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Sammendrag Resultatet av undersøkelsene er klart negativt og vi må anbefale at prospekteringsarbeidet ved Lillebotn ansees for å være avsluttet.				

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SAKSBEARBEIDER J. Færdén

RAPPORT VEDRØRENDE:

Sluttrapport

LILLEBOTN KOBBERFOREKOMSTER, TYSFJORD, NORDLAND:

FORDELING

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☐	
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KONKLUSJON

Undersøkelsesarbeidene ble startet med håp om å finne en prekambrisk, "porphyry copper"-forekomst. Det er riktignok ennå ikke bevist at slike finnes, men ertsmineralene og også bergartene ved Lillebotn viser likheter med de kjente forekomstene fra den alpine orogenese.

Av den grunn er det utført både regionale og mere konsentrerte undersøkelser omkring kjente forekomster.

Resultatet av undersøkelsene er klart negativt og vi må anbefale at prospekteringsarbeidet ved Lillebotn ansees for å være avsluttet.

KIRKENES:

☒	Dir. Smith-Meyer
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ANDRE:

☒	<u>Bergmesteren i Nordland</u>
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KOMMENTAR:

29. 

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I rapporten fra 1973.06.12 finnes
bl.a. rapport over geofysiske
målinger og oppredningsforsøk.

LILLEBOTN KOBBERFOREKOMSTER, TYSEFJORD, NORDLAND.Innledning.

Undersøkelsene av Lillebotn Kobberforekomster begynte i 1972.

I 1973 deltok geolog dr. Richard C. Swainbank med geologisk kartlegning og kjernerapportering (borhullene 1-4). Fru Swainbank foretok maskinskrivning, karttegning og merking av prøver.

Kjell Stenmark sto for røsking, prøvetagning av røskene samt innsamling av jordprøver.

Geofysiker Per Eidsvig, NGU, foretok VLF-målinger over spesielle deler av feltet.

Diamantboringen ble utført av vår avd. Bjørkaasen.

Beliggenhet.

Forekomstene ligger på Tysneshalvøya mellom Tysfjorden og Vestfjorden, nord og vest for Botn Campingplass ved E6. Det er 2-3 km langs en sti, tidligere grubevei, opp til forekomsten som ligger 290-350 m.o.h.

Rettigheter.

A/S Sydvaranger hadde 31 anvisninger i feltet, hvorav 2 med Hei-berg Karlsens arvinger etter en avtale av 7. september 1971.

Avtalen er sagt opp i brev av 1973-12-10.

Tilbake står nu 7 mutinger.

Tidligere arbeider.

A/S Skandia Kobberverk foretok undersøkelsesarbeider i 1906 og skjæringer, stoller, synker og et mindre dagbrudd skriver seg fra den tiden:



På hovedforekomsten H3, koordinater 4850Ø - 5870N tegn. nr.1 er drevet et mindre dagbrudd, ca. 160 m² øverst og ca. 100 m² nederst tils. 5 m dyp. I sålen er drevet ned en synk, nu gjenfylt, til gjennomslag med en underliggende 55 m lang stoll.

I enden av stollen er et 20 m langt tverrslag. Syd for forekomsten er berghaller i to nivåer både fra dagbrudd og stoll.

På forekomst H, koordinater 5100Ø - 5120N, er drevet en slep-synk til ukjent dyp. Øst for forekomsten er en berghall.

På forekomst H5, koordinater 5760Ø - 6540N, er drevet en ca. 10 m² synk, etter berghallen størrelse å dømme, ca. 20 m dyp.

Ved H2, koordinater 5040Ø - 5340N, er det drevet ned en mindre synk.

På forekomst H6, koordinater 4830Ø - 3850N er det drevet en 10 m lang skjæring på tvers av strøket. Stuffen i skjæringen er ca. 5 m høy. I åpningen av skjæringen er det en 1½ m dyp synk.

På forekomstene H4, koordinater 5810Ø - 6500N, H7, koordinater 5040Ø - 5130N og H8, koordinater 4860Ø - 5100N, er det bare satt noen få skudd.

Oversikt over arbeider 1971-73.

Herr Heiberg Karlsen tilbød i 1971 sitt skjerp "Kopparen" (her benevnt H3) til A/S Sydvaranger. Malmen derfra er bournitt og kobberglans og er usædvanlig sølvrik.

Utgående ertsmineralisering er ikke imponerende. Men i Repparfjord hvor man har samme ertsmineraler (om enn i andre bergarter) viste det seg at mineraliseringen tildels er mikroskopisk og at denne var utslagsgivende ved beslutning om drift.

Våre undersøkelser har derfor gått ut på å undersøke om en slik mikroskopisk ertsmineralisering var tilstede.



Undersøkelsene i 1972 var geologisk kartlegning (S.Peters), geofysiske målinger (IP, RP, SP og magnetometri) over et 4 km² stort område. Systematisk innsamling av et større antall prøver (534) og oppredningsforsøk med malm tatt på berghallen utenfor H3.

Geologien i området er ganske komplisert med ofte subtile bergartsoverganger og det viste seg at det geologiske og det geofysiske kartet på ingen måte falt sammen.

I 1973 ble det derfor tatt opp et nytt geologisk kart, som viser god overstemmelse med geofysiske kart. Det ble videre diamantboret 612 m fordelt på 7 hull, gravet og skutt 380 m fordelt på 3 røsker. Over noe av den nordlige del ble VLF-målinger samt nye SP-målinger forsøkt.

Malmen.

Hovedertsmineralene er bornitt ($\text{Cu}_3\text{FeS}_3 - \text{Cu}_5\text{FeS}_4$), kobberglans (Cu_2S) kobberkis (CuFeS_2) og magnetitt.

Mineraliseringen forekommer som følger:

1. Bornitt-kobberglans i gjennomsettende granat-epidotfels og i/brecciert gneis i felsens umiddelbare nærhet. Dette gjelder hovedforekomsten H3, samt H4 og H5.

Kobberglansen er rik på sølv. Ved H3 er funnet fritt gull, dessuten har F.S. Nordrum påvist små mengder djurleitt, blyglans, nittichenitt, hersitt-naumannitt, molybdenglans, kobberkis-covellin, idaitt og hematitt.

Fra tidligere drift (1906) er det rapportert en gjennomsnittsgehalt på 1,9% Cu. Prøver tatt over et lengdesnitt av nedre berghall viste 1,05% Cu mens prøve av skeldegods viste 6,23% Cu.

Prøver tatt av oss i taket i nevnte tverrslag ved H3 viser 0,52% Cu over 14 m og viser ujevn mineralisering.



Skulle granatfelsen ha noen utstrekning måtte det enten være mot dypet eller mot nord. Diamantborhull BTY4 er satt på øst for forekomsten og skjærer under denne i omtrent Ø-V retning. 20 m under stollnivå er det her en 0,6 m sone med 0,61% Cu eller intet eller meget lave verdier (bilag 1/I side 4). Granatfels ble ikke funnet (bilag 1/III side 17-18). Fra nord er satt borhull BTY2 som skulle fange opp granatfelsens eventuelle fortsettelse mot nord: Det finnes granatskarnbanker, men det er intet tegn til den gjennomsettende granat-epidotfels. Det ble funnet to tynne soner henholdsvis 0,65 m og 1 m med 0,3% Cu. Ertsmineralet er kobberkis. Forøvrig ble det funnet magnetitt og svak imp. av svovelkis. (Bilag 1/I side 3)

2. Konkordant mineralisering finnes ved slepsynken H. Kobberertsmineralisert mæktighet er mellom 1,5 og 2 m og ertsmineraliseringen er bornitt og kobberkis med accessoriske mengder (funnet av F.S. Nordrum) linnaeitt, argentitt, covellin og idaitt. Magnetitt opptrer ganske riklig.

Et prøveprofil over berghallen viser 1,25% Cu.

Diamantborhull BTY 6 A og B er satt på nord for synken med helning mot syd for å skjære en eventuell fortsettelse av mineraliseringen. Borhull A måtte oppgis på 17 m p.g.a. ras og fastkiling av kjernerøret, men B ble boret til 65 m. Hullet er praktisk talt sterilt bortsett fra noe fattig kisimpregnasjon og magnetitt. (Bilag 1/I side 5 og bilag 1/III side 24-25.)

3. Særlig i basiske gneiser finnes små mengder kobberkis foruten svovelkis, magnetkis, sinkblende og magnetitt. Blyglans, molybdenglans, hematitt og ilmenitt er også funnet, magnetkis er ofte omvandlet til markasitt. Dette gjelder H6, og visse mafiske soner.



4. I småkupper med grov hornblendegabbro (mafic xenoliths) opptrer cm-tykke bånd med kobberkis, bornitt og magnetitt. F.S. Nordrum har dertil påvist covellin og idatt. Funnpunktene H7 og H8 er typisk for denne mineraliseringen.
5. Jernmalm finnes flere steder på Tysneshalvøya. Den største er Storjorden. Malmen er magnetitt med 40,7% Fe (tilsv. 56% Fe_3O_4) 0,25% Mn, og 0,005% Cu. Malmen opptrer her som en foldet oppsprukket linse, for liten til å være av økonomisk interesse.
6. Ved Skarvik finnes hematitt - ilmenitt-impregnasjon i gneis. Ertsen opptrer i striper opptil 10 mm tykke, for det meste som helt tynne striper. Kobberkis finnes på tynne striper. Bornitt og molybdenglans finnes helt underordnet. Mektigheten kan gi opp i 50 m, men mineraliseringen er alt for fattig til at den er av økonomisk interesse, fra 0 til 0,2% Cu.
7. I Tiltvik finnes en euxenitt-forekomst i forbindelse med pegmatitt. Forekomsten har vært undersøkt flere ganger, men er for liten.

Geologi

av R.C. Swainbark.

SUMMARY:

Copper mineralization is widely scattered on the low ridge to the west of Botn in Tysfjord, and geophysical surveys were conducted by N.G.U. in 1972 on a grid-system covering the region. Several anomalous areas were indicated, particularly by induced polarization methods and follow-up work in 1973 by N.G.U. using the V.L.F. method traced conducting zones to the northwest in an extension of the grid-system.

Detailed geologic mapping and rock sample collection was carried out in the 1973 season in the region of the most intense I.P. anomalies, which had been selected for investigation by diamond drilling. A few soil and stream sediment samples were also collected from strategic locations to test the feasibility of geochemical prospecting techniques in this terrane, and a pilot-program was initiated late in the season.

Three main groups of rocks, with complex inter-relation, outcrop in the area, and these groups were subdivided into eleven mappable units on a compromise between apparent bulk chemistry, mineralogy and weathering characteristics. In the northwestern part of the region, the most abundant rocks are paragneisses, including calcareous, quartzo-feldspathic and mafic-rich units. In the extreme northwest the mafic paragneisses are metasedimentary in aspect, and contain graphite and minor sulphides (pyrrhotite, pyrite, chalcopyrite and possibly zincblende). Further east the mafic zone, which contains both hornblenderich and biotite-rich variants, becomes more cohesive, and is spatially related to the V.L.F. and I.P. anomalous zones, and are the probable cause of the anomalies. The biotite-rich unit is schistose, and the biotite is usually pseudomorphous after amphibole.



Skarn development has affected many of the units of the paragneiss, and is apparently selectively based on the original bulk chemistry of the paragneiss. The process is progressive, and results in a resistant garnet-epidote-diopside skarn with little or no relict texture, which occurs both as aligned pods and lenses within paragneisses, and also as discreet but irregular lensoid bodies.

Much of the southern and eastern parts of the area is underlain by deceptively coarse grained quartz-plagioclase-orthoclase-hornblende-gneisses containing zones with abundant well-defined xenoliths of mafic paragneiss and massive skarn, and also a few more felsic and less distinct clasts which are probably felsic paragneisses and gneissic skarn. Gradations of the xenolithic gneiss into all types of paragneiss and skarn is observed.

Gradations of the xenolithic gneiss into the third group of rocks may have been observed but not recognised as such, due to the similarity in apparent grain-size and texture. The granitic gneisses and gneissic granite are poorly foliated and again deceptively coarse-grained, but orthoclase is predominant over plagioclase, and biotite is the dominant, or only mafic constituent, and the glomeroporphyroblastic hornblende characterizing the xenolithic gneiss is absent or extremely altered. These granitic rocks outcrop in cohesive bodies in the northeast and southwest of the area, and are usually in fault contact or very sharp contact with other rock groups.

The regional tectonic grain, except where realigned by folding or faulting, is northwest-southeast with dips 25° - 45° to the northeast. Strike-slip movement between units caused local drag-folding with axes conformable with the dip and also causes many enigmatic outcrop patterns. Isoclinal recumbent fold axes plunging about 35° to N 65° are common in the northwest of the area, particularly in calcareous units, and the outcrop of the mafic paragneiss units defines a much larger scale rockfold on the upper limb of a complex, large-scale recumbent fold with a northeasterly plunging axes.



Small drag-folds along faultplanes are common, but some larger isoclinal recumbent folds within the xenolithic gneisses have NW-SE axes, and unless these folds are reorientated by drag along several northeasterly and southeasterly faults, they may indicate polymetamorphism.

Fracturing is pervasive throughout the area, especially in the central part. Some of the major faults, particularly those on NE, SE and N-S salients, have a demonstrable right-lateral component which is often of considerable magnitude. One of the northeasterly faults fractures and displaces the mafic-rich paragneiss zone and associated geophysical anomalies. The mafic gneiss is garnetiferous in the immediate vicinity and in fault-slices along the zone. The fault-plane is itself folded and faulted along a N 120° strike-slip fracture, and the two segments of the mafic zone have been relatively rightlaterally displaced in this manner. A similar process causes changes in the direction and hade of major northeasterly fractures near prospect H3, and recurrent movement of all portions of the system creates further complications.

Weak sulphide mineralization in the mafic paragneisses is more abundant in the lower parts of unit, probably due in part to strike-slip faulting, and the mineralization can be traced from the coast at 396668, (seks-sifrete koordinater henviser til punkter på AMS-kart 1:50.000) to the 3100 Ø line in the extreme northwest of the grid, and thence in a sinuous folded zone to 5600 N / 4600 Ø where it is terminated by a strong NE fault. The zone can be traced via large xenoliths and lenses to prospect H8, where enriched margins of the xenolith are observed, to prospect H. Though the mineralization is stronger in more mafic-rich parts of the xenolithic gneiss at prospect H, molybdenite is present with bornite and chalcopyrite within a 4 m. wide zone concordant with the grain of the foliation.



Potassic alteration is associated with the xenolithic gneiss, but is restricted to a narrow zone with a north-south trend. Similar mineralization at prospect H6 is restricted to a 3 m wide zone within a thin, rather larger zone of pyrite-rich mafic gneiss and gneissic skarn, where it is intersected by potassic aplites or pegmatites in a N-S fault zone. A fault zone with the same trend outcrops south and north of prospect H, apparently offset by southeasterly and northeasterly faults, and then trends northwards to prospect H2 and H3.

At H3, bornite and chalcocite mineralization with minute traces of free gold occur as void and fracture fillings associated with late felsic pegmatites in massive garnet-diopside-epidote skarn. A little chalcocite, as fracture-fillings and occasionally as weak impregnations occurs in the surrounding gneiss in the immediate vicinity, but drilling shows that the skarn has limited size, is probably lens- or pod-like, and that only traces of bornite and chalcopyrite, related to fracture zones, are present in the surrounding gneisses. Prospects H4 and H5 are of the same type, but are less strongly mineralized.

Swainbanks rapport følger som bilag 1.



Geofysiske undersøkelser. Av Ø. Logn.

Geofysiske undersøkelser er utført:

- 1) I tiden 5. - 28. juni 1972
- 2) I tiden 28. juni - 6. juli 1973.

Begge undersøkelser er utført ved N.G.U., Geofysisk avdeling. Ansvarshavende geofysiker var P. Eidsvig.

Undersøkelsene er rapportert i:

- 1) N.G.U: Rapport nr. 1107, datert 15. mai 1973.
- 2) N.G.U. Rapport nr. 1197, datert 26. februar 1974.

1. Geofysiske betingelser.

Det var på forhånd klarlagt at malmen - som finnes på en berghall ved et mindre brudd - består vesentlig av kobberkis og bornitt i en impregnasjon som har relativt dårlig elektrisk ledningsevne. Ledningsevnen av 16 prøver av malm og bergarter fra feltet er målt ved N.G.U.'s laboratorium og viser seg å ligge mellom 0,18 og 2,0 mho/m. Svovelkisimpregnasjon synes å ha gitt den høyeste ledningsevne. Ledningsevnene er lave sett i relasjon til de ledningsevner man vanligvis påviser i kompakte kismalmer.

IP-effekt for 63 prøver av malm og bergarter er bestemt ved N.G.U.'s laboratorium. IP-effekten varierer mellom 0,1 og 26%.

Videre er magnetittinnholdet bestemt for de samme prøver. Magnetittgehalten varierer mellom 0 og 24%. De høyeste IP-effekter er påvist i prøver med

- 1) Høy magnetittgehalt
- 2) Svovelkisimpregnasjon.

Prøvene med bornitt og kobberkis (kobberglans) har gitt IP-effekter beliggende mellom de høyeste verdier påvist i svovelkis-magnetittimpregnasjonene, og de lavere påvist i kisle bergarter.



2. Målemetoder.

Som følge av at eventuelle malmer i feltet måtte ansees som dårlige elektriske ledere, ble det valgt å anvende de geofysiske metoder som ansees å ha mulighet for å indikere svakt ledende impregnasjonsmalmer og disseminerte kisansamlinger.

Følgende metoder er anvendt:

- 1) Indusert polarisasjon (IP)
- 2) Tilsynelatende spesifikk elektrisk ledningsevne (ρ)
- 3) Selvpotensial (SP)
- 4) Magnetisk vertikalintensitet
- 5) Very low frequency (VLF) E.M.

Metodene finnes kort beskrevet i N.G.U. rapportene.

3. Målingene.

Målingene er utført innen et ca. 5 km² stort område. Terrenget er ikke særlig gunstig for utførelse av geofysiske målinger, idet store høydeforskjeller forekommer innen feltet.

Feltet er gjennomgående dekket med målinger langs profiler i innbyrdes avstand ca. 100 m. Målepunkts-avstand langs profilene er nesten overalt 25 m.

4. Geofysiske resultater.

Resultatene er fremstillet i separate karter bilagt de to rapporter. Variasjoner i IP, tilsynelatende spesifikk ledningsevne, SP, samt magnetisk feltstykke er vist i kotelagte anomalikarter, mens VLF-resultatene er fremstillet som indikasjonsskart på lignende måte som man vanligvis gjør ved turam-målinger.



Samtlige elektriske målinger viser:

1) Ingen indikasjon på malmen i skjerpet H3. En prøve på å vise potensialforskjellen (SP) mellom utgående malm og sidebergart ved direkte elektrodekontakt med malmen, utført ved Logn under en befaring, viste at malmen i elektrodekontakt har negativt potensial på ca. 400 millivolt, mens det praktisk talt ikke finnes potensialdifferanser i malmens nærmeste omgivelser. Dette må tydes derhen at malmen - som er dårlig ledende - er av ytterst små dimensjoner.

2) Godt ledende soner av tildels betydelig utstrekning i feltets nordlige og nordvestlige deler. Ved etterfølgende røsking og diamanthoring er det påvist grafittholdige skifre av god elektrisk ledningsevne, og det er grunn til å anta at alle de sterkere indikasjoner i feltet skyldes grafittholdige skifre.

De gode ledende soner finnes i sedimenter (paragneiser), som sterkt sammenfoldet ligger i en grensesone omkring det store gneisgranittmassiv som dekker praktisk hele den nordre del av feltet. Relativt høy tilsynelatende ledningsevne og IP-effekt under massivets vestlige og sydvestlige del (se vedlagte ^{tegning 7} kartskisse) tyder på at de grundtliggende godt ledende grafittholdige skifre strekker seg inn under massivet med forholdsvis flatt fall.

Utbredte høye negative selvpotensialer som dekker omtrent samme område av massivet synes å tyde på ledende soner beliggende i dyp av størrelsesorden 100 til 200 m. De to vedlagte profiler (tegning 5-6) lagt i to retninger over massivet (profilene er innlagt på kartskissen tegning 7, viser potesialvariasjoner, som er så sterke at de bare av denne grunn naturlig assosieres med godt ledende grafittskifre.

Liknende forhold synes å foreligge under gneisgranittmassivet sydvestligst i feltet, men her er forholdene ikke så fullstendige geofysisk undersøkt som over det nordlige massiv.



5. Konklusjon.

Forholdene i feltet synes å ligge dårlig tilrette for å påvise malmer av den kobberkis-bornittførende type som finnes i skjerp H.3. Den foreliggende oppgave er således å finne relativt dårlig ledende kisimpregnasjoner av sannsynligvis meget begrenset utstrekning, beliggende i et miljø med utstrakte, godt elektrisk ledende grafittholdige skifre med plateformet opptreden. Oppgaven synes geofysisk sett noe nær umulig.

Diamantboring.

Det ble boret tilsammen 612 m fordelt på 7 hull.

Borehull 1 (BTY) (lengde 140,30 m) er satt på koordinat Ø 4450 - N 6575 for å skjære de nordlige sterke IP-SP-VLF-anomalier. Karakteristisk for sonen er hornblendegneis.

To grafittførende lag som forklarer anomaliene ble funnet. Mineraliseringen var ubetydelig med spor av kobberkis med fra 0 til 0,11% Cu.

Borhull 2 (BTY 2), lengde 190,20 m, er satt på koordinater Ø 4800 - N 6075, på en IP-SP-anomali i skarn. Hullet skulle skjære en eventuell nordlig fortsettelse av granatskarnet i hovedforekomsten H3. Samtidig ble et skarnparti nord for H3 undersøkt.



Fortsettelse av H3 ble ikke funnet. Foruten små mengder svovelkis, magnetkis og magnetitt, ble det funnet finfordelt kobberkis innen cm-tykke striper fordelt over 1,4 m med 0,22% Cu og 1 m med 0,30% Cu. Utenom disse sonene, finnes spor av kobberkis med fra 0 til 0,07% Cu.

Borhull 3 (BTY 3) lengde 33,60 m ble satt fra samme stamplass som 2, men mot nord. Hensikten var å undersøke om en forkastnings- eller skjærsone var mineralisert hvilket den ikke var.

Borhull 4 (BTY 4), lengde 79 m, koordinater Ø 4875 - N 5910, ble satt på for å skjære eventuell fortsettelse av malmen i H3 mot dypet, fra 22 til 42 m under sålen i stollen.

I borhullet ble bare funnet gneis, uten antydning til granat-skarn.

I fortsettelsen av forekomstens antatte heng (se profil, tegn nr. 4) fant man i borhullet 0,60 m med litt bornitt og spor av kobberglans og kobberkis med 0,61% Cu. Forøvrig er gehaltene fra 0 til 0,05% Cu, helst 0.

Borhull 5, lengde 87 m, koordinater Ø 4500 - N 5570. Hullet er satt på en sterk IP-anomali over hornblendegneis og glimmergneis. De samme bergartene ble funnet i borhullet, dertil granittisk gneis. Uttatte prøver for analyse viste fra 0,04% Cu til 0,05% Cu.

Borhull 6A, lengde 17,10 m, koordinater Ø 5100 - N 5205. Hullet ble satt på for å undersøke eventuell fortsettelse av malm i slepsynken, forekomst H. P.g.a. ras i hullet med påfølgende fastboring, ble hullet oppgitt.

Borhull 6B, lengde 65 m, samme koordinater som 6A, men 3° brattere.

Borkjernen viste seg å være sjeldent steril.

Røsking

Det ble gravet og skutt 3 røsker:

Røsk 0 ble gravet over en IP-anomali og ble begynt ved Ø 4600 - N 6800 med retning S 24^GW. Røsken er 77 m lang og det ble tatt ut 16 prøver. Ingen registrering av kobber.

Røsk 1 ble satt parallelt borhull 1. Røsken begynner ved Ø 4425 - N 6560 med retning S 84^GW og er 127 m lang. Hensikten med røsken var å få bragt på det rene eventuelle forskjeller i gehalter av eventuelle mineraliseringer i dagen og i dypet. Det ble tatt ut 13 prøver. Analyser viser 0,01 - 0,03% Cu. (Bilag 1/I side 6-7.)

Røsk 2 ble lagt parallelt borhull 2 og ble begynt ved Ø 4800 - N 6075 med retning S 16^GW og er 175 m lang. Hensikten var den samme som for røsk 1. Det ble tatt ut 25 prøver. Analyseresultatene varierer mellom 0,03-0,11% Cu. (Bilag 1/I side 8.)

Bergartsprøver.

I 1972 ble det tatt i alt 655 prøver.

534 av prøvene er tatt systematisk over Tysneshalvøya. Prøvetagningskart er gitt i rapporten for 1972.

9 stykker representerer forskjellige bergartstyper som ble analysert med resultat 0,004 - 0,008% Cu. 19 prøver er mikroskopert for erts, 11 for bergart. 495 prøver er undersøkt med binokularlupe.

Resultatet av prøvetagningene er klart negativt.

I 1973 ble det tatt 3 prøver ved Skarvik hvor det finnes en hematittimpregnert horisont med malakitt og spor av kobberglans og bornitt. Det ble tatt 3 prøver av hva som så ut til å være de rikeste malmtyper. Resultatet var 0,20 - 0% Cu.



GEOKEMISK PROVTAGNING

Geolog Nils B. Hollander

1. INNLEDNING

I området har insamlats 356 jordprover efter ett profilnät med 50-100 m mellan linjerna och 25/50 m mellan proverna. Provtagningsdjupet är < 0,5 m. Proverna är tagna nära fast fjäll.

Materialet har analyserat med atomabsorptionspektrofotometer på Cu, Mn och Fe. Analyserna har utförts hos A/S Sydvaranger i Kirkenes.

2. GEOKEMISK TOLKNING

2.1 Definition av bakgrund och anomali

Följande definitioner används:

- a) bakgrund är den fördelning till vilken de flesta observationerna i en serie av tillfälliga prov hör.
- b) anomali är varje fördelning som skiljer sig från denna.

Av detta följer att bakgrundsvärden kan inkludera anomalier om fördelningskurvan (den s.k. frekvensfördelningen, se nedan) är svår att tolka. Man skall också lägga märke till att en anomalös fördelning ej nödvändigtvis indikerar närvaron av en malmkropp.

2.2 Tolkning av frekvensfördelning.

För tolkningen har analyserna indelats i intervaller om 5 ppm, i vilka mängden prov i antal och procent samt kumulativ frekvens beräknats. Se tabell 2. Resultaten i denna har sedan plottats som en kumulativ frekvensfördelning, figur 1.



I lognormala fördelningar av detta slag representeras varje population av en rät linje, som är en del av hela kurvan. Olika populationer har - enkelt uttryckt - olika lutningar på sina linjer. Linjerna blir i praktiken ej räta på grund av provtagnings- och analysfel. Knäckpunkterna (s.k. inflexionspunkter) anger var man går från en population till nästa.

I fördelningen finnes 3 inflexionspunkter vid 55, 145 resp. 470 ppm Cu, vilket tyder på 4 olika fördelningar. Fördelningen med 1-55 ppm koppar innefattar 90,7 % av alla prov och anges här som bakgrund. De övriga fördelningarna, som har 5,3; 3,08 resp 0,9% av proverna, får alla betraktas som anomalösa men i varierande grad. Följande värdering kan anges:

Intervall (ppm Cu)	Frekvens (%)	Anomaligradering	Beteckning på figur
1- 55	90,7	Bakgrund	(a)
56-145	5,3	Eventuellt anomalös	(b)
146-470	3,1	Sannolikt ---"----	(c)
470	0,9	Definitivt ---"----	(d)

3. RESULTAT

För värderingen av resultaten har Cu-halterna plottats efter provtagningsnätet. Endast 316 av de 356 proverna fanns dock med.

Den geokeniska bilden visar flera anomlösa områden (tegn. nr. 3):

a) I nordväst ligger tre områden, av vilka de två i öst kan korreleras med svag sulfidimpregnation i grafitskiffer. Det västligaste ligger i strykningens riktningen från dessa och tolkas därför på samma sätt.



b) Rakt söder om a) finnes ett stort eventuellt anomalöst område med ett par förhöjningar i halterna. Borrningar har endast påvisat mycket svaga spår av sulfider.

c) I områdets södra del och sydöst om b) finnes ett område med samma anomalimönster. Mineraliseringar har ej observerats.

d) I östra delen av området finnes enstaka lokala tilldelvis kraftiga anomalier, som i vissa fall direkt kan korreleras med små skärp. De andra fördelningar tolkas på samma sätt.

4. REKOMMENDATIONER.

Den geokemiska undersökningen har påvisat flera anomalösa områden. Anomalierna orsakas av svaga sulfidimpregnationer i skiffer och gnejs samt små och rika mineraliseringar. Det finns inga indikationer på andra möjligheter. Fortsatta geokemiska undersökningar kan därför ej rekommenderas.



Tabell 2. Frekvensfordeling av Cu i jordprov fra
Tysfjord, Nordland.

Intervall (ppm Cu)	Antall (st.)	Frekvens (%)	Kumulativ frekvens (Kum. %)
1- 5	118	33,15	33,15
6- 10	105	29,49	62,64
11- 15	33	9,27	71,91
16- 20	18	5,06	76,97
21- 25	19	5,33	82,30
26- 30	11	3,09	85,39
31- 35	6	1,69	87,08
36- 40	6	1,69	88,77
41- 45	1	0,28	89,05
46- 50	1	0,28	89,33
51- 55	5	1,40	90,74
56- 60	5	1,40	92,14
61- 65	0		
66- 70	3	0,84	92,98
71- 75	0		
76- 80	1	0,28	93,26
81- 85	1	0,28	93,54
86- 90	2	0,56	94,10
91-105	0		
106-110	1	0,28	94,38
110-115	1	0,28	94,66
116-120	1	0,28	94,94
121-125	0		
126-130	1	0,28	95,22
131-135	1	0,28	95,50
136-140	0		
141-145	2	0,56	96,06
146-165	0		
166-170	2	0,56	96,62
171-210	0		



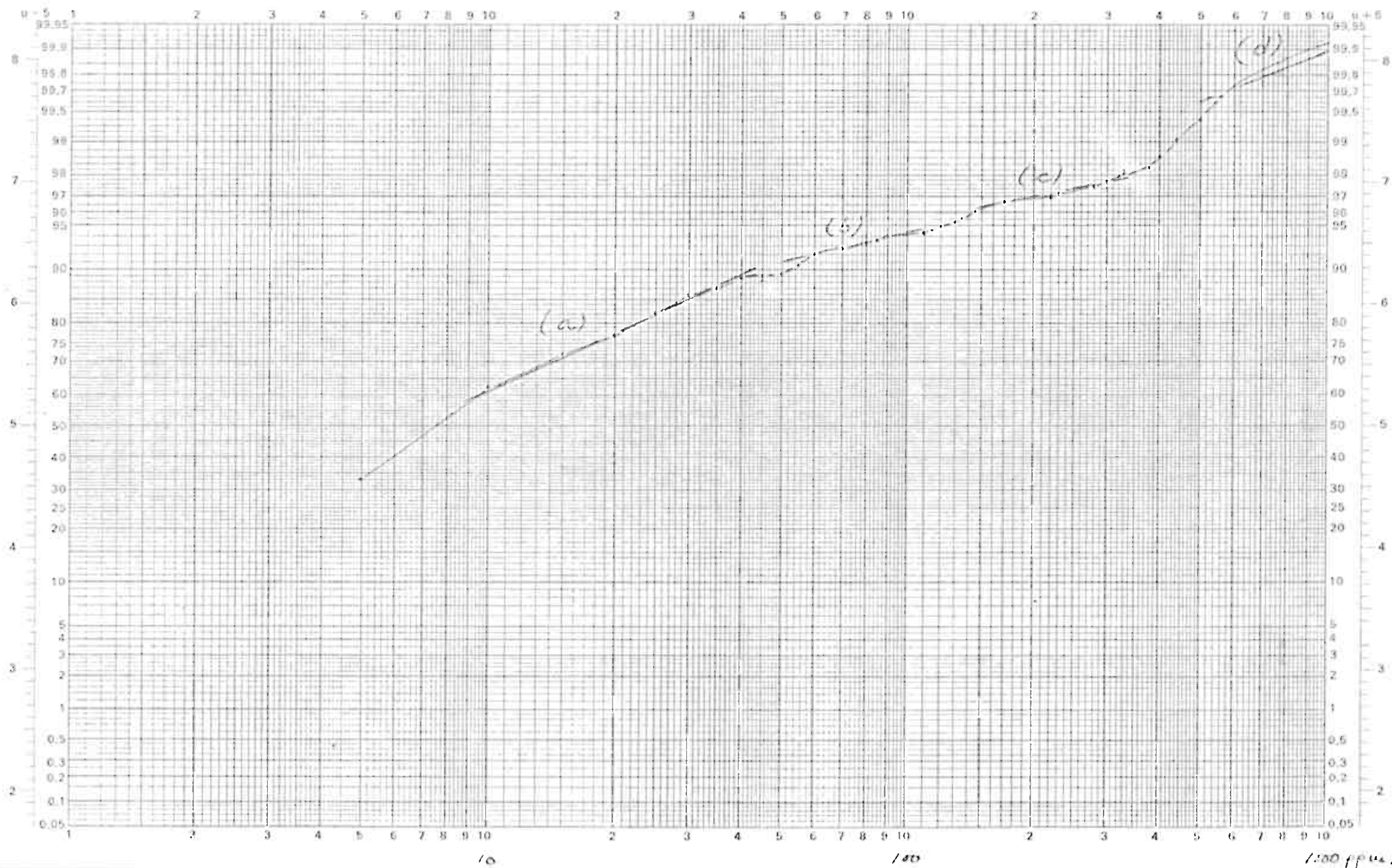
Intervall (ppm Cu)	Antall (st.)	Frekvens (%)	Kumulativ frekvens (Kum. %)
211-220	1	0,28	96,90
221-240	0		
241-250	1	0,28	97,18
251-270	0		
271-280	1	0,28	97,46
281-290	0		
290-300	1	0,28	97,74
301-320	0		
321-330	1	0,28	98,02
331-370	0		
371-380	1	0,28	98,30
381-390	0		
391-400	1	0,28	98,58
401-440	2	0,56	99,14
441-490	0		
491-500	1	0,28	99,42
501-540	0		
541-560	1	0,28	99,70
561-1449	0		
1450	1	0,28	99,98

356

Nr. 2109
 Tryk af Forside
 Model 8123



Kumulativ frekvensfordeling av data fra Iysfjord, Nordland.



1:100 gpm.

131031

Bilog 1

ECONOMIC GEOLOGIC INVESTIGATION OF
THE PROSPECT AT BOTN IN TYSFJORD,
1973 FIELD SEASON

INTRODUCTION

The exploration program for 1973 at Botn in Tysfjord was a continuation of the work done in 1972. Most of the work was concerned with detailed geologic mapping within Innhavnet map area 1231, Sheet II, in the area covered by a geophysical survey grid system which was laid-in in 1972, and with the northwesterly extension of the grid, surveyed in 1973. Only brief visits were made to other locations within the same map area, particularly in the Titlivik area. 300 rock samples were collected, particularly where anomalous induced polarization (I.P.) profiles were obtained in the previous year's geophysical work and seventy rock samples were collected from a number of old prospects. Fifteen soil and stream-sediment samples were collected to test the feasibility of such geochemical methods on this prospect, and a pilot sampling-program was begun in early October.

A diamond-drilling program was begun in early August to investigate the geophysically anomalous areas, particularly the I.P. anomalies, and trenches were dug to expose the surficial geology along the direction of the drill-holes, directed by K. Stenmark.

This program is still progressing at the time of writing (October 26, 1973), without intersecting any significant mineralized zones. Split-samples of the core have been sent for copper and sulphur analysis.

Geophysical investigations, using very low frequency methods, were carried out by P. Eidsvik of the N.G.U. in July of 1973.

GEOPHYSICS

A grid system, 1500 m. wide in a N104°-N284° direction and 2600 m. long in a general N14°-N94° direction was used in 1972 as a control for ground magnetometric (vertical component), conductivity, self-potential and induced polarization surveys. A brief review of the results of these surveys is necessary.

1) Magnetic vertical component (V.M.) Anomalously high (>1000γ) areas are small and discontinuous, usually narrow and elongate in a general east-west direction. There are few anomalously very high areas, always very small, and without lateral continuity exceeding a few tens of meters. Anomalously low areas are very narrow, seldom exceeding 300 meters in length. Probably fault zones.

2) Conductivity. Anomalously high, (> 5m. Mho/m), only in northwest of grid, in region of common geophysical anomalies. Significant drop in values to east between 4800γ and 4900γ north from 6200N. Low values in narrow east-west trending zones; probably very deep vegetation.

3) Self-potential (S.P.) Anomalous areas in the northwestern part of the grid correspond with the anomalously conductive areas. They are narrow, with northwesterly trends and terminated rather sharply at the 4500γ line. A number of irregular, weakly anomalous areas with vaguely circular shape are scattered around the grid between the 5000N and 6200N baselines. These are usually less than 300 meters in diameter and do not appear to be significant. The largest anomaly, centering on 5200γ/7000N, and extending south to 6400N, west to approximately 4600γ and east to 5500γ, is enigmatic.

4) Induced Polarization (I.P.) These anomalies are well-defined and have considerable continuity, though most tend to be rather narrow. The results culled from Tegning No. 1107-01 of the 1972 report have been used to reconstruct an alternative contour map, which takes into account the geology as known at present. This new map is included in this report on Map 1b, a 1:2500 overlay of the geologic map.

Most of the anomalies over 5% are demonstrably associated with certain lithologic units but one centered on 6275N/5400Ø cannot be explored in that way.

A well-defined hiatus trending north from 6300N/4900Ø is also of interest.

This brief discussion indicates that though significant self-potential and conductivity anomalies exists, they are by and large duplicated with greater clarity by the induced polarization method with the notable exception of the large anomalous area indicated by the self-potential method in the northern part of the grid.

During July of the 1973 season Mr. P. Eidsvik of the M.C.U. extended the geophysical grid to the northwest in order to define the extent of the anomalies indicated there by the previous season's work. Using very low frequency (V.L.F.) apparatus he delineated a number of very weak to moderately strongly conducting zones extending northwest towards locality 396668 and 395690 (Map 1231 II) on the coast. One moderately strong zone extends almost continuously from 7300N/3100Ø to 6750N/4700Ø, where it is displaced to the southwest to 6550N/4350Ø, and continues sporadically to 6200N/5000Ø. This zone is flanked on the north and south by several weaker zones with less continuity, and all are coincident with stream valleys as far east as the 4150Ø grid line, and in the case of the stronger zone as far as the 4450Ø grid line. The conducting material in at least one of these zones is almost certainly graphite (3110Ø/7425N, sample RS-73-1TY), but the location of most of these zones is in valleys obscured by colluvium and vegetation, and without trenching it is probably impossible to say with certainty whether graphite is always the conducting medium.

Discussion of the relationships between lithology, structure, geophysics and mineralization is reserved for the summary.

GEOCHEMISTRY

Samples were collected from splits of the diamond-drill core and also from the bottom and top of the trenches dug along the direction of the drill-holes. These samples were submitted to Kirkenes for copper and sulphur analysis under the designation BTY, RTY, DTY respectively (B-Borehole, R-Rösk, D-Daylight, TY-Tysfjord), with a suffix dependent upon the number of the borehole. One trench trending N220° from 6800N/4600E for which there is no borehole, was suffixed 0 (zero). The depth interval of the borehole and distance interval of the trenches from the borehole collar was used as an additional suffix. For example a sample from 05.00-06.30 meters deep in Borehole number 2 would be BTY2 05.00-06.30. Similarly a sample from the bottom of trench 2 from 05.00 to 08.00 m. would be RTY2 05.00-08.00m. A total list of all these samples is given in Appendix I. Analytic results are available only from the split samples of BTY 1 at this time, and copper values (Appendix I) are very low, generally <0.1%, with traces of Ni, and most of the sulphur in pyrrhotite and pyrite.

Although exposure is generally good in the higher elevations of the grid, significant parts of the lower-lying areas are obscured by swamps, especially in the most highly fractured areas. Geochemical sampling programs using soil samples have proved invaluable elsewhere in such terrane, especially if molybdenum or silver, which have a superior mobility to copper and lead, are present. A note on sampling and analytical techniques accompanies Appendix II.

Ten soil samples were collected in order to test the usefulness of the method on the Botn prospect. Sample sites were chosen to construct soil geochemical profiles across the drainage a little distance from two prospects which had formerly been worked and where mineralization was known to exist.

Sampling was so spaced that at least the two end samples of the traverse should provide elemented "background" values for comparison with the values in the center of the traverse, which

were expected to be significantly higher.

Samples RS-73-J1TY to RS-73-J5TY (analysed as ARS10 to ARS14) were collected along the 5200Ø line 100 m. east of prospect H, at 5050, 5075, 5100, 5125 and 5150N. Although silver was not detected and apparently the samples were not analysed for molybdenum, the results appear encouraging, as the high values of J2 (122 ppm. Cu) and J3 (520 ppm. Cu) would certainly be significantly anomalous in a background of 6 ppm. or 36 ppm. Cu. Other elements are inconclusive.

The results of the traverse 50 meters south of prospect H3 are less encouraging, and the high value of 60 ppm. in a "background" of from 8 to 22 ppm. copper is probably not significant. These samples RS-73-J15TY to RS-73-J19TY, analysed as ARS15 to ARS19, were collected along the 5750N line at 4850, 4875, 4900, 4925 and 4950Ø.

Four stream-sediment samples were collected to test the viability of the method in this environment. These are as follows, with values in ppm.

RS-73-S1TY(5200Ø/5100N) Analysed as ARS6 Cu 110 Zn 60 Ni 5 Ag 0
 RS-73-S2TY(4200Ø/6775N) Analysed as ARS7 Cu 68 Zn 68 Ni11 Ag 0
 RS-73-S3TY(4300Ø/6900N) Analysed as ARS8 Cu 280 Zn143 Ni45 Ag 0
 RS-73-S4TY(4725Ø/6300N) Analysed as ARS9 Cu 48 Zn 91 Ni13 Ag 0

Although copper values for S1 and S3 are high, as are zinc values for S3, the method appears inconclusive, since S4 is taken from a stream draining from rocks which contain some chalcopyrite. Possibly the fact that the streams also drain from basic rocks, (marbles), may affect the mobility of the copper.

All geochemical samples, with original and analytical designations are listed in Appendix I, and sample locations are plotted on Maps 1b and 2b.

A pilot soil-sampling program with single samples at 50-meter intervals along grid-lines between the two base lines was started in early October. No information regarding specific sites or number of samples is available. "Background" geochemical values will probably vary as the lithologic units vary, but as a rule-of-thumb in such felsic environments, values greater than 50ppm. copper, 5ppm. molybdenum and 2ppm. silver are usually considered interesting.

GEOLOGY

Detailed geologic mapping was carried out along the grid lines in July and early August of 1973. Interpolation of these traverses was completed by early September. Only a few days were occupied with geologic investigations external to the grid and its northwesterly extension; a day around Titlivik, one at various small mineralized locations along the coast north and south of Titlivik, and a couple of days around the south end of the grid in the vicinity of the prospect H6. The regional geology and topography around the grid is described by S. Peters in the 1972 report.

Early in the season the mapping was concerned mainly with the relationship, if any, between the bedrock geology and the geophysical anomalies defined in the 1972 season, and very detailed mapping of the anomalous areas in the northwest corner of the main grid was carried out to aid in the positioning of the diamond-drill holes which were spudded in early August.

LITHOLOGY

It became clear at an early stage that in order to indicate structural relationships, a somewhat arbitrary grouping of the highly gradational sequence of metasediments and gneisses would have to be adopted. Progressive, but irregular, development of skarn within this sequence further complicated the mapping, especially as the skarn development appeared to be selectively based on the bulk chemistry of the rock types. Difficulty was also experienced in differentiating between the variants of gneiss which outcrop over most of the grid area south of the 6200N base line, and in the central part of the grid north of that line, particularly as much of the gneiss is xenolithic, with very localized variants. These gneisses were classified on an uneasy compromise between their erosional characteristics, and the apparent minerology. With these provisions in mind,

the rocks in the geophysical grid area are classified and mapped as eleven lithologic units which can be recognized in the field, and these are described in what is thought to be the chronologic sequence.

- a) Marble and impure limestones
- b) Hornblende-rich paragneiss both coarse-grained (gabbroic) and fine-grained, (amphibolite)
- c) Biotite-rich paragneiss, usually coarse-grained and schistose
- d) Felsic paragneiss, very little or no skarn development
- e) Skarnic paragneiss with some or all of the following developed: garnet, epidote, diopside
- f) Foliated skarns, usually containing abundant epidote, diopside, garnet and retaining (?) recognizable gneissic texture.
- g) Massive skarn. Usually garnet, epidote, diopside and very little or no gneissic texture
- h) Xenolithic quartzo-feldspathic gneiss
- i) Xenolith-free quartzo-feldspathic gneiss
- j) Granitic gneiss
- k) gneissic granite

Two hundred and ninety seven samples were collected from these various units, particularly around the geophysical anomalous areas. A brief description of the petrographic and petrofabric character of these rocks after study under a binocular microscope is given in Appendix II and the sample locations are plotted on Maps 1b and 2b.

Marbles and Impure Limestones

Within the map area the most important outcrops are in the northwestern corner of the main grid and in the extension of the grid, and in the extreme west of the grid around the 6200N base line. Small outcrops, probably as fault slices dragged along the numerous fractures, are present on the 4900Ø line between 5200N and the large lake, and between the lines 5400Ø and 5500Ø at 5900N. In both cases skarn and marmorite are associated with

the marble. A similar limestone/marble pod is associated with mineralized mafic rocks at the prospect H6, south of the map area.

The marbles in the northwest of the grid are coarse-grained except where partially altered to garnet-epidote skarn assemblages. The best examples of this rock type are in the core from borehole 1 in the 102 to 114 m. interval, but the outcrops are traceable continuously from 6300N/4700Ø to 6450N/4200Ø and thence to the northwest off the grid. Outcrops are usually markedly cavernous and this is particularly noticeable in the region around 6200N in the west of the grid, at 6750N/4300Ø, and between the 4300Ø and 4500Ø lines in the 6400-6300N area. Larger bodies of cavernous limestone occur near the southward extrapolation of the 3700Ø line at about 6800N.

Where a thin marble unit at 6650N/4300Ø approaches the nose of a fold a gradation to amphibolite and then into massive garnet-epidote skarn can be observed, and it may be that several of the lensoid skarn pods in gneissic skarn elsewhere were calcareous nodules in other sediments. Though in general the marbles have sharp contacts with other rock types this is not always the case, and calcareous gneisses are common in the northwestern and western part of the grid. It may be of significance that skarn development is more pervasive in the same region, due to the potentially greater reactivity of impure calcareous rocks during metamorphism.

Hornblende-rich Paragneisses

Textures vary from coarse-grained "gabbroic" to fine felty or compact amphibolites with a "basaltic" texture. The mineralogy of both is approximately the same; hornblende with a little epidote, biotite, quartz, plagioclase and orthoclase. In the coarser variants diopsidic cores are frequently present in the hornblende, which is generally glomeroporphyroblastic, and biotite, where present, is often pseudomorphous after hornblende. Garnetiferous variants are occasionally observed.

Except for the abundant occurrence in xenoliths in the felsic gneiss, where a pre-existent foliation is generally

developed, outcrops of the hornblende-rich paragneisses are invariably associated, to a greater or lesser extent, with biotite-rich paragneisses. Contacts with the biotite-gneisses are transitional, with interlamination of hornblende-rich gneisses, with successively increasing amounts of biotite-rich paragneiss, and the biotite is generally pseudomorphous after the hornblende. Since they are intimately associated, field relationships are better discussed as a unit.

Biotite-rich Paragneisses

These are mineralogically similar to the hornblende-rich gneisses, except that biotite, usually pseudomorphous after amphibole to a greater or lesser extent, is the predominant mafic component, and imparts a schistose texture to the gneisses. Hornblende is sometimes present in these gneisses as a rim around very altered diopside, and the amphibole is frequently altered to fine-grained chlorite and biotite.

Inclusion of the mafic paragneisses as xenoliths in felsic gneiss is discussed in that section. A second mode of occurrence, volumetrically of minor importance, is along narrow elongate zones in obvious connection with fault-planes. Hornblende-rich variants are rare in this situation. Small examples, up to a few meters in length and one or two centimeters wide, of mafic-enrichment along joint planes with a little obvious movement, are observed in the granite and granite gneiss in the area around 7000N on the 4400Ø and 4500Ø line. The mafic-rich zones with dike-like form along fault-planes northeast of prospect H (5125N/5100Ø), in the vicinity of 5750N/5200Ø, and most noticeably northeast from about 6800N/4600Ø across the summit of Bjornkjeften are thought to have the same origin, - mafic enrichment due to localized dynamothermal metamorphism. The hiatus associated with the latter zone, in the region between 6700N/4600Ø and 6550N/4350Ø will be referred to frequently as the "fault zone northwest of borehole 1", and will be discussed in the structure section more thoroughly. It should be noted that the zone across Bjornkjeften summit (7100N/5100-5200Ø) is not continuous, but pinches and swells along the length, and in the

wider parts contains hornblende-rich gneisses. Foliation is near vertical, parallel to the fault, but the zone does not connect with the larger body, and the garnet-rich folded mafics in the outcrop southwest of 6600N/4600Ø are a discreet and separate lens.

A number of larger xenoliths and pods of mafic paragneisses are included within the xenolithic gneiss in a zone trending northwest from the 5000N baseline in the vicinity of prospect H (5100Ø), and are occasionally associated with skarn lenses and sometimes with weak mineralization (H8).

In the vicinity of 5600N/4600Ø the xenolithic habit becomes consolidated into massive outcrops of fine-grained sulphide-bearing (pyrrhotite with minor pyrite and trace chalcopyrite) amphibolites and amphibole-rich gneisses surrounded by an irregular mantle of biotite-rich paragneisses. At least spatially this outcrop of mafic paragneiss is associated with moderately strong V.L.F. and strong I.P. anomalies. Disconnected or tenuously connected segments of a mafic "zone", frequently associated with massive or foliated skarns, at about 6000N/4800Ø with a strong I.P. anomaly, can be traced to the 6200N baseline on 5000Ø.

From there the mafic paragneisses, skarns, V.L.F. anomaly and strongly linear I.P. anomaly trend northwest to the fault near borehole 1, where the V.L.F. anomaly terminates, and the mafic unit is in part displaced southwards on the north side of the fault zone, to thin out against a marble unit close to a second fault zone. However, the geophysical anomalies are apparently displaced to the northeast, and continue to trend northwest from 6700N/4600Ø, associated with what is almost certainly the continuation of the main mafic paragneiss horizon. The I.P. survey was not conducted over the northwestern extension of the grid, but moderate to strong V.L.F. anomalies are spatially associated with mafic paragneisses, in which hornblende becomes increasingly subordinate to biotite, all the way to the 3100Ø line in the extreme northwest of the map area (inset on maps). Some repetitions of lithology, probably by folding and faulting, are indicated by outcrop patterns. From 3100Ø line the same

unit can be traced continuously to locality 395690 on the coast about 1 km. to the northwest.

Traces of weak sulphide mineralization, mainly of pyrrhotite, but with a little pyrite and chalcopyrite can be seen along the whole length of the mafic zone from the baseline at 6200N to the coast, and larger areas of limonite and jarosite-staining, notably around 7250N/4050Ø, are quite common.

Sample RS-73-1-TY, collected from schistose mafic paragneisses with obvious sedimentary structures near 3100Ø line contains abundant graphite, and the presence of graphite in similar rocks from 396668 indicates that though it may not be obvious due to the dark color of the rock, it is widespread, and is the probable cause of many of the V.L.F. anomalies within the mafic paragneisses.

Felsic Paragneisses

Granular texture and often mineralogical banding and flaggy lamination characterize these gneisses, and although they form steep cliffs in the 6200-6400N area of lines 4200-4600Ø and elsewhere, a freshly broken surface is usually crumbly. They are usually fine-grained, and quartz and feldspar are the dominant minerals, usually with an orthoclase-plagioclase ratio of between 1:1 and 3:1. A little primary biotite and hornblende are generally present, in about equal proportions. Small euhedral garnet and epidote are frequently present, up to about 10% total. They typically contain one or two percent of scattered magnetite octahedra, often with a little ilmenite. The felsic minerals tend to occur as rounded grains and alteration of plagioclase to clays, and hornblende to chlorite is common close to the more skarnic rocks. Both these factors combine to cause the granular nature of the rock.

Much of the northwestern part of the grid is underlain by these white or pink gneisses, and the flaggy units, though prominent and easily mapped, constitute only a small part of the total. Gradations into the skarnic gneiss are fairly rapid, and occur within a couple of meters, with increasing garnet, epidote and diopside and increasing grain size.

In the eastern and southeastern part of the map this gneiss frequently grades into xenolithic gneisses along the foliation, and only occasionally are xenoliths distinguishable. In the process, the mafics of the fine-grained gneiss tend to become aggregated and glomeroporphyroblastic, with many inclusions of the small rounded quartz and feldspar grains.

The flaggy units, and presumably the surrounding paragneisses, are folded in isoclinally recumbent style west of 5575N/4500Ø and at 4700Ø, where the axis plunges northeast. A small mineralized horizon within the gneiss at 6650N/4500Ø is folded in the same style with the same axial direction. Since these felsic gneisses are only a part of the larger paragneiss sequence, the small structures detected in these gneisses may be very useful indicators of larger-scale structures.

Skarnic Paragneisses

Except that the proportion of garnet and epidote is greater, and that diopside is frequently present, it is almost impossible to distinguish some of these skarns from the felsic paragneisses at first glance. In detail, glomeroporphyroblastic amphibole is quite common, dilating an earlier biotite-hornblende-feldspar foliation, and occasionally large irregular clots of amphibole seriously disrupt the foliation. Garnet and epidote crystals are usually fairly small, and are an essential part of the fabric. Diopside is generally present as small, fine grains, usually associated with the amphibole. Plagioclase is apparently unstable, and an unusual "birds-eye" texture, with clay development around cores of chlorite, possibly from original biotite and plagioclase is widespread and common.

Magnetite, where present, forms lensoid aggregates of fine crystals and in the area between the 4200Ø and 4700Ø lines, at about 6200-6400N, ilmenite is common, rather than magnetite. An interesting rounded ovoid to barrel-shaped green mineral with waxy lustre is abundant in the area around 6000N/4700Ø, and is probably perovskite.

A small outcrop of skarnic gneiss occurs as a narrow horizon from 5800N/5300Ø to 5650N/5100Ø where it swings back

east to 5575N/5200Ø, apparently folded in isoclinal recumbent style around a southeasterly axis. This unit may be a continuation of a flaggy paragneiss unit to the east. A small outcrop is exposed just to the west of the prospect H3.

The bulk of the skarnic gneiss occurs in a single unit curving north from 5800N/4400Ø to 6200N/4600Ø, then northwest to join a marble unit, pinching out at 6500N/4200Ø, west of the major fracture which trends north of borehole 1. Many pods and lenses of massive garnet-epidote-diopside skarn occur within this unit, generally with long axes parallel to the trend of the unit, and from 5950N/4600Ø to 5825N/4500Ø several thin (20-50 cm.) concordant garnet-epidote-diopside skarn bands are interlayered with the unit. The origin of these coarser-grained, more massive skarns is probably controlled by the bulk chemistry of layers within the paragneisses.

Foliated Skarns

Gradations between this map unit and the previous unit are rather sharp, and characterized by increasing grain-size, often with aggregates of small crystals into large knots or lenses. Hornblende, epidote and diopside are particularly susceptible to this aggregation. Concomitant with the aggregation is the segregation of felsic minerals, often with some calcite, into pods and lenses sub-parallel to the crude foliation. Orthoclase is usually more abundant than plagioclase. Garnet and diopside are not common in the gneissic skarn, and alteration of the hornblende to chlorite and sometimes actinolite is pervasive. Metallics are generally rare, and consist of small discreet scattered octahedra of magnetite.

Field relations of this skarn are diverse, ranging from very small pods and lenses as xenoliths in felsic gneisses and caught as exotic blocks along fracture zones to the persistent and massive units flanking folded limestones and marbles south and west of the 6200N baseline at 4500Ø. To the north of prospect H, a folded siliceous variant, possibly associated with a fault, outcrops in the cliff-base and can be traced from the

50000 line eastward to the 56000 line where it is obscured by rubble. Pods and lenses frequently occur in the vicinity of the aforementioned mafic paragneisses, and a large pod, with internal folding and much alteration, outcrops concordant with the mafic rocks in the region between 6350N/46000 and 6450N/45000.

Mineralization, as distinct from the original magnetite, usually consists of a little pyrite and traces of chalcopyrite in fractures and interstices.

Massive Skarns

Some relict foliation can be discerned in some of the more massive units, but generally quartzo-feldspathic components of these skarns, with some calcite, occur as extremely convolute pegmatitic streaks and veinlets within the more massive and sheared garnet, diopside, epidote and amphibole components. The garnet and diopside are usually sheared, secondary epidote is developed along the shears, and the felsic minerals form within any and every void space. Later, felsic pegmatites, with more consistently vein-like habit, cut across all the earlier fabric elements.

Field-relations of the massive skarns are complex, but may be considered to be of two types.

The first group occur as small discreet lenses and thin intercalated units within skarnic gneiss, and these are probably reflections of local, pre-skarn bulk-chemical variations within the gneiss. The appearance is "knotty", with deeply pitted and eroded exposed surfaces. Where the layers are interfolded within less distinctive gneiss units they form very useful marker-horizons for elucidating structure, particularly fold-style and orientation. Contacts with the adjacent units are generally sharply defined.

Smaller, but more irregular pods and lenses occur throughout the map area, and except where they are obviously detached clasts from originally larger bodies occurring as xenoliths, they are considered to be examples of the second type of occurrence. These irregular bodies, which include the largest massive

skarn outcrops are usually terminated by fracture zones, with incremental displacement along a number of fractures. In places this process leads to detachment of fragments, and this is well-displayed in the small body of skarn at 5050N/5200W near prospect H, and on a larger scale in the northeastern part of the area west and northwest of prospects H4 and H5. In the 6800N/4250W region a deceptively large area of massive skarn is in fact the dip slope of a 2-meter thick layer of resistant massive skarn, of the first type. In part the large outcrops south and west of 6100N/4800W and southeast of 4900W on the 6200N baseline are also topographic expressions of the resistant nature of relatively thin massive skarn layers.

Many of the isolated pods and lenses of the massive skarn are mineralized, predominantly with bornite and chalcocite, and such mineralization has been prospected at pits H4 and H5 in the northeastern part of the area, and at several localities in the vicinity. Traces of copper mineralization can also be found in many of the small pods to the north. Mineralization of the same type has been extensively prospected at H3 in a quarry and in adits, and though weak mineralization is present in the surrounding gneiss, it is generally late, and occurs as fracture-fillings and impregnations or segregations proximal to fractures. Results from boreholes 1 and 2 confirm the discreet nature of the skarn lens at H3.

Xenolithic Quartz-Feldspar Gneiss

Total gradation is demonstrable with the xenolith-free quartz-feldspar gneiss, but it is convenient to map this as a separate unit, and to discuss it as such. Structural features which are not obvious in the homogeneous gneiss can be discerned by studying the clasts in the xenolithic phase.

Size of the clasts ranges from ten or twenty centimeters up to as long as twenty meters, but they are characteristically much longer than they are wide, usually by a factor of about 10. Pre-existing structure within the clasts is almost invariable, usually sub-concordant with the margins of the clasts, and occasionally folding can be observed within the internal structure. Angular fragments are the most common, but tend to

thin out at the eastern or southeastern end, giving an impression of westerly or northwesterly movement. Generally the internal structure is sub-concordant with the external foliation, but in some restricted zones this is not the case.

Composition of the clasts is generally mafic. Clasts of biotite-rich and hornblende-rich paragneisses, and finely banded paragneisses predominate, but selective recrystallization of the felsic layers is apparent. In a very few cases larger clasts of felsic paragneiss can be recognized. Clasts of skarn, mainly of hornblende-rich gneissic skarn and of massive garnet skarn, occur infrequently, and tend to be congregated within several restricted areas (eg. 4800N/5200Ø, 4700N/4900Ø). Sharp contacts, with no zoneation are the rule.

With increasing abundance of clasts of generally decreasing size, the xenolithic phase of the felsic gneiss grades into felsic and banded paragneisses, (eg. 4800N/5300Ø), into mafic paragneisses, (around 5600N/4500Ø and 6700N/5100Ø), into gneissic skarn (5600N/4400Ø, 5250N/5100Ø) and into massive skarn around 4700N/5200Ø. With decreasing abundance of less distinct clasts the xenolithic phase grades into the quartz-feldspar gneiss.

Quartz-feldspar Gneiss

As mapped (maps 1b and 2b) this unit contains a few small xenoliths, but they are relatively rare. Grain size is variable, from fine to coarse, though the coarseness is deceptive and usually consists of aggregates of smaller, rounded grains similar to those evident in the felsic paragneisses.

Though some variations occur, these gneisses are usually composed mainly of quartz and plagioclase, with subordinate orthoclase and hornblende, and occasionally with a little epidote and garnet. Magnetite is a frequent accessory mineral, and only rarely abundant. Biotite is uncommon except in a few elongate zones, possibly associated with faulting. The hornblende is characteristically glomeroporphyroblastic and fresh, with numerous small rounded grains of all other constituents.

This gneiss is the matrix for the xenolithic phase and the xenoliths generally occur in well-defined zones and areas

within the deceptively coarse-grained felsic gneiss, which by and large are elsewhere homogeneous and massive with strong similarity to the granitic gneisses with which they are intimately mixed.

These gneisses are the predominant rock type in the southeastern and central parts of the area, but small areas are exposed in association with mafic paragneisses all the way to 41000 in the northwest extension of the grid. A large area of this gneiss is enclosed within granitic gneisses with sharply gradational or faulted contacts west of 6700N/57000.

Structure within the gneiss is indicated by variation in trends of the xenoliths, and complex strike-slip movement of a fault-plane at 4700N/52000, or simple lateral displacement along a fault at 5650N/50000 may be discerned.

Several small limonite-stained mineralized zones occur within the gneiss and prospects H8 (5100N/48500), and H (5125N/51000) occur in mafic-rich xenolithic units within the gneiss.

Granitic Gneiss

This gneiss is very similar to the previous gneiss, and the association of smaller grains in aggregates is pervasive, especially in the area around 6375N/50000 (sample 297), and west and southeast of 6300N/48000. The gneiss is pink, crumbly and granular, generally with poor foliation, and differs from the previous gneiss in that orthoclase is the predominant feldspar, and that amphibole, where present, is glomeroporphyroclastic, and generally altered to biotite, sometimes with a little chlorite. Biotite is the most common mafic constituent, and occurs as large grains, often pseudomorphic after hornblende, in contrast with the white felsic gneiss where hornblende is the predominant mafic constituent.

Close association with the gneissic granite characterize the field relationships of the granitic gneiss, and continuous gradation into the granite is common. In fact, the demarcation between the two is arbitrary, and the gneiss is generally a marginal phase of the granite. The granite however weathers to granular sandy "grub", whereas the gneiss is more resistant to weathering.

Large areas of white felsic gneiss are contained within the granitic gneiss west-northwest of 6700N/5700W, and the contacts between these are usually faulted, but otherwise sharply gradational, with increasing abundance of hornblende and plagioclase contents into the xenolithic gneiss.

Contacts with the granite are highly transitional and irregular, with some folding of the granite apparent near 5475N/4300W. The irregular field relationships of the contacts suggest that the numerous apophyses of the granite may represent folded contacts.

Limonite-stained mineralized zones in the gneiss are uncommon, small, and usually localized at fracture intersections, as at 5300N/4500W.

Gneissic Granite

Weathering to granular aggregates of small size characterizes the quartz-orthoclase-plagioclase-biotite granite, and the texture of the pink rock is deceptively coarse. In fact the matrix is aggregated from small rounded grains, quite similar to those in the fine and coarse felsic gneisses, but with plagioclase generally subordinate to orthoclase. Biotite is the only coarse mineral in the rock, and only occasionally can be seen to be pseudomorphous after glomeroporphyroclastic amphibole. Two large areas of gneissic "gruss" granite occur within the map area, one in the north and one in the southwest, and both are enveloped almost totally by granitic gneiss which contains relict hornblende. One small outcrop at 5600N/5500W has apparently no mantle of gneiss, but the contacts with the plagioclase-rich hornblende-bearing gneiss are very poorly exposed and may be faulted.

Xenoliths of mafic rocks are rare, if present, and though intensely weathered, the granite appears relatively homogeneous.

Pervasive fracturing of the granite faults off some of the apophyses, but large displacement is only present along major northeasterly faults, and this displacement, (unless the two largest outcrops were previously spatially coincident) is relatively less than for other lithologic types. Schistose

biotite gneiss is present in one major fracture in the granite, and some biotite enrichment is evident along many of the minor fractures.

A little mineralization is indicated by limonite-staining along fractures around 5475N/4300Ø, and in conjunction with a small but intense I.P. anomaly at 5050N/4400Ø. Pyrite was the only sulphide observed.

Resume

Biotite-rich gneiss is associated with and possibly derived from hornblende-rich "gabbroic" gneiss intercalated within fine-grained granular quartzo-feldspathic gneisses and marbles. These units are probably all paragneisses and progressive development of skarn minerals is common in the more felsic units, particularly in the northwestern part of the geophysical grid and the extension of it. The skarns have been artificially classified on the basis of mineral proportions combined with texture, and intensity of skarn development is probably due to a combination of structural situation and the chemical composition of the parent rock.

Conformable clasts of all these paragneisses and skarns are present in a later xenolithic gneiss, and gradation into the various paragneisses can be discerned, usually with increasing frequency and diminishing size of the clasts. These later gneisses are characterized in both the xenolith-bearing and homogeneous phases by a predominance of plagioclase over orthoclase feldspar, segregation of small grains into coarser aggregates, and the predominance of hornblende, usually glomeroporphyroblastic, over biotite.

Pink granitic gneiss, also with segregated finer-grained material into coarser aggregates, has a preponderance of orthoclase over plagioclase and hornblende is subordinate to biotite. The hornblende, if present, is porphyroclastic, and biotite is usually pseudomorphous after the amphibole. Gneissic granite forms the central portions of the granitic gneiss outcrops, and is almost unfoliated, with virtually no amphibole and weathers readily to granular sands. Although the granite

appears to be the oldest rock in the area, it is probably the youngest.

Folding of the sequence is apparently selective along the more calcareous units, and movement between various units probably occurred. Faulting is pervasive, locally intense but generally with little displacement.

STRUCTURE

Except in the proximity of the many fractures in the area, where realignment of fabric is common within a few meters of the fault-plane, and in the vicinity of fold noses, foliation of all lithologic units has a northwest-southeast trend, and dips moderately (25° to 45°) to the northeast. Foliation in the western part of the grid, around 5900N/4600E has a general westerly trend with northerly dips, and can be shown to be related to large scale recumbent folding. Terminology referring to "upper", "lower", "above" and "below" must be understood to be relative to the present horizontal, rather than as having any connotation of absolute or original position.

FAULTING

Several distinct linear features with considerable lateral continuity, connected by many shorter and less persistent topographic linears, can be observed on aerial photographs of the map area. Most of these features can be observed directly on the ground, where they vary in width from one or two to ten or more meters in width, with steep sides from two to twenty meters in height. Drainage is generally controlled by these features, and usually foliation in the adjacent rocks is discordant with the regional grain and sub-parallel or parallel to the linear valleys. Lithologic disruption or offset can usually be demonstrated, and all these features are interpreted as faults.

Although faulting is observed throughout the map area, pervasive fracturing and shearing is most abundant in the central part, between the 5000N and 6200N base lines, and particularly in the northeastern part, east of the 5500E line.

The majority of the most distinct air photo linears are faults with N-S, $N020^{\circ}$, $N120^{\circ}$ and $N60^{\circ}/N80^{\circ}$ directions. The trend of the northeasterly faults is particularly variable, and fractures with this trend appear to have a greater tendency to split and coalesce, with attendant changes in attitude of the fault plane. Of the four fault-trends, the northeasterly and $N120^{\circ}$ are the most continuous, and possibly constitute a

conjugate set, while the N-S and N020° are more subtle, either terminated by, or otherwise controlled by the earlier set.

a) Northeasterly faults. (N60°-N80°) Joints and minor fractures with this general trend are extremely common throughout the whole area, and occasionally, as with the skarns around prospect H, can be seen to offset lithologic units. Three major fractures with this trend are among the most obvious of the geologic features of the area. One restricted and well-defined zone trends northeast from the extreme southwest of the map to 5600N/5700E, but apart from a little right-lateral displacement and an unknown amount of vertical displacement it does not seem to be of great importance. A second zone extends southwest from the summit of Bjornkjerten (7100N/5100E), and truncates and displaces the two segments of the main zone of mafic paragneisses and the associated geophysical anomalies without apparent displacement of several of the intervening folded lithologic units, nor of the granitic gneiss and granite. Several other lithologic units either terminate at, or pinch out close to this zone. Similar contradictory relations pertain to other, less well-defined fracture zones with the same general trend to the northwest, and although not directly observed, pervasive northeasterly faulting is thought to be present in much of the extension of the grid, displacing both lithologic units and also associated V.L.F. anomalies. These zones appear to have a right-lateral component, though this apparent effect could be achieved by downthrow to the southeast.

The third fracture zone of this set is composed of many smaller fractures, with more changeable trends, but this change in trend is partially due to the attitude of the fault planes, which hade steeply to the southeast in the extreme northeast of the grid area near prospects H4 and H5, but appear to dip about 50° to the north in the central part of the area in the vicinity of prospect H3. The southernmost of this group of shears is well-defined, and extends southwest from the 6200N baseline at 5800E and coincides with the southern limit of the large I.P. anomaly in the vicinity of 5600N/4600E. Schistose biotite-rich gneisses are coincident along part of the length, and a large

fault-slice of skarn and marble is caught up with it. Relative displacement of xenolithic gneiss units and xenolith trends indicate a right-lateral component. The more complex fracture zone extends S.S.W. from 7000N/5700 ϕ almost to the 6200N baseline at 5200 ϕ , and then irregularly westwards in many separate segments north of prospect H3. To the west of H3 many strands coalesce and continue in a stronger zone to the west. This zone displaces fragments of the large skarn lens at H4 and H5, and numerous segments of skarn trail out along the fracture zone to the northeast, indicating substantial right-lateral movement. Xenolithic gneisses and granitic gneisses in the same general area are relatively undisturbed, except for a little vertical displacement. Similarly other segments of this zone exhibit more apparent displacement of some lithologic units than of others, and evidence of both dextral and sinistral movement across the plane can be seen near 5600N/4600 ϕ .

b) N120° faults. These are not so readily apparent as the northeasterly faults, since their trend is concordant with the regional tectonic grain. South of prospect H one of these faults, sub-parallel to the 5000N baseline, dips 50° north and mylonitic gneisses are associated with part of the zone.

Four obvious fault zones with this trend appear to be important in the northern part of the area, among which the most apparent is that to the southeast of 7600N/4050 ϕ which brings several rock units into contact, apparently hade 40° to the northeast and probably has a right-lateral component. Southeast of 7250N/3700 ϕ another zone also brings several lithologies into fault contact, and is associated with a narrow limonite-stained mineralized zone in which chalcopyrite was found by K. Stenmark. Many of these faults are suspected in the intervening area.

Further south a major fault with this trend forms the contact between granitic gneiss and skarn near H5, and between xenolithic gneiss and granitic gneiss to the northwest. In the major stream valley near 5500 ϕ on the 6200N baseline the fourth significant fault with this trend apparently changes the direction and hade of the northeasterly shears.

Less apparent $N120^{\circ}$ faults occur in the valley which forms the lower contact of the northern segment of mafic gneiss, and a similar fault with about 30° northeast dip may be associated with the limonite-stained zone "underlying" the southerly extension of the mafic gneiss unit in the vicinity of 6475N/44000.

c) N-S faults. From the extreme south end of the 52000 line a well-defined fault with apparent dip 35° to the east trends north to the 5000N base line at 50000, and then apparently splits, with one branch swinging northwest near the contact of the western granite and the xenolithic gneisses, and the other swinging N.N.W. and cutting into the I.P. anomaly at 5600N/46000. All segments of this fault re-align fabric elements, have many fragments of skarn and mafic gneiss associated with them, and have an apparent right-lateral displacement. This displacement may have been oscillatory, as the foliation makes an S-shaped kink before becoming parallel to the fault trace. Subsidiary conjugate joints at 4700N/51500 are also indicative of lateral movement. Mafic gneisses at 5600N/46000 are strongly mineralized, and prospect H8 is close to the bifurcation of this fault zone.

A second fault with a general north-south trend extends from the south end of the 54000 line to the $N120^{\circ}$ fault at 5000N/52000, where it is apparently terminated. 100 m. northeast north of a second $N120^{\circ}$ fault, a small segment continues north to the major $N70^{\circ}$ fault, where it is again apparently terminated. No definite trace can be observed until at 5500N/50000 it forms a well-defined valley, and intersects a major northeasterly fault and terminates east of the prospect H3. Sporadic segments of fault in the 48500 region extend N to the small lake at 6250N/48000, and may represent the northward extension. This zone is closely associated with the most abundant mineralization in the area, at prospects H and H3, and may also be related to the weak mineralization at prospect H2.

d) $N020^{\circ}$ Faults. As has been mentioned, these faults are more subtle than the preceding fractures, and are less persistent. The most obvious of these, in the vicinity of the 48000 line in the southern part of the area brings granitic gneiss and xenolithic gneiss into fault contact, and a less obvious zone east of the 43000 line at 5500N also forms a fault contact between the same lithologic units, but is also evident in folded paragneisses further north.

The mafic paragneiss unit extending northwest from the 6200N baseline is disrupted near the 43000 and 47500 line by fracture zones, apparently small, with this trend, and although no surficial evidence is observed, the fracture at 6300N/47750 may also cause the rapid thinning of the xenolithic gneiss outcrop at 6800N/50000. A distinct $N20^{\circ}$ trending hiatus in the I.P. anomalies occurs along this zone.

FOLDING

Apart from a few drag-folds in the proximity of faults, particularly those with northeast trend, folding in the granitic gneisses and xenolithic gneisses is rarely observed, though several million structures plunging to the northeast are indicative of the presence of folding.

Isoclinal folds with axes plunging 5° to $N100^{\circ}$ and to $N340^{\circ}$ in gneissic skarns just north of prospect H, are substantiated as regional and not purely local structures by more open chevron folding with the same axial direction, (though opposite plunge) at 5500N/51000 and at 5600N/52000 respectively. The flaggy lithology of a skarnic gneiss unit at 5600N/52000 serves to demonstrate the rather open, recumbent style of the folding around the $N160^{\circ}$ axis.

In the northwestern part of the region however the distinctive lithological units selected for mapping (somewhat fortuitously) provide admirable evidence of widespread isoclinal recumbent folding. Fold axes generally plunge about 25° to 35° in a northeasterly direction, and the amount of plunge and the direction of plunge vary little. No folding with highly

discordant axial trend was observed in the paragneiss units of the northwestern part of the grid. Tectonic b-elements, (roading, mullion structure and boudinage) also plunge about 30° to $N67^{\circ}$, and are more widespread than fold-axes, especially in the northwest extension of the grid, where outcrop patterns are indicative of folding, with similar recumbent style to folds exposed in detail elsewhere.

Folding in calcareous units at $6750N/4300E$ is more intense than in the surrounding felsic paragneisses, and the same is true near $5800N/4500E$, where marbles and limestones are intensely folded in isoclinal-recumbent style, with some small drag folds, but the flanking gneissic skarn units are relatively undisturbed. In the area between the two truncated ends of the mafic paragneiss unit just to the north of borehole 1, folding of the intervening units, probably with some slip along $N120^{\circ}$ faults, has caused relative dextral displacement of the mafic zone, and also partially folded the early part of the fault plane which cause the initial right-lateral offset of the mafic paragneisses.

Indications of folding with northeasterly plunging axes, combined with tectonic b-lineaments, also plunging N.E., are pervasive continuously around the faulted outcrop of paragneiss and associated skarns from $5700N/4300E$ in the west to $5000E$ on the $6200N$ baseline. It is highly probable therefore that the mafic paragneiss outcrop defines a large-scale ruck-fold on the "upper" limb of a regional-scale isoclinal recumbent fold with a northeasterly plunging axis. This folding has changed the hade of the strong northeasterly fracture zone in the central part of the area, near H3, but has itself been disrupted by drag along later northeasterly faulting.

Complexly folded and faulted outcrops of mafic paragneisses in the region of $5600N/4600E$ appear to be a continuation of the fold-limb, but the trend has been strongly modified on the southeast side of the well-defined northeasterly fault which bounds the southern side of the geophysical anomaly at this location. From $5600N/4600E$ the mafic paragneiss horizon may be represented by larger pods and clasts of hornblende-rich

paragneiss within the xenolithic paragneiss extending towards prospect H.

Folding in the granitic gneisses and granite is less evident, if it exists, due to the homogeneity of the lithology, and faulting appears to be the more important stress-relief mechanism in that environment.

Resume'

Very strong faulting with a dextral strike-slip component and general northeasterly trend has displaced various units of paragneiss with interlayered skarn, particularly along zones near borehole 1, near prospect H3 and in the central part of the region.

Subsequent isoclinal folding with northeasterly-plunging axes, in part facilitated by slip along N120° faults is particularly obvious in the more calcareous units of the paragneiss near borehole 1. This folding and faulting folds and displaces the earlier northeasterly fault planes, and allows relative dextral movement of the previously separated lithologic units, as can be determined with reference to the mafic paragneiss horizon west of borehole 1. A little mineralization or enrichment may be associated with the N120° faults.

On a larger scale, the outcrop of mafic paragneiss in the central part of the map area, north of prospect H3, appears to be a ruck-fold on the "upper" limb of a recumbent isoclinal fold of regional proportions, almost certainly with a northeasterly-plunging axis, but the continuation of the outcrop to the southeast of a northeast fault at 5600N/4600E, if present, is represented by large clasts within the xenolithic gneiss.

Faulting with a N20° trend, which brings granitic and xenolithic gneiss into fault-contact in the southern part of the area, may account for the hiatus in the I.P. contours along the same salient north of the 6200N baseline.

Discontinuous segments of a well-defined N-S fault zone with strong right-lateral component in part of its trace link up prospects H, H2 and H3, and may be related to the mineralization.

These faults appear to have offset segments by $N120^{\circ}$ fractures. Prospect H₃ is at the intersection of the main N-S trending zone and the extrapolation of the southernmost $N20^{\circ}$ zone.

Folding appears to be an important stress-relief mechanism in the northwestern part of the area, but may only be more apparent due to the less homogeneous nature of the paragneisses, while fracturing appears to be the main agent of tectonic control in the rest of the area, particularly in a northeast-trending zone through the central region.

MINERALIZATION AND BOREHOLE DATA

MINERALIZATION

A number of prospects have been dug in the past to investigate the mineralization of the area. Among these are the prospects H to H6, and several unnumbered prospects at 7325N/3580Ø, 6525N/5550Ø, 6525N/5600Ø and 6475N/5710Ø. The position of these prospects, except H6 which has a position about 3500N/5000Ø off the south edge of the map, are plotted on all the maps.

Three other mineralized localities which were visited are outside the map area, at 396668, 395690 and 378649 (Innhavnet, area 1231-II). Of these the first two are discussed in relation to the map area, and the last is a uranium prospect in pegmatite.

Six diamond-drill holes were scheduled to investigate the relation between mineralization on geophysical anomalies, and these are discussed in the next section.

Mineralization in the main area may be categorized into five main types. Examples of intermediate or gradational type are common however. These associations are:

- 1) with pegmatite
- 2) with mafic paragneiss
- 3) with xenolithic quartzo-feldspathic gneiss
- 4) with massive skarn
- 5) with small fractures

Pegmatite

Uraninite (pitchblende) at 378649 occurs as small amygdular lenses and pods with a few veinlets in a 3 meter wide northwest trending zone. The pitchblende is closely associated with black cataclastic amphibole in a hematite-stained quartz-orthoclase-microcline pegmatite containing little primary muscovite but abundant sericite, dominantly in shears in the mineralized zone. The mineralized zone is abruptly terminated by flat-lying joints in the pegmatite, and may be expected to be displaced in a step-like manner at depth, if it persists. The general appearance (samples RS-73-314 to 318TY) of the zone is that of the upper

parts of uraninite veins in the Cornish tin-mining areas, and uraninite accounts for about 5% by volume of the mineralized zone. A "soft yellow clay which can be dug out with a spoon" (probably carnotite clay) mentioned by a local could not be found.

Mineralization in Mafic Paragneiss

Mineralization at the localities 396668 and 395690 consists of pyrite and pyrrhotite disseminates with a little copper in mafic, (hornblende-biotite-quartz-feldspar), gneisses, usually of fine grain and with relict sedimentary textures, and usually containing graphite. Metamorphic or primary banding causes segregation of mafic and felsic minerals, and the layers pinch and swell along the strike. The mafic unit at 396668 is traceable directly to the 3100Ø line of the grid, and that at 395690 appears to be part of the same zone.

From the 3100Ø line the mafic paragneisses trend southeasterly and are probably folded in isoclinal recumbent style and faulted dominantly along N70° and N120° salients. Graphite is present in some restricted zones within the gneiss, and probably accounts for the V.L.F. anomalies associated with the unit. Irregular areas of limonite-stained and jarosite-stained paragneiss, particularly near 7200N/4050Ø are related to weak pyrrhotite-pyrite-chalcopryrite-zincblende disseminates within the biotite-rich gneiss.

The mafic zone is better-defined to the east of the 4200Ø line, and is associated with an anomalous I.P. zone as well as to a moderately strong V.L.F. zone. Minor quantities of pyrite with traces of chalcopryrite are present as disseminates and small interstitial patches within very thin hornblende-rich bands in the "lower" part of the unit. At about 6700N/4600Ø the mafic paragneisses have garnet development, and are displaced to the southeast along a complexly-folded fault zone with schlieren of garnetiferous amphibole paragneiss streaked out along the zone.

Traces of pyrrhotite, pyrite and chalcopryrite are seen

in the lower parts of the unit as small disseminated interstitial segregates to about 50000 on the 6200N baseline, where the grain size of the amphibolite decreases and the quantity of sulphides increases substantially. I.P. and V.L.F. anomalies are also associated with this segment of the paragneiss zone. To the west of this point the outcrops are more sporadic, but can be traced with some certainty to 5600N/46000, and as at about 6000N/48000 the mafic gneisses are spatially related to distinct I.P. anomalies, and contain disseminated pyrrhotite, pyrite and chalcopyrite in thin zones. The sulphide content of these mafic paragneisses is only appreciable in bands of 1-2 cm. and although these are distributed widely throughout the apparent thickness of the unit, the overall sulphide content is probably less than about 0.5%, of which pyrrhotite and pyrite constitute the bulk.

Mineralization in Xenolithic Paragneiss

It is strongly suspected that many of the xenoliths in the quartz-plagioclase-orthoclase-hornblende gneiss are clasts of mafic paragneiss dissociated from a continuation of the main zone.

Mineralization at prospect H8 consists of abundant chalcopyrite disseminates with a little bornite, both restricted to a very narrow zone at the margin of a large discreet amphibolite lens within xenolithic paragneiss.

One hundred and fifty meters to the east, and 50 m. west of prospect H is a small pit designated H7, in which weak pyrite disseminates and a trace of chalcopyrite occur in the outer part of a mafic xenolith in banded quartzo-feldspathic paragneiss. Abundant magnetite is present in the felsic gneiss, and traces of disseminate are present along more mafic bands in the gneiss.

At prospect H (5125N/51000) many large elongate xenoliths of mafic paragneiss are contained within the quartzo-feldspathic gneiss, which has a tendency to large-scale banding due (?) to metamorphic segregation. However introduction of secondary minerals, particularly biotite and orthoclase, indicates some potassic alteration, but this appears to be restricted to the

immediate vicinity of the prospect, and is not apparent to the east or west. Mineralization at H is apparently selective along the more mafic horizons of a northeasterly dipping 4 meter-wide zone sub-concordant with the strike of the xenolithic gneisses. Within the more strongly mineralized zones strong impregnations of both chalcopyrite and bornite, in approximately equal abundance, are associated with magnetite and a little molybdenite. Aggregation (segregation?) of the disseminated copper minerals results in elongate and flattened pods and lenses of massive bornite and chalcopyrite, but cross-cutting veinlets are very rare. It has already been mentioned that prospect H is on the trend of a strong N-S fault zone which can be seen to the south and to the north, and the mineralization may be related to an obscured segment of this fault. A cliff 25 meters north of prospect H is thought to be the manifestation of a $N120^{\circ}$ fault trend with a dip of 40° - 50° to the northeast, and this may truncate the mineralized zone to the north.

Mineralization in Skarn

Very weak copper mineralization at prospect H2 (5350N/5050E) appears to be connected with a mafic-rich xenolith within a somewhat gneissic amphibole-epidote-feldspar skarn, and if so represents an intermediate stage between the mineralization in skarn and that in mafic paragneisses or xenolithic gneisses. This prospect also lies close to the trend of the N-S fault east of H and H3, although the fault is not observed at this location.

Bornite-chalcocite mineralization of massive garnet-diopside-epidote skarn at prospect H3 is identical with that exposed in the skarn to the northeast in pits H4 and H5, and in many small prospects in that same area. Traces of similar mineralization confined within the small fault-segments of skarn extending to 6900N/5600E attest to a right-lateral displacement of mineralized massive skarn. These skarns are invariably highly fractured, particularly along northeasterly salients, and a little mineralization occurs within the fractures. At H3 chalcocite within one fracture is slickensided, testifying

to post mineralization movement.

The bornite-chalcopyrite mineralization within the massive skarn at these prospects occurs as veinlets and massive segregates within and around later irregular veinlets of calcite, feldspar, and quartz. Later and more regular felsic veins and pegmatites contain a little chalcocite, and frequently alter the skarn to asbestiform tremolite-actinolite amphibole in the immediate proximity.

Minute specks of free gold, with no obvious relation to any particular phase of mineralization appear to be confined to the massive skarn.

Mineralization is not restricted to the skarn, but occurs as interstitial impregnations and fracture fillings interconnected by fine veinlets within the surrounding gneiss, and at H5 within gneiss inclusions, which are altered to skarn. This mineralization does however appear to be directly related to remobilization of minerals of the skarn.

Although prospect H3 has been most intensively investigated by adit and quarry construction, drilling confirms that it is a discreet lens of small size, and the position at the intersection of the strong N-S fault zone from east of prospect H, and the northeast fracture extending to the south of prospects H4 and H5 is considered significant.

Copper mineralization at prospect H6 (ca. 3500N/50000E) is also associated with a N-S fracture zone, with some pegmatite intrusion along the zone. Abundant chalcopyrite, as disseminates and small aggregates, associated with a little molybdenite, occur in a thin skarn and mafic gneiss horizon in the immediate vicinity of the intersection by the north-south fracture zone. The mafic gneiss horizon contains abundant pyrite along a fifty meter length to the southeast, and calcareous units "above" and gneissic skarns "below" are almost unmineralized. Copper occurs only in the 3 m. wide and 1 m. thick portion of this horizon, and though not strictly in massive skarn, but rather in a mafic gneiss association, it is considered here because of the relation of the N-S. fault. This fault may be an extension of that through H3 and H, offset

right-laterally by a N120° fault south of the grid at about the 4000N/5000E area.

Mineralization Associated with Small Fractures

Southeast of about 7000N/3900E a N120° fracture is weakly mineralized along the length until terminated by a northeasterly fault. Pyrite and traces of chalcopyrite are present in small quantities in a $\frac{1}{2}$ -1m. wide zone which is limonite-stained at the surface. The zone is controlled by the fracture only along part of its length, and trends irregularly northwest to 7000N/3700E where it is offset by a second sinistral N120° fault.

At several places along the "lower" contacts of the mafic paragneiss unit limonite-staining in the adjacent felsic paragneisses indicates weak pyrite-chalcopyrite disseminations. Some of these zones are folded, (6700N/4450E) but others appear to be controlled by N120° strike-slip faults with a gentle hade to the northeast (6450N/4500E, 6000N/4750E). Many other thin zones of pyrite-chalcopyrite mineralization occur elsewhere along fractures with various concentrations, but the lateral continuity is generally slight.

BOREHOLE DATA

Six diamond drill-holes were planned for the 1973 season to test strategic geophysical anomalies. Four have been completed, and the fifth is almost complete at this writing. Full information concerning drill-holes and trenches, including location, profiles, verbal and visual logs of the core, lists of samples and where available, analytical results are compiled in Appendix 3. Briefly, these holes are as follows:

- BH1 6575N/4450E, 60° to N256°, total depth 140.20m
- BH2 6075N/4800E, 45° to N195°, total depth 190.20m
- BH3 6075N/4800E, 20° to N015°, total depth 33.60m
- BH4 5910N/4875E, 50° to N245°, total depth 79.00m
- BH5 5565N/4500E, 50° to N195°, total depth in excess of 75m
- BH6 5205N/5100E, 70° to N195°, total depth probably in excess of 60m.

Holes 4 and 6 are specifically to investigate mineralization in prospects H3 and H respectively, and BH2 was directed in part to test prospect H3. The results of this drilling can be best summarized individually.

BH 1 Weak pyrrhotite mineralization as interstitial impregnations from about 40 to 70 meters, stronger at 40-50 meters. Very small amounts of pyrite, with traces of chalcopyrite from ca. 40 to 75 meters, with 0.1% copper only in the 72.00-73.50 interval. Most sulphide mineralization is within mafic paragneiss and intercalated skarns, with the most significant quantities in the finer-grained fractures. The highest copper values are however in the limonite-stained pyrite-bearing felsic paragneiss "beneath" the mafic gneisses. No surprises.

BH2 Traces of sulphide-mineralization from 35 m. to 85 m. with minor pyrrhotite from 35m. to 65m, minor pyrite from 35m to 85m, and traces of copper from 35m to 80m. Most of the mineralization is in mafic-rich paragneiss, predominantly hornblende-rich, and associated skarns. The very thin zones of weak sulphide mineralization (117.50-118.00, 140.00-140.30, and 148.00-149.00m) are also associated with hornblende-rich gneiss. No evidence of a northwesterly continuation of the massive skarn at H3 was found, and the lithology and mineralization are about as was expected from previous mapping. Several analyses with copper above 0.1% but less than 0.3% are expected.

Many shear zones, particularly at expected extensions of surficial fault traces dipping 50° to north.

BH3 Designed to investigate suspected NE-SW shear zones between 6075 and 6125N on 4900%. Shears were expected to have 50° N, so very shallow angle-hole needed. Investigated fractured skarn and drilled 10m. into unsheared gneiss with no visible mineralization.

BH4 Investigating vertical extension of skarn at prospect H3. Traces of copper (chalcopyrite) at 22.0m-24.0m, and a little bornite at 50.40-50.50m. In generally fine light paragneisses with much shearing and little mafic gneiss in 48m-50m region.

Apparently the skarn does not extend down as far as 40 meters (50m in borehole), which is most likely an extension of the fracture zone associated with the skarn at the surface.

BH 5 To test mineralization of mafic paragneisses and amphibolites at the western end of anomalous I.P. area. This area is at the southern end of the almost continuous mafic paragneiss zone. Pyrrhotite and minor pyrite-chalcopryrite are visible on the surface, and it is expected that the results will be similar to those in boreholes 1 and 2, but structures here are very complex and prognostication of lithology is not possible.

BH 6 Designed to test observed mineralization in cliff north of prospect H, and also to test extension of 25° NE-dipping strata at prospect H. Difficult to site hole in order to intersect probable fault at base of cliff, and also to intercept mineralized zone to south of probable fault and assure adequate sampling. Potential for mineralization at 15m-20m (in xenolithic gneiss), at ca. 45m (in schistose mafic paragneiss zone) and in the 55m-70m interval, particularly at 59/63m zone which may contain substantial quantities of copper unless the mafic units at surface are small xenoliths.

Resume'

The most pervasive mineralization is associated with the mafic paragneiss unit which trends southeast from the coast at 396668 and with some faulting and folding outcrops almost continuously to about 5600N/4600E. Where the I.P. survey exists the most definite anomalies are related to this horizon, and V.L.F. anomalies in the northwestern part of the area appear to be related to graphite-rich zones within the mafic paragneiss. The generally weak and stratiform pyrrhotite-pyrite-chalcopryrite mineralization may be locally enriched by Ni_{20}° faulting along the "lower" contact of the mafic gneiss. A little zincblende may be present, as indicated by stream sediment samples.

At prospect H the stratiform nature of the deposit appears

to be due to selective mineralization along mafic-rich bands within xenolithic quartz-feldspar gneiss, and local enrichment may be directly related (as at H8 and H7) to mafic xenoliths within the gneiss. Bornite and chalcopyrite disseminates and impregnations, sometimes aggregated as concordant, flattened lenses, are associated with abundant magnetite and a little molybdenite. Potassic alteration of the xenolithic gneiss (and possibly mineralization) does not apparently have much lateral continuity along the trend, and may be related to faulting or a N-S salient as is the copper mineralization within a pyrite-rich zone at prospect H6 to the south. At H6 chalcopyrite, pyrite and molybdenum are present as impregnations in mafic gneiss/gneissic skarn in the immediate vicinity of where a pegmatite-bearing N-S fracture zone intersects a pyrite-bearing mafic gneiss horizon of limited lateral extent.

Mineralization of the massive skarns at H3, H4, H5 and at several prospects in the vicinity of H5 consists of chalcocite and bornite fracture-fillings, veinlets and interstitial impregnations associated with late pegmatite veins in the skarns. Mineralization in the adjacent gneisses is generally confined to fracture planes, and post-mineralization movement on these planes probably with right-lateral offset, is likely. The origin of the minute quantity of free gold in the skarns is uncertain but probably relates to the copper mineralization.

Boreholes 2 and 4 confirm the limited size and general lensoid form of the massive skarn at prospect H3. They also indicate that mineralization in the surrounding gneisses is very minor, confined to fractures and contains chalcopyrite as well as bornite and chalcocite. All drill holes confirm what was deduced from the geology, with, so far, no contradictions.

SUMMARY

Copper mineralization is widely scattered on the low ridge to the west of Botn in Tysfjord, and geophysical surveys were conducted by N.G.U. in 1972 on a grid-system covering the region. Several anomalous areas were indicated, particularly by induced polarization methods and follow-up work in 1973 by N.G.U. using the V.L.F. method traced conducting zones to the northwest in an extension of the grid-system.

Detailed geologic mapping and rock sample collection was carried out in the 1973 season in the region of the most intense I.P. anomalies, which had been selected for investigation by diamond-drilling. A few soil and stream sediment samples were also collected from strategic locations to test the feasibility of geochemical prospecting techniques in this terrane, and a pilot-program was initiated late in the season.

Three main groups of rocks, with complex inter-relation, outcrop in the area, and these groups were subdivided into eleven mappable units on a compromise between apparent bulk chemistry, mineralogy and weathering characteristics. In the northwestern part of the region the most abundant rocks are paragneisses, including calcareous, quartzo-feldspathic and mafic-rich units. In the extreme northwest the mafic paragneisses are metasedimentary in aspect, and contain graphite and minor sulphides (pyrrhotite, pyrite, chalcopyrite and possibly zincblende). Further east the mafic zone, which contains both hornblende-rich and biotite-rich variants, becomes more cohesive, and is spatially related to the V.L.F. and I.P. anomalous zones, and are the probable cause of the anomalies. The biotite-rich unit is schistose, and the biotite is usually pseudomorphous after amphibole.

Skarn development has affected many of the units of the paragneiss, and is apparently selectively based on the original bulk chemistry of the paragneiss. The process is progressive, and results in a resistant garnet-epidote-diopside skarn with little or no relict texture, which occurs both as aligned pods and lenses within paragneisses, and also as discreet but irregular lensoid bodies.

Much of the southern and eastern parts of the area is underlain by deceptively coarse grained quartz-plagioclase-orthoclase-hornblende- gneisses containing zones with abundant well-defined xenoliths of mafic paragneiss and massive skarn, and also a few more felsic and less distinct clasts which are probably felsic paragneisses and gneissic skarn. Gradations of the xenolithic gneiss into all types of paragneiss and skarn is observed.

Gradations of the xenolithic gneiss into the third group of rocks may have been observed but not recognised as such, due to the similarity in apparent grain-size and texture. The granitic gneisses and gneissic granite are poorly foliated and again deceptively coarse-grained, but orthoclase is predominant over plagioclase, and biotite is the dominant, or only mafic constituent, and the glomeroporphyroblastic hornblende characterizing the xenolithic gneiss is absent or extremely altered. These granitic rocks outcrop in cohesive bodies in the northeast and southwest of the area, and are usually in fault contact or very sharp contact with other rock groups.

The regional tectonic grain, except where realigned by folding or faulting, is northwest-southeast with dips 25° - 45° to the northeast. Strike-slip movement between units causes local drag-folding with axes conformable with the dip, and also causes many enigmatic outcrop patterns. Isoclinal recumbent fold axes plunging about 35° to $N65^{\circ}$ are common in the northwest of the area, particularly in calcareous units, and the outcrop of the mafic paragneiss units defines a much larger scale ruck-fold on the upper limb of a complex, large-scale recumbent fold with a northeasterly plunging axis.

Small drag-folds along fault-planes are common, but some larger isoclinal recumbent folds within the xenolithic gneisses have NW-SE axes, and unless these folds are reorientated by drag along several northeasterly and southeasterly faults, they may indicate polymetamorphism.

Fracturing is pervasive throughout the area, especially in the central part. Some of the major faults, particularly those on NE, SE and N-S salients, have a demonstrable right-

lateral component which is often of considerable magnitude. One of the northeasterly faults fractures and displaces the mafic-rich paragneiss zone and associated geophysical anomalies. The mafic gneiss is garnetiferous in the immediate vicinity and in fault-slices along the zone. The fault-plane is itself folded and faulted along a $N120^{\circ}$ strike-slip fracture, and the two segments of the mafic zone have been relatively right-laterally displaced in this manner. A similar process causes changes in the direction and hade of major northeasterly fractures near prospect H3, and recurrent movement of all portions of the system creates further complications.

Weak sulphide mineralization in the mafic paragneisses is more abundant in the lower parts of the unit, probably due in part to strike-slip faulting, and the mineralization can be traced from the coast at 396668 to the 31000 line in the extreme northwest of the grid, and thence in a sinuous folded zone to 5600N/46000 where it is terminated by a strong NE fault. The zone can be traced via large xenoliths and lenses to prospect H8, where enriched margins of the xenolith are observed, to prospect H. Though the mineralization is stronger in more mafic-rich parts of the xenolithic gneiss at prospect H, molybdenite is present with bornite and chalcopyrite within a 4m. wide zone, concordant with the grain of the foliation. Potassic alteration is associated with the xenolithic gneiss, but is restricted to a narrow zone with a north-south trend. Similar mineralization at prospect H6 is restricted to a 3m. wide zone within a thin, rather larger zone of pyrite-rich mafic gneiss and gneissic skarn, where it is intersected by potassic aplites or pegmatites in a N-E fault zone. A fault zone with the same trend outcrops south and north of prospect H, apparently offset by southeasterly and northeasterly faults, and then trends northwards to prospect H2 and H3.

At H3, bornite and chalcocite mineralization with minute traces of free gold occur as void and fracture fillings associated with late felsic pegmatites in massive garnet-diopside-epidote skarn. A little chalcocite, as fracture-fillings and

occasionally as weak impregnations occurs in the surrounding gneiss in the immediate vicinity, but drilling shows that the skarn has limited size, is probably lens- or pod-like, and that only traces of bornite and chalcopyrite, related to fracture zones, are present in the surrounding gneisses. Prospects H4 and H5 are of the same type, but are less strongly mineralized.

CONCLUSIONS

A brief hypothetical geologic history serves as a basis for the conclusions:

Metamorphism of limestones, marls, sandstone, shale and mudstone resulted in the paragneisses, including calcareous, quartzo-feldspathic and mafic variants. Graphite and primary sulphides, present in the shales and mudstones, were somewhat segregated in the process.

Progressive skarn development in this sequence, ultimately resulting in massive garnet-diopside-epidote skarn, was apparently selectively based on the original bulk chemistry, and was probably in part caused by the metamorphic process.

After the development of skarn and of well-defined foliation in the paragneisses, cataclasis and intrusion by remobilized basement (?) material caused the absorption of more felsic paragneiss and the inclusion of clasts of the more refractory mafic variants and skarns to create the xenolithic gneiss. This event probably occurred at the culmination of the regional amphibolite grade metamorphic pulse. Apart from later dynamic metamorphism, which locally caused conditions to exceed the garnet isograd in mafic rocks, subsequent events resulted in retrogression of hornblende and diopside to biotite and chlorite, and of plagioclase to clay minerals. The metamorphism caused further segregation of the sulphides in the mafic paragneiss units and also in the larger mafic xenoliths, (eg. H8), but at greater depths total absorption of mafic rocks occurred, and the inherent sulphides were redistributed with the more potassic and silicic fractions of the remobilization process. These sulphides were probably then deposited via suitable channels, particularly with southeast and northerly trends, in sites with more suitable physico-chemical conditions, and the mineralization along strike-slip faults in the paragneisses, and some of the mineralization in the massive skarns possibly results from this period.

Folding and faulting after the cooling and consolidation

of the xenolithic gneiss was accompanied a short time later by fracturing on a large scale, particularly with northeasterly trends and probably with considerable right-lateral movement. Interaction of the two stress-relieving mechanisms resulted in parasitic drag folds on the limbs of major isoclinal recumbent folds with northeasterly trending axes. Dextral strike-slip movement along southeasterly trending fault planes was an important factor in these tectonic readjustments, and also controlled some of the later mineralization.

The quartz-orthoclase-biotite granite, with a little retrograded hornblende, consolidated at this time, and included a few large fragments of xenolithic gneiss. Segregation of the late, low-melting fraction of the earlier metamorphic pulse which produced the xenolithic gneiss is the probable origin of the granite, and the tectonic and metamorphic events beginning with the remobilization of the basement are viewed as a pulsating and continuous process of diminishing intensity.

Folding and faulting, with some retrogressive metamorphism, continued with the same style and orientation as earlier pulses. Later faulting and folding along and around more northerly salients was accompanied by introduction of potassium and silica, probably the latest fractions of the metamorphic episode. A little late mineralization with molybdenum and copper accompanied the veins and pegmatites, particularly at favorable structural sites. Very minor readjustments along all the pre-existing fractures, subsequent erosion, and glacial scouring, particularly of the most fractured zones, complete the history.

In conclusion the I.P. anomalies and V.L.F. anomalies are related to the mafic paragneiss unit, and particularly to segregations of sulphide (pyrrhotite, pyrite, chalcopyrite and possibly zincblende) and graphite within the unit. The graphite and sulphides are probably primary constituents of the mafic paragneiss, and have been subsequently segregated by metamorphism, and locally enriched by strike-slip faulting accompanied by retrogressive metamorphism. A little pyrite-chalcopyrite mineralization of more felsic gneisses "underlying" the mafic

paragneisses accompanied the strike-slip faulting. Possibly significant areas of enrichment occur in the 7200N/40500 region of the grid, and can be investigated by simple geochemical techniques. Unless other, and as yet unrecognized, processes of sulphide enrichment are present, the economic potential of the mafic paragneiss unit at this time is negligible. Mineralization at prospects H7 and H8 probably has the same origin, but occurs in detached fragments of the mafic unit, and have therefore even less potential.

In the massive skarn pods at H3, H4, H5 and elsewhere, mineralization is related to two stages of late pegmatitic veins, and occurs as fracture and void fillings in the skarn. Weak mineralization of fractures in the immediately adjacent gneisses is probably derived from that in the skarn by remobilization.

Reconstruction of the paleogeology by left-lateral movement of 1 km. along the major northeasterly fracture zone north of H3 serves to juxtapose not only the massive skarn pods at H3 and H4, but also the two large areas of granite and granite gneiss, and the amount of mineralization, though still minor, is increased. Minor readjustments of folds and faults serve to remove any objections to this reconstruction.

The bornite-chalcopyrite mineralization in the skarns may be exotic, but probably derives from sulphide-bearing mafic paragneiss, by elemental redistribution, during the process of formation of the xenolithic gneiss.

The remobilized sulphides, together with late silicic and potassic fractions were probably introduced into sites with suitable conditions, in part chemical but dominantly structural, along fracture zones, particularly those with northerly salients. Though offset in part by southeasterly trending fractures the most important of these zones appears to be that linking prospects H3, H2, H, and H6. At both H and H6 this zone intersects part of a mafic-rich zone, but at H6 the copper-enrichment attributable to the northerly fracture is small, and all indications

are that the same situation pertains at prospect H. This may be due to the limited supply of sulphides or to the prior erosion of much more strongly mineralized material. No other zones of this type have been recognized. The proposed mechanism requires absorption of large amounts of sulphide-bearing paragneiss, combined with fortuitously located fracture zones and large resistant, well-fractured lithologic units of suitable chemistry to produce deposits of significant potential. These are apparently absent from the prospect area.

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APPENDIX I

TOTAL LIST OF SAMPLES FROM BOTH IN TYSEFJORD FOR CHEMICAL ANALYSIS

SAMPLE NUMBER IN TEXT & ON MAPS 1B & 2B	TYPE OF SAMPLE	RESULTS, PPM., %					ANALYSIS NUMBER IF DIFFERENT
		Cu	Zn	As	Ni	S	
RS-73-J1TY	Soil	36	38	0	4	-	ARS 10
RS-73-J2TY	"	122	25	0	4	-	ARS 11
RS-73-J3TY	"	520	22	0	5	-	ARS 12
RS-73-J4TY	"	6	22	0	5	-	ARS 13
RS-73-J5TY	"	6	79	0	15	-	ARS 14
RS-73-J6TY	"	16	40	0	4	-	ARS 15
RS-73-J7TY	"	18	44	0	8	-	ARS 16
RS-73-J8TY	"	22	15	0	3	-	ARS 17
RS-73-J9TY	"	60	20	0	3	-	ARS 18
RS-73-J10TY	"	8	9	0	3	-	ARS 19
RS-73-S1TY	Stream Sediment	110	60	0	4	-	ARS 6
RS-73-S2TY	"	68	68	0	11	-	ARS 7
RS-73-S3TY	"	280	143	0	45	-	ARS 8
RS-73-S4TY	"	48	91	0	13	-	ARS 9
BTY1 05.00-06.00m	Split Core	-	-	-	-	0.02	
BTY1 10.00-11.00	"	-	-	-	-	0.01	
BTY1 15.00-16.00	"	-	-	-	<0.01	-	
BTY1 20.00-21.00	"	-	-	-	<0.01	-	
BTY1 25.00-26.00	"	-	-	-	<0.01	-	
BTY1 30.00-31.00	"	-	-	-	<0.01	-	
BTY1 35.00-36.00	"	<0.01	-	-	0.01	0.01	
BTY1 36.00-36.70	"	0.02	-	-	<0.01	1.14	
BTY1 36.70-38.15	"	0.01	-	-	0.02	0.10	
BTY1 38.15-38.75	"	<0.01	-	-	<0.01	0.05	
BTY1 38.75-39.70	"	0.02	-	-	0.01	0.25	
BTY1 39.70-40.70	"	0.01	-	-	<0.01	0.11	
BTY1 40.70-41.70	"	<0.01	-	-	<0.01	0.15	
BTY1 41.70-43.00	"	<0.01	-	-	<0.01	0.28	
BTY1 43.00-43.40	"	0.07	-	-	0.03	5.79	
BTY1 43.40-44.50	"	<0.01	-	-	0.02	0.04	
BTY1 44.50-45.00	"	0.02	-	-	0.01	1.30	
BTY1 45.00-46.40	"	0.01	-	-	<0.01	0.79	
BTY1 46.40-47.50	"	0.01	-	-	<0.01	0.33	
BTY1 47.50-48.60	"	0.01	-	-	<0.01	0.19	
BTY1 48.60-49.30	"	0.01	-	-	<0.01	0.29	
BTY1 49.30-50.20	"	0.02	-	-	<0.01	0.37	
BTY1 50.20-51.50	"	0.04	-	-	0.01	0.58	
BTY1 51.50-52.70	"	0.01	-	-	<0.01	0.31	
BTY1 52.70-53.80	"	0.05	-	-	0.01	0.68	
BTY1 53.80-55.20	"	0.02	-	-	<0.01	0.53	
BTY1 55.20-56.70	"	0.02	-	-	<0.01	0.27	
BTY1 56.70-58.00	"	0.04	-	-	0.01	0.55	
BTY1 58.00-59.10	"	<0.01	-	-	<0.01	0.14	
BTY1 59.10-59.95	"	0.04	-	-	0.02	1.17	
BTY1 59.95-60.65	"	0.01	-	-	0.01	0.31	

2

SAMPLE NUMBER	TYPE OF SAMPLE	RESULTS, PPM., %		
		Cu%	Ni%	S%
BTY1 60.65- 62.15	Split Core	<0.01	0.01	0.09
BTY1 62.15- 63.65	"	0.03	0.01	0.06
BTY1 63.65- 65.00	"	0.03	<0.01	1.33
BTY1 65.00- 66.10	"	0.05	-	0.11
BTY1 66.10- 67.40	"	0.02	0.01	0.14
BTY1 67.40- 68.40	"	0.04	0.01	0.45
BTY1 68.40- 69.20	"	0.05	0.01	0.39
BTY1 69.20- 70.60	"	0.03	<0.01	0.82
BTY1 70.60- 72.00	"	0.01	-	0.29
BTY1 72.00- 73.50	"	0.11	-	0.22
BTY1 73.50- 75.00	"	0.01	-	0.01
BTY1 80.00- 81.00	"	-	-	-
BTY1 85.00- 86.00	"	-	-	-
BTY1 90.00- 91.00	"	-	-	-
BTY1 95.00- 96.00	"	-	-	-
BTY1 100.00-101.00	"	-	-	-
BTY1 105.00-106.00	"	-	-	0.02
BTY1 110.00-111.00	"	-	-	0.09
BTY1 115.00-116.00	"	-	-	0.01
BTY1 120.00-121.00	"	-	-	0.01
BTY1 125.00-126.00	"	-	-	0.02
BTY1 130.00-131.00	"	-	-	0.18
BTY1 135.00-136.00	"	-	-	0.03
BTY2 05.00- 06.00	"	-	-	-
BTY2 10.00- 11.00	"	-	-	-
BTY2 15.00- 16.00	"	-	-	-
BTY2 20.00- 21.00	"	-	-	-
BTY2 25.00- 26.00	"	-	-	-
BTY2 30.00- 31.00	"	-	-	0.06
BTY2 35.10- 36.50	"	0.01	-	0.19
BTY2 36.50- 38.00	"	-	-	0.24
BTY2 38.00- 39.50	"	-	-	0.21
BTY2 39.50- 41.00	"	-	-	0.22
BTY2 41.00- 42.50	"	-	-	0.23
BTY2 42.50- 44.00	"	-	-	0.21
BTY2 44.00- 45.50	"	0.02	-	0.54
BTY2 45.50- 46.40	"	0.04	-	0.57
BTY2 46.40- 48.00	"	0.02	-	0.24
BTY2 48.00- 49.50	"	0.01	-	0.24
BTY2 49.50- 51.00	"	0.01	-	0.10
BTY2 51.00- 52.50	"	0.02	-	0.30
BTY2 52.50- 54.00	"	0.06	-	1.04
BTY2 54.00- 55.50	"	0.02	-	0.35
BTY2 55.50- 57.00	"	0.03	-	0.15
BTY2 57.00- 58.50	"	0.07	-	0.11
BTY2 58.50- 60.00	"	0.03	-	0.23
BTY2 60.00- 61.50	"	0.02	-	0.10
BTY2 61.50- 63.00	"	0.03	-	0.41
BTY2 63.00- 63.30	"	0.08	-	1.68
BTY2 63.30- 64.25	"	0.01	-	0.25
BTY2 64.25- 64.70	"	0.08	-	1.77
BTY2 64.70- 65.55	"	0.03	-	0.34

SAMPLE NUMBER	TYPE OF SAMPLE	RESULTS, PPM., %		
		Cu%	Ni%	S%
BTY2 65.55-66.55	Split Core	0,01	-	0,12
BTY2 66.55-68.00	"	0,03	-	0,55
BTY2 68.00-68.30	"	0,05	-	0,85
BTY2 68.30-69.65	"	0,04	-	0,77
BTY2 69.65-70.95	"	0,01	-	0,20
BTY2 70.95-71.60	"	0,31	-	0,64
BTY2 71.60-72.35	"	0,14	-	1,54
BTY2 72.35-73.50	"	0,06	-	0,39
BTY2 73.50-74.25	"	<0,01	-	0,02
BTY2 74.55-75.65	"	<0,01	-	0,01
BTY2 75.65-76.65	"	0,03	-	0,04
BTY2 76.65-77.90	"	0,01	-	0,01
BTY2 77.90-79.00	"	<0,01	-	0,01
BTY2 79.00-80.00	"	0,01	-	0,01
BTY2 80.00-81.00	"	0,03	-	0,04
BTY2 81.00-82.05	"	-	-	0,01
BTY2 84.20-85.00	"	-	-	0,03
BTY2 85.00-86.00	"	-	-	-
BTY2 90.00-91.00	"	-	-	-
BTY2 95.00-96.00	"	-	-	-
BTY2 100.00-101.00	"	-	-	-
BTY2 105.00-106.00	"	<0,01	-	0,03
BTY2 110.00-111.00	"	-	-	-
BTY2 115.00-116.00	"	-	-	-
BTY2 117.40-117.95	"	<0,01	-	0,01
BTY2 120.00-121.00	"	-	-	-
BTY2 125.00-126.00	"	-	-	-
BTY2 130.00-131.00	"	-	-	-
BTY2 135.00-136.00	"	-	-	-
BTY2 139.40-140.00	"	<0,01	-	0,05
BTY2 140.00-141.00	"	-	-	0,01
BTY2 145.00-146.00	"	-	-	0,01
BTY2 147.80-148.95	"	<0,01	-	0,02
BTY2 150.00-151.00	"	<0,01	-	0,01
BTY2 155.00-156.00	"	0,05	-	0,01
BTY2 160.00-161.00	"	-	-	-
BTY2 165.00-166.00	"	0,01	-	0,04
BTY2 170.00-171.00	"	-	-	-
BTY2 175.00-176.00	"	-	-	-
BTY2 180.00-181.00	"	-	-	-
BTY2 185.00-186.00	"	0,30	-	0,05
BTY2 189.00-190.20	"	-	-	-
BTY3 05.00-06.00	"	-	-	0,04
BTY3 10.00-11.00	"	-	-	0,01
BTY3 15.00-16.00	"	<0,01	-	0,03
BTY3 18.00-19.00	"	<0,01	-	0,03
BTY3 20.00-21.00	"	0,01	-	0,03
BTY3 25.00-26.00	"	-	-	0,06
BTY3 30.00-31.00	"	<0,01	-	0,05

SAMPLE NUMBER

TYPE OF
SAMPLERESULTS, PPM., %
Cu% Ni% S%

BTY4	00.45-02.00	Split Core	-	-	0,01
BTY4	02.00-03.50	"	-	-	0,01
BTY4	03.50-04.50	"	-	-	-
BTY4	04.50-05.50	"	-	-	-
BTY4	05.50-06.70	"	-	-	-
BTY4	06.70-08.00	"	-	-	-
BTY4	08.00-09.50	"	-	-	-
BTY4	09.50-10.20	"	-	-	0,01
BTY4	10.20-10.80	"	0,01	-	0,01
BTY4	10.80-12.00	"	0,05	-	0,03
BTY4	12.00-13.50	"	<0,01	-	0,03
BTY4	13.50-14.50	"	-	-	0,02
BTY4	14.50-15.25	"	-	-	0,02
BTY4	15.25-16.00	"	<0,01	-	0,01
BTY4	16.00-17.50	"	-	-	0,03
BTY4	17.50-19.00	"	-	-	0,03
BTY4	19.00-20.50	"	-	-	0,01
BTY4	20.50-21.50	"	-	-	0,01
BTY4	21.50-22.15	"	-	-	-
BTY4	22.15-23.20	"	-	-	0,02
BTY4	23.20-24.60	"	-	-	0,01
BTY4	24.60-26.00	"	-	-	0,01
BTY4	26.00-27.50	"	-	-	-
BTY4	27.50-28.40	"	-	-	0,01
BTY4	28.40-29.90	"	-	-	-
BTY4	29.90-31.30	"	-	-	-
BTY4	31.30-32.75	"	-	-	0,01
BTY4	32.75-34.25	"	-	-	-
BTY4	34.25-35.25	"	-	-	-
BTY4	35.25-36.75	"	-	-	-
BTY4	36.75-38.25	"	-	-	-
BTY4	38.25-39.75	"	-	-	-
BTY4	39.75-41.25	"	-	-	-
BTY4	41.25-42.75	"	-	-	-
BTY4	42.75-44.25	"	-	-	-
BTY4	44.25-45.25	"	-	-	-
BTY4	45.25-46.10	"	0,04	-	0,03
BTY4	46.10-47.00	"	0,01	-	0,03
BTY4	47.00-48.00	"	0,01	-	-
BTY4	48.00-49.00	"	0,01	-	-
BTY4	49.00-50.20	"	0,03	-	0,01
BTY4	50.20-50.80	"	0,61	-	0,02
BTY4	50.80-52.00	"	0,01	-	-
BTY4	52.00-52.95	"	-	-	-
BTY4	52.95-54.00	"	0,03	-	0,03
BTY4	54.00-55.50	"	-	-	0,01
BTY4	55.50-57.00	"	-	-	0,01
BTY4	57.00-58.50	"	-	-	-
BTY4	58.50-60.00	"	-	-	0,01

SAMPLE NUMBER	TYPE OF SAMPLE	RESULTS, %		
		Cu	Ni	S
BTY4 60.00-61.50	Split Core	-	-	-
BTY4 61.50-63.05	"	-	-	0,03
BTY4 63.05-64.05	"	-	-	0,02
BTY4 64.05-65.50	"	0,02	-	0,01
BTY4 65.50-66.20	"	-	-	-
BTY4 66.20-67.50	"	-	-	-
BTY4 67.50-69.00	"	-	-	-
BTY4 69.00-70.50	"	-	-	-
BTY4 70.50-71.50	"	-	-	-
BTY4 71.50-72.50	"	-	-	-
BTY4 72.50-73.30	"	-	-	-
BTY4 73.30-74.05	"	0,01	-	0,01
BTY4 74.05-75.40	"	-	-	0,01
BTY4 75.40-76.80	"	-	-	0,02
BTY4 76.80-77.50	"	-	-	0,03
BTY4 77.50-78.50	"	-	-	0,01
BTY4 78.50-79.00	"	-	-	0,01
BTY5 14.80-15,00	"	0,004	-	-
BTY5 18,00-18,10	"	0,050	-	-
BTY5 24,00-24,45	"	0,006	-	-
BTY5 29,90-30,00	"	0,032	-	-
BTY5 50,00-50,10	"	0,013	-	-
BTY5 86,30-86,55	"	0,005	-	-
BTY6B 25,00-25,05	"	0,003	-	-
BTY6B 26,00-26,05	"	0,002	-	-
BTY6B 27,25-27,30	"	0,002	-	-
BTY6B 28,00-28,05	"	0,002	-	-
BTY6B 29,00-29,05	"	0,002	-	-
BTY6B 31,20-31,25	"	0,003	-	-
BTY6B 31,35-31,45	"	0,002	-	-
BTY6B 32,50-32,60	"	0,002	-	-
BTY6B 33,05-33,20	"	0,002	-	-
BTY6B 39,30-39,45	"	0,002	-	-
BTY6B 40,00-40,25	"	0,001	-	-
BTY6B 41,00-41,25	"	0,002	-	-
BTY6B 42,00-42,25	"	0,004	-	-
BTY6B 43,00-43,25	"	0,004	-	-
BTY6B 44,00-44,25	"	0,002	-	-
BTY6B 45,00-45,25	"	0,004	-	-
BTY6B 46,00-46,25	"	0,035	-	-
BTY6B 47,00-47,25	"	0,089	-	-
BTY6B 48,00-48,25	"	0,003	-	-
BTY6B 49,00-49,25	"	0,005	-	-
BTY6B 50,00-50,25	"	0,001	-	-
BTY6B 51,00-51,25	"	0,035	-	-
BTY6B 52,00-52,25	"	0,004	-	-
BTY6B 53,00-53,25	"	0,201	-	-
BTY6B 54,00-54,25	"	0,044	-	-
BTY6B 55,00-55,25	"	0,037	-	-
BTY6B 56,00-56,25	"	0,050	-	-
BTY6B 57,00-57,25	"	0,018	-	-
BTY6B 58,00-58,25	"	0,004	-	-
BTY6B 59,00-59,25	"	0,003	-	-

SAMPLE NUMBER	TYPE OF SAMPLE	RESULTS %		
		Cu	Ni	S

DTY 0 1	00.0 - 03.0m	Rock		
DTY 0 2	03.0 - 06.0	(Trench Top)		
DTY 0 3	06.0 - 09.0	"		
DTY 0 4	25.0 - 28.0	"		
DTY 0 5	28.0 - 31.0	"		
DTY 0 6	31.0 - 34.0	"		
DTY 0 7	34.0 - 36.0	"		
DTY 0 8	38.3 - 41.3	"		
DTY 0 9	41.3 - 41.5	"		
DTY 0 10	47.0 - 48.8	"		
DTY 0 11	60.0 - 63.0	"		
DTY 0 12	63.0 - 66.0	"		
DTY 0 13	66.0 - 69.0	"		
DTY 0 14	69.0 - 72.0	"		
DTY 0 15	72.0 - 75.0	"		
DTY 0 16	75.0 - 78.0	"		

Ikke analysert

DTY 1 1	22.5 - 23.5	"	0	
DTY 1 2	25.0 - 26.0	"	0	
DTY 1 3	28.0 - 29.0	"	0	
DTY 1 4	57.0 - 60.0	"	0,01	
DTY 1 5	60.0 - 63.0	"	0,02	
DTY 1 6	65.0 - 68.0	"	0,01	
DTY 1 7	77.0 - 80.0	"	0,01	
DTY 1 8	80.0 - 83.0	"	0,01	
DTY 1 9	108.0 - 111.0	"	0,01	
DTY 1 10	111.0 - 114.0	"	0,01	
DTY 1 11	114.0 - 117.0	"	0,01	
DTY 1 12	122.0 - 125.0	"	0,01	
DTY 1 13	125.0 - 127.0	"	0	

SAMPLE NUMBER			TYPE OF SAMPLE	RESULTS %		
				Cu	Ni	S
RTY	0	1	00.0 - 03.0m (Trench Base)			
RTY	0	2	03.0 - 06.0			
RTY	0	3	06.0 - 09.0			
RTY	0	4	25.0 - 28.0			
RTY	0	5	28.0 - 31.0			
RTY	0	6	31.0 - 34.0			
RTY	0	7	34.0 - 36.0			
RTY	0	8	38.3 - 41.3			
RTY	0	9	41.3 - 41.5			
RTY	0	10	47.0 - 48.8			
RTY	0	11	60.0 - 63.0			
RTY	0	12	63.0 - 66.0			
RTY	0	13	66.0 - 69.0			
RTY	0	14	69.0 - 72.0			
RTY	0	15	72.0 - 75.0			
RTY	0	16	75.0 - 78.0			
Ikke analysert						
RTY	1	1	22.5 - 23.5			
RTY	1	2	25.0 - 28.0			
RTY	1	3	28.0 - 29.0			
RTY	1	4	57.0 - 60.0			
RTY	1	5	60.0 - 63.0			
RTY	1	6	65.0 - 68.0			
RTY	1	7	77.0 - 80.0			
RTY	1	8	80.0 - 83.0			
RTY	1	9	108.0 - 111.0			
RTY	1	10	111.0 - 114.0			
RTY	1	11	114.0 - 117.0			
RTY	1	12	122.0 - 125.0			
RTY	1	13	125.0 - 127.0			
				0		
				0		
				0		
				0		
				0,01		
				0,02		
				0,03		
				0,01		
				0,01		
				0,02		
				0,01		
				0,01		
				0		

	<u>Prøve nr.</u>				<u>g Cu</u>
G2	1	1	-	4 m	0,006
G2	2	4	-	7 "	0,005
G2	3	90	-	93 "	0,040
G2	4	93	-	96 "	0,006
G2	5	96	-	99 "	0,005
G2	6	99	-	102 "	0,006
G2	7	102	-	105 "	0,007
G2	8	105	-	108 "	0,012
G2	9	108	-	111 "	0,008
G2	10	111	-	114 "	0,006
G2	11	114	-	117 "	0,017
G2	12	117	-	120 "	0,008
G2	13	120	-	123 "	0,114
G2	14	123	-	126 "	0,020
G2	15	126	-	129 "	0,009
G2	16	129	-	132 "	0,008
G2	17	132	-	135 "	0,007
G2	18	135	-	138 "	0,004
G2	19	138	-	141 "	0,005
G2	20	141	-	144 "	0,006
G2	21	144	-	145 "	0,004
G2	22	164	-	167 "	0,003
G2	23	167	-	170 "	0,004
G2	24	170	-	173 "	0,004
G2	25	173	-	175 "	0,005

3100 '15

B.199 1/11

APPENDIX II

TOTAL LIST, LOCATIONS, AND
MICROSCOPIC STUDY OF ROCK SAMPLES

ROCK SAMPLES FROM TYSFJORD AREA

(RS-73-1TY to RS-73-369TY)

Number	Description	Location	
		E	N
1	Medium-grained hornblende-feldspar gneiss with minor quartz. Includes small sub angular clasts of fine dark metasediment and abundant graphite in lensoid aggregates.	3110	7425
2	Very fine quartz-feldspar paragneiss (?) with minor biotite and hornblende, trace diopside, epidote and chlorite. Limonite and jarosite coating on grains, about 1% small magnetite crystals.	3950	7200
3	Limonite-stained quartz-feldspar gneiss with euhedral hornblende and minor biotite. Mineralogical banding evident with fine to medium biotite in more mafic layers and few medium sized magnetite crystals.	4000	7220
4	Fine-grained amphibolite with minor epidote, quartz, feldspar. Typical of amphibolites, with minor pyrrhotite (interstitial), trace pyrite and chalcopyrite.	4030	7375
5	Fine-grained mineralogically banded quartz-feldspar-epidote-plagioclase paragneiss with trace biotite and chlorite. Trace pyrite and chalcopyrite in the more mafic layers, and limonite-jarosite staining along banding common.	4050	7050 A
6	Medium amphibole-quartz-feldspar gneiss with minor epidote and chlorite and trace biotite (after amphibole). Quartz milky and opaque. Few small cubes of pyrite in mafic layers and little jarositecoating.	4050	7050 B
7	Fine to medium banded quartz-feldspar-amphibolite with minor euhedral epidote. Minor surficial limonite coatings.	4050	7100
8	Fine banded quartz-feldspar amphibolite with a little biotite pseudomorphous after hornblende	4050	7125
9	Medium equigranular hornblende-biotite-feldspar gneiss with euhedral mafics and subhedral quartz feldspar. No metallics.	4130	7230
10	Homogeneous coarse granitic quartz-feldspar gneiss with a little euhedral hornblende and biotite. The latter pseudomorphous after amphibole; quartz and feldspar subhedral.	4140	7250
11	Coarse gabbroic biotite-hornblende-(chlorite) quartz-feldspar gneiss with minor diopside and epidote. No visible metallics. No relict igneous texture and presence of orthoclase and primary biotite indicate probable sedimentary origin.	4150	7225

Number	Description	Location	
		E	N
12	Medium-grained quartz-orthoclase-plagioclase gneiss with minor amphibole and biotite, trace small magnetite. Very limonite-stained. From very thin limonite-stained zone in gneiss.	4300	5480
13	Limonite and jarosite-coated coarse, poorly foliated granitic quartz-feldspar gneiss with very minor hornblende. Minor amounts of pyrite in small interstitial aggregates contain traces of pyrrhotite and chalcopyrite. Minor amounts of small euhedral magnetite crystals throughout.	4300	5500
14	Fine-grained quartz-orthoclase-plagioclase-epidote-hornblende skarnic paragneiss with little subhedral garnet, tending to form aggregates.	4300	6375
15	Coarse knotted aggregates of hornblende, epidote and magnetite in fine quartz-orthoclase-epidote paragneiss with little plagioclase, garnet and secondary biotite. Characteristically has white clay (from plagioclase) runs surrounding rounded chlorite (from hornblende) cores interstitially throughout finer matrix.	4300	6385
16	Very coarse quartz-feldspar-epidote-garnet-hornblende foliated skarn with trace biotite and chlorite. Most crystals subhedral to euhedral, but quartz anhedral with secondary silica overgrowths. Ca. 5% small euhedral magnetite throughout.	4300	6395
17	Medium to fine epidote skarn with minor quartz plagioclase and garnet. Poorly foliated with dilation around porphyroclastic hornblende, altered to biotite-chlorite in part. Minor small magnetite-ilmenite throughout.	4300	6405
18	Coarse quartz-orthoclase-(plagioclase)-calcite-hornblende-biotite gneissic skarn with ca. 10% of epidote and garnet. Calcite tends to be segregated. Magnetite, as aggregates of finer grains, up to 10% of total.	4300	6415
19	Minor calcite in similar rock to the above, but with ca. 20% epidote and less magnetite ilmenite.	4300	6425
20	Sugary fine-grained epidote-rich quartz-orthoclase-(plagioclase)-paragneiss with minor garnet and little biotite, chlorite. Plagioclase altered to clays. No visible metallics.	4300	6500 A
21	Very fine white quartzo-feldspathic paragneiss with little epidote. Compact but with sugary texture.	4300	6500 B

Number	Description	Location	
		Ø	N
22	Poorly foliated, fine-grained quartz-orthoclase paragneiss with a little plagioclase, epidote and garnet, trace diopside and hornblende and ca. 2% small aggregates of subhedral magnetite.	4300	6525
23.	Homogeneous fine to medium-grained quartz-orthoclase-plagioclase amphibolite with minor epidote and biotite. No visible metallics	4300	6555
24	Fine mineralogically banded biotite-hornblende-quartz-plagioclase gneiss with minor epidote in the mafic bands. Amphibole fine-grained and more common in felsic layers, whereas biotite coarser and comprises bulk of mafic layers. Plagioclase slightly altered to clays.	4300	6560
25	Fine-medium equigranular quartz-orthoclase hornblende-biotite gneiss with little plagioclase (altered to clay minerals in part) and epidote. <u>May</u> be orthogneiss.	4300	6570
26	Poorly foliated fine quartz-orthoclase-hornblende-biotite-epidote paragneiss with minor plagioclase and scattered small euhedral magnetite crystals.	4300	6575 A
27	Homogeneous, fine-grained and well foliated quartz-feldspar-amphibole paragneiss with minor plagioclase, biotite and epidote; trace diopside hornblende porphyroclastic with little chlorite in fractures. Minor scattered euhedral magnetite crystals.	4300	6575 B
28	Finely banded and foliated quartz-feldspar-hornblende paragneiss with minor epidote, diopside and euhedral magnetite. Small amounts of clays along shears in plagioclase.	4300	6600
29	Fine-grained light quartz-orthoclase-plagioclase paragneiss with little epidote and biotite, trace hornblende and diopside. Ca. 5% spindle-shaped aggregates of small magnetite crystals throughout.	4300	6625
30	Fine-grained, poorly foliated quartz-feldspar gneiss, as above, with small limonitic zones around magnetite.	4300	6650
31	Fine to medium light quartz-orthoclase-plagioclase gneiss with little biotite, hornblende, and epidote, trace diopside and chlorite. Minor amounts of small ilmenite crystals scattered.	4300	6675
32	Fine-grained, poorly foliated quartz-orthoclase-plagioclase gneiss with trace amphibole epidote and small euhedral magnetite.	4350	6500
33	Fine sugary banded quartz-feldspar-amphibole epidote paragneiss with trace biotite and ca. 5% scattered, small magnetite crystals.	4350	6525

Number	Description	Location
		E N
34	Fine pinkish quartz-orthoclase-(plagioclase) amphibole-epidote-garnet gneiss with minor biotite. Few small octahedra of magnetite concentrated in amphibole porphyroclasts.	4350 6550
35	Limonite-stained medium banded quartz-plagioclase-orthoclase gneiss with minor biotite, hornblende (porphyroblastic) and garnet. Trace epidote and chlorite.	4350 6560
36	Crudely foliated, limonitic hornblende-diopside-quartz-feldspar gneiss with trace of biotite, chlorite and epidote. Amphibole, porphyroblasts. No visible metallics.	4350 6565
37	Slightly limonitic quartz-feldspar-amphibole gneiss with little biotite and chlorite.	4350 6575 A
38	Crudely foliated and sheared quartz-feldspar tremolite gneiss with abundant chlorite, sericite and clay alteration. Medium to coarse-grained and limonite-stained. Ca. 5% pyrite, scattered in cubic crystals, with trace chalcopyrite.	4350 6575 B
39	Medium-grained biotite-hornblende-quartz-orthoclase-(plagioclase)-gneiss with abundant secondary chlorite and greenish-white clay minerals derived from amphibole and plagioclase. Small quantities of small magnetite throughout.	4350 6585
40	Sugary fine pink quartz-feldspar paragneiss with minor hornblende and magnetite, trace biotite, garnet, and epidote.	4350 6600
41	Fine-grained, very light quartz-feldspar paragneiss with minor hornblende and magnetite, trace biotite, epidote and garnet.	4350 6610
42	As above, garnet attains minor proportion somewhat skarnic.	
43	Fine-grained and sugary pink quartz-orthoclase-garnet-plagioclase-epidote gneissic skarn with minor diopside and trace hornblende and biotite.	4350 6630
44	Fine white poorly foliated quartz-orthoclase plagioclase paragneiss with ca. 10% pink porphyroblastic garnets up to $\frac{1}{2}$ cm., ca. 20% epidote, minor diopside and trace amphibole.	4350 6640
45	Fine pink quartz-orthoclase-plagioclase paragneiss with large glomeroporphyroblastic amphibole, trace epidote, garnet and magnetite.	4350 6650 A
46	Poorly foliated fine-grained quartz-feldspar paragneiss with minor hornblende, epidote, and scattered magnetite.	4350 6650 B
47	Fine pink quartz-orthoclase-plagioclase gneiss with minor amphibole and magnetite.	4350 6660

Number	Description	Location	
		E	N
48	Sugary fine-grained pink quartz-feldspar-epidote-garnet-hornblende skarnic gneiss (see no. 44), with minor aggregates of small octahedral magnetite.	4350	6675 A
49	Medium-grained white epidote-diopside-quartz feldspar skarnic paragneiss.	4350	6675 B
50	Coarse pink sugary quartz-plagioclase-orthoclase gneiss with minor hornblende, anhedral magnetite and biotite. Strongly sheared, with opaque grey drusy quartz. Near small vein of gneissic granite.	4400	5475
51	Granitic gneiss, pink and fine-grained, poorly foliated. Dominantly quartz and orthoclase with minor plagioclase, trace hornblende. Appears coarse due to segregation of fine crystals into large aggregates.	4400	5500
52	White medium-grained quartz-feldspar gneiss with trace hornblende, biotite, epidote, and garnet. No visible metallics.	4400	5525
53	Pink medium quartz-orthoclase-biotite gneiss. Biotite tends to porphyroclastic aggregates after hornblende, only trace of which remains. Minor epidote and diopside.	4400	5550
54	Fine to medium well foliated biotite-quartz-orthoclase-plagioclase gneiss with trace of garnet. No visible metallics.	4400	5575
55	Fine biotite-quartz-feldspar-epidote paragneiss with minor hornblende in steep gully. (fault?)	4400	5600
56	Medium banded orthoclase-rich and plagioclase rich gneiss. Minor biotite and hornblende, trace epidote. No visible metallics.	4400	5610
57	Limonitic quartz-orthoclase-plagioclase-biotite-hornblende gneiss, somewhat streaky and coarse grained, with epidote in mafic areas.	4400	5625
58	Medium to coarse dark xenolith of hornblende-biotite-quartz-feldspar gneiss with trace of epidote.	4400	5650
59	Medium to coarse dark slightly banded hornblende-biotite-quartz-feldspar segregated gneiss with trace epidote and biotite. Tendency to schistosity.	4400	5670
60	Medium light banded quartz-feldspar-biotite gneiss with trace epidote, hornblende.	4400	6470
61	Fine light banded quartz-feldspar-hornblende-diopside paragneiss with trace chlorite and epidote. No visible metallics.	4400	6472
62	Fine light quartz-feldspar skarnic gneiss with minor epidote, garnet, diopside and trace amphibole, biotite and scattered magnetite.	4400	6475
63	Limonitic fine quartz-feldspar gneiss with minor hornblende, biotite and trace garnet. No metallics, but iridescence on amphibole cleavage.	4400	6480

Number	Description	Location	
		Ø	N
64	Fine to medium-grained dark quartz-feldspar-biotite amphibolite with minor epidote and chlorite. Plagioclase altered to clay, and limonite-staining prevalent. No visible metallics	4400	6495
65	Light fine-medium quartz-feldspar-biotite amphibole gneiss with minor epidote and trace garnet. Few scattered pyrite cubes with trace chalcopyrite associated.	4400	6510 A
66	As above, no amphibole, more epidote and ca. 2% pyrite and associated chalcopyrite. From very small (1/8 m.) band in dark amphibolites.	4400	6510 B
67	Dark quartz-feldspar-biotite amphibolite, slightly schistose with trace epidote, chlorite and garnet.	4400	6515 A
68	Medium hornblende-biotite-diopside-quartz-orthoclase "gabbroic" gneiss with minor chloritic alteration of hornblende. Limonitic but no visible metallics.	4400	6515 B
69	Fine-medium-grained jarositic hornblende-biotite-quartz-feldspar gneiss with much chloritic alteration of amphibole.	4400	6525 A
70	Weathered and limonitic hornblende-biotite-quartz-orthoclase-plagioclase medium-grained gneiss, poorly foliated.	4400	6525 B
71	Coarse biotite-hornblende-quartz-feldspar gneiss, poorly foliated and limonitic.	4400	6525 C
72	Medium-grained, as above.	4400	6530
73	Fine quartz-feldspar-biotite amphibolite. Gneissic with trace diopside, epidote and garnet. No visible metallics.	4400	6535
74	Coarse "gabbroic" quartz-orthoclase-(plagioclase)-hornblende gneiss with trace epidote and chlorite around glomeroporphyroblastic amphibole.	4400	6550 A
75	As above with trace garnet and minor biotite.	4400	6550 B
76	Coarse cataclastic gabbroic gneiss with much shearing parallel to foliation. Hornblende glomeroporphyroblastic with alteration to chlorite along cleavage and crystal margins. Trace garnet.	4400	6550 C
77	Coarse gabbroic quartz-plagioclase-biotite-diopside-epidote-hornblende gneiss. Amphibole glomeroporphyroblastic and close to small amygdular cavities very etched, as is quartz. Plagioclase altered to clays. Very minor rounded interstitial chalcopyrite near cavities usually in proximity of amphibole and diopside.	4400	6550 D
78	Pink fine sugary quartz-orthoclase-plagioclase gneiss with minor amphibole, epidote, and magnetite.	4400	6565
79	Compact grey fine-grained quartz-orthoclase-plagioclase-diopside-epidote-amphibole skarnic paragneiss. No visible metallics.	4400	6585

Number	Description	Location	
		Ø	N
80	Fine light quartz-orthoclase-plagioclase-garnet-epidote-diopside-hornblende-biotite skarnic paragneiss.	4400	6600
81	Fine light quartz-feldspar paragneiss with minor porphyroblastic hornblende and biotite trace of diopside and epidote. No visible metallics.	4400	6610
82	Fine light quartz-feldspar gneiss with minor porphyritic amphibole, trace epidote and scattered small magnetite.	4400	6620
83	Coarse quartz-orthoclase veinlets in medium quartz-feldspar paragneiss with minor biotite and amphibole. No visible metallics.	4400	6635
84	Poorly foliated light gneiss as above but with trace diopside and scattered octahedra of magnetite.	4400	6650
85	Finely banded hornblende-diopside-epidote-garnet-quartz-plagioclase gneissic skarn.	4400	6675
86	Fine pink quartz-orthoclase paragneiss with minor hornblende and trace biotite. Magnetite ca. 1% total, but in mafic bands up to 10% magnetite octahedra.	4400	6800
87	Coarse quartz-feldspar-hornblende-diopside gneiss with trace epidote and biotite. No visible metallics.	4400	6815
88	Fine light quartz-orthoclase-plagioclase gneiss with minor garnet and epidote.	4400	6820
89	Quartz-orthoclase veinlets in medium to fine dark quartz-feldspar-hornblende gneiss with trace chlorite, epidote and garnet. (See 83).	4400	6840
90	Medium-grained quartz-orthoclase-(plagioclase)-hornblende gneiss with minor garnet, epidote, chlorite, diopside. No visible metallics.	4400	6875 A
91	Dark schistose coarse hornblende-biotite-diopside-quartz-feldspar gneiss with trace epidote, garnet, and diopside.	4400	6875 B
92	Dark fine-grained segregated quartz-orthoclase-hornblende-biotite gneiss with trace epidote and no visible metallics.	4400	6900
93	Coarse chloritized amphibolite with many small amygdular cavities.	4450	6415
94	Garnet-bearing fine-grained quartz-orthoclase plagioclase-epidote gneiss.	4450	6425
95	Pink sugary fine quartz-feldspar paragneiss with minor amphibole, epidote and trace diopside. Hornblende tends to be glomeroporphyroblastic. Trace small magnetite.	4450	6435
96	Coarse diopside-hornblende-(chlorite)-quartz-orthoclase skarn; amphibole glomeroporphyroblastic.	4450	6455
97	Coarse, poorly foliated limonite-stained hornblende-(chlorite)-epidote-quartz-feldspar skarn.	4450	6460

Number	Description	Location	
		O	N
98	Garnet-epidote-hornblende-(quartz-orthoclase) skarn with very poor foliation and minor scattered ilmenomagnetite. Trace chalcopyrite in chlorite alteration of hornblende.	4450	6475
99	Fine felty quartz-orthoclase chloritic amphibolite gneiss with trace chalcopyrite in chlorite-amphibole alteration.	4450	6500 A
100	Very fine dark amphibolite, chloritized with a little quartz, plagioclase, epidote. Relict igneous texture. Little (ca. 1%) chalcopyrite and pyrite disseminates in chloritic amphibole.	4450	6500 B
101	Very fine amphibolite with minor biotite, quartz, and plagioclase. Minor amounts of small cubes of pyrite and trace chalcopyrite. Relict igneous texture.(?)	4450	6500 C
102	Fine altered chloritic and clayey biotite amphibolite with minor quartz and plagioclase. No visible metallics.	4450	6500 D
103	Fine quartz-plagioclase-hornblende-biotite gneiss with minor epidote. Slight alteration around plagioclase margins to clay minerals. Trace interstitial pyrite and chalcopyrite.	4450	6500 E
104	Coarse "gabbroic" quartz-hornblende-orthoclase gneiss with minor epidote, plagioclase, and trace biotite. Amphibole glomeroporphyroclastic.	4450	6510
105	Medium light quartz-feldspar-biotite-hornblende-epidote gneiss.	4450	6530
106	Sheared, coarse "gabbroic" hornblende-biotite-quartz-feldspar-epidote gneiss.	4450	6540
107	Medium pink hornblende-biotite-quartz-orthoclase gneiss with minor epidote. Thin stringers of quartz-orthoclase cut foliation.	4450	6550
108	Fine banded quartz-feldspar-biotite-hornblende gneiss with minor epidote. Tendency for felsic/mafic segregation.	4450	6560
109	Fine, pink, sugary quartz-feldspar gneiss with minor biotite and relict hornblende. Minor amounts of small scattered magnetite.	4450	6575
110	Fine white quartz-orthoclase gneiss with trace biotite and magnetite. Poorly foliated.	4450	6600
111	Fine, pink, poorly foliated quartz-orthoclase gneiss with minor biotite and epidote, few small scattered magnetite octahedra.	4450	6625
112	Fine-medium grained pink quartz-feldspar gneiss with minor hornblende and biotite, trace epidote. Well foliated-probably out of fold-nose.	4450	6685

Number	Description	Location	
		E	N
113	Medium-grained diopside-epidote-garnet-amphibole-(quartz-feldspar) skarn with minor biotite and chlorite. Trace pyrite, chalcopyrite in cleavages and fractures in porphyroclastic hornblende.	4450	6700
114	Fine quartz-feldspar-epidote paragneiss with minor diopside and hornblende. No visible metallics.	4450	6705
115	Lowest unit of 3m. layer extending to 6720, fine black amphibolite with minor quartz, epidote, plagioclase. No visible metallics.	4450	6708
116	Fine dark quartz-feldspar-hornblende-diopside epidote gneiss with trace chlorite. No visible metallics.	4450	6710
117	Fine light quartz-plagioclase-hornblende-(chlorite)-epidote-diopside gneiss with minor garnet. 1-2% small disseminated pyrite with trace chalcopyrite.	4450	6713
118	Fine banded amphibole-quartz-plagioclase-epidote-diopside-garnet skarn. Very finely disseminated pyrite with minor chalcopyrite throughout mafic-rich bands.	4450	6715
119	Medium hornblende-actinolite-epidote-quartz-plagioclase gneiss with minor garnet and trace magnetite.	4450	6718
120	Medium-coarse hornblende-diopside-quartz-plagioclase gneiss with minor epidote and garnet and trace fine disseminated chalcopyrite. Whole unit mapped as skarn on 1:2500 map.	4450	6720
121	Limonitic medium-grained quartz-feldspar-epidote-hornblende-diopside gneiss with trace garnet. Poorly foliated with no visible metallics.	4450	6725
122	Medium quartz-orthoclase gneiss with trace hornblende and biotite.	4450	6730
123	Medium hornblende-actinolite-epidote-quartz feldspar gneiss. Alteration of porphyroclastic hornblende to chlorite and plagioclase to clays.	4450	6750
124	Coarse (schistose) hornblende-quartz-orthoclase-plagioclase gneiss with glomeroporphyroblastic euhedral hornblende.	4450	6760
125	Coarse hornblende-(chlorite)-epidote-quartz-feldspar gneiss with minor biotite. Felty chloritic alteration of porphyritic amphibole, generally porphyritic.	4450	6775
126	Medium to fine light quartz-feldspar gneiss with minor hornblende with garnet cores. Minor epidote and biotite, trace scattered magnetite.	4450	6785
127	Coarse porphyroclastic hornblende in medium to fine quartz-feldspar-epidote gneiss with "gabbroic" texture. No visible metallics.	4450	6800

Number	Description	Location	
		E	N
128	Coarse pink orthoclase-quartz-plagioclase granitic gneiss with ca. 10% large biotite pseudomorphs after amphibole.	4450	6810
129	Coarse pink quartz-feldspar-biotite granitic gneiss.	4450	6820
130	Fine hornblende-chlorite-quartz-plagioclase gneiss with trace epidote and small disseminated pyrite.	4475	6725 A
131	Fine hornblende-chlorite-quartz-gneiss with minor pyrite and ca. 1% pyrite in small lensoid aggregates in mafic folia.	4475	6725 B
132	Medium-grained, as above with much chloritic alteration of hornblende. Taken from lower margin of schistose biotite gneiss unit- no sign of any igneous texture.	4475	6725 C
133	Coarse plagioclase-quartz-orthoclase-hornblende gneiss with few small scattered magnetite octahedra.	4500	5445
134	Ca. 20% glomeroporphyroblastic hornblendes with actinolitic margins in medium quartz-feldspar gneiss.	4500	5455 A
135	Fine-medium equigranular hornblende-quartz-orthoclase gneiss with minor biotite and plagioclase.	4500	5455 B
136	Coarse pegmatitic hornblende and biotite in fine quartz-plagioclase-epidote gneiss.	4500	5455 C
137	Limonitic medium-grained quartz-plagioclase-hornblende-(chlorite) gneiss with minor epidote and biotite. Trace of small scattered pyrite cubes.	4500	5475
138	Fine-medium dark quartz-plagioclase amphibolite with ca. 10% decussate brown biotite and trace epidote. Iron-stained but no visible metallics.	4500	5490
139	Dark fine to medium schistose biotite-hornblende-(chlorite)-quartz-plagioclase gneiss.	4500	5500
140	Poorly foliated hornblende-biotite-quartz-plagioclase gneiss; biotite pseudomorphous after hornblende. Iron-stained but no visible metallics.	4500	5525 A
141	Foliated medium biotite-hornblende-quartz-plagioclase gneiss with quartzofeldspathic veinlets or segregations. Biotite porphyroblastic.	4500	5525 B
142	Poorly foliated fractured quartz-feldspar gneiss with trace biotite, hornblende.	4500	5525 C
143	Fresh and well foliated hornblende-biotite-quartz-feldspar gneiss. Trace epidote.	4500	5525 D
144	Medium quartz-orthoclase-plagioclase gneiss with trace hornblende and coarse biotite.	4500	5550
145	Coarse pink quartz-feldspar gneiss with little hornblende, biotite and few veinlets of quartz-feldspar.	4500	5575

Number	Description	Location	
		E	N
146	Biotite-rich quartz-feldspar gneiss with minor hornblende and epidote. Coarse grained and poorly foliated, plagioclase slightly altered to clays.	4500	5600
147	Fine, sugary paragneiss xenolith in coarse quartz-feldspar gneiss.	4500	5625
148	Medium-grained quartz-orthoclase-plagioclase gneiss with minor glomeroporphyroblastic amphibole and trace garnet associated with amphibole.	4500	5650
149	Fine-grained epidote-quartz-plagioclase skarnic gneiss with trace hornblende and garnet.	4500	6410
150	Finely foliated pink quartz-orthoclase-hornblende gneiss with trace garnet and epidote. (skarnic gneiss.)	4500	6430
151	Coarse pegmatitic chloritized amphibole skarn	4500	6450
152	Banded fine and coarse schistose biotite-quartz-feldspar gneiss with minor epidote, hornblende and magnetite.	4500	6470
153	Medium, homogeneous hornblende-biotite-epidote quartz-feldspar gneiss.	4500	6475 A
154	Coarse porphyroblastic hornblende with minor epidote in quartz-orthoclase-plagioclase gneiss groundmass. "Gabbroic" gneiss.	4500	6475 B
155	Fine to medium schistose biotite-hornblende-quartz-feldspar gneiss.	4500	6485
156	Coarse glomeroporphyroblastic hornblende in medium quartz-orthoclase-plagioclase gneiss.	4500	6500
157	Fine light quartz-orthoclase-plagioclase gneiss with minor biotite, hornblende.	4500	6505
158	Fine sugary quartz-orthoclase gneiss with little biotite and aggregated grains to produce apparent coarse texture.	4500	6510
159	Light, poorly foliated coarse quartz-microcline-biotite-plagioclase gneiss with minor epidote and trace chlorite.	4500	6690
160	Medium schistose biotite-quartz-plagioclase- (orthoclase) gneiss with minor epidote and chlorite, trace large garnets. Limonite-stained and orthoclase kaolinitized.	4500	6700
161	Medium schistose hornblende-biotite-quartz-feldspar gneiss with trace epidote and garnet. Very limonite-stained. No visible metallics.	4500	6710
162	Limonite and jarosite-stained altered schistose hornblende-biotite-quartz-plagioclase gneiss.	4500	6720 A
163	Medium biotite-hornblende-quartz-plagioclase-gneiss with minor epidote and flattened garnet. No visible metallics.	4500	6720 B
164	"Spotted" medium grained hornblende-biotite-quartz-plagioclase-orthoclase gneiss. Spots are altered feldspars.	4500	6730

Number	Description	Location	
		ϕ	N
165	Medium to coarse hornblende-(chlorite)-epidote-biotite-quartz-plagioclase gneiss with minor orthoclase.	4500	6740
166	Coarse "gabbroic" hornblende-epidote-quartz-feldspar gneiss with glomeroporphyroblastic amphibole.	4500	6750
167	Glomeroporphyroblastic amphibole in medium epidote-quartz-orthoclase-plagioclase gneiss.	4500	6775
168	As above, with fine felsics in segregated and sheared with secondary epidote.	4500	6780
169	Medium to fine light quartz-orthoclase-plagioclase gneiss with minor hornblende and biotite. Quartz and hornblende etched. No visible metallics.	4500	6790
170	Coarse pink crudely foliated granitic gneiss with quartz and orthoclase and little biotite (after hornblende.)	4500	6800
171	Fine iron-stained hornblende-biotite-epidote quartz-feldspar gneiss. Feldspars altered to clays, limonite and jarosite coatings common.	4510	5550
172	Garnetiferous fine quartz-plagioclase amphibolite with minor epidote.	4550	6710
173	Coarse schistose biotite-garnet-quartz-feldspar gneiss. Very sheared.	4550	6710
174	Medium to coarse white quartz-orthoclase-plagioclase gneiss with minor biotite and hornblende. Recrystallization gives finer grains from original coarse porphyritic orthoclase.	4600	5500
175	Schistose hornblende-biotite gneiss with little quartz and feldspar, minor epidote and trace magnetite. Vuggy and iron-stained.	4600	5515
176	Fine-grained compact amphibolite with little quartz, feldspar and epidote, minor secondary biotite and little fine disseminated pyrite and chalcopyrite.	4600	5520
177	Fine biotite-hornblende-epidote skarnic gneiss with minor quartz and feldspar in medium-grained lentic segregation. Iron-stained but no visible metallics.	4600	5525
178	Fine compact quartz-epidote amphibolite with ca. 10% secondary biotite.	4600	5530 A
179	Medium-grained quartz-feldspar gneiss with minor hornblende, epidote and garnet. Much secondary overgrowths of silica. Mafics tend to be glomeroporphyroclastic. Trace disseminated pyrrhotite.	4600	5530 B
180	Coarse iron-stained hornblende-quartz-feldspar gneiss with clay alteration of feldspars, trace chlorite and abundant secondary biotite. Large crystals of pyrrhotite with trace chalcopyrite total ca. 5%.	4600	5540

Number	Description	Location	
		E	N
181	Fine quartz-feldspar-epidote-biotite amphibolite. Very compact but foliated with no original texture evident.	4600	5550
182	Fine foliated quartz-orthoclase-epidote-biotite-hornblende schistose gneiss. Very iron-stained but no visible metallics.	4600	5610
183	Coarse schistose biotite-hornblende gneiss with minor quartz and plagioclase and trace epidote. Some quartz-orthoclase discordant veinlets.	4600	5620
184	Across small swale (?) fault. Coarse pink quartz-orthoclase gneiss with minor porphyroclastic biotite, pseudomorphous after hornblende	4600	5625
185	Coarse pink quartz-orthoclase gneiss with minor biotite, hornblende and numerous inclusions of finer quartz-feldspar-hornblende gneiss with sharp boundary.	4600	5650
186	Fine quartz-orthoclase gneiss with little epidote, hornblende, biotite, plagioclase, trace magnetite. Few aggregates of finer hornblende-biotite-epidote gneiss enclosed.	4600	6400
187	Medium-grained white quartz-orthoclase-feldspar gneiss with few porphyroblastic hornblende crystals associated with garnet and epidote, partially altered to chlorite.	4600	6425
188	Medium equigranular gabbroic quartz-feldspar biotite-hornblende gneiss.	4600	6440
189	Coarse gabbroic biotite-hornblende-quartz-orthoclase gneiss with minor epidote.	4600	6450 A
190	Well foliated, schistose biotite-hornblende-quartz-orthoclase gneiss with minor epidote.	4600	6450 B
191	Coarse gabbroic hornblende-biotite-epidote-quartz-orthoclase gneiss with little diopside and trace garnet. Hornblende is glomero-porphyroblastic.	4600	6460
192	Similar to above, but amphibole has cores of diopside, highly fractured and retrograded.	4600	6470
193	Fine sugary pink quartz-orthoclase-(plagioclase)-gneiss with few coarse aggregates of biotite-hornblende. Texture appears coarse due to aggregation of finer material.	4600	6475
194	Sugary crudely-foliated quartz-orthoclase granitic gneiss with streaky aggregates of biotite with minor hornblende and trace epidote.	4600	6500
195	Well-foliated medium-grained quartz-feldspar biotite gneiss.	4600	6675
196	Granitic gneiss, as above with little epidote. Plagioclase and orthoclase somewhat altered to clays. Slightly schistose.	4600	6700
197	Coarse fresh quartz-orthoclase-plagioclase granitic gneiss with little biotite.	4600	6710 A

Number	Description	Location	
		Ø	N
198	Coarse dark schistose biotite gneiss with little quartz, feldspar, hornblende and epidote- only 5m. west of No. 197, across fault(?).	4600	6710 B
199	Coarse porphyroblastic garnets dilate foliation of quartz-orthoclase-biotite granitic gneiss. Biotite pseudomorphous after hornblende. Garnet developed in response to shearing (?) pressure.	4600	6720
200	Medium-grained quartz-orthoclase-biotite-hornblende gneiss with ca. 10% small euhedral garnet and minor epidote. Up to 30% garnet locally.	4600	6725 A
201	Medium schistose biotite-hornblende-quartz-orthoclase gneiss with minor epidote.	4600	6725 B
202	Fine-medium banded hornblende-biotite-quartz-feldspar gneiss with minor epidote. Somewhat schistose in coarser bands.	4600	6740
203	As above, medium-grained and equigranular; biotite pseudomorphous after hornblende.	4600	6750
204	Coarse, sheared garnetiferous biotite-quartz-feldspar gneiss, very contorted foliation and secondary biotite in cleavage planes.	4600	6760
205	Coarse quartz-plagioclase-orthoclase granitic gneiss, foliation poorly developed. Minor hornblende, biotite and large grains magnetite.	4600	6775
206	Medium-grained quartz-orthoclase-plagioclase-hornblende gneiss with minor epidote, biotite and garnet, trace magnetite.	4700	5500
207	Very fine quartz-epidote amphibolite, well foliated.	4700	5525
208	Very fine, compact quartz-feldspar-epidote-amphibolite gneiss with minor garnet and biotite. Relict bedding (?) observable.	4700	5550
209	Massive fine-grained amphibolite with minor quartz, epidote, and abundant secondary coarse biotite. Very jarosite-stained.	4700	5575
210	As above, on small knoll. Little quartz and epidote, and relict bedding.	4700	5600
211	Very fine recrystallized hornblende-diopside biotite-plagioclase amphibolite gneiss.	4700	5625
212	Fine grey schistose biotite-quartz-orthoclase gneiss.	4700	5670
213	Medium-grained quartz-orthoclase gneiss with inclusions of finer hornblende-epidote-biotite-quartz gneiss which are changing to glomeroporphyroblastic hornblende. Trace magnetite.	4700	5675
214	Coarse quartz-orthoclase gneiss with ca. 30% glomeroporphyroblastic amphibole and minor magnetite as coarse scattered grains.	4700	5700
215	Fine pink quartz-orthoclase gneiss with trace hornblende and biotite and numerous small magnetite octahedra.	4700	6000
216	Limonitic fine laminated quartz-orthoclase-gneiss with trace biotite and pyrite.	4700	6005
217	Fine-medium diopside-hornblende-biotite-quartz gneiss with inclusions of finer and coarser gneiss of same composition-streaky schistose gneiss.	4700	6010
218	Fine banded quartz-garnet-?perovskite?	4700	6025

Number	Description	Location	
		Ø	N
	gneissic skarn on edge of coarse garnet-epidote skarn.		
219	Perovskite (?) -rich garnet-epidote-quartz-orthoclase gneissic skarn.	4700	6035
220	Limonitic fine-grained quartz-orthoclase-(plagioclase) paragneiss-skarn with few misshapen cubes of pyrite, trace epidote and garnet.	4700	6050
221	Fine quartz-orthoclase paragneiss with minor garnet, ?perovskite, epidote, hornblende and magnetite.	4700	6080
222	Medium quartz-orthoclase-(hornblende-biotite) gneiss with minor epidote.	4700	6325
223	Massive garnet-epidote-hornblende skarn with little magnetite, trace quartz and orthoclase.	4700	6350
224	Coarse quartz-orthoclase-hornblende-biotite gneiss with streaks of glomeroporphyroclastic hornblende.	4700	6375
225	Schistose fine-medium biotite-epidote gneiss with minor quartz, orthoclase and hornblende.	4700	6390
226	Coarse "gabbroic" hornblende-quartz-orthoclase gneiss with a little plagioclase and perovskite (?), minor epidote and calcite.	4700	6395
227	Medium, well-foliated epidote-hornblende-quartz gneiss with little orthoclase, plagioclase. Hornblende tends to be glomeroporphyroblastic.	4700	6400
228	Coarse "gabbroic" gneiss as above.	4700	6420
229	Coarse "granitic" quartz-orthoclase-biotite gneiss with streaks of biotite (pseudomorphous after hornblende) and little epidote.	4700	6425
230	Coarse pink quartz-orthoclase gneiss with little biotite and minor hornblende and plagioclase.	4700	6435
231	Poorly foliated granitic gneiss as above.	4700	6450
232	Fine well-foliated garnet-epidote-plagioclase hornblende-diopside skarn with very large porphyritic ilmenomagnetite.	4750	6345
233	Medium-grained garnetiferous quartz-feldspar biotite gneiss with minor chlorite and epidote. Only 2m. thick.	4750	6360
234	Coarse "gabbroic" biotite-hornblende-quartz feldspar gneiss with inclusions of finer quartz hornblende-perovskite (?) -epidote gneiss. Gradational boundary.	4750	6375
235	Coarse glomeroporphyroblastic hornblende in biotite-quartz-plagioclase gneiss with minor epidote and large magnetite crystals.	4750	6400 A
236	Coarse "gabbroic" gneiss, as above, with alteration of hornblende to chlorite.	4750	6400 B
237	Medium to coarse well-foliated quartz-feldspar gneiss with little biotite and glomeroporphyroblastic hornblende.	4750	6420

Number	Description	Location	
		E	N
238	Medium-grained, well-foliated quartz-feldspar gneiss with little biotite and minor hornblende.	4800	5900
239	Fine but eroded goethitic quartz-feldspar-hornblende-diopside skarnic gneiss with trace fluorite, bornite and chalcopyrite and minor small euhedral magnetite.	4800	5915 A
240	Compact fine quartz-feldspar-garnet-diopside-epidote-hornblende gneissic skarn and skarnic gneiss. Much fine magnetite.	4800	5915 B
241	Coarse "gabbroic" gneiss. Aggregation of large glomeroporphyroblasts of hornblende creates very large pegmatitic masses.	4800	5915 C
242	Fine compact garnetiferous quartz-orthoclase-plagioclase skarnic gneiss with minor diopside hornblende, epidote and magnetite.	4800	5920
243	Schistose biotite-rich quartz-feldspar gneiss with minor epidote and hornblende. Little coarse biotite pseudomorphous after hornblende.	4800	5925
244	Coarse schistose biotite gneiss, as above.	4800	5930
245	Biotite-rich medium-grained quartz-feldspar gneiss with minor garnet, epidote and glomeroporphyroclastic hornblende.	4800	5950
246	Medium-grained pink quartz-orthoclase-(plagioclase) paragneiss with minor hornblende and garnet, trace epidote.	4800	5975
247	Fine light paragneiss, as above with minor small euhedral scattered ilmenomagnetite crystals.	4800	5985
248	Coarse "gabbroic" hornblende-quartz-orthoclase gneiss with little plagioclase, diopside biotite, epidote and garnet.	4800	5995
249	Light sugary paragneiss layer in hornblende-biotite-feldspar gneiss.	4800	6000
250	Epidote-rich fine-grained hornblende-diopside garnet-quartz gneissic skarn.	4800	6010
251	Medium to coarse dark schistose hornblende-quartz-feldspar gneiss with minor epidote and biotite and trace garnet.	4800	6020
252	Fine banded epidote-rich hornblende-diopside skarn with mica-quartz, feldspar and garnet.	4800	6040
253	Fine epidote-rich amphibolite with minor garnet, quartz, feldspar and diopside.	4800	6050
254	Fine hornblende-quartz-feldspar gneiss fragments in garnet-quartz-feldspar "skarn".	4800	6060
255	Massive convolute, but faintly foliated garnet-diopside-hornblende-epidote-quartz-feldspar skarn.	4800	6075
256	Quartz-garnet-feldspar skarn with clots of fine hornblende-quartz-feldspar gneiss.	4800	6100
257	Fine light quartz-feldspar gneiss with trace garnet, epidote and few glomeroporphyroblastic hornblende crystals.	4800	6250

Number	Description	Location	
		ϕ	N
258	Fine, well-foliated as above, garnet only in porphyritic amphibole.	4800	6320
259	Segregations of quartz-feldspar fine ground-gneiss in epidote-garnet-amphibole-diopside skarnic gneiss.	4800	6325
260	Coarse quartz-feldspar-hornblende gneiss with finer quartz and plagioclase inside the porphyritic hornblende. Irregular patches of garnet-diopside-epidote skarnic gneiss mixed in.	4800	6330
261	Fine dark amphibolite with little quartz, epidote and feldspar. Minor amounts of secondary biotite.	4800	6335
262	As above, but slightly coarser with some felsic segregations.	4800	6345
263	Medium to coarse schistose gneiss with little epidote, diopside and secondary biotite in dominant hornblende-quartz-feldspar fabric.	4800	6350
264	Fine well-foliated quartz-orthoclase gneiss with minor biotite.	4800	6375
265	Massive garnet-epidote-diopside skarn.	4850	6250
266	Fine poorly foliated quartz-feldspar gneiss with trace small hornblende, magnetite.	4850	6275
267	Fine compact and well-foliated amphibolite with minor quartz, feldspar, biotite, diopside and epidote. Skarnic amphibolite.	4850	6280
268	Schistose medium to coarse biotite-hornblende gneiss with little quartz, feldspar, epidote and minor garnet.	4850	6285
269	Fine hornblende-diopside-quartz gneiss with little feldspar, biotite, and epidote, trace garnet.	4850	6325
270	Coarse, poorly foliated hornblende-quartz-feldspar "gabbroic" gneiss with fragments of fine hornblende-quartz-feldspar gneiss.	4850	6330
271	Coarse pink schistose biotite-hornblende-quartz-orthoclase gneiss with trace epidote.	4900	5950 A
272	Banded coarse schistose biotite gneiss and fine quartz-feldspar gneiss with minor biotite.	4900	5950 B
273	Medium-grained dark hornblende-biotite-diopside gneiss with minor quartz, feldspar and trace epidote.	4900	5960
274	Fine hornblende-quartz-feldspar gneiss with trace epidote and biotite. Minor felsic mafic segregation banding.	4900	5970
275	Hornblende-diopside-epidote-quartz-feldspar massive skarn.	4900	5985
276	Fine quartz-orthoclase gneiss with little plagioclase, trace hornblende and magnetite.	4900	5997
277	Coarse schistose biotite-hornblende-quartz-feldspar gneiss with laminae of felsic hornblende-biotite gneiss.	4900	6000
278	Coarse quartz-feldspar gneiss with lensoid segregations of very large biotite and minor hornblende.	4900	6005

Number	Description	Location
		Ø N
279	Coarse quartz-orthoclase-plagioclase gneiss with patches of amphibole and biotite.	4900 6025
280	Poorly-foliated coarse pink quartz-orthoclase (plagioclase) gneiss with large hornblende (essential) crystals partly altered to biotite.	4900 6050
281	Fine to medium quartz-feldspar-biotite gneiss with trace epidote and magnetite.	4900 6060
282	Fine quartz-orthoclase-plagioclase gneiss compact with minor epidote, hornblende and abundant porphyritic magnetite	4900 6100
283	Massive very coarse hornblende from skarn	4900 6250
284	Mafic/felsic segregated banding of medium-coarse schistose biotite-rich quartz-feldspar-hornblende gneiss. Hornblende glomeroporphyroblastic with minor included epidote and garnet.	4900 6275
285	Skarnic hornblende-diopside-quartz-feldspar gneiss.	4900 6280
286	Pink coarse quartz-orthoclase-(plagioclase) granitic gneiss with minor glomeroporphyroblastic amphibole.	4900 6325
287	Medium-grained banded hornblende-biotite gneiss with little quartz and feldspar and few fine garnet-rich bands. Abundant pyrrhotite with minor pyrite and chalcopyrite in garnetiferous bands.	4970 6220
288	Massive fine-grained schistose amphibolite near stream. Minor quartz and biotite and feldspar with trace epidote and garnet.	4975 6220 A
289	Fine quartz-feldspar-hornblende gneiss with minor epidote and biotite.	4975 6220 B
290	Fine-medium-grained hornblende-biotite-quartz-feldspar gneiss with trace pyrrhotite in mafic bands.	4975 6225 A
291	Abundant chalcopyrite and pyrrhotite as fine disseminates and small aggregates in fine amphibole-epidote-quartz-feldspar gneiss.	4975 6225 B
292	Weak pyrrhotite-chalcopyrite impregnation as disseminates in quartz-orthoclase-hornblende gneiss with minor epidote and abundant, coarse secondary biotite.	4975 6225 C
293	Medium equigranular schistose hornblende-quartz-feldspar gneiss with secondary biotite after hornblende.	4975 6225 D
294	Coarse aggregates (recrystallized coarse grained?) of quartz-orthoclase-plagioclase with small glomeroporphyroclastic hornblende and minor magnetite.	5000 6200
295	As above, with minor original (?) hornblende and minor small biotite grains.	5000 6225
296	As above, poorly foliated and sugary texture	5000 6250
297	As above, much coarse biotite and glomeroporphyroclastic amphibole.	5000 6275

Number	Description	Location
301	Very fine dark graphite-rich amphibolite with minor quartz and epidote.	396668 A
302	Coarse porphyroblastic hornblende (secondary) in graphitic fine amphibolite.	" B
303	Coarse graphitic quartz-feldspar-biotite-hornblende-(chlorite) gneiss	" C
304	Fine dark banded amphibolite and quartz-feldspar-biotite gneiss with minor disseminates of pyrrhotite, and minor chalcopyrite in amphibolite.	" D
305	Fine jarosite-stained hornblende-(biotite)-quartz-feldspar-epidote gneiss with fine decussate secondary biotite, and alteration of plagioclase to clays.	" E
306	Epidote-rich, as above.	" F
307	Fine, grey jarositic hornblende-quartz-feldspar gneiss with minor chlorite, epidote and biotite, trace pyrrhotite and graphite.	" G
308	Fine to medium hornblende-quartz-feldspar gneiss with trace of epidote, and few lensoid quartz-feldspar segregations. Minor quantities of finely disseminated chalcopyrite throughout, small segregations bordering quartz veins.	395690 A
309	Coarse equigranular hornblende-quartz-feldspar-biotite gneiss with abundant pyrrhotite and chalcopyrite impregnations, segregations close to marics.	" B
310	Medium quartz-orthoclase gneiss with trace biotite and hornblende.	" C
311	Fine and coarse banded hornblende-quartz-feldspar-biotite gneiss with minor epidote and trace pyrrhotite.	" D
312	Medium dark quartz-feldspar-hornblende-biotite gneiss with minor epidote.	" E
313	Coarse "gabbroic" hornblende-(chlorite)-quartz-feldspar gneiss with trace pyrrhotite.	" F
314	Fine quartz-orthoclase-(microcline)-muscovite gneiss with coarse porphyritic hornblende. Minor fine pyrite crystals and ca. 30% pitchblende associated with hornblende.	378649 A
315	As above.	" B
316	Similar, but less hornblende, 10-20% pitchblende.	" C
317	As above.	" D
318	As above, 50% pitchblende.	" E
319	Massive magnetite aggregate of small grains in quartz-orthoclase-hornblende gneiss.	401652 A
320	Coarse tourmaline veinlet in quartz-orthoclase-biotite granitic gneiss.	" B
321	As above.	" C

Number	Description	Location
322	At small prospect in sheared massive skarn. Typical garnet-hornblende-epidote-calcite skarn with trace of malachite on shears.	5500ø 6550N
323	Fine segregation of diopside and epidote with minor hornblende and chalcocite in fine quartz-feldspar-epidote gneiss with minor interstitial bornite and chalcocite, trace perovskite(?)	5500ø 6550N
324	Medium-coarse light blue quartz-feldspar gneiss with trace epidote.	5500ø 6550N
325	Massive sheared quartz-epidote-feldspar skarn with small rounded aggregates of bornite with trace of chalcocite. Abundant secondary copper minerals on shears.	5710ø 6475N
326	Same as above.	5710ø 6475N
327	Fine-grained garnet-epidote skarn with little coarse rounded chalcocite as veinlets and segregations.	5710ø 6475N
328	Massive metal-free skarn with fine laminae of hornblende, diopside and epidote.	" "
329	Coarse massive garnet-epidote-diopside-quartz-orthoclase with minor amounts of bornite and chalcocite in fracture intersections and as interstitial disseminates in coalescent grains. Few irregular aggregates.	" "
330	Small prospect pit. Coarse massive garnet with a little diopside, epidote and amphibole. The <u>sheared skarn enclosed in unsheared quartz-feldspar gneiss with few grains of diopside, epidote, hornblende and euhedral garnet.</u> Bornite, as interstitial segregations of minor importance <u>only</u> in massive sheared skarn.	H4
331	Massive garnet-epidote-quartz-feldspar-diopside-amphibole skarn with little bornite and minor chalcocite as segregations and fracture fillings.	H5
332	Fine quartz-amphibole-epidote-diopside knot in compact garnet-quartz-feldspar skarn. Trace bornite as fracture fillings.	H5
333	Malachite-stained massive garnet skarn with trace epidote along shears.	H5
334	Small interstitial bornite in shears in same rock type as above.	H5
335	Sheared coarse-grained garnet-diopside skarn with minor rounded bornite and secondary epidote surrounded by coarse hornblende-epidote diopside-plagioclase skarn, totally enclosed in mediumgrained quartz-feldspar gneiss with minor garnet, epidote, diopside and hornblende.	H5
336	Fine epidote-diopside-amphibole gneissic skarn around massive garnet-epidote-diopside skarn with trace disseminated bornite.	H5
337	Fine light skarnic quartz-feldspar gneiss surrounding massive quartz-epidote-diopside skarn containing minor small rounded aggregates of chalcocite with minor bornite.	H5

Number	Description	Location
338	Fine epidote-garnet-diopside skarn	H5
339	Coarse pegmatitic quartz-calcite-orthoclase vein with interstitial bornite and chalcocite, occasionally veinlike. Little asbestiform tremolite.	H3
340	Pegmatitic vein as above in massive garnet-epidote-diopside skarn. Skarn very much fractured, but metallic only in vein.	H3
341	Coarse aggregate of <u>sheared</u> chalcocite with minor bornite and trace magnetite in fine grained quartz-orthoclase-plagioclase gneiss with minor epidote, hornblende and diopside.	H3
342	As above, more bornite, less chalcocite	H3
343	Irregular masses of chalcocite with minor bornite in massive garnet-diopside-epidote skarn.	H3
344	Similar but little mineralization along shears in skarn.	H3
345	Irregular aggregates of bornite, some veinlets and disseminates in quartz-orthoclase-plagioclase-hornblende-epidote-diopside gneissic skarn.	H3
346	Veinlet of chalcocite with minor bornite in shears in massive garnet (epidote, diopside) skarn.	H3
347	Diopside-calcite vein in massive garnet-epidote diopside skarn. Minor chalcocite and bornite in irregular veinlets in both vein and skarn.	H3
348	Minor small disseminated chalcopyrite in contact zone between coarse aggregate of fine quartz-feldspar-hornblende-garnet gneiss and amphibolite.	H8
349	Impregnation of fine and rather coarse chalcopyrite in medium-grained foliated amphibolite with minor quartz, epidote and feldspar. Many small garnets in felsic areas.	H8
350	Irregular chalcopyrite disseminates discordant with foliation in medium-grained amphibolite.	H8
351	Finely disseminated chalcopyrite in fine-grained epidote-amphibolite.	H8
352	Coarse blue plagioclase, slightly altered to clay, with small interstitial aggregates of bornite and chalcopyrite in amphibolite/gneiss contact zone.	H8
353	Vuggy medium to coarse quartz-feldspar-hornblende-biotite gneiss with small knots of garnet and epidote. Irregular aggregates of fine-grained chalcopyrite and magnetite associated with skarn and mafic constituents.	H
354	Glomeroporphyroblastic orthoclase associated with quartzo-feldspathic segregations in fine banded quartz-feldspar-biotite-hornblende gneiss. Minor epidote, trace garnet and a little secondary biotite in fine gneiss. Small crystals of molybdenite, small segregates of magnetite and fine disseminated chalcopyrite and bornite throughout.	H

Number	Description	Location
355	Irregular interstitial segregations of bornite with minor disseminated chalcopyrite in fine quartz-feldspar-hornblende-biotite-epidote gneiss.	H
356	Massive bornite segregations and minor chalcopyrite disseminates in fine quartz-feldspar-hornblende-gneiss with some secondary biotite.	H
357	Large segregates and aggregates of disseminated bornite and chalcopyrite in quartz-feldspar-hornblende-epidote skarnic gneiss with abundant secondary biotite.	H
358	Chalcopyrite segregations with disseminated magnetite and bornite in gneiss as above.	H
359	Coarse quartz-hornblende-plagioclase-orthoclase-epidote gneiss with abundant secondary brown biotite enclosed with gradationed boundary in fine gneiss of the same composition (?xenolith?). Disseminated magnetite, molybdenite chalcopyrite and bornite abundant in the coarser gneiss.	H
360	Coarse secondary biotite in fine-medium quartz-feldspar-hornblende gneiss. Little chalcopyrite-bornite disseminated throughout.	H
361	Banded quartz-feldspar-hornblende-diopside-epidote gneiss with more massive and compact mafic bands. Molybdenite crystals sited interstitially in felsic laminae, disseminated chalcopyrite in the mafic.	H6
362	Fine quartz-feldspar-hornblende gneiss with trace malachite on shears from 100m. west of prospect	H6
363	Coarse pegmatitic hornblende-epidote-diopside-quartz-feldspar skarn with little garnet. Few large crystals of molybdenum and abundant pyrite and chalcopyrite in finer fraction as disseminates and small aggregates.	H6
364	Garnet-epidote-quartz-diopside skarn with minor magnetite and bornite, trace chalcocite.	H6
365	Segregation-banded quartz-feldspar-hornblende gneiss with finely disseminated chalcopyrite in mafic bands.	H6
366	Coarse skarnic quartz-orthoclase-epidote-diopside gneiss with small chalcopyrite grains disseminated in mafic folia.	H6
367	Blue feldspar and trace garnet in fine to coarse quartz-feldspar-epidote gneiss with minor fine chalcopyrite disseminates.	H6
368	Fine-grained massive magnetite segregation with minor hornblende, quartz and trace of small chalcopyrite disseminates.	H6
369	Fine segregation-banded quartz-feldspar-hornblende gneiss with minor amounts of small chalcopyrite grains interstitially disseminated in mafic folia.	H6

18100 V11

APPENDIX III

BOREHOLE DATA

Kjerneobservasjoner.

Borhull nr. 1

Profil ~~Attached~~

Koordinater: Y Ø 4450

X N 6575

På satt i høyde m.

« i retning N 256° (W 25° S)

« med helning 60°

Borhullets lengde

Boret meter	Bergart	Kjerne- mangel	Skilfrighet	Bergart prove
01.00	Vegetation and weathered rock	-	-	-
02.30	Fine grained hornblende-quartz-feldspar gneiss with minor epidote; trace garnet and magnetite	-	-	-
04.95	Fine grained quartz-feldspar paragneiss with minor hornblende, biotite; trace epidote, garnet, pyrrhotite, magnetite	-	-	-
07.20	Fine quartz-feldspar paragneiss with little hornblende, biotite; trace epidote, magnetite	-	-	Partial
08.40	Medium-grained pink quartz-feldspar paragneiss with minor hornblende; trace epidote, chlorite, magnetite	-	-	-
09.40	Medium-grained pink quartz-feldspar paragneiss with minor hornblende, ca. 10% epidote; ca. 2% magnetite	-	-	-
09.50	Epidote-rich quartz-feldspar paragneiss with ca. 2% magnetite	-	-	-
11.90	Medium-grained, slightly banded quartz-feldspar paragneiss with ca. 20% hornblende, ca. 10% epidote; trace magnetite	-	-	Partial
12.50	Medium-grained quartz-feldspar paragneiss with minor hornblende, biotite, trace epidote and magnetite	-	-	-
13.40	Fine epidote-rich felsic paragneiss with minor hornblende, biotite; trace quartz, magnetite	-	-	-
14.35	Fine felsic paragneiss with minor quartz, amphibole, biotite; trace epidote, ca. 2% magnetite	-	-	-
15.90	Fine epidote-rich quartz-feldspar paragneiss with minor hornblende, biotite; trace magnetite, pyrrhotite	-	-	Partial
17.80	Fine epidote-rich quartz-feldspar paragneiss with minor hornblende, biotite; trace magnetite	-	-	-
18.50	Medium-grained hornblende-plagioclase gneiss with minor quartz, biotite; trace epidote, chlorite; ca. 2% magnetite	-	-	-

Boret meter	Bergart	Kjerne- mangel	Skilfrighet	Bergart prøve
19.40	Fine schistose hornblende-biotite-feldspar gneiss with minor quartz, epidote, chlorite; ca. 2% magnetite	-	X	-
21.80	Medium schistose hornblende-biotite-feldspar gneiss with minor quartz, epidote; trace chlorite, magnetite	-	X	Partial
22.90	Coarse hornblende-feldspar gneiss with minor biotite, quartz; trace chlorite, epidote, magnetite	-	-	-
23.50	Medium schistose hornblende-biotite-feldspar gneiss with trace chlorite, epidote, magnetite	-	X	-
24.10	Fine felsic gneiss with ca. 30% biotite minor hornblende; trace epidote, chlorite, magnetite	-	-	-
26.60	Medium biotite-feldspar-hornblende gneiss with minor quartz, chlorite; trace epidote, magnetite	-	-	Partial
28.90	Coarse biotite-amphibole-chlorite-feldspar gneiss with minor quartz; trace epidote, magnetite. Somewhat schistose	-	X	-
29.10	Fine feldspar-biotite-hornblende gneiss with minor quartz; trace epidote, chlorite, magnetite	-	-	-
32.50	Coarse biotite-hornblende-feldspar gneiss with minor quartz, epidote, chlorite; trace magnetite. Schistose	-	X	Partial
32.70	Coarse feldspar-hornblende-biotite gneiss; trace epidote, quartz, magnetite	-	-	-
35.95	Medium hornblende-feldspar gneiss with ca. 10% each of biotite, quartz, epidote; trace magnetite. Finely banded	-	-	Partial
36.70	Medium hornblende-biotite-quartz-feldspar gneiss with ca. 10% epidote and chlorite; minor quartz	-	-	Yes
38.15	Coarse schistose biotite-hornblende-feldspar-quartz gneiss with minor epidote; ca. 1% pyrite	-	X	Yes
38.75	Fine feldspar-biotite-hornblende-quartz gneiss with trace epidote, chlorite; ca. 1% pyrite	-	-	Yes
41.70	Fine hornblende-biotite-feldspar gneiss with minor quartz; trace epidote, chlorite; ca. 2% pyrrhotite; ca. 1% pyrite; trace chalcopyrite	-	X	Yes
43.00	Schistose Medium hornblende-biotite-plagioclase-quartz gneiss with minor epidote; trace chlorite. Ca 1% pyrrhotite, trace pyrite and chalcopyrite	-	-	Yes

Boret meter	Bergart	Kjerne- mangel	Skilrighet	Bergart prove
43.40	Medium hornblende-biotite-feldspar gneiss with minor quartz, chlorite, ca. 10% disseminated pyrrhotite; trace pyrite, chalcopyrite	-	-	Yes
44.50	Fine and coarse banded hornblende-biotite-feldspar gneiss with minor quartz, chlorite; trace epidote; ca. 5% disseminated pyrrhotite; minor pyrite; trace chalcopyrite	-	-	Yes
46.40	Fine and coarse banded schistose biotite-hornblende-feldspar gneiss with minor quartz, chlorite; trace epidote ca. 1% pyrrhotite; trace pyrite and chalcopyrite	-	X	Yes
48.60	Medium hornblende-feldspar-quartz - chlorite gneiss with minor biotite, epidote; trace garnet; ca. 1% pyrrhotite	-	-	Yes
49.30	Epidote-amphibole-plagioclase-quartz skarn with about 1% pyrrhotite and pyrite; trace chalcopyrite	-	-	Yes
50.20	Coarse gneissic hornblende-feldspar-chlorite-biotite-quartz skarn, with ca. 1% pyrrhotite, ca. 1/2% pyrite; trace chalcopyrite	-	-	Yes
52.70	Coarse schistose biotite-hornblende-plagioclase-chlorite-quartz gneiss with minor epidote, ca. 1/2% pyrrhotite trace pyrite	-	X	Yes
53.80	Coarse gneissic biotite-hornblende-chlorite-plagioclase-quartz skarn with trace epidote, garnet, ca. 2% pyrite, trace chalcopyrite	-	-	Yes
55.20	Contorted garnet-epidote-hornblende-chlorite-biotite-plagioclase-quartz skarn with ca. 1/2% pyrite, ca. 1/2% chalcopyrite	-	-	Yes
56.70	Plagioclase-hornblende-biotite-quartz-chlorite-epidote skarn with minor pyrite, trace chalcopyrite	-	-	Yes
59.10	Hornblende-plagioclase-chlorite-quartz-epidote-biotite-garnet skarn with minor pyrite, trace chalcopyrite	-	-	Yes
59.95	Coarse schistose hornblende-biotite-gneiss with minor feldspar, quartz, epidote; trace chlorite. No metallics	-	X	Yes
60.65	Hornblende-chlorite-plagioclase-epidote-garnet skarn with trace quartz, pyrrhotite, pyrite	-	-	Yes
63.65	Fine hornblende-biotite-plagioclase gneiss with minor quartz, chlorite; trace pyrrhotite, pyrite, chalcopyrite	-	-	Yes
65.00	Fine quartz-feldspar-biotite gneiss with minor hornblende; trace pyrrhotite and pyrite	-	-	Yes

Boret meter	Bergart	Kjerne- mangel	Skiirighet	Bergart prove
67.40	Fine hornblende-biotite-feldspar-quartz gneiss with trace pyrrhotite and pyrite	-	-	Yes
68.40	Fine skarnic hornblende-chlorite-biotite-plagioclase-quartz gneiss with trace epidote; minor pyrite; trace chalcopryrite	-	-	Yes
69.20	Banded, skarnic biotite-hornblende-plagioclase gneiss with minor quartz, chlorite, epidote; trace pyrite, chalcopryrite	-	-	Yes
72.00	Fine quartz-feldspar gneiss with minor biotite, hornblende; trace pyrite, chalcopryrite; minor tiny flakes of ?graphite?	-	-	Yes
75.00	Fine quartz-feldspar-hornblende-biotite gneiss with minor epidote, garnet; trace pyrite	-	-	Yes
82.50	Fine pink quartz-feldspar gneiss with ca. 10% each of hornblende, biotite, epidote, garnet; trace magnetite	-	-	Partial
84.30	Fine pink epidote-rich quartz-feldspar gneiss with minor hornblende, biotite, garnet; no visible metallics	-	-	-
86.10	Fine pink quartz-feldspar gneiss with minor hornblende, biotite; trace magnetite, ?graphite?	-	-	Partial
92.00	Fine quartz-feldspar gneiss with minor epidote, biotite, hornblende; trace calcite, ilmenite, magnetite	-	-	Partial
93.25	Fine pink quartz-feldspar gneiss with minor epidote, biotite, amphibole ca. 2% ilmenite	-	-	-
94.40	Banded skarnic quartz-feldspar-hornblende-epidote gneiss with ca. 2% ilmenite	-	-	-
94.75	Hornblende-epidote-plagioclase-quartz skarn with ca. 5% ilmenite	-	-	-
95.05	Fine quartz-feldspar-epidote-hornblende skarn with trace ilmenite	-	-	-
96.65	Fine quartz-feldspar-epidote gneiss with minor biotite, hornblende; trace ilmenite	-	-	Partial
96.75	Coarse schistose biotite-hornblende-chlorite-plagioclase gneiss with trace ilmenite	-	X	-
101.80	Fine banded hornblende-epidote-quartz-feldspar gneiss with ca. 2% ilmenite	-	-	Partial
106.00	Fine grained calcite-plagioclase-garnet-epidote calc-skarn with minor amphibole, chlorite, quartz; no visible metallics	-	-	Partial
106.40	Fine marble with minor garnet, epidote; trace amphibole, plagioclase; no visible metallics	-	-	-

Boret meter	Bergart	Kjerne- mangel	Skidriget	Bergart prove
106.90	Fine quartz-feldspar-epidote gneiss with minor calcite, hornblende; trace ilmenite	-	-	-
113.60	Coarse marble with minor amphibole, feldspar; trace diopside, garnet no visible metallics	-	-	Partial
114.20	Coarse calcite-epidote calc-skarn with minor hornblende, diopside, garnet, quartz. no visible metallics	-	-	-
119.05	Medium gneissic hornblende-epidote-feldspar-garnet-quartz-calcite skarn with trace ilmenite	-	-	Partial
119.40	Coarse hornblende-feldspar-epidote-garnet skarnic gneiss with minor quartz, chlorite, ca. 5% ilmenite	-	-	-
126.60	Medium gneissic amphibole-epidote-feldspar-garnet-calcite-quartz-biotite skarn with ca. 10% ilmenite	-	-	Partial
132.90	Medium gneissic hornblende-feldspar-quartz-epidote-biotite skarn with ca. 5% ilmenite	-	-	Partial
134.45	Banded hornblende-biotite-feldspar-quartz-epidote-garnet-skarnic gneiss with ca. 5% ilmenite	-	-	-
138.40	Medium quartz-feldspar gneiss with minor hornblende, biotite; trace epidote, garnet, ilmenite	-	-	Partial
139.60	Medium quartz-feldspar gneiss with minor hornblende, biotite; trace muscovite, ilmenite	-	-	-
139.65	Quartz-feldspar pegmatite with trace fluorite. No visible metallics	-	-	-
140.30	Medium quartz-feldspar gneiss with minor biotite, hornblende; trace epidote, ilmenite	-	-	-

BOREHOLE 1, BOTTN I TYSFJORD (4450 Ø, 6575 N, 60° to N 255°

Total list of samples for analysis

05.00 - 06.00	Quartz-feldspar paragneiss
10.00 - 11.00	Quartz-feldspar-hornblende gneiss
15.00 - 16.00	Quartz-feldspar paragneiss
20.00 - 21.00	Hornblende-biotite-feldspar gneiss
25.00 - 26.00	Biotite-hornblende-quartz-feldspar gneiss
30.00 - 31.00	Biotite-feldspar-hornblende gneiss
35.00 - 36.00	Hornblende-feldspar-biotite gneiss
36.00 - 36.70	Hornblende-feldspar-biotite gneiss
36.70 - 38.15	Schistose biotite-feldspar-hornblende gneiss
38.15 - 38.75	Quartz-feldspar-biotite gneiss
38.75 - 39.70	Hornblende-biotite-feldspar gneiss
39.70 - 40.70	Hornblende-biotite-feldspar gneiss
40.70 - 41.70	Hornblende-biotite-feldspar gneiss
41.70 - 43.00	Hornblende-feldspar-biotite gneiss
43.00 - 43.40	Hornblende-feldspar-biotite gneiss
43.40 - 44.50	Biotite-feldspar-hornblende gneiss
44.50 - 45.00	Schistose biotite-feldspar-hornblende-gneiss
45.00 - 46.40	Schistose biotite-feldspar-hornblende-gneiss
46.40 - 47.50	Hornblende-feldspar gneiss
47.50 - 48.60	Hornblende-feldspar gneiss
48.60 - 49.30	Skarn
49.30 - 50.20	Skarn
50.20 - 51.50	Schistose biotite-hornblende-feldspar gneiss
51.50 - 52.70	Schistose biotite- hornblende-feldspar gneiss
52.70 - 53.80	Gneissic skarn
53.80 - 55.20	Contorted skarn
55.20 - 56.70	Skarn
56.70 - 58.00	Skarn
58.00 - 59.10	Skarn
59.10 - 59.95	Schistose hornblende-biotite gneiss
59.95 - 60.65	Skarn
60.65 - 62.15	Amphibolite
62.15 - 63.65	Amphibolite
63.65 - 65.00	Quartz-feldspar gneiss
65.00 - 66.10	Quartz-feldspar-biotite-hornblende gneiss
66.10 - 67.40	Biotite-hornblende-feldspar gneiss
67.40 - 68.40	Gneissic skarn
68.40 - 69.20	Schistose biotite-hornblende-feldspar gneiss
69.20 - 70.60	Quartz-feldspar gneiss
70.60 - 72.00	Quartz-feldspar gneiss
72.00 - 73.50	Quartz-feldspar-hornblende gneiss
73.50 - 75.00	Quartz-feldspar-hornblende gneiss
80.00 - 81.00	Quartz-feldspar gneiss
85.00 - 86.00	Quartz-feldspar gneiss
90.00 - 91.00	Quartz-feldspar gneiss
95.00 - 96.00	Quartz-feldspar-epidote gneiss
100.00 - 101.00	Quartz-feldspar-epidote-hornblende gneiss
105.00 - 106.00	Calc-skarn
110.00 - 111.00	Marble
115.00 - 116.00	Gneissic skarn
120.00 - 121.00	Gneissic skarn
125.00 - 126.00	Gneissic skarn
130.00 - 131.00	Gneissic skarn
135.00 - 136.00	Quartz-feldspar gneiss

Kjerneobservasjoner.

Borhull nr. 2

Profil Attached

Koordinater: Y Ø 4800

X N 6075

Påsett i høyde 295 m.o.h. m.

« i retning N 195 (S15°W)

« med helning 45°

Borhullets lengde 190.20 m.

Boret meter	Bergart	Kjerne- mangel	Skilfrighet	Bergart prove
01.00	Soil and weathered rock	-	-	-
07.10	Garnet-hornblende-plagioclase-epidote skarn with minor diopside, quartz; trace biotite, calcite. no visible metallics	-	-	Partial
08.00	Medium-grained quartz-feldspar gneiss with minor hornblende, epidote; trace diopside. no visible metallics	-	-	-
17.25	Hornblende-epidote-plagioclase-quartz skarn with minor garnet, diopside. no visible metallics	-	-	Partial
18.35	Coarse hornblende-biotite-diopside- feldspar-quartz-epidote "gabbroic" gneiss with trace chlorite. no visible metallics	-	-	-
24.60	Fine hornblende-diopside-epidote gneiss with minor quartz, feldspar; trace garnet. no visible metallics	-	-	Partial
30.10	Gneissic hornblende-biotite-epidote- feldspar skarn with minor quartz; trace chlorite, diopside. no visible metallics	-	-	Partial
33.50	Medium biotite-hornblende-feldspar- quartz "gabbroic" gneiss with minor epidote; trace diopside, chlorite. no visible metallics	-	-	Partial
33.75	Epidote-hornblende-chlorite-skarn, fine-grained with no visible metallics	-	-	-
46.40	Fine hornblende-feldspar-quartz-bio- tite gneiss with minor chlorite, epi- dote, sporadic garnet. ca. 2% magne- tite to 38.50; minor pyrrhotite, pyrite; trace chalcopryrite	-	-	Yes
63.00	Medium biotite-hornblende-feldspar- quartz gneiss with minor chlorite, epidote, sporadic garnet; minor pyrrhotite, pyrite, locally chalco- pyrite in thin bands	-	-	Yes

Boret meter	Bergart	Kjerne- mangel	Skilfrighet	Bergart prove
63.30	Dark fine amphibolite gneiss with minor biotite, plagioclase, quartz; minor pyrite, pyrrhotite throughout; Chalcopyrite minor, in restricted bands	-	-	Yes
64.25	Coarse hornblende-feldspar-quartz-biotite gneiss with trace epidote, chlorite, diopside; ca. 2% pyrrhotite, minor pyrite; trace chalcopyrite	-	-	Yes
64.70	Medium hornblende-feldspar-quartz-biotite gneiss with trace epidote, chlorite; ca. 2% pyrrhotite; minor pyrite; trace chalcopyrite	-	-	Yes
65.55	Coarse hornblende-feldspar-biotite-quartz gneiss, with trace epidote, chlorite; ca. 2% pyrrhotite, minor pyrite and ca. 1% chalcopyrite concentrated in thin bands	-	-	Yes
66.55	Fine hornblende-feldspar-quartz-epidote-chlorite gneissic skarn with minor pyrrhotite, pyrite; trace chalcopyrite	-	-	Yes
66.90	Fine garnet-hornblende-feldspar-quartz-epidote skarnic gneiss with minor chlorite, pyrite; trace chalcopyrite	-	-	Yes
69.65	Coarse hornblende-feldspar-quartz-epidote skarnic gneiss with minor diopside, garnet; trace chlorite. Minor pyrite throughout, and chalcopyrite minor overall, though abundant in 1 cm. layers as disseminates.	-	-	Yes
70.95	Medium hornblende-biotite-feldspar-quartz gneiss with trace epidote, chalcopyrite; minor pyrite	-	-	Yes
71.60	Coarse skarnic biotite-hornblende-feldspar-quartz gneiss with minor epidote, garnet, pyrite; trace chalcopyrite	-	-	Yes
72.35	Garnet-epidote-feldspar-chlorite-hornblende-quartz skarn with trace diopside, biotite, chalcopyrite, pyrite	-	-	Yes
73.50	Coarse hornblende-feldspar-biotite-chlorite-quartz "gabbroic" gneiss with minor garnet, epidote, diopside, pyrite; trace chalcopyrite	-	-	Yes
74.55	Fine quartz-feldspar-hornblende-gneiss with minor garnet, diopside, epidote; trace pyrite, chalcopyrite	-	-	Yes
75.65	Fine and coarse skarnic hornblende-quartz-feldspar-biotite-epidote gneiss with minor garnet, chlorite; trace pyrite, chalcopyrite	-	-	Yes
77.90	Fine quartz-feldspar-hornblende-garnet-epidote gneissic skarn with minor diopside, chlorite; trace pyrite, chalcopyrite	-	-	Yes

Boret meter	Bergart	Kjerne- mangel	Skiffrighet	Bergart prøve
81.00	Banded garnet-hornblende-(chlorite)-quartz-feldspar-epidote gneissic skarn with trace diopside, pyrite, chalcopyrite	-	-	Yes
82.05	Fine quartz-feldspar-hornblende-(chlorite)-gneiss with trace diopside, epidote, pyrite, chalcopyrite	-	-	Yes
82.35	Medium quartz-feldspar-garnet-amphibole gneiss with trace epidote, diopside. no visible metallics	-	-	-
82.65	Fine quartz-feldspar-hornblende-gneiss with trace epidote, garnet, magnetite,	-	-	-
83.25	Coarse hornblende-biotite-quartz-feldspar gneiss with trace magnetite	-	-	-
83.70	Fine hornblende-quartz-feldspar gneiss with minor epidote. no visible metallics	-	-	-
84.10	Fine garnet-quartz-feldspar-hornblende-gneiss with trace epidote. no visible metallics	-	-	-
84.20	Sheared fine quartz-feldspar-amphibole gneiss with minor epidote. no visible metallics	-	-	-
84.95	Medium skarnic garnet-quartz-feldspar-hornblende-calcite-epidote gneiss with trace chlorite, biotite, pyrite	-	-	Yes
92.00	Medium hornblende-quartz-feldspar-biotite gneiss; sheared with foliation at 30° to core axis. Minor magnetite	-	-	Partial
94.10	Medium hornblende-quartz-feldspar-gneiss with minor biotite, diopside, magnetite	-	-	-
94.55	Medium quartz-feldspar-hornblende-gneiss with trace biotite, magnetite	-	-	-
98.60	Medium quartz-feldspar-hornblende-gneiss with trace magnetite	-	-	Partial
99.20	Medium skarnic garnet-hornblende-quartz-feldspar gneiss with minor epidote; trace magnetite	-	-	-
100.00	Medium quartz-feldspar-hornblende-epidote gneiss with trace chlorite, biotite	-	-	-
100.95	Medium quartz-feldspar-hornblende-gneiss with minor biotite; chlorite-trace	-	-	Yes
101.20	Coarse hornblende-(chlorite)-quartz-feldspar-biotite gneissic skarn with minor diopside. no visible metallics. Sheared	-	-	-
102.20	Garnet-diopside-epidote-quartz skarn no visible metallics	-	-	-
102.85	Medium garnet-epidote-quartz-diopside gneissic skarn	-	-	-
105.05	Medium garnet-hornblende-diopside-quartz-feldspar-epidote gneissic skarn with trace chlorite, biotite	-	-	-

Boret meter	Bergart	Kjerne- mangel	Skiffrighet	Bergart prøve
108.05	Medium quartz-feldspar-hornblende-diopside-epidote-garnet-skarnic gneiss with trace chlorite, trace pyrite to 105.50	-	-	Partial
109.25	Massive hornblende-diopside-quartz-feldspar skarn with trace epidote, garnet, magnetite	-	-	-
109.55	Hornblende-feldspar-diopside-epidote-skarnic gneiss with trace quartz, magnetite	-	-	-
111.85	Massive hornblende-calcite-epidote-feldspar-garnet skarn with trace magnetite	-	-	Partial
112.60	Massive garnet-free skarn as above, trace magnetite	-	-	-
113.70	Gneissic garnet-epidote-diopside-quartz-feldspar-hornblende-skarn with trace magnetite	-	-	-
115.05	Gneissic skarn, as above. no visible metallics	-	-	-
116.05	Fine quartz-feldspar-hornblende-diopside-garnet gneiss with trace epidote and ca. 2% magnetite crystals	-	-	Partial
116.50	Fine quartz-feldspar-epidote-garnet-(diopside) gneiss with ca. 2% magnetite	-	-	-
117.30	Medium quartz-feldspar-hornblende-biotite gneiss with trace epidote	-	-	-
117.40	Massive hornblende-chlorite skarn with trace magnetite	-	-	-
117.95	Medium hornblende-quartz-feldspar gneiss with trace epidote, pyrite; trace chalcopyrite in the amphibole	-	-	Yes
118.25	Coarse hornblende-biotite-quartz-feldspar "gabbroic" gneiss with trace epidote; ca. 2% magnetite	-	-	-
135.55	Fine hornblende-quartz-feldspar-biotite gneiss with trace epidote, chlorite, magnetite	-	-	Partial
135.80	Medium hornblende-quartz-feldspar-gneiss with minor biotite, magnetite	-	-	Yes
138.55	Fine quartz-feldspar-hornblende-epidote gneiss with minor magnetite	-	-	-
138.70	Coarse quartz-feldspar-hornblende-biotite gneiss with no visible metallics	-	-	-
139.05	Fine quartz-feldspar-hornblende-biotite gneiss with minor magnetite	-	-	-
139.10	Hornblende-biotite schistose gneiss with trace quartz, feldspar	-	X	-
139.40	Fine quartz-feldspar-hornblende-biotite gneiss with ca. 2% magnetite	-	-	-
140.10	Medium banded quartz-feldspar-biotite-hornblende gneiss with trace epidote and magnetite	-	-	Partial

Boret meter	Bergart	Kjerne- mangel	Skiffrighet	Bergart prove
141.25	Medium hornblende-quartz-feldspar-biotite gneiss with minor magnetite; trace pyrite, chalcopyrite to 140.40	-	-	Partial
141.55	Coarse hornblende-(chlorite)-quartz-feldspar gneiss with minor magnetite	-	-	-
144.70	Medium hornblende-quartz-plagioclase gneiss with trace biotite, magnetite	-	-	-
145.10	Fine quartz-feldspar-hornblende gneiss with minor diopside, garnet, magnetite	-	-	Partial
147.80	Medium quartz-feldspar-hornblende gneiss with minor magnetite, sporadic garnet	-	-	Partial
148.95	Coarse sheared quartz-feldspar-hornblende gneiss with small xenoliths (?) of black metasediments. Trace magnetite pyrite, and (?) chalcopyrite	-	-	Yes
149.45	Coarse quartz-feldspar-hornblende gneiss with minor magnetite	-	-	-
150.05	Sheared and brecciated pink quartz-feldspar gneiss with trace epidote, and ca. 2% magnetite	-	-	Partial
151.00	Medium quartz-feldspar-hornblende gneiss with minor epidote, magnetite	-	-	Yes
151.75	Coarse quartz-feldspar-hornblende gneiss with minor magnetite	-	-	-
152.15	Coarse "gabbroic" hornblende-biotite-quartz-feldspar gneiss with minor diopside; ca. 2% magnetite	-	-	-
154.70	Banded quartz-feldspar-hornblende gneiss with trace epidote, chlorite ca. 2% magnetite	-	-	-
157.60	Medium hornblende-quartz-feldspar gneiss with trace epidote and ca. 3% magnetite. Sheared	-	-	Partial
157.95	Quartz-feldspar pegmatite, trace magnetite	-	-	-
159.20	Banded quartz-feldspar-hornblende gneiss with trace chlorite, epidote, ca. 2% magnetite	-	-	-
159.75	Xenolith (?) of coarse "gabbroic" hornblende-biotite-quartz-feldspar gneiss with trace epidote. no visible metallics	-	-	-
162.45	Fine quartz-feldspar gneiss with minor hornblende; trace epidote, garnet ca. 3% magnetite. Some shears	-	-	Partial
162.75	Banded hornblende-quartz-feldspar gneiss with trace epidote, ca. 5% magnetite	-	-	-
163.10	"Gabbroic" hornblende-quartz-feldspar epidote gneiss with ca. 2% magnetite	-	-	-
168.85	Medium sheared quartz-feldspar-hornblende gneiss with trace epidote and ca. 5% magnetite	-	-	Partial

Boret meter	Bergart	Kjerne- mangel	Skilfrihet	Bergart prove
171.05	Medium hornblende-quartz-feldspar gneiss with trace epidote and ca. 2% magnetite. Sheared	-	-	Partial
173.90	Medium quartz-feldspar-hornblende gneiss with trace epidote, garnet and magnetite	-	-	-
175.05	Fine quartz-feldspar-hornblende gneiss with trace epidote and ca. 2% magnetite	-	-	Partial
184.80	Fine quartz-feldspar-hornblende-garnet gneiss with trace epidote and ca. 3% magnetite in thin bands	-	-	Partial
187.75	Fine garnet-epidote-quartz-feldspar skarnic gneiss, sheared with ca. 3% magnetite	-	-	Partial
188.50	Garnet-epidote-quartz-feldspar gneissic skarn with trace diopside, magnetite	-	-	-
190.20	Fine garnet-diopside-quartz-plagioclase-hornblende gneissic skarn with ca. 3% magnetite	-	-	Yes

BOREHOLE 2, BOTN I TYSFJORD (6075 N, 4800 Ø) 45° to N195°

Total list of samples for analysis

05.00 - 06.00	Garnet-hornblende skarn
10.00 - 11.00	Skarn
15.00 - 16.00	Skarn
20.00 - 21.00	Amphibole-diopside-biotite skarnic gneiss
25.00 - 26.00	Amphibole-diopside-biotite skarnic gneiss
30.00 - 31.00	"Gabbroic" hornblende-feldspar-quartz gneiss
35.10 - 36.50	Fine hornblende-feldspar-quartz gneiss
36.50 - 38.00	" " " " "
38.00 - 39.50	" " " " "
39.50 - 41.00	" " " " "
41.00 - 42.50	" " " " "
42.50 - 44.00	" " " " "
44.00 - 45.50	" " " " "
45.50 - 46.40	" " " " "
46.40 - 48.00	Coarse biotite-hornblende-feldspar-quartz gneiss
48.00 - 49.50	" " " " "
49.50 - 51.00	" " " " "
51.00 - 52.50	" " " " "
52.50 - 54.00	" " " " "
54.00 - 55.50	" " " " "
55.50 - 57.00	" " " " "
57.00 - 58.50	" " " " "
58.50 - 60.00	" " " " "
60.00 - 61.50	" " " " "
61.50 - 63.00	" " " " "
63.00 - 63.30	Fine amphibolite
63.30 - 64.25	Coarse amphibole-quartz-plagioclase gneiss
64.25 - 64.70	Hornblende-quartz-feldspar gneiss
64.70 - 65.55	Hornblende-quartz-feldspar gneiss
65.55 - 66.55	Gneissic hornblende-quartz-feldspar-epidote skarn
66.55 - 66.90	" " " " "
66.90 - 68.30	" " " " "
68.30 - 69.65	" " " " "
69.65 - 70.95	Hornblende-biotite-quartz-feldspar gneiss
70.95 - 71.60	Biotite-hornblende-epidote skarnic gneiss
71.60 - 72.35	Skarn
72.35 - 73.50	"Gabbroic" hornblende-quartz-plagioclase
73.50 - 74.55	Fine quartz-feldspar gneiss
74.55 - 75.65	Gneissic skarn
75.65 - 76.65	" "
76.65 - 77.90	" "
77.90 - 79.00	" "
79.00 - 80.00	" "
80.00 - 81.00	" "
81.00 - 82.05	Quartz-feldspar-amphibole gneiss
84.20 - 85.00	Gneissic skarn

BOREHOLE 2 List of Samples (con't)

85.00 - 86.00	Quartz-feldspar gneiss
90.00 - 91.00	" " "
95.00 - 96.00	" " "
100.00 - 101.00	Quartz-feldspar-hornblende gneiss
105.00 - 106.00	Quartz-feldspar gneiss
110.00 - 111.00	Skarn
115.00 - 116.00	Quartz-feldspar gneiss
117.40 - 117.95	Quartz-feldspar-hornblende gneiss
120.00 - 121.00	Quartz-feldspar gneiss
125.00 - 126.00	Quartz-feldspar gneiss
130.00 - 131.00	Quartz-feldspar gneiss
135.00 - 136.00	Quartz-feldspar gneiss
139.40 - 140.00	Banded quartz-feldspar gneiss
140.00 - 141.00	Hornblende-quartz-feldspar gneiss
145.00 - 146.00	Hornblende-quartz-feldspar gneiss
147.80 - 148.95	Quartz-feldspar-hornblende gneiss
150.00 - 151.00	" " " "
155.00 - 156.00	" " " "
160.00 - 161.00	" " " "
165.00 - 166.00	" " " "
170.00 - 171.00	Hornblende-quartz-feldspar gneiss
175.00 - 176.00	Quartz-feldspar-hornblende gneiss
180.00 - 181.00	" " " "
185.00 - 186.00	Gneissic skarn
189.00 - 190.20	" "

Kjerneobservasjoner.

Borhull nr. 3

Profil ~~Attached~~

Koordinater: Y Ø 4800

X N 6075

Påsett i høyde 295 m.o.h. m.

« i retning N 015°

« med helning 20°

Borhullets lengde 33.60 m.

Boret meter	Bergart	Kjerne- mangel	Skilfrighet	Bergart prøve
16.90	Massive contorted garnet-hornblende-diopside skarn with minor epidote, quartz, feldspar. Very sheared and cavitous. No visible metallics	-	-	Partial
19.75	Garnet-hornblende-quartz-feldspar gneissic skarn, sheared at upper and lower margins of unit for 50 cm. No visible metallics	-	-	Partial
24.25	Sheared and contorted hornblende-epidote-garnet skarn with minor quartz, feldspar; trace calcite. No visible metallics	-	-	Partial
33.60	Fine garnet-hornblende-quartz-feldspar-biotite gneiss with minor shearing to 25.20 m. Minor magnetite	-	-	Partial

BOREHOLE 3, BOTN I TYSFJORD (6075 N, 4800 Ø) 20° to N 015°

Total List of Samples for Analysis

05.00 - 06.00	Massive skarn
10.00 - 11.00	" "
15.00 - 16.00	" "
18.00 - 19.00	Gneissic hornblende-garnet-quartz-feldspar skarn
20.00 - 21.00	Massive skarn
25.00 - 26.00	Hornblende-quartz-feldspar-garnet gneiss
30.00 - 31.00	" " " " "

Kjerneobservasjoner.

Borhull nr. 4

Profil Attached

Koordinator : Y Ø 4875

x N 5910

Pisatt i høyde 285 m.o.h. m.

« i retning N 245° (W 25°S)

« med helning 50°

Borhullets lengde 79.00 m.

Boret meter	Bergart	Kjerne- mangel	Skiffrighet	Bergart prøve
00.45	Soil and weathered rock	-	-	-
06.70	Medium grained hornblende-quartz-feldspar-biotite gneiss with minor epidote and trace magnetite	-	-	Yes
10.20	Coarse hornblende-biotite-quartz-feldspar gneiss with ca. 10% chlorite, minor epidote. No visible metallics. Foliation parallel to axis	-	-	Yes
10.80	Fine pink quartz-feldspar-hornblende gneiss, sheared	-	-	Yes
15.25	Medium quartz-feldspar-biotite-hornblende gneiss with ca. 5% garnet, ca. 2% magnetite; trace pyrite. Foliation 30° to core axis	-	-	Yes
22.15	Medium quartz-feldspar-biotite-hornblende gneiss with minor garnet, epidote; ca. 2% magnetite. Few coarse segregations of felsics	-	-	Yes
24.60	Coarse quartz-feldspar-biotite-hornblende gneiss with minor garnet. Trace chalcopyrite aggregates in hornblende	-	-	Yes
28.40	Fine hornblende-quartz-feldspar gneiss with trace epidote. Foliation 30° to core axis	-	-	Yes
32.75	Coarse pink quartz-feldspar-biotite-hornblende gneiss with minor epidote and magnetite. Sheared to 28.75; foliation 30° to axis	-	-	Yes
35.25	Coarse hornblende-(chlorite)-biotite-quartz-feldspar gneiss with minor epidote and xenolithic aspect. Minor garnet; foliation irregular	-	-	Yes
46.10	Coarse pink quartz-orthoclase-hornblende-biotite gneiss with minor garnet, epidote, magnetite; trace chlorite	-	-	Yes
48.00	Medium biotite-hornblende-(chlorite)-quartz-feldspar gneiss with minor epidote and trace magnetite	-	-	Yes

Boret meter	Bergart	Kjerne- mangel	Skiftrighet	Bergart prøve
50.20	Coarse hornblende-biotite-quartz-feldspar "gabbroic" gneiss with minor epidote, chlorite. Some shearing, usually malachite-stained	-	-	Yes
50.80	Fine quartz-feldspar-biotite gneiss with cupriferous veinlets and streaks from 50.30 - 50.45 only, containing a little bornite and traces of chalcopryrite, chalcocite, ca. 2% magnetite throughout	-	-	Yes
52.95	Medium "gabbroic" hornblende-biotite-quartz-feldspar gneiss with minor epidote and chlorite; trace magnetite	-	-	Yes
63.05	Medium pink quartz-feldspar-hornblende-biotite gneiss with minor epidote, chlorite, ca. 5% magnetite in crystal segregations. Sheared 55.40 - 55.80	-	-	Yes
65.50	Fine grey biotite-quartz-feldspar-muscovite gneiss with minor epidote, garnet, magnetite	-	-	Yes
66.20	Coarse grey quartz-feldspar-hornblende-biotite-epidote gneiss with minor magnetite; biotite decussate	-	-	Yes
72.50	Fine grey to pink quartz-orthoclase-biotite-epidote gneiss with trace plagioclase, garnet, hornblende; minor magnetite	-	-	Yes
74.05	Coarse quartz-feldspar-hornblende-biotite-epidote gneiss with trace garnet and ca. 3% magnetite	-	-	Yes
77.50	Fine light quartz-feldspar-biotite-gneiss with minor garnet, epidote, and ca. 2% magnetite	-	-	Yes
78.50	Coarse quartz-feldspar-biotite gneiss with minor garnet, epidote, and ca. 5% small magnetite	-	-	Yes
79.00	Fine light quartz-feldspar-biotite-hornblende gneiss with minor epidote and garnet, and ca. 5% small magnetite	-	-	Yes

BOREHOLE 4, BOTN I TYSEFJORD (4875 O, 5910 N, 50 to N245

Total List of Samples for Analysis

00.45 - 02.00	Quartz-feldspar-hornblende-biotite gneiss
02.00 - 03.50	" " " " "
03.50 - 04.50	" " " " "
04.50 - 05.50	" " " " "
05.50 - 06.70	" " " " "
06.70 - 08.00	Hornblende-biotite-quartz-feldspar gneiss
08.00 - 09.50	" " " " "
09.50 - 10.20	" " " " "
10.20 - 10.80	Quartz-feldspar gneiss
10.80 - 12.00	Quartz-feldspar-biotite-hornblende gneiss
12.00 - 13.50	" " " " "
13.50 - 14.50	" " " " "
14.50 - 15.25	" " " " "
15.25 - 16.00	" " " " "
16.00 - 17.50	" " " " "
17.50 - 19.00	" " " " "
19.00 - 20.50	" " " " "
20.50 - 21.50	" " " " "
21.50 - 22.15	" " " " "
22.15 - 23.20	Quartz-feldspar-hornblende-biotite gneiss
23.20 - 24.60	" " " " "
24.60 - 26.00	Quartz-hornblende-feldspar-biotite-gneiss
26.00 - 27.50	" " " " "
27.50 - 28.40	" " " " "
28.40 - 29.90	Quartz-feldspar gneiss
29.90 - 31.30	" " " " "
31.30 - 32.75	" " " " "
32.75 - 34.25	Quartz-feldspar-hornblende-biotite gneiss
34.25 - 35.25	" " " " "
35.25 - 36.75	" " " " "
36.75 - 38.25	" " " " "
38.25 - 39.75	" " " " "
39.75 - 41.25	" " " " "
41.25 - 42.75	" " " " "
42.75 - 44.25	" " " " "
44.25 - 45.25	" " " " "
45.25 - 46.10	" " " " "
46.10 - 47.00	Biotite-hornblende-quartz-feldspar gneiss
47.00 - 48.00	" " " " "
48.00 - 49.00	Hornblende-feldspar-biotite-quartz gneiss
49.00 - 50.20	" " " " "
50.20 - 50.80	Quartz-feldspar gneiss
50.80 - 52.00	" " " " "
52.00 - 52.95	Hornblende-biotite-quartz-feldspar "gebroic" gneiss
52.95 - 54.00	" " " " "
54.00 - 55.50	Quartz-feldspar-(hornblende-biotite) gneiss
55.50 - 57.00	" " " " "
57.00 - 58.50	" " " " "
58.50 - 60.00	" " " " "
60.00 - 61.50	" " " " "
61.50 - 63.05	" " " " "

BOREHOLE 4 BOTTN I TYSFJORD (continued)

63.05 - 64.05	Biotite-muscovite-quartz-feldspar gneiss
64.05 - 65.50	" " " "
65.50 - 66.20	Quartz-feldspar-hornblende gneiss
66.20 - 67.50	Quartz-feldspar-biotite gneiss
67.50 - 69.00	" " " "
69.00 - 70.50	" " " "
70.50 - 71.50	" " " "
71.50 - 72.50	" " " "
72.50 - 73.30	Quartz-feldspar gneiss
73.30 - 74.05	" " "
74.05 - 75.40	Quartz-feldspar-biotite gneiss
75.40 - 76.80	" " " "
76.80 - 77.50	" " " "
77.50 - 78.50	" " " "
78.50 - 79.00	Quartz-feldspar-biotite-hornblende gneiss



Botn Tysfjord 1973

BTY 5

Koordinater Ø 4500 N 5570

Retning S 15°W

Helning 55°

- 0.00
- 1.00 Jordboring
- 2.60 Glimmergneis
- 2.70 Glimmergneis, prøve
- 6.60 Glimmergneis
- 9.05 Meget biotittrik gneis
- 9.40 Gabbro
- 10.60 Hornblendegneis med granater
- 11.40 Gabbro
- 12.90 Hornblendegneis, små render med magnetkis og kobberkis
- 17.10 Granittisk gneis med granater
- 13.35 Biotitt
- 14.80 Granittisk gneis
- 15.00 Granittisk gneis, prøve
- 15.75 Granittisk gneis, spor av pyritt
- 18.00 Hornblendegneis
- 18.10 Hornblendegneis, prøve
- 18.90 Hornblendegneis
- 19.60 Biotittskiifer
- 23.70 Hornblendegneis
- 24.00 Finkornet granittisk gneis
- 24.15 Finkornet granittisk gneis, prøve
- 27.35 Finkornet granittisk gneis, magnetittkrystaller
- 25.50 Hornblendegabbro
- 29.00 Hornblendegneis
- 29.20 Biotittskiifer
- 29.90 Gneisgranitt, dvs. den grovere arten av granittene med magnetitt
- 30.00 Samme bergart, prøve
- 31.50 Gneisgranitt
- 34.95 Biotittskiifer
- 35.60 Paragneis



35.85	Biotittskiifer
36.30	Paragneis
44.45	Biotittskiifer
44.90	Diabas med magnetkisimpregnasjon, fattig
46.00	Hornblendeskiifer
46.40	Gneisgranitt med magnetitt
50.00	Biotittskiifer
50.10	Biotittskiifer, prøve
54.50	Biotittskiifer
54.80	Gneisgranitt
56.25	Biotittskiifer
56.60	Granittisk gneis, finkornet
72.72	Biotittskiifer, enkelte striper svovelkis
73.30	Finkornet granittisk gneis
73.35	Biotittskiifer med magnetkis og spor av kobberkis
73.70	Biotittskiifer
74.05	Granittisk gneis
74.40	Finkornet gneis
75.20	Granittisk gneis
75.65	Biotittskiifer
76.40	Finkornet granittisk gneis
76.65	Biotittskiifer med fattig impregnasjon, magnetkis
77.00	Biotittskiifer
77.90	Hornblendegneis
79.00	Paragneis
81.70	Biotittskiifer
82.00	Granittisk gneis
83.45	Biotittskiifer meget fattig impregnasjon
84.20	Granittisk gneis
85.20	Finkornet granittisk gneis
86.50	Granittisk gneis, prøve
87.00	Samme bergart



Botn Tysfjord 1973

BTY 6 A

Koordinater Ø 5100 N 5205

Retning S 15°W

Helning 70°

- 0.00
- 1.00 Jordboring
- 1.10 Paragneis
- 1.20 Granittisk gneis
- 1.35 Paragneis
- 1.75 Biotittgneis
- 2.30 Paragneis
- 2.75 Granittisk gneis
- 3.65 Paragneis
- 6.00 Granittisk gneis
- 6.30 Paragneis
- 11.05 Tysfjordgranitt
- 11.50 Biotittgneis
- 13.60 Forvitret epidotisert gneis
- 13.85 Skarn
- 17.10 Forvitret epidotisert gneis sannsynligvis kalkholdig

Ras, boret fast, hullet oppgitt



Botn Tysfjord 1973

BTY 6 B

Koordinater: Ø 5100 N 5205

Retning S 15°W

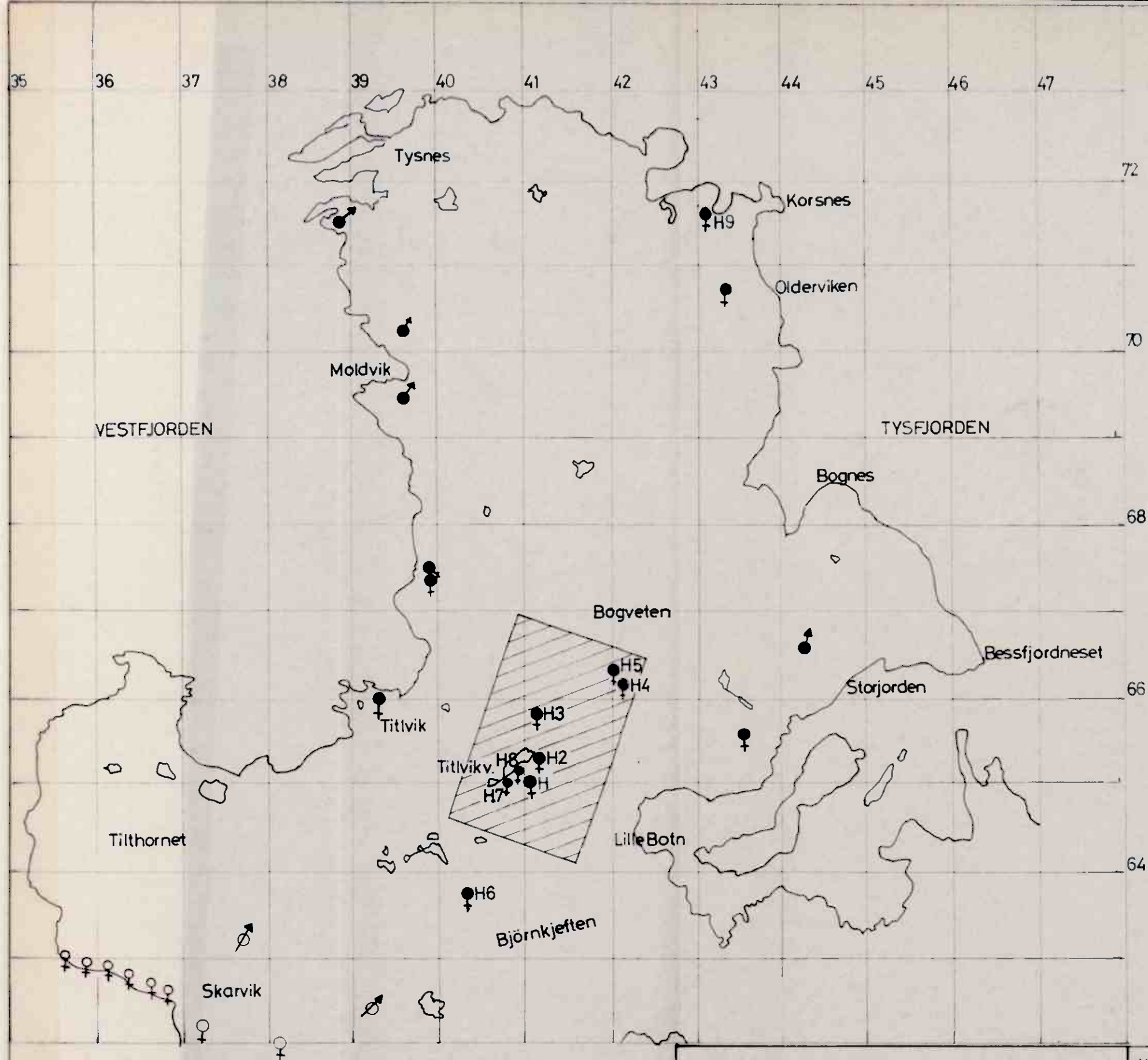
Helning 73°

- 0.00
- 1.00 Jordboring
- 9.70 Tysfjordgranitt
- 9.95 Paragneis
- 11.00 Tysfjordgranitt
- 11.70 Paragneis
- 12.40 Epidotrik bergart, noe granatskarn
- 15.00 Forvitret gneis, antagelig kalkholdig
- 16.50 Hornblendegneis
- 18.70 Kjernetap
- 19.00 Hornblendegneis
- 20.60 Kjernetap
- 21.50 Paragneis
- 22.55 Kjernetap
- 23.00 Paragneis
- 23.50 Kjernetap
- 24.00 Paragneis
- 24.30 Kjernetap
- 25.05 Paragneis, prøve 5 cm
- 26.05 Paragneis, prøve 5 cm
- 26.20 Hornblendeskiifer
- 26.72 Paragneis
- 26.87 Granatepidotskarn
- 30.00 Paragneis, epidotisert
- 33.50 Paragneis med granatskarnsoner, (granat og epidot)
- 34.00 Biotittskiifer
- 36.15 Paragneis
- 38.25 Granittisk gneis
- 38.40 Biotittskiifer
- 39.30 Granittisk gneis
- 39.60 Granittisk gneis med store granater
- 40.70 Granittisk gneis



- 41.85 Granittisk gneis
- 45.00 Epidotisert granittisk gneis
- 65.00 Finkornet granittisk gneis

Taunton



- Tegnforklaring:
- ♀ Jern-Kobber
 - Kobber
 - ♂ Jern
 - ♂ Jern-Mangan
 - ▨ Geofysisk måle-område 1973

LILLEBOTN KOBBERFOREKOMST
TYSFJORD

A/S SYDVARANGER

MÅLESTOKK

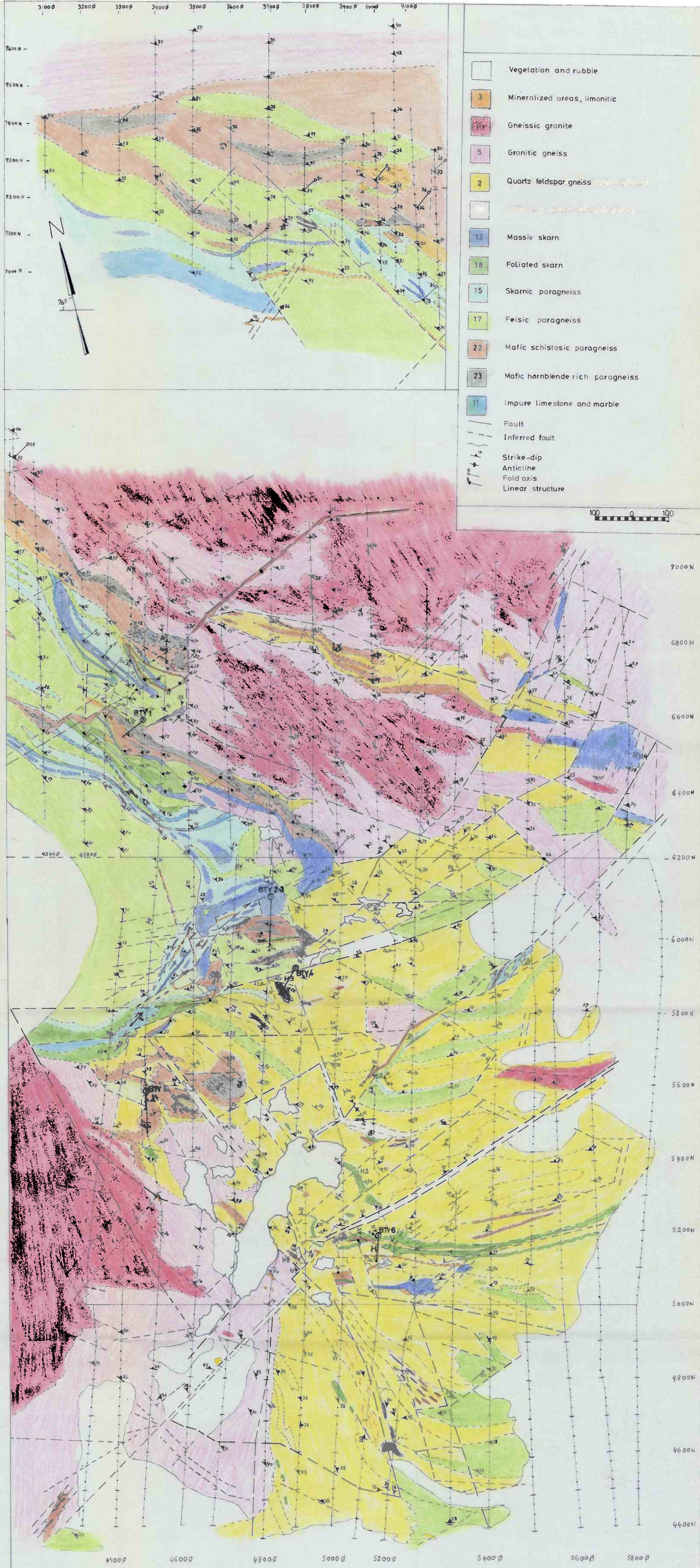
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OBS.			
TEGN.	L. J.	MAI	-73
TRAC.	L. J.	MAI	-73
KFR.			

TEGNING NR.

1

1231 I
1231 II



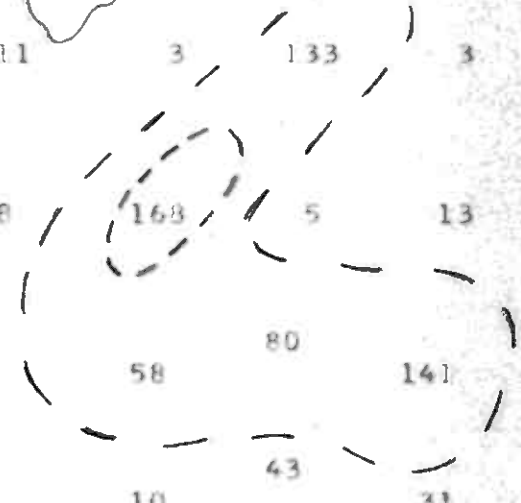
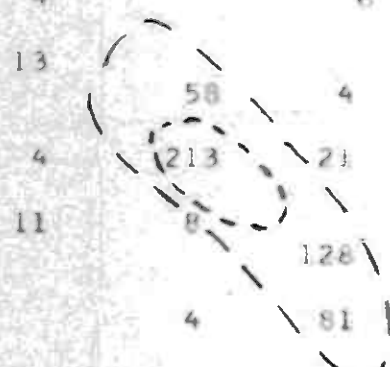
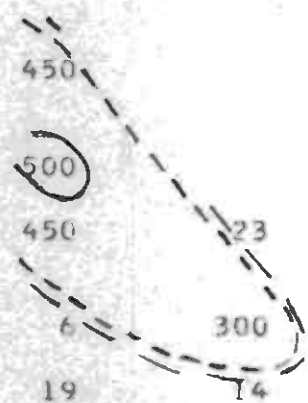
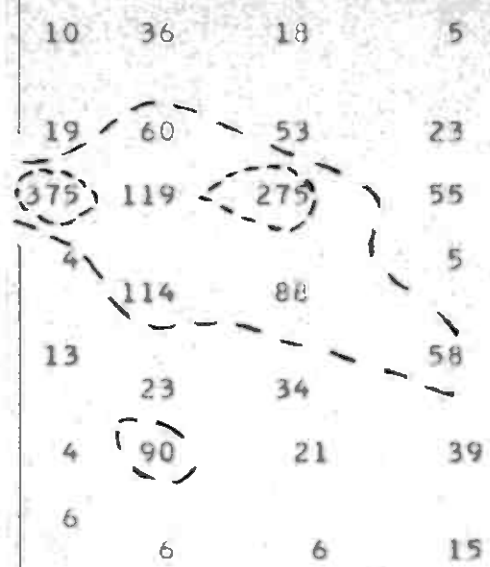
Geologisk kort
Lillebotn Kobberforekomst
TYSFJORD

MÅLESTOKK	OBS
1:5000	TEGN
	TRAC. L. N. 1974

A/S SYDVARANGER

TEGNING NR.
2

KARTBLAD AMS
1231 I-II



Legend:

- 56-145 ppm Cu
- 146-470 — " —
- > 470 — " —

Geokjemiske jordprøver, Cu
LILLEBOTN KOBBERFOREKOMST
TYSFJORD

N.B.H. Dec. 1974

MÅLESTOKK

1: 5000

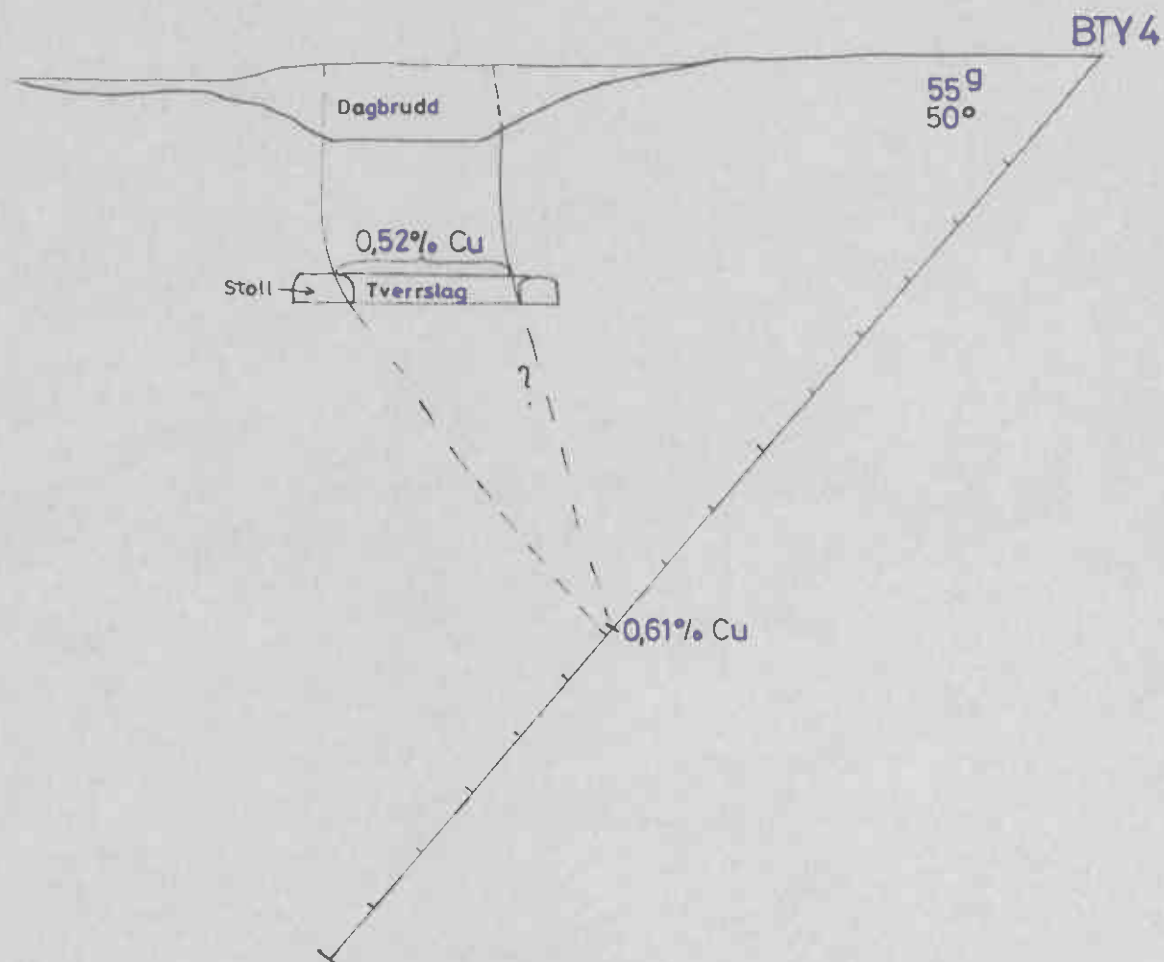
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3

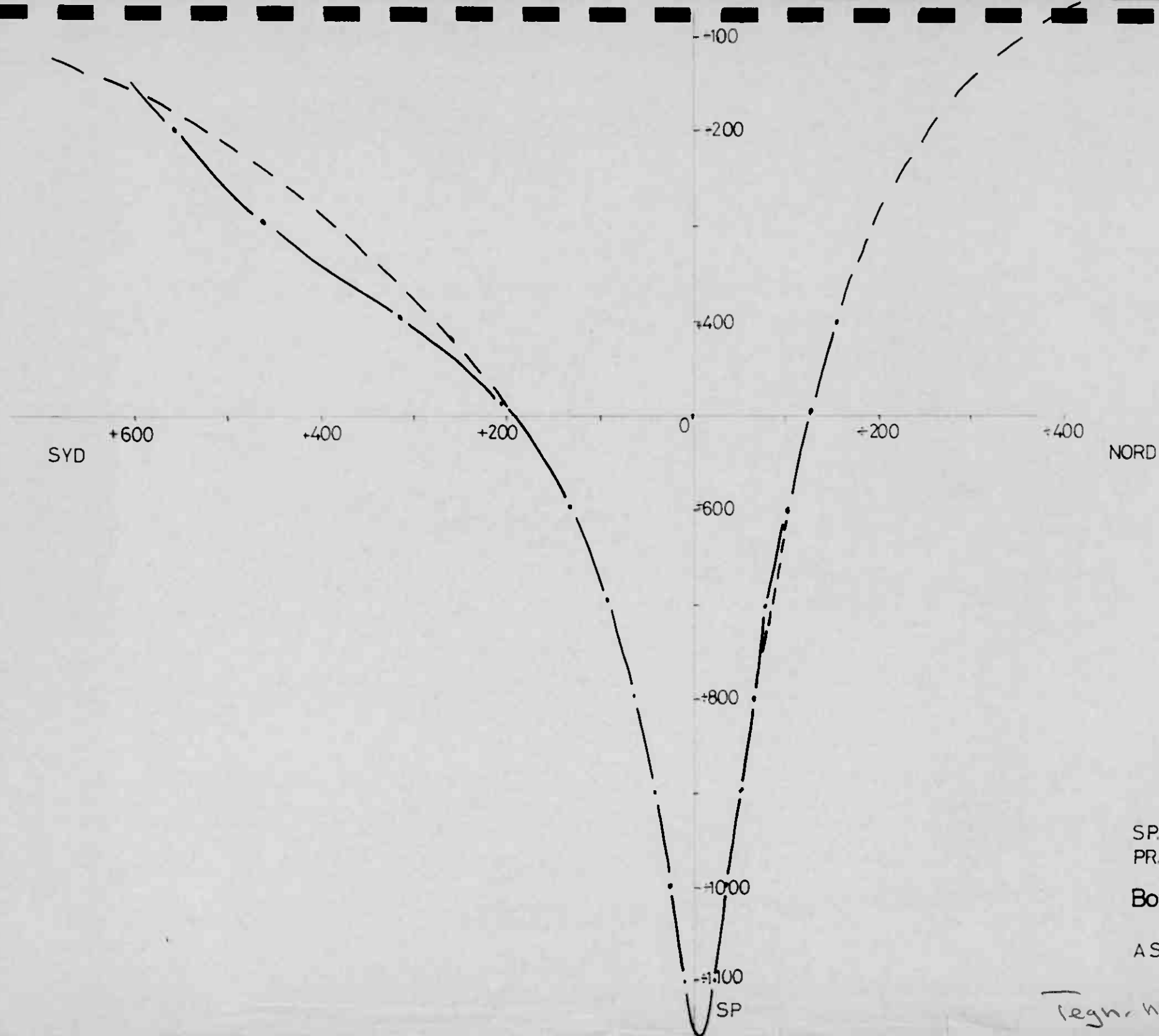
1231

I-II

A S SYDVARANGER



Profil over H3 LILLEBOTN KOBBERFOREKOMST TYSFJORD	Målestokk 1 500	Målt	J.F.	1973
		Tegn	J.F.	1973
		Trac	L.N.	1974
A/S SYDVARANGER	TEGNING NR.			
	4			



SP.-anomali
PR.1

Botn, Tysfjord

AS SYDVARANGER

Tegn. nr. 5

SP

