ppm	Ni ppm	Fe %	Mn ppm
H79 04398	563	223	7	273	<.4	<10	19	36	130	12.70	850
H79 04399	564	197	9	296	<.4	<10	8	20	68	19.00	700
H79 04400	565	131	5	193	<.4	<10	13	22	73	8.80	680
H79 04401	566	230	16	370	.4	<10	41	32	150	15.00	855
H79 04402	567	197	9	292	<.4	<10	26	34	134	12.00	800
H79 04403	568	185	6	218	<.4	<10	13	17	60	15.80	875
H79 04404	569	97	16	167	<.4	<10	22	33	45	7.14	1040
H79 04405	570	111	4	291	<.4	<10	<2	21	67	12.50	1080
H79 04406	571	151	8	248	<.4	<10	12	22	68	14.50	975
H79 04407	572	96	34	141	<.4	<10	6	21	48	6.25	749
H79 04408	573	119	5	345	<.4	<10	3	34	125	12.80	1200
H79 04409	574	57	7	124	<.4	<10	<2	18	60	6.00	740
H79 04410	575	70	5	191	<.4	<10	<2	21	80	7.51	800
H79 04411	576	123	<4	264	<.4	<10	3	23	102	12.60	985
H79 04412	577	94	8	207	<.4	<10	4	19	85	9.82	930
H79 04413	578	145	7	340	<.4	<10	4	30	113	13.90	1135
H79 04414	579	89	4	145	<.4	<10	19	16	32	9.30	625
H79 04415	580	164	<4	236	0.5	<10	58	11	39	22.80	590
H79 04416	581	263	4	314	<.4	20	15	30	98	13.10	725
H79 04417	582	176	7	450	<.4	<10	<2	30	128	13.70	930
H79 04418	583	140	4	465	<.4	10	<2	30	126	13.25	928
H79 04419	584	149	<4	290	<.4	<10	<2	24	85	14.30	881
H79 04420	585	79	12	79	<.4	20	3	13	31	3.79	580
H79 04421	586	145	<4	250	<.4	<10	25	35	110	12.20	1025
H79 04422	587	197	9	307	<.4	16	10	30	134	11.80	780
H79 04423	588	100	10	262	<.4	20	<2	29	92	10.60	1090
H79 04424	589	93	<4	73	<.4	<10	<2	15	47	3.80	520
H79 04425	590	358	21	306	.7	20	180	29	95	28.00	453
H79 04426	591	248	23	256	.4	<10	46	33	146	12.18	734
H79 04427	592	415	36	460	.7	30	81	53	237	18.50	850
H79 04428	593	980	52	800	.9	<10	197	75	383	21.60	837
H79 04429	594	950	75	1000	2.3	20	299	74	315	28.00	1020
H79 04430	595	74	18	145	<.4	24	39	20	78	6.50	710
H79 04431	596	690	40	380	.5	<10	75	43	172	15.65	750
H79 04432	597	100	4	260	<.4	<10	<2	29	111	10.80	1050
H79 04433	598	110	6	250	<.4	<10	<2	27	100	10.30	970
H79 04434	599	157	8	259	.4	<10	2	21	83	14.00	770
H79 04435	600	123	<4	105	<.4	<10	17	21	183	5.00	525
H79 04436	601	43	<4	106	<.4	20	<2	21	90	4.61	820

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	As ppm	Co ppm	Ni ppm	Fe %	Mn ppm
H79 04359	506	238	26	406	.4	<10	69	29	118	17.50	908
H79 04360	507	166	19	276	.4	<10	103	27	96	10.60	940
H79 04361	508	65	4	117	<.4	<10	6	30	57	7.00	836
H79 04362	509	105	18	96	<.4	12	4	13	31	3.50	436
H79 04363	510	60	21	142	<.4	<10	5	21	37	5.90	840
H79 04364	511	202	20	215	<.4	<10	77	42	84	9.70	595
H79 04365	512	800	34	1140	1.1		168	37	238	29.00	820
H79 04366	513	530	39	1090	.8		101	40	295	21.00	682
H79 04367	514	845	58	1000	1.6	<10	127	69	218	28.00	740
H79 04368	515	570	49	770	1.0	<10	59	41	112	21.00	550
H79 04369	517	570	49	770	1.0	<10	112	41	178	18.80	800
H79 04370	518	230	13	326	<.4	<10	53		154	11.60	770
H79 04371	520	150	12	280	<.4	<10	34	29	116	10.30	750
H79 04372	521	175	7	314	<.4	<10	25	41	165	12.40	825
H79 04373	523	195	10	280	<.4	16	27	31	119	11.10	790
H79 04374	524	349	21	427	<.8	16	170	40	164	15.30	700
H79 04375	525	165	6	222	<.4	<10	12	22	49	14.30	1030
H79 04376	528	53	<4	132	<.4	<10	3	17	57	5.63	760
H79 04377	531	41	4	99	<.4	<10	<2	17	55	4.10	650
H79 04378	532	51	5	64	<.4	<10	<2	17	48	2.90	448
H79 04379	533	134	<4	129	<.4	14	8	16	104	9.60	368
H79 04380	536	112	6	133	<.4	20	2	9	50	10.90	326
H79 04381	537	157	4	164	<.4	<10	7	15	75	12.00	538
H79 04382	538	67	<4	136	<.4	<10	2	11	56	7.50	620
H79 04383	541	65	<4	262	<.4	<10	4	23	107	10.60	1150
H79 04384	544	88	5	256	<.4	<10	19	22	125	6.80	612
H79 04385	546	73	11	233	<.4	<10	4	26	98	9.00	1120
H79 04386	549	129	4	162	<.4	<10	7	23	60	7.30	730
H79 04387	551	286	14	400	<.4	<10	185	34	132	16.60	883
H79 04388	552	312	13	370	<.4	<10	172	35	146	18.20	880
H79 04389	553	329	16	404	<.4	<10	108	35	160	17.50	830
H79 04390	554	156	10	250	<.4	22	22	17	65	15.50	700
H79 04391	555	183	8	123	.4	<10	90	3	12	24.20	575
H79 04392	556	286	20	404	.4	<10	64	40	148	15.50	890
H79 04393	557	310	24	500	.5	<10	10	39	175	17.00	930
H79 04394	559	249	16	352	.4	<10	36	35	152	13.30	660
H79 04395	560	278	14	323	.4	<10	115	38	119	16.30	690
H79 04396	561	380	16	460	.4	<10	122	38	158	19.00	677
H79 04397	562	250	13	215	.5	<10	178	12	28	26.00	840

KARRAT JOB V80 — 0118H

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Au ppb	As ppm	Co ppm	Ni ppm	Mn ppm	W ppm
H80 00069	756B	540	61	820	1.8	<10	18	54	290	775	6
H80 00070	763B	324	24	195	.4	<10	44	50	316	718	6
H80 00071	947B	135	14	114	<.4	<10	11	22	69	330	2

Where analysis requested but no values shown, results are to follow

ANALYTICAL METHODS

Au
Aqua regia/solvent extr/AA

As
W
$K_2S_2O_7$ fusion/colorimetric

Cu
Pb
Zn
Ag
Co
Ni
Mn
Aqua regia/AA

SAMPLE NUMBER	FIELD NUMBER	Mo ppm	U ppm
H80 00069	756B	3	16.0
H80 00070	763B	i	i
H80 00071	947B	4	3.5

Where analysis requested but no values shown, results are to follow
i - insufficient or missing sample

ANALYTICAL METHODS
Mo
HNO3-HC104/colorimetric

U
HNO3/fluorimetric

KARRAT

JOB V80 - 0118H

REPORTING DATE 7 APR 1980

SAMPLE NUMBER	FIELD NUMBER	VOLUME ml	YIELD g	RATIO g/l
H80 00069	756B	450	10.2	22.6
H80 00070	763B	450	22.3	49.5
H80 00071	947B	450	34.4	76.4

HMG yield data: 'VOL (ml)' is the approximate volume of -18 mesh material processed through heavy liquids; 'YIELD (g)' is the weight of heavies (after removal of ferromagnetics) obtained from that volume; 'RATIO (g/l)' is the yield per unit volume

KARRAT JOB V79 - 1170S

REPORTING DATE 11 JAN 1980

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Mn ppm	Fe %	Sb ppm	Ni ppm	Co ppm
S79 46844	# 693	50	4	82	<.4	22	375	2.78	<5	45	14
S79 46845	# 696	73	7	101	<.4	31	481	3.32	<5	57	19
S79 46846	# 697	66	<4	73	<.4	5	315	2.65	<5	62	18
S79 46847	# 698	60	<4	74	<.4	8	402	2.80	<5	47	16
S79 46848	# 699	32	<4	26	<.4	19	129	1.12	<5	22	4
S79 46849	# 700	17	<4	12	<.4	3	87	.78	<5	19	4
S79 46850	# 714	24	<4	29	<.4	3	116	1.07	<5	14	5
S79 46851	# 728	40	<4	68	<.4	57	295	2.49	<5	36	16
S79 46852	# 730	62	5	135	<.4	10	316	2.79	<5	50	13
S79 46853	# 733	40	<4	65	<.4	16	237	2.24	<5	45	12
S79 46854	# 734	16	<4	9	<.4	2	52	.52	<5	12	3
S79 46855	# 735	44	<4	15	<.4	26	84	.95	<5	27	9
S79 46856	# 739	19	<4	19	<.4	6	113	1.05	<5	26	6
S79 46857	# 747	44	<4	101	<.4	10	370	2.70	<5	42	12
S79 46858	# 748	103	16	132	<.4	67	286	4.46	<5	85	25
S79 46859	# 756	54	5	110	<.4	4	362	2.90	<5	55	15
S79 46860	# 757	58	<4	93	<.4	22	371	2.82	<5	52	14
S79 46861	# 758	68	<4	117	<.4	27	471	3.28	<5	67	20
S79 46862	# 759	77	<4	125	<.4	67	405	3.59	<5	67	19
S79 46863	# 760	122	6	194	<.4	30	483	3.81	<5	75	22
S79 46864	# 761	52	5	105	<.4	17	425	2.99	<5	54	17
S79 46865	# 762	43	<4	83	<.4	38	259	2.46	<5	35	12
S79 46866	# 763	35	<4	70	<.4	30	301	2.52	<5	37	11
S79 46867	# 772	54	<4	44	<.4	3	373	2.36	<5	42	14
S79 46868	# 773	42	<4	37	<.4	5	285	1.83	<5	23	9
S79 46869	# 774	66	<4	61	<.4	<2	313	2.23	<5	28	13
S79 46870	# 775	49	<4	62	<.4	6	260	2.05	<5	24	9
S79 46871	# 776	100	<4	26	<.4	<2	278	2.02	<5	24	11
S79 46872	# 785	20	<4	8	<.4	15	57	.79	<5	13	11
S79 46873	# 842	56	7	106	<.4	22	410	3.40	<5	52	18
S79 46874	# 845	60	8	117	<.4	9	582	4.66	<5	57	26
S79 46875	# 846	42	6	103	<.4	8	422	3.14	<5	43	13
S79 46876	# 850	45	5	86	<.4	11	439	3.10	<5	45	15
S79 46877	# 852	52	5	96	<.4	7	480	3.52	<5	48	16
S79 46878	# 853	42	<4	72	<.4	7	342	2.68	<5	36	13
S79 46879	# 855	68	<4	93	<.4	11	443	3.41	<5	61	18
S79 46880	# 857	80	<4	53	<.4	3	402	2.90	<5	65	17
S79 46881	# 860	55	<4	61	<.4	15	300	2.68	<5	42	13
S79 46882	# 861	[illegible]	4	[illegible]	<.4	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1316

KARRAT JOB V79 — 11708

REPORTING DATE 11 JAN 1980

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Mn ppm	Fe %	Sb ppm	Ni ppm	Co ppm
S79 46883	# 865	68	<4	53	<.4	5	345	2.23	<5	68	15
S79 46884	# 872	73	<4	86	<.4	10	322	2.79	<5	49	14
S79 46885	# 886	53	<4	92	<.4	23	410	3.44	<5	46	17
S79 46886	# 891	70	<4	87	<.4	13	440	3.25	<5	60	20
S79 46887	# 895	46	<4	66	<.4	16	327	2.57	<5	36	11
S79 46888	# 900	43	<4	57	<.4	4	370	2.46	<5	47	13
S79 46889	# 902	47	<4	66	<.4	4	406	2.78	<5	42	14
S79 46890	# 907	74	<4	43	<.4	45	356	2.30	<5	38	13
S79 46891	# 908	52	<4	59	<.4	15	336	2.80	<5	61	18
S79 46892	# 911	52	<4	101	<.4	16	445	4.50	<5	61	18
S79 46893	# 916	57	<4	49	<.4	<2	365	2.90	<5	40	14
S79 46894	# 923	65	<4	33	<.4	<2	340	2.30	<5	35	14
S79 46895	# 924	75	5	51	<.4	<2	453	2.68	<5	35	15
S79 46896	# 927	60	4	38	<.4	3	319	2.20	<5	26	12
S79 46897	# 935	40	<4	51	<.4	4	185	2.00	<5	41	11
S79 46898	# 939	34	<4	33	<.4	8	205	2.20	<5	52	15
S79 46899	# 545	40	10	77	<.4	20	252	2.65	<5	36	13
S79 46900	# 921	36	<4	41	<.4	10	262	2.15	<5	33	11

Where analysis requested but no values shown, results are to follow

ANALYTICAL METHODS

Cu
Pb
Zn
Ag
Mn
Fe

1335

Sb
Ni
Co
20% HNO3/AA

As
K2S207 fusion/colorimetric

1316

KARRAT

JOB U79 – 11708

REPORTING DATE 2 APR 1980

SAMPLE NUMBER	FIELD NUMBER	Mo ppm	U ppm
S79 46727	# 506	6	2.6
S79 46728	# 507	2	4.0
S79 46729	# 508	3	2.3
S79 46730	# 509	2	2.6
S79 46731	# 510	2	3.4
S79 46732	# 511	2	2.4
S79 46733	# 512	10	4.5
S79 46734	# 513	8	4.5
S79 46735	# 514	12	7.0
S79 46736	# 515	10	4.6
S79 46737	# 517	4	2.7
S79 46738	# 518	2	2.3
S79 46739	# 520	2	1.9
S79 46740	# 521	2	3.0
S79 46741	# 523	3	2.4
S79 46742	# 524	4	3.2
S79 46743	# 525	8	3.0
S79 46744	# 528	2	2.9
S79 46745	# 531	2	3.5
S79 46746	# 532	2	2.2
S79 46747	# 533	8	2.8
S79 46748	# 536	5	1.3
S79 46749	# 537	9	1.9
S79 46750	# 538	8	2.2
S79 46751	# 541	7	4.6
S79 46752	# 544	9	4.0
S79 46753	# 546	2	3.6
S79 46754	# 549	2	2.9
S79 46755	# 551	i	3.5
S79 46756	# 552	4	3.4
S79 46757	# 553	6	4.0
S79 46758	# 554	3	1.3
S79 46759	# 555	6	0.6
S79 46760	# 556	2	3.0
S79 46761	# 557	5	3.9
S79 46762	# 558	6	2.8
S79 46763	# 559	4	2.4
S79 46764	# 560	3	1.4
[illegible]	[illegible]	4	[illegible]

10619

SPEEDIFLO MOORE BUSINESS FORMS

SAMPLE NUMBER	FIELD NUMBER	Mo ppm	U ppm
S79 46766	# 562	15	0.5
S79 46767	# 563	2	2.0
S79 46768	# 564	5	2.2
S79 46769	# 565	3	4.0
S79 46770	# 566	3	2.7
S79 46771	# 567	6	2.2
S79 46772	# 568	5	1.8
S79 46773	# 569	3	6.3
S79 46774	# 570	7	7.4
S79 46775	# 571	9	20.0
S79 46776	# 572	2	15.0
S79 46777	# 573	3	2.6
S79 46778	# 574	2	8.0
S79 46779	# 575	2	7.6
S79 46780	# 576	7	6.5
S79 46781	# 577	4	12.0
S79 46782	# 578	7	7.6
S79 46783	# 579	2	1.7
S79 46784	# 580	6	0.5
S79 46785	# 581	7	2.4
S79 46786	# 582	4	2.3
S79 46787	# 583	3	2.2
S79 46788	# 584	5	3.1
S79 46789	# 585	2	3.1
S79 46790	# 586	2	1.9
S79 46791	# 587	3	2.0
S79 46792	# 588	2	9.0
S79 46793	# 589	4	1.5
S79 46794	# 590	9	3.0
S79 46795	# 591	2	2.6
S79 46796	# 592	5	3.5
S79 46797	# 593	3	3.4
S79 46798	# 594	8	6.0
S79 46799	# 595	2	4.6
S79 46800	# 596	2	2.5
S79 46801	# 597	2	2.6
S79 46802	# 598	2	2.5
S79 46803	# 599	6	2.4
S79 46804	# 600	2	2.5

10620

REPORTING DATE 2 APR 1980

SAMPLE NUMBER	FIELD NUMBER	Mo ppm	U ppm
S79 46805	# 601	2	4.1
S79 46806	# 602	7	7.6
S79 46807	# 603	2	1.3
S79 46808	# 604	3	2.5
S79 46809	# 605	5	1.5
S79 46810	# 606	6	3.8
S79 46811	# 607	2	5.0
S79 46812	# 608	2	4.1
S79 46813	# 637	2	2.0
S79 46814	# 638	2	2.0
S79 46815	# 639	2	2.5
S79 46816	# 640	2	1.0
S79 46817	# 641	2	2.2
S79 46818	# 642	2	2.6
S79 46819	# 643	2	4.3
S79 46820	# 644	2	1.7
S79 46821	# 645	2	2.0
S79 46822	# 646	5	6.2
S79 46823	# 647	2	1.2
S79 46824	# 648	2	2.2
S79 46825	# 649	4	2.2
S79 46826	# 650	2	2.4
S79 46827	# 651	2	2.5
S79 46828	# 654	6	1.5
S79 46829	# 659	23	6.0
S79 46830	# 660	3	3.4
S79 46831	# 662	5	3.0
S79 46832	# 665	3	3.1
S79 46833	# 667	2	1.9
S79 46834	# 673	6	5.0
S79 46835	# 674	2	2.5
S79 46836	# 677	3	1.5
S79 46837	# 678	2	1.5
S79 46838	# 679	2	1.8
S79 46839	# 682	3	3.4
S79 46840	# 685	2	1.8
S79 46841	# 686	2	2.7
S79 46842	# 688	2	1.3
S79 46843	# 692	2	1.3

10621

SAMPLE NUMBER	FIELD NUMBER	Mo ppm	U ppm
S79 46844	# 693	2	2.0
S79 46845	# 696	2	2.7
S79 46846	# 697	2	1.5
S79 46847	# 698	2	2.7
S79 46848	# 699	2	1.7
S79 46849	# 700	2	0.9
S79 46850	# 714	2	3.5
S79 46851	# 728	2	2.5
S79 46852	# 730	4	3.6
S79 46853	# 733	2	1.3
S79 46854	# 734	2	1.4
S79 46855	# 735	2	0.7
S79 46856	# 739	2	1.5
S79 46857	# 747	2	2.8
S79 46858	# 748	4	1.7
S79 46859	# 756	3	2.5
S79 46860	# 757	3	2.7
S79 46861	# 758	2	2.9
S79 46862	# 759	2	2.7
S79 46863	# 760	4	4.4
S79 46864	# 761	2	3.0
S79 46865	# 762	2	2.2
S79 46866	# 763	2	1.7
S79 46867	# 772	2	1.0
S79 46868	# 773	2	2.5
S79 46869	# 774	2	1.5
S79 46870	# 775	3	3.8
S79 46871	# 776	2	0.5
S79 46872	# 785	2	3.5
S79 46873	# 842	2	2.7
S79 46874	# 845	2	1.5
S79 46875	# 846	2	2.1
S79 46876	# 850	2	1.5
S79 46877	# 852	2	1.7
S79 46878	# 853	2	1.1
S79 46879	# 855	2	2.0
S79 46880	# 857	2	0.6
S79 46881	# 860	2	1.4
S79 46882	# 861	2	1.1

10622

10623

SAMPLE NUMBER	FIELD NUMBER	Mo ppm	U ppm
S79 46883	# 865	2	0.6
S79 46884	# 872	2	3.4
S79 46885	# 886	2	2.0
S79 46886	# 891	2	2.9
S79 46887	# 895	2	1.0
S79 46888	# 900	2	1.4
S79 46889	# 902	2	1.1
S79 46890	# 907	2	0.4
S79 46891	# 908	2	1.4
S79 46892	# 911	2	2.0
S79 46893	# 916	2	0.9
S79 46894	# 923	2	0.6
S79 46895	# 924	3	1.4
S79 46896	# 927	3	1.4
S79 46897	# 935	2	2.1
S79 46898	# 939	4	1.4
S79 46899	# 545	2	2.3
S79 46900	# 921	4	1.3

Where analysis requested but no values shown, results are to follow
i - insufficient or missing sample

ANALYTICAL METHODS

Mo
HNO3-HClO4/colorimetric

U
HNO3/fluorimetric

JOB U79 - 1170S

REPORTING DATE 11 JAN 1980

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Mn ppm	Fe %	Sb ppm	Ni ppm	Co ppm
S79 46805	# 601	33	<4	38	<.4	2	278	1.45	<5	47	10
S79 46806	# 602	65	4	100	<.4	11	325	2.56	<5	65	14
S79 46807	# 603	27	<4	44	<.4	4	130	1.40	<5	22	5
S79 46808	# 604	92	<4	119	<.4	13	335	3.20	<5	92	21
S79 46809	# 605	53	<4	79	<.4	5	245	2.90	<5	23	7
S79 46810	# 606	99	5	142	<.4	6	440	3.36	<5	174	30
S79 46811	# 607	77	11	130	<.4	55	440	3.17	<5	80	22
S79 46812	# 608	42	7	79	<.4	12	280	2.26	<5	44	12
S79 46813	# 637	48	4	57	<.4	77	250	2.27	<5	35	13
S79 46814	# 638	99	4	144	<.4	66	445	4.43	<5	169	30
S79 46815	# 639	84	6	184	<.4	24	484	3.35	<5	97	32
S79 46816	# 640	29	5	50	<.4	47	250	1.41	<5	27	9
S79 46817	# 641	61	6	70	<.4	36	336	2.45	<5	45	15
S79 46818	# 642	52	6	77	<.4	63	390	2.54	<5	42	14
S79 46819	# 643	84	7	104	<.4	28	566	3.85	<5	66	21
S79 46820	# 644	53	4	65	<.4	20	328	2.38	<5	38	13
S79 46821	# 645	50	6	74	<.4	29	277	1.77	<5	36	13
S79 46822	# 646	100	12	151	<.4	44	480	4.22	<5	92	26
S79 46823	# 647	66	<4	82	<.4	4	520	3.92	<5	61	23
S79 46824	# 648	51	<4	76	<.4	16	343	2.76	<5	47	15
S79 46825	# 649	75	9	127	<.4	59	385	2.98	<5	63	17
S79 46826	# 650	79	11	78	<.4	52	412	2.66	<5	55	19
S79 46827	# 651	53	<4	80	<.4	19	230	2.34	<5	43	11
S79 46828	# 654	83	5	120	<.4	75	237	3.95	<5	58	17
S79 46829	# 659	265	13	230	0.5	30	288	5.50	<5	68	22
S79 46830	# 660	81	8	158	<.4	34	410	2.78	<5	66	18
S79 46831	# 662	86	5	141	<.4	29	410	4.10	<5	70	22
S79 46832	# 665	90	60	140	<.4	28	475	3.64	<5	78	25
S79 46833	# 667	43	<4	57	<.4	22	166	1.79	<5	35	10
S79 46834	# 673	103	7	100	<.4	17	255	2.53	<5	47	15
S79 46835	# 674	49	<4	58	<.4	13	280	3.10	<5	29	9
S79 46836	# 677	47	<4	58	<.4	2	166	1.85	<5	30	7
S79 46837	# 678	34	<4	36	<.4	5	103	1.21	<5	20	6
S79 46838	# 679	25	<4	32	<.4	21	138	1.09	<5	15	5
S79 46839	# 682	106	6	147	<.4	45	460	3.70	<5	94	24
S79 46840	# 685	50	5	62	<.4	32	320	2.06	<5	38	16
S79 46841	# 686	60	6	83	<.4	61	279	2.76	<5	47	20
S79 46842	# 688	48	<4	53	<.4	46	175	1.88	<5	36	12
S79 46843	# [illegible]	35	5	60	<.4	43	[illegible]	[illegible]	<5	[illegible]	[illegible]

KARRAT

JOB U79 – 11705

REPORTING DATE 11 JAN 1980

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Mn ppm	Fe %	Sb ppm	Ni ppm	Co ppm
S79 46727	# 506	73	6	107	<.4	27	372	3.29	<5	50	15
S79 46728	# 507	56	5	133	<.4	11	400	2.65	<5	50	14
S79 46729	# 508	40	4	83	<.4	12	400	3.12	<5	40	18
S79 46730	# 509	48	13	83	<.4	7	339	2.13	<5	23	10
S79 46731	# 510	32	8	71	<.4	5	365	2.14	<5	20	10
S79 46732	# 511	28	3	53	<.4	18	225	1.72	<5	23	10
S79 46733	# 512	167	11	430	0.5	42	570	4.32	<5	175	27
S79 46734	# 513	197	17	620	0.4	48	800	5.73	<5	236	37
S79 46735	# 514	142	14	191	0.4	28	412	3.50	<5	66	26
S79 46736	# 515	140	15	142	<.4	15	248	3.73	<5	33	10
S79 46737	# 517	95	15	156	<.4	32	380	3.28	<5	79	20
S79 46738	# 518	70	4	107	<.4	26	264	2.97	<5	59	16
S79 46739	# 520	52	4	85	<.4	16	260	2.54	<5	51	14
S79 46740	# 521	90	3	129	<.4	12	330	3.78	<5	87	23
S79 46741	# 523	100	5	120	<.4	15	360	3.43	<5	90	22
S79 46742	# 524	142	8	157	<.4	24	400	4.18	<5	114	29
S79 46743	# 525	89	4	98	<.4	10	325	4.55	<5	33	12
S79 46744	# 528	48	3	60	<.4	4	330	2.30	<5	45	12
S79 46745	# 531	27	5	46	<.4	3	265	1.72	<5	44	12
S79 46746	# 532	13	1	17	<.4	5	92	.55	<5	13	3
S79 46747	# 533	84	5	81	<.4	7	258	3.75	<5	77	13
S79 46748	# 536	50	4	51	<.4	10	135	3.08	<5	22	4
S79 46749	# 537	68	3	69	<.4	8	204	4.10	<5	56	9
S79 46750	# 538	63	2	83	<.4	7	310	3.85	<5	44	10
S79 46751	# 541	95	3	166	<.4	8	425	3.36	<5	122	24
S79 46752	# 544	34	4	101	<.4	14	174	1.96	<5	68	11
S79 46753	# 546	33	3	62	<.4	10	255	2.00	<5	34	9
S79 46754	# 549	48	2	70	<.4	9	240	2.10	<5	39	11
S79 46755	# 551	106	8	158	<.4	112	437	4.06	<5	73	22
S79 46756	# 552	86	5	151	<.4	81	428	3.46	<5	74	20
S79 46757	# 553	124	8	204	<.4	35	530	4.22	<5	113	29
S79 46758	# 554	45	4	82	<.4	14	240	3.38	<5	24	7
S79 46759	# 555	48	2	50	<.4	32	170	4.40	<5	13	4
S79 46760	# 556	34	4	71	<.4	10	236	2.09	<5	31	9
S79 46761	# 557	100	6	172	<.4	6	354	4.10	<5	85	19
S79 46762	# 558	140	13	231	<.4	15	445	4.38	<5	135	33
S79 46763	# 559	110	7	150	<.4	18	339	3.97	<5	92	23
S79 46764	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1337

KARRAT — JOB V79 – 11708

REPORTING DATE 11 JAN 1980

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	As ppm	Mn ppm	Fe %	Sb ppm	Ni ppm	Co ppm
S79 46766	# 562	53	1	66	<.4	90	209	8.40	<5	20	5
S79 46767	# 563	84	2	78	<.4	25	258	2.96	<5	49	17
S79 46768	# 564	59	3	82	<.4	3	245	3.27	<5	25	8
S79 46769	# 565	85	6	142	<.4	12	372	3.45	<5	67	21
S79 46770	# 566	73	5	123	<.4	12	310	3.00	<5	59	18
S79 46771	# 567	128	4	146	<.4	10	377	4.15	<5	77	23
S79 46772	# 568	74	4	95	<.4	11	281	4.23	<5	34	10
S79 46773	# 569	41	<4	77	<.4	12	322	2.34	<5	31	11
S79 46774	# 570	57	7	95	<.4	2	327	3.28	<5	29	10
S79 46775	# 571	86	5	135	<.4	10	360	3.00	<5	67	16
S79 46776	# 572	15	4	27	<.4	8	91	0.73	<5	9	3
S79 46777	# 573	64	<4	110	<.4	2	430	3.44	<5	75	21
S79 46778	# 574	38	6	64	<.4	8	280	2.33	<5	39	11
S79 46779	# 575	49	6	99	<.4	8	255	2.27	<5	53	13
S79 46780	# 576	86	4	145	<.4	6	418	3.86	<5	83	20
S79 46781	# 577	41	<4	75	<.4	10	241	2.12	<5	36	9
S79 46782	# 578	117	6	183	<.4	10	530	4.21	<5	84	25
S79 46783	# 579	30	<4	56	<.4	13	120	2.10	<5	12	5
S79 46784	# 580	58	<4	74	<.4	6	248	5.55	<5	21	7
S79 46785	# 581	46	<4	78	<.4	4	222	3.00	<5	30	10
S79 46786	# 582	88	4	133	<.4	<2	265	2.94	<5	51	16
S79 46787	# 583	64	<4	111	<.4	17	224	2.79	<5	42	12
S79 46788	# 584	81	4	119	<.4	3	346	4.13	<5	46	14
S79 46789	# 585	16	<4	19	<.4	<2	89	0.70	<5	7	3
S79 46790	# 586	54	<4	86	<.4	9	277	2.75	<5	38	12
S79 46791	# 587	110	5	145	<.4	13	350	3.88	<5	85	22
S79 46792	# 588	53	3	88	<.4	<2	313	2.48	<5	44	13
S79 46793	# 589	53	<4	50	<.4	2	188	1.72	<5	30	9
S79 46794	# 590	103	9	116	<.4	32	303	4.89	<5	58	15
S79 46795	# 591	64	6	100	<.4	10	281	2.70	<5	60	16
S79 46796	# 592	143	11	181	<.4	30	430	4.33	<5	118	30
S79 46797	# 593	107	8	130	<.4	36	322	3.31	<5	80	19
S79 46798	# 594	156	18	210	0.4	77	560	4.20	<5	96	25
S79 46799	# 595	50	8	97	<.4	25	373	2.17	<5	53	14
S79 46800	# 596	78	8	76	<.4	22	290	2.15	<5	43	14
S79 46801	# 597	54	<4	82	<.4	4	277	2.40	<5	48	13
S79 46802	# 598	55	<4	96	<.4	4	300	2.56	<5	49	14
S79 46803	# 599	58	<4	93	<.4	7	272	3.21	<5	25	6
S79 46804	# 600	[illegible]	[illegible]	[illegible]	<.4	20	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]

1316

SAMPLE NUMBER	FIELD NUMBER	As ppm	U ppm
S80 00718	# 893	20	3.8
S80 00719	# 894	35	2.3
S80 00720	# 899	12	2.2
S80 00721	# 903	7	1.6
S80 00722	# 904	8	1.0
S80 00723	# 906	11	1.4
S80 00724	# 909	15	1.6
S80 00725	# 910	22	1.7
S80 00726	# 912	43	1.4
S80 00727	# 913	46	1.4
S80 00728	# 919	6	3.0
S80 00729	# 922	5	3.0
S80 00730	# 925	5	2.0
S80 00731	# 926	3	4.1
S80 00732	# 944	12	2.0
S80 00733	# 945	26	2.5
S80 00734	# 946	14	2.4
S80 00735	# 948	5	0.9

Where analysis requested but no values shown, results are to follow

ANALYTICAL METHODS

As

K2S207 fusion/colorimetric

U

HNO3/fluorimetric

174.9

KARRATT — JOB V80 - 00255

REPORTING DATE 25 FEB 1980

SAMPLE NUMBER	FIELD NUMBER	As ppm	U ppm
S80 00679	# 751	11	5.2
S80 00680	# 752	82	3.0
S80 00681	# 784	19	2.9
S80 00682	# 801	63	.1
S80 00683	# 802	47	3.5
S80 00684	# 803	25	2.8
S80 00685	# 804	18	2.7
S80 00686	# 805	32	4.5
S80 00687	# 806	30	3.7
S80 00688	# 807	33	3.2
S80 00689	# 808	49	3.7
S80 00690	# 809	69	2.5
S80 00691	# 810	189	6.0
S80 00692	# 811	78	2.2
S80 00693	# 824	33	4.0
S80 00694	# 825	47	6.0
S80 00695	# 826	65	4.9
S80 00696	# 827	39	5.2
S80 00697	# 828	25	18
S80 00698	# 829	68	6.8
S80 00699	# 830	17	1.3
S80 00700	# 831	22	1.0
S80 00701	# 832	2	2.1
S80 00702	# 833	15	2.7
S80 00703	# 834	7	2.4
S80 00704	# 835	9	1.7
S80 00705	# 836	7	1.3
S80 00706	# 837	<2	2.8
S80 00707	# 838	<2	3.6
S80 00708	# 839	21	2.3
S80 00709	# 876	18	2.4
S80 00710	# 877	14	3.8
S80 00711	# 881	32	4.7
S80 00712	# 882	42	2.9
S80 00713	# 883	21	2.7
S80 00714	# 885	23	2.9
S80 00715	# 888	21	2.9
S80 00716	# 890	23	3.3
S80 00717	# 892	15	2.9

Fe
Mn
Sb
20% HNO3/AA

Mo
HNO3-HClO4/colorimetric

2772

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Co ppm	Ni ppm	Fe %	Mn ppm	Sb ppm	Mo ppm
S80 00718	# 893	103	4	104	<.4	25	87	4.6	540	<4	2
S80 00719	# 894	89	7	116	<.4	26	89	5.1	594	<4	2
S80 00720	# 899	46	5	93	<.4	17	53	3.4	440	<4	2
S80 00721	# 903	66	8	104	<.4	21	73	4.4	580	<4	2
S80 00722	# 904	61	4	87	<.4	17	66	3.9	530	<4	2
S80 00723	# 906	80	<4	89	<.4	19	78	4.2	556	<4	2
S80 00724	# 909	60	8	111	<.4	18	69	4.1	540	<4	2
S80 00725	# 910	70	6	100	<.4	19	73	4.0	520	<4	2
S80 00726	# 912	51	4	105	<.4	16	58	3.8	500	<4	2
S80 00727	# 913	57	<4	105	<.4	16	66	3.9	520	<4	2
S80 00728	# 919	54	<4	70	<.4	14	48	3.4	513	<4	2
S80 00729	# 922	91	<4	80	<.4	19	57	3.7	550	<4	2
S80 00730	# 925	75	6	92	<.4	17	54	3.3	500	<4	2
S80 00731	# 926	75	<4	67	<.4	13	34	2.7	442	<4	2
S80 00732	# 944	84	<4	69	<.4	18	55	3.2	400	<4	2
S80 00733	# 945	107	6	180	<.4	16	106	4.4	640	<4	5
S80 00734	# 946	220	<4	195	<.4	33	249	5.1	290	<4	3
S80 00735	# 948	90	4	58	<.4	20	87	3.1	410	<4	2

Where analysis requested but no values shown, results are to follow

ANALYTICAL METHODS

Cu
Pb
Zn
Ag
Co
Ni

SAMPLE NUMBER	FIELD NUMBER	Cu ppm	Pb ppm	Zn ppm	Ag ppm	Co ppm	Ni ppm	Fe %	Mn ppm	Sb ppm	Mo ppm
S80 00679	# 751	141	15	233	<.4	22	119	4.7	488	<4	7
S80 00680	# 752	125	15	161	<.4	20	79	4.7	360	<4	12
S80 00681	# 784	85	11	140	<.4	18	86	4.9	316	<4	9
S80 00682	# 801	80	10	70	0.4	3	19	11.0	200	<4	13
S80 00683	# 802	61	13	88	<.4	15	55	3.3	366	<4	2
S80 00684	# 803	47	14	70	<.4	12	39	2.7	280	<4	2
S80 00685	# 804	78	15	86	<.4	16	57	3.4	342	<4	2
S80 00686	# 805	64	23	120	<.4	17	60	3.6	460	<4	2
S80 00687	# 806	57	14	100	<.4	13	46	2.9	284	<4	2
S80 00688	# 807	63	21	117	<.4	17	62	3.3	419	<4	3
S80 00689	# 808	108	14	119	<.4	14	58	4.0	330	<4	4
S80 00690	# 809	83	13	100	<.4	9	42		281	<4	5
S80 00691	# 810	152	16	220	<.4	29	124	5.7	537	<4	7
S80 00692	# 811	90	13	103	<.4	10	35	5.6	270	<4	8
S80 00693	# 824	81	29	140	<.4	18	71	3.8	418	<4	8
S80 00694	# 825	150	50	240	<.4	31	196	5.8	646	<4	11
S80 00695	# 826	126	46	229	<.4	31	215	5.7	540	<4	11
S80 00696	# 827	153	17	191	<.4	26	112	4.6	480	<4	10
S80 00697	# 828	85	31	300	<.4	29	135	4.2	420	<4	12
S80 00698	# 829	204	25	620	0.7	47	224	8.8	790	<4	70
S80 00699	# 830	103	14	110	0.4	8	36	6.9	250	<4	22
S80 00700	# 831	95	17	115	0.7	6	28	8.3	269	<4	3
S80 00701	# 832	52	<4	54	<.4	7	27	2.6	181	<4	5
S80 00702	# 833	106	22	155	<.4	18	75	4.7	300	<4	3
S80 00703	# 834	72	7	112	<.4	16	61	3.2	265	<4	2
S80 00704	# 835	62	11	94	<.4	9	36	5.2	229	<4	8
S80 00705	# 836	46	<4	67	<.4	15	34	3.0	284	<4	2
S80 00706	# 837	35	<4	39	<.4	7	24	1.6	145	<4	2
S80 00707	# 838	45	<4	40	<.4	7	25	1.5	160	<4	2
S80 00708	# 839	73	15	159	<.4	25	105	4.2	440	<4	6
S80 00709	# 876	67	8	115	<.4	21	66	4.3	459	<4	3
S80 00710	# 877	64	8	120	<.4	18	74	3.9	450	<4	2
S80 00711	# 881	77	12	132	<.4	24	93	4.2	445	<4	2
S80 00712	# 882	44	8	111	<.4	16	64	3.8	350	<4	2
S80 00713	# 883	93	4	139	<.4	26	95	5.0	600	<4	3
S80 00714	# 885	77	<4	105	<.4	22	81	4.2	510	<4	2
S80 00715	# 888	95	6	130	<.4	27	96	5.2	620	<4	2
S80 00716	# 890	88	7	117	<.4	24	91	4.8	560	<4	2

GRØNLANDS GEOLOGISKE UNDERSØGELSE

GEUS
Report File no
20435

Comments on Cominco's report by C.R. Allen and C.J. Harris, 1980-05:

Karrat Group Reconnaissance Program, Mârmorilik, West Greenland (period: May 1979 - May 1980).

Last year's exploration of the Karrat concession is reported here. Earlier exploration had indicated extensive cherty, graphitic pyrrhotite-pyrite sheets carrying up to 0.41% Cu and 0.5% Zn, in the Karrat supergroup of metaclastics. It therefore had been hoped that stratabound Zn-Cu-Pb deposits existed here. The 1979 exploration results appear to eliminate this possibility, but instead found various geochemical anomalies worth follow-up:

- 4 Fe sulphide assemblages: (1) cherty Fe sulphide ± graphite, (2) pyrrhotite-graphite bearing black metasediments, (3) black shale with a little pyrrhotite, (4) cherty pyrrhotite-bearing Fe formation at the Nukavsak metasediment's contact with underlying Kangigdleq volcanics.
- Cu-Zn anomalies flanked by Ba anomalies in the carbonate-black shale facies front in the north drainage of Alfred Wegeners Halvø - possibly the most promising anomalies so far found. Mârmorilik-type carbonates and PbZn deposits were hoped for on the north side of Wegeners Halvø at this transition from carbonates (on the south) to black shale (on the north), but were not found.
- A little molybdenite of no economic significance was found in granite pegmatites.
- Some W anomalies were found, also of no economic significance.

Kimberlites were also an exploration target, but kimberlite indicator minerals, such as chrome diopside, pyrope and olivine, were lacking in all samples.

This unusually complete report brings together results of earlier exploration in this 6'750-Km^2 area just north of Mârmorilik, as well as giving exceptionally detailed observations on the mineral deposits and stratigraphy. Henderson and Pulvertaft's GGU 1:100'000 maps were reported to be quite accurate and very useful. The area is very rugged, so exploration was mainly alongshore in the fjords, with limited helicopter support inland. Samples taken included 177 heavy mineral, 234 stream silt, and 133 rock chip. Multielement analysis for all samples are given, with some statistical treatment. The geology and ore showings are well illustrated in 14 color photographs.

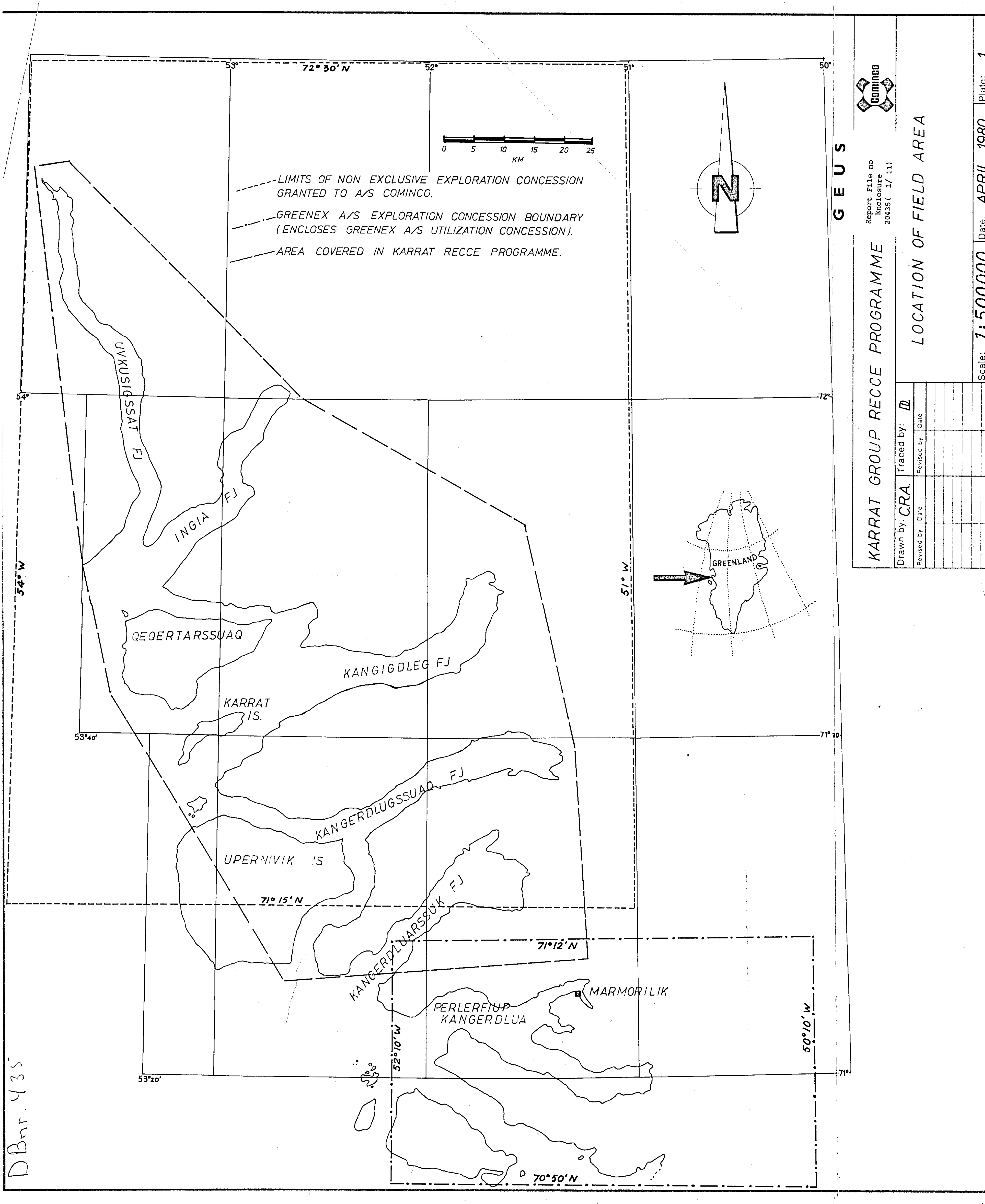
Nej! rocks mangler desværre

The stratigraphy seems to show that the Karrat metaclastics are a basin time-equivalent of the Mârmorilik shelf carbonates, i.e., the Karrat group grades laterally southward into the Mârmorilik and overlying Nukavsak formations, all overlying the Umanak basement gneiss unconformably, but with the contact now "parallelized" by metamorphism. Pedersen and Gannicott developed similar concepts in their still unpublished paper.

A uranium anomaly was located as a spin-off from the multielement analyses: 8 consecutive anomalous samples (570-577) were found in the Qioque headland drainage. These appear to be worth follow-up by GGU.

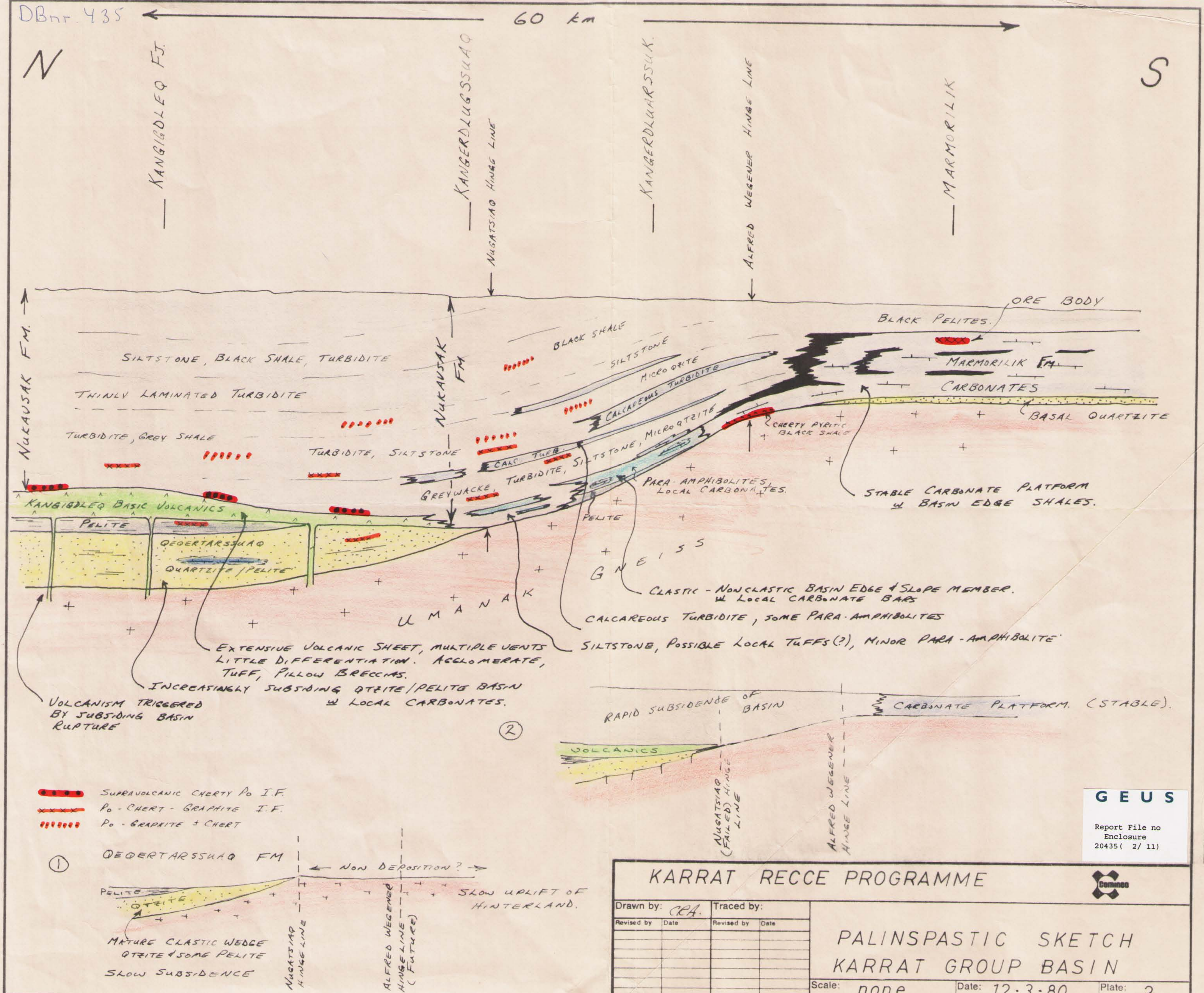
This excellent and voluminous report deserved better binding: it is presented in legal-size format (36 cm long), presumably to better accomodate the tables of geochemical analyses. The manila cover has already ripped and been taped. The large folded maps are bound in, and several have torn during unfolding, and been mended with tape. They could be better preserved in a jacket envelope, with the whole report in stiffer covers. The laboratory doing the analyses is not noted (Cominco's?). Many typos occur. The meaning of "confident" in Fig.3 is not clear to me ("confident volcanic associated sulfides").

H.R. Cooke
4 October 1980



LIMITS OF NON EXCLUSIVE EXPLORATION CONCESSION GRANTED TO A/S COMINCO.
GREENEX A/S EXPLORATION CONCESSION BOUNDARY (ENCLOSES GREENEX A/S UTILIZATION CONCESSION).
AREA COVERED IN KARRAT RECCE PROGRAMME.
0 5 10 15 20 25
KM
N
72° 30' N
53°
52°
51°
50°
54°
72°
54° W
51° W
71° 30'
53°40'
71° 15' N
71° 12' N
53°20'
71°
52°10' W
50°10' W
70° 50' N
UVKUSIGSSAT FJ
INGIA FJ
QEQERTARSSUAQ
KANGIGDLEG FJ
KARRAT IS.
KANGERDLUGSSUAQ FJ
UPERNIVIK IS
KANGERDLUARSSUK FJ
MARMORILIK
PERLERFIUP KANGERDLUA
GREENLAND
GEUS
Report File no Enclosure 20435(1/ 11)
Cominco
KARRAT GROUP RECCE PROGRAMME
LOCATION OF FIELD AREA
Drawn by: C.R.A.
Traced by: D
Revised by
Date
Scale: 1:500,000
Date: APRIL 1980
Plate: 1

DBnr. 435



GEUS

Report File no
Enclosure
20435(2/ 11)

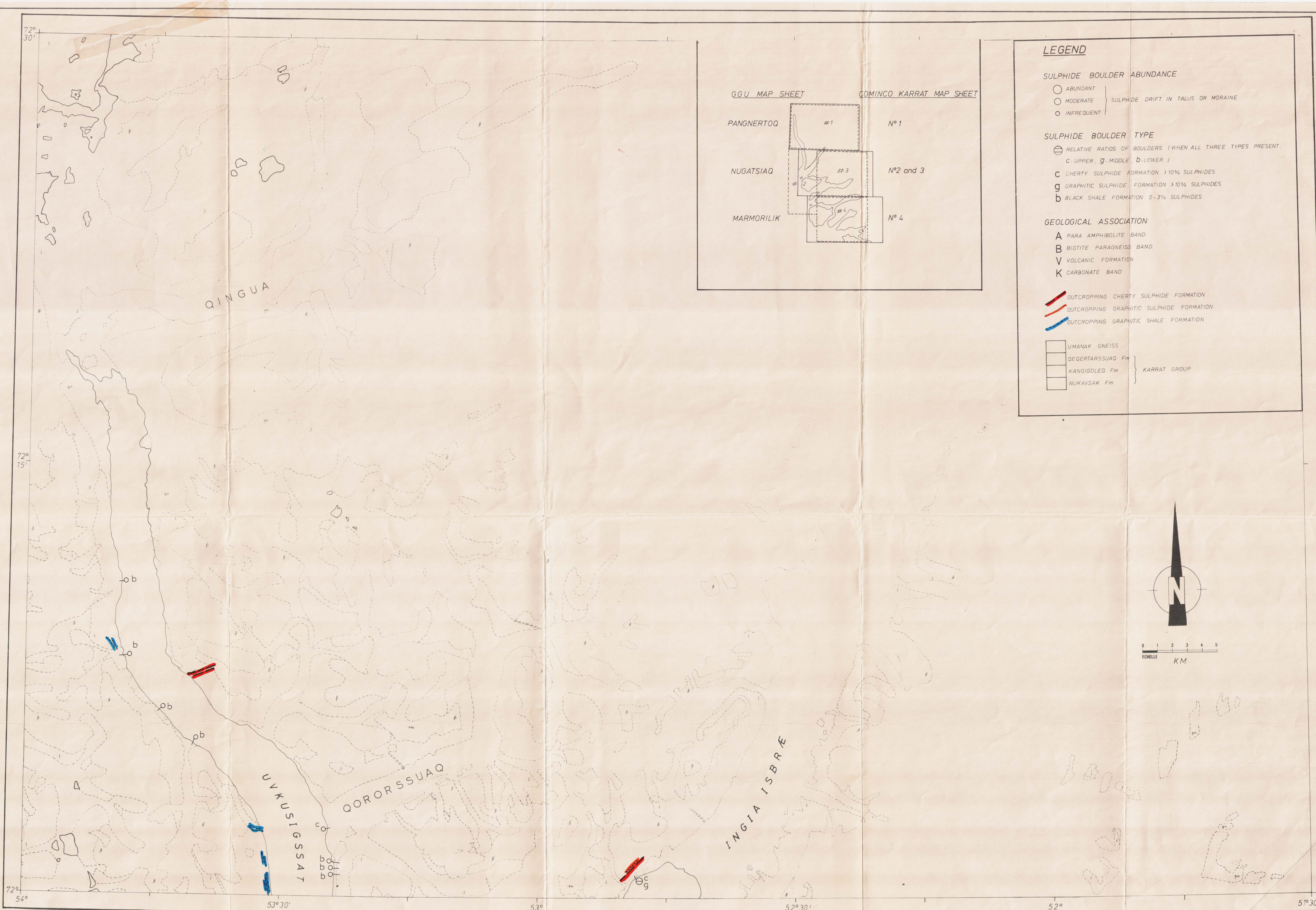
KARRAT RECCE PROGRAMME

Cominco

Drawn by: CRA.	Traced by:
Revised by / Date	Revised by / Date

PALINSPASTIC SKETCH
KARRAT GROUP BASIN

Scale: none | Date: 12·3·80 | Plate: 2



GEUS
Report File no
Enclosure
20435(3/ 11)

KARRAT GROUP RECCE PROGRAMME

Drawn by: C.R.A. Traced by: ID

Revised by	Date	Revised by	Date

GEOLOGY RECCE SHEET Nº 1

DISTRIBUTION OF SULPHIDE AND BLACK SHALE UNITS, AND SULPHIDE BOULDER TYPE AND ABUNDANCE.

Scale: 1: 100,000 Date: APRIL 1980 Plate: 3

FORM 210-067

LEGEND

SULPHIDE BOULDER ABUNDANCE

- ABUNDANT
- MODERATE
- INFREQUENT

} SULPHIDE DRIFT IN TALUS OR MORAINE

SULPHIDE BOULDER TYPE

- ⊖ RELATIVE RATIOS OF BOULDERS (WHEN ALL THREE TYPES PRESENT; C-UPPER, g-MIDDLE, b-LOWER)
- c CHERTY SULPHIDE FORMATION >10% SULPHIDES
- g GRAPHITIC SULPHIDE FORMATION >10% SULPHIDES
- b BLACK SHALE FORMATION 0-3% SULPHIDES

GEOLOGICAL ASSOCIATION

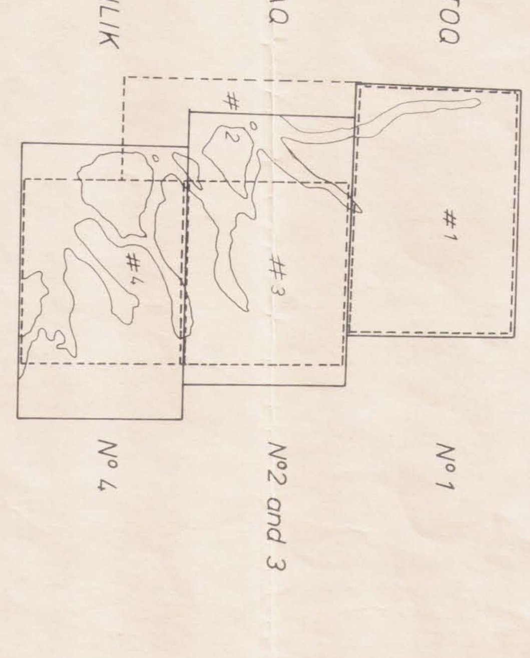
- A PARA AMPHIBOLITE BAND
- B BIOTITE PARAGNEISS BAND
- V VOLCANIC FORMATION
- K CARBONATE BAND

- OUTCROPPING CHERTY SULPHIDE FORMATION
- OUTCROPPING GRAPHITIC SULPHIDE FORMATION
- OUTCROPPING GRAPHITIC SHALE FORMATION

- UMANAK GNEISS
- QEQERTARSSUAQ Fm
- KANGIGDLEQ Fm
- NUKAVSAK Fm

} KARRAT GROUP

GGU MAP SHEET	COMINCO KARRAT MAP SHEET
PANGNERTOQ	Nº 1
NUGATSIAQ	Nº2 and 3
MARMORILIK	Nº 4



KARRAT GROUP RECCE PROGRAMME

GEOLOGY RECCE SHEET Nº 2

DISTRIBUTION OF SULPHIDE AND BLACK SHALE UNITS, AND SULPHIDE BOULDER TYPE AND ABUNDANCE.

Drawn by: C.R.A. | Traced by: D
Revised by | Date | Revised by | Date

Scale: 1:100.000 | Date: APRIL 1980 | Plate: 4

GEUS
Report File no
Enclosure
20435(4/ 11)

FORM 210-0670

DBor 435

LEGEND

SULPHIDE BOULDER ABUNDANCE

- ABUNDANT
- MODERATE
- INFREQUENT

} SULPHIDE DRIFT IN TALUS OR MORAINE

SULPHIDE BOULDER TYPE

- RELATIVE RATIOS OF BOULDERS (WHEN ALL THREE TYPES PRESENT: c-UPPER, g-MIDDLE, b-LOWER)
- c CHERTY SULPHIDE FORMATION >10% SULPHIDES
- g GRAPHITIC SULPHIDE FORMATION >10% SULPHIDES
- b BLACK SHALE FORMATION 0-3% SULPHIDES

GEOLOGICAL ASSOCIATION

- A PARA AMPHIBOLITE BAND
- B BIOTITE PARAGNEISS BAND
- V VOLCANIC FORMATION
- K CARBONATE BAND

- OUTCROPPING CHERTY SULPHIDE FORMATION
- OUTCROPPING GRAPHITIC SULPHIDE FORMATION
- OUTCROPPING GRAPHITIC SHALE FORMATION

- UMANAK GNEISS
- QEQERTARSSUAQ Fm
- KANGIGDLEQ Fm
- NUKAVSAK Fm

} KARRAT GROUP

GGU MAP SHEET		COMINCO KARRAT MAP SHEET
PANGNERTOQ	#1	Nº 1
NUGATSIAQ	#2, #3	Nº 2 and 3
MARMORILIK	#4	Nº 4

GEUS
Report File no
Enclosure
20435(5/ 11)

KARRAT GROUP RECCE PROGRAMME

Cominco

Drawn by: C.R.A.	Traced by: D
Revised by / Date	Revised by / Date

GEOLOGY RECCE SHEET Nº 3

DISTRIBUTION OF SULPHIDE AND BLACK SHALE UNITS, AND SULPHIDE BOULDER TYPE AND ABUNDANCE.

Scale: 1:100.000 | Date: APRIL 1980 | Plate: 5

BCIL - 2401 - C
FORM 210-0670

DBnr 435

LEGEND

SULPHIDE BOULDER ABUNDANCE

- ABUNDANT
- MODERATE
- INFREQUENT

} SULPHIDE DRIFT IN TALUS OR MORAINE

SULPHIDE BOULDER TYPE

- RELATIVE RATIOS OF BOULDERS (WHEN ALL THREE TYPES PRESENT: c-UPPER, g-MIDDLE, b-LOWER)
- c CHERTY SULPHIDE FORMATION >10% SULPHIDES
- g GRAPHITIC SULPHIDE FORMATION >10% SULPHIDES
- b BLACK SHALE FORMATION 0-3% SULPHIDES

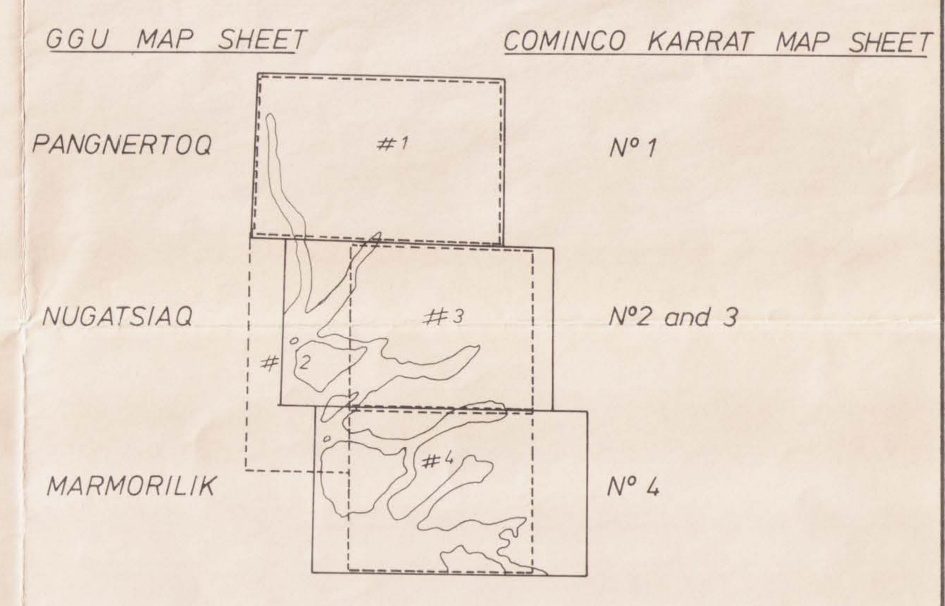
GEOLOGICAL ASSOCIATION

- A PARA AMPHIBOLITE BAND
- B BIOTITE PARAGNEISS BAND
- V VOLCANIC FORMATION
- K CARBONATE BAND

- OUTCROPPING CHERTY SULPHIDE FORMATION
- OUTCROPPING GRAPHITIC SULPHIDE FORMATION
- OUTCROPPING GRAPHITIC SHALE FORMATION

- UMANAK GNEISS
- QEQERTARSSUAQ Fm
- KANGIGDLEQ Fm
- NUKAVSAK Fm

} KARRAT GROUP



GEUS
Report File no
Enclosure
20435(6/ 11)

KARRAT GROUP RECCE PROGRAMME

Drawn by: C.R.A. | Traced by:
Revised by | Date | Revised by | Date

GEOLOGY RECCE SHEET Nº 4

DISTRIBUTION OF SULPHIDE AND BLACK SHALE UNITS, AND SULPHIDE BOULDER TYPE AND ABUNDANCE.

Scale: 1:100.000 | Date: APRIL 1980 | Plate: 6

BCIL - 2461 - C
FORM 210-0670

DBnr 435

Rock sample

△ Talus or boulder

▫ Heavy mineral sample

○ Silt sample

GEUS

Report File no
Enclosure
20435(7/ 11)

KARRAT GROUP RECCE PROGRAMME	
Drawn by: CPK	Traced by:
GEOCHEM SURVEY STREAM SAMPLE LOCATION MAP PANGNERTOQ (NORTH) SHEET	
Scale: 1:100,000	Date: FEB '80 Plate: 7

NCI - 118 - C.L.

■ Heavy mineral sample

● Silt sample

GEUS

Report File no
Enclosure
20435(8/ 11)

KARRAT GROUP RECCE PROGRAMME

Drawn by	Traced by	
CGH		GEOCHEM SURVEY STREAM SAMPLE LOCATION MAP NUGATSIAQ (CENTRAL) SHEET
Revised by / Date	Revised by / Date	
Scale 1:100,000	Date: FEB '80	Plate: 8

NCI - 118 - C.L.

FORM 210 0675

■ Heavy mineral sample
● Silt sample

KARRAT GROUP RECCE PROGRAMME

GEOCHEM SURVEY
STREAM SAMPLE LOCATION MAP
MARMORILIK (SOUTH) SHEET

Drawn by	Traced by
CCL	

Scale 1:100,000 Date FEB '80 Plate 9

GEUS
Report File no 20435
Enclosure 9/11

▲ Talus or boulder ie 'drift'

● Outcrop sample

KARRAT GROUP RECCE ; PROGRAMME

Drawn by: CPA	Traced by:	
		GEOLOGY RECCE ROCK SAMPLE LOCATION MAP MARMORILIK (SOUTH) SHEET
Scale: 1:100,000	Date: FEB '80	Plate: 10

GEUS
Report File no
Enclosure
20435(10/11)

▲ Talus or boulder i.e. 'drift'

● Out crop sample

KARRAT GROUP RECCE PROGRAMME	
Drawn by: CAR. Traced by:	GEOLOGY RECCE ROCK SAMPLE LOCATION MAP NUGATSIAQ (CENTRAL) SHEET
Scale: 1:100,000	Date: FEB '80 Plate: 11

GEUS
Report File no
Enclosure
20435(11/ 11)

NCI-118-C.L.

FORM 212 0677