Bergvesenet

Postboks 3021, N-7441 Trondheim

Rapportarkivet

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Folldal Verk AS		Folldal Verk a.s.		

Tittel

Diverse rapporter og materiale fra undersøkelsene i Rombakvinduet

Forfatter	Dato År	Bedrift (oppdragsgiver og/eller oppdragstaker)
Korneliussen, Are, Tollefsrud, Jan Inge,		

Kommune	Fylke	Bergdistrikt	1: 50 000 kartblad	1: 250 000 kartblad
Narvik	Nordland		14311 14313	Narvik

Fagområde	Dokument type	Forekomster (forekomst, gruvefelt, undersøkelsesfelt)
Geologi		Rombaksvinduet

Råstofgruppe	Råstofftype
Malm/metall	Au

Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse

Rapporten består av en samling av kortere rapporter og notater hovedsaklig fra 1985 - 1988, samt noen kart og figurer vedr. undersøkelsene etter gull i Rombaksvinduet i Nordland.

Trondheim 22/3-88

Notat

Til: NGU

Fra: Are Korneliussen

Undersøkelser i Rombakvinduet sommeren 1988

Rombaken grunnfjellsvindu har i de senere år vært gjenstand for omfattende geologiske undersøkelser både med henblikk på mineralressurser og vitenskapelige formål. Viktige arbeider har vært: (1) ARCO's og Folldal Verk's malmprospektering henholdvis i periodene 1983-84 og 1983-86, (2) NGU's malmrettede undersøkelser i 1983-87, (3) doktorgradsarbeider av Rolf Romer (Luleå) om tidlig Proterozoisk vulkansk/sedimentær og metamorf (basert på isotop-tolkninger) utvikling, Gerhard Bax (Stockholm) om kaledonsk deformasjon av de nordøstlige deler av vinduet, Patricia Cashman (USA) om kaledonsk påvirkning av de nordlige deler av vinduet, og (4) arbeider av Arild Andresen (Tromsø; nå Oslo) m/studenter om den kaledonske påvirkning av vinduet. På grunnlag av disse arbeider foreligger nå et omfattende materiale om Rombakvinduets geologiske utvikling både i Prekambrisk og Kaledonsk tid.

Aktivitetene i vinduet i 1988 er som følger:

(1) Geologiske Tjenester v/ B.Flood vil samarbeide med selskapet Resources Exploration Norway videreføre ARCO's undersøkelser i de nordlige deler av vinduet m.h.p. Zn-Pb-Ag og Au forekomster. Det vil bl.a. bli utført diamantboringer.

(2) Gautelisfjell gullforekomst vil bli videre undersøkt av siv.ing. Trond Skyset som et ledd i et MASTER-studium ved State University of New York (Buffalo, USA). Feltutgiftene (1988-89) vil bli dekket av NGU og han vil ha tilgang til alt Folldal Verk's materiale.

(3) NGU vil begynne kartleggingsarbeider m.h.p. det geologiske kartblad Rombakfjord (1:50000). En stor del av Geologiske Tjenesters undersøkelser vil ligge innenfor dette kartbladet.

(4) Gerhard Bax har fått et post-doktor NTNF-stipend for å

arbeide med kaledonsk skjærsoneproblematikk i vinduet og assosierte malmmineraliseringer. Han vil utføre et fjernanalysetolkning av vinduet ved et billedbehandlings- anlegg ved Stockhom universitet, og følge dette opp med detaljstudier av flybilder og dernest feltundersøkelser. Det vil i feltoppfølgingen bli lagt vekt på de områder som har malmgeologisk interesse.

(5) Arild Andresen og Erling Rykkelid
fortsetter sitt NAVF-finansierte prosjekt om relasjonen mellom grunnfjellet og dekkekomplekset. De vil særlig arbeide i de sydlige deler av vinduet.

Hei, dette ble skrevet i første stilling til Trond Skyset fordi han ønsket et tilleggs til en NTNF-prosjektsøknad.

Are.

Trondheim 22/3-88

Notat

Til: - NGU
- Trond Skyset
- Folldal Verk / Norsulfid

Fra: Are Korneliussen (NGU)

Videre undersøkelse av Gautelisfjell gullforekomst i Rombakvinduet, Nordland.

Innledning:

Formålet med dette notatet er å gi en meget kortfattet oppsummering av situasjonen ang. Gautelisfjell gullforekomst inkludert å skissere hvilke videre undersøkelser som er planlagt.

Forekomsten ble undersøkt av Folldal Verk i perioden 1983-86 med bl.a. diamantboringer (1500m). Den er beskrevet i flere interne Folldal Verk rapporter, samt av J.I.Tollefsrud (Folldal Verk) i NGU-rapport nr. 86.193 (Korneliussen,A., J.I.Tollefsrud, Flood,B. og Sawyer,E.: Precambrian volcano-sedimentary sequences and related ore deposits, with special reference to the Gautelisfjell carbonate-hosted, disseminated gold deposit, Rombaken basement window, northern Norway. Delrapport i EF/NTNF-prosjektet "Gold in Early-Proterozoic volcano-sedimentary belts". 46s).

Geologi:

Området inneholder et tonalittisk bergartskompleks av arkeisk eller tidlig-proterozoisk alder som er overlagret av et basalkonglomerat. Over denne ligger en dolomittisk kalkstein. Gautelisfjell gullforekomst er tilknyttet denne kalken. Stratigrafisk over kalken kommer en gråvakke-vulkanittserie som er tolket å være dannet i et aktivt kontinentmargin-miljø. Disse bergarter er intrudert av granittiske plutoner og basiske ganger med sannsynlig alder 1700-1800

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mill.år. Metamorfosegraden er nedre amfibolittfacies med retrogradering til grønnskifer-facies langs skjærsoner.

De gullførende mineraliseringer som er påvist kan inndeles i tre typer: (1) relativt massiv arsenkis i en mindre malmkropp i kontakten mellom karbonaten og gråvakke/tuffitt-serien, (2) disseminert svovelkis +/- kopperkis i kalk-silikat lag i karbonaten, og (3) større volum av mere-eller-mindre "usynlig" lavgehaltig svovelkis i karbonaten. Gullgehalten i alle disse mineraliseringstyper varierer stort sett mellom 0 og 10 ppm, unntaksvis opp mot 300 ppm i mineraliseringstype 2. Assosierte elementer er As, W, Bi, Te, Cu og C (grafitt).

Videre undersøkelser:

Folldal Verks undersøkelser var for å undersøke mulighetene for økonomisk utnyttelse, og lite arbeide er utført med henblikk på malmgenetisk tolkning. Fordi det geologiske miljøet er kjent i grove trekk og fordi en har adgang til et omfattende prøvemateriale av bergarter og mineraliseringer (bl.a. Folldal Verk's borkjerner), er situasjonen gunstig for å gå videre med et detaljert geologisk studium av forekomsten m.h.p. malmdannelsen, samt også for å beskrive dens "signatur" i det geologiske miljøet mere presist. Detaljert kunnskap om disse forhold vil være viktig når det gjelder leting etter liknende forekomster i andre områder.

Forekomsten er planlagt videre undersøkt av siv.ing. Trond Skyset som et ledd i et MASTER-studium ved State University of New York (Buffalo, USA), med professor Paul Reitan som veileder. Skyset vil utføre feltundersøkelser i forekomstområdet i 1988 og 1989. Feltutgiftene vil bli dekket av NGU, begrenset oppad til kr 25.000,- pr. år i 2 år. Han vil videre ha adgang til alt Folldal Verk's rapport- og prøvemateriale, og han vil bl.a. studere i detalj de forskjellige mineraliseringstypers mineralogi, tekstur og kjemi samt deres geolgiske opptreden, for å kunne komme fram til en modell for malmdannelsen.

contents of precious metals, they represent no economic potential

Tatt ut del om Zn-Pb.

Comparison of correlation coefficients for Klubbvatnet and Haugfjellet (rock samples). After Flood (1985).

	Klubbv. (n=31)	Haugfj. (n=179)
Ag-Au	0.63	0.21
Au-As	0.01	0.55
Ag-Pb	0.65	0.90
Pb-Au	0.73	0.25
Pb-Zn	0.23	0.87
Zn-Cu	0.06	0.68
Cu-Pb	0.13	0.60

Tatt ut fordi har lavt r² på behandlet data kompliderer

SEDIMENT ANOMALIES

INNHOLD

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PLANSJER, KART

Henvisninger til prøvepunkter, Gautelis.....10 sider

Fastfjellsprøver, geologi, Gautelisvann-Kjørisvann.. 1 kart

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Fastfjellsprøver, geologi, Cunojavre..... 1 "

Fastfjellsprøver, geologi, Ruvssot..... 1 "

Skjomen 1986.

Sommerens aktiviteter i Rombak-prosjektet ble konsentrert om fastfjellprøvetaking av kalksteinshorisonter i Cunojavri-, Ruvssot-, Kjørisvann- og Gautelis-områdene.

I løpet av juli måned ble i alt 675 prøver innsamlet, dessuten ble det foretatt begrensede kartleggingsarbeider i målestokk 1 : 2600 i Cunojavri- og Russot-områdene. Arbeidet ble utført av en geolog og to hjelpere. Prøvene ble fraktet ut av feltet med helikopter.

Resyme, aktiviteter

Sommeren 1985 ble det tatt 464 fastfjellsprøver av kalken i Gautelis-området. 330 av disse ble tatt langs profiler over den sydlige del av kalksteinshorisonten, mens 69 prøver ble tatt langs traseen i dagen av borhull 4-84. Analysene av disse 69 prøvene gjenspeilte tydelig anomaliene vi hadde i borhullene. metoden ble derfor betraktet som gunstig for å plukke ut områder som er anomale på gull. De 330 prøvene fra Gautelis S ga kun spredte sulfid-tilknyttede Au-anomalier, og på bakgrunn av disse resultatene ble gull-mineraliseringene i Gautelis-området delt i to hovedgrupper:

1. Gull knyttet til begrensede sulfidmineraliserte linser.

2. "Usynlig" disseminasjon av gull i kalkstein over større områder.

Bare den sistnevnte av disse ble ansett å være av økonomisk interesse.

Kartleggingen samme år syntes å vise at den disseminerte type gull-mineralisering var knyttet til en type mørk brun, tremolitt-rik kalk.

Aktivitetene i 1986 ble av disse årsaker konsentrert om fast-fjellprøvetaking for å finne ut om gullet virkelig var konsentrert om en spesiell type karbonat-bergart, - og hvis ikke, - definere utbredelsen av den kjente, disseminerte gull-mineraliseringen i Gautelis SV. Også andre kjente kalk-horisonter ble prøvetatt med samme hensikt: Cunojavri, Ruvssot, Gautelis-vann- og Kjørisvann-området.

Prøvene er fordelt på følgende måte:

Gautelis-området	350 prøver
N for Gautelisvann	5 prøver
Vest for demning, Gautelisvann	26 prøver
Kjørisvann	19 prøver
Kjørisvann S	4 prøver
Cunojavri	254 prøver
Ruvssot	22 prøver
Cainhavarre	6 prøver
Totalt	675 prøver

Av disse prøvene er det bare 4 spredte prøver som skiller seg klart ut:

Gau-86-P1-91: > 10 ppm Au
Gau-86-P4-59: > 10 ppm Au
Gau-86-P5-11: 2,2 ppm Au
Gau-86-P10-16: 1,1 ppm Au

Samtlige av disse er i større eller mindre grad knyttet til sulfid- og/eller magnetitt - (P5-11) mineraliseringer.

Gautelisfjell.

Aktiviteter: Fastfjellprøvetaking. Prøvene ble tatt langs "profiler" tvers over kalksteinshorisonten. Profilene ble lagt der blotningsgraden gjorde det mulig å få en best mulig dekning med prøveavstand maks. 2 m.

Formålet var å forsøke å definere området som er anomalt på gull ut fra to muligheter:

a. Den mørke kalken var anriket på gull.
b. Hvis ikke den mørke kalken var generelt anriket på gull, - forsøke å avgrense det anomale området av kalkhorisonten på en slik måte at man kunne vurdere det økonomiske potensiale.

I Gautelis-kalken ble det tatt 350 prøver, fordelt på følgende måte:

P1	100 prøver	P6	20 prøver
P2	44 prøver	P7	3 prøver
P3	33 prøver	P8	17 prøver
P4	70 prøver	P9	15 prøver
P5	22 prøver	P10	16 prøver
Spredte prøver			10
Totalt			350 prøver

Resultater: Av de 350 prøvene som ble tatt i Gautelis-området, var fire klart anomale:

Gau-86-P1-91: > 10 ppm Au
Gau-86-P9-59: > 10 ppm Au
Gau-86-P5-11: 2,2 ppm Au
Gau-86-P10-86: 1,1 ppm Au

P1-91 er prøve av sterkt rusten m2 stor bolle i lyst karbonat. I tillegg til denne prøven, har prøvene P1-90 (28 ppb) og P1-92-96 noe forhøyet innhold av gull, med henholdsvis P1-92: 26 ppb, P1-93: 6 ppb, 94: 86 ppb, 95: 6 ppb. Dette kan skyldes mindre fragmenter av py-mineralisert materiale som er fordelt i kalken.

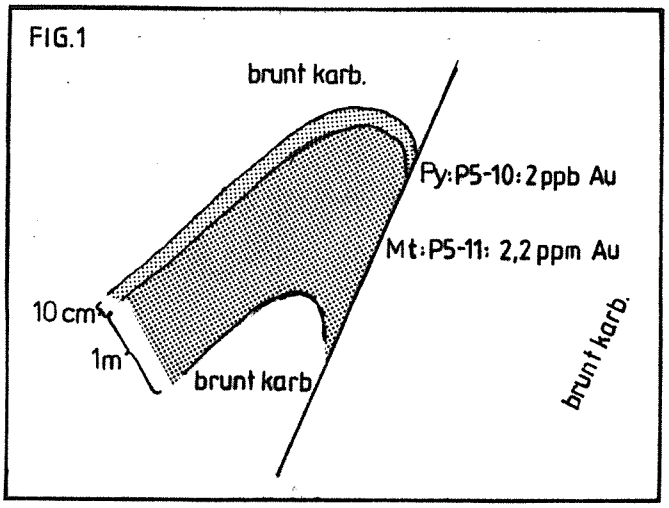
Også i 1985-sesongen ble det tatt to prøver av kalk i dette området: 85-403 er en 8 x 4 cm stor, rusten py- og chp - mineralisert bolle med > 10 ppm Au. Prøven hadde dessuten > 4000 ppm Cu, Zn og Pb.

Prøve 404 er tatt av nærmest breksjert kalkstein, helt i kanten mot fyllittene. Prøven hadde 14 ppb Au og > 4000 ppb Cu, men mindre mengder Pb og Zn, henholdsvis 220 og 150 ppb.

Om prøve P4-59 (> 10 ppm) kan kobles til samme sone som prøvene over kan først avgjøres når flere elementer er analysert. Det er imidlertid verdt å merke seg at prøven ligger i tilnærmet samme "nivå" i kalkhorisonten relativt til fyllitt-seriens bergarter.

Prøve P5-10 og -11 er interessante prøver fra den nedre, mørke del av kalkhorisonten. P10 er tatt fra en ca. 4 m lang og 10-20 cm tykk tremolittisk åre, rik på py (rusten). Prøven inneholder kun 2 ppb Au. I underkant av denne åren ligger en opptil meter tykk sone med nærmest massiv magnetitt. Prøve P5-11 er tatt fra denne sonen og inneholder 2200 ppb Au. Hele sonen er kuttet av en skarp liten forkastning, eller forskyvning. Mineraliseringen ser ut til å ligge "konkordant" i kalken (Se fig.1).

FIG.1



Lenger nord ble det i tilsynelatende samme nivå tatt en prøve (85-402), med 1400 ppb Au, og > 4000 ppm Cu. Også i denne prøven var det stor anrikning av magnetitt, så også her vil en sammenligning av forskjellige elementer være av interesse for om mulig å koordinere disse mineraliseringene. Generelt bør mineraliseringen ved P5-11 undersøkes nærmere, fordi den er lett synlig og synes å være relativt lite deformert. Den skulle dessuten være lett å følge med et magnetometer.

P10-16 er en mørk brun py-mineralisert kalkstein med 1100 ppb Au. P 15 er tatt like ved, men har ingen tydlig py-mineralisering, - og bare 59 ppb Au. Py-mineraliseringen, kan tyde på at vi her har å gjøre med en mineralisering av den begrensede, sulfidtilknyttede type, men siden vi i området har flere prøver med over 100 ppb, og siden de ligger nært til området med disseminasjonstypen mineralisering, er det grunn til å vurdere om de kan representere ytterkant av dette området.

Cunojavri.

Aktiviteter: Kartlegging, fastfjellprøvetaking.
Arbeidet i Cunojavri-området ble gjenopptatt som resultat av funnene av disseminert gull i Gautelis-kalken: Nordvest for Cunojavri finnes en flere hundre meter lang og bred kalkhorisont. Denne horisontens nære beliggenhet til Ruvssots ultrabasiske bergarter gjorde dette området spesielt interessant m.h.p. gull. Hensikten med kartleggingen var å legge inn kalkhorisontens grenser, - og om mulig å inndele kalken på samme måte som ved Gautelisfjell. Informasjonene fra dette arbeidet skulle brukes til å legge opp et prøvetakingsprogram. Kartleggingen ble gjort i målestokk 1 : 2600. Det ble tatt 254 prøver fordelt på følgende måte:

P1	160 prøver
P2	57 prøver
P4	37 prøver
Sum	254 prøver

Resultater: Kartleggingen i Cunojavri-området avdekket at sentrale områder av kalksonen består av glimmerskifre og meta-vulkanitter. Selve kalken er sterkt deformert. Klare horisonter som det vi finner i Gautelis-området kunne ikke skilles ut, men generelt kan det sies lyse grå-hvite kalker dominerer i den sydøstlige del av kalken. Disse lyse kalkene er ikke direkte sammenlignbare med de hvite kalkene i Gautelis, fordi de har et høyere innhold av silikater og en viss båndning med bånd av lyse tremolitter og wollastonitt (?). Andre av kalkene er brunere til mørk grå-brune. De har ofte tremolitt-årer, men generelt av en lysere type enn den man finner i Gautelis. Stedvis inneholder de wollastonitt. I overkant (nordsiden) finnes ofte et ganske høyt innhold av boller med kvartsittiske og kvartsfyllittisk materiale. "Anomale" prøver (22 ppb) finnes innenfor alle typer kalker: P1-1 (22 ppb) er funnet øverst i horisonten, i en

kalk som er full av boller av kvartsittisk materiale. P1-10 (22 ppb) er brunt karbonat med tremolittårer. P1-35 (21 ppb) er funnet i lyst karbonat. P1-76 (31 ppb) er funnet i inhomoget - brunt karbonat med varierende innhold av tremolitt-årer. Ett sted ble det funnet 0,5 cm stor py-krystall i tremolitt-holdig brunt karbonat (P2-14: 9 ppb) som på Gautelis. Det var forøvrig flere steder diffuse rustne bånd i kalksteinen, uten at høye gull-gehalter ble påvist i disse.

Ruvssot.

Aktiviteter: Det var fra tidligere kjent (Priesemann,1983) at det løper en tynn kalkhorisont fra like øst for Ruvssot-toppen vestover mot Vavratjokka. Denne sonen ble lagt inn på flybilde i målestokk 1 : 2600. Også denne kalken ble betraktet som spesielt interessant m.h.p. Au på grunn av sin nære beliggenhet til Ruvssots ultramafiske bergarter. Det ble tatt 2o prøver i horisontens vest-ende, hvor den hadde størst mektighet. Det ble dessuten tatt prøver av tynn flik av kalkhorisonten like over et av Mt-Cu-skjerpene på Ruvssot (prøve 276) og av alterert serpen-tinitt like syd-øst for Ruvssot-toppen (prøve 275).

Resultater: Av prøvene som ble tatt av Ruvssot-kalken, er det kun en som skiller seg noe ut (P3-8: 16 ppb). Denne prøven ble tatt av 1 x 0,4 m stor rusten tremolittisk åre. For øvrig er kalken av brunbeige type med tremolitt-årer.

Vest for demningen, Gautelisvann.

Aktiviteter: Etter som kalkhorisonten i dette området er en forlengelse av Gauteliskalken, var det av åpenbar interesse å prøveta denne. En profil med 26 prøver ble tatt (Gau-86-405-430).

Resultater: Kalken her er av mørk, brun type med varierende mengde tremolitt-årer. Flere steder ble det funnet opp til 1,5 cm store kubiske og oktahedriske py-krystaller, foruten rustne flekker eller spetter som trolig inneholder desseminert py. Kalken ligner på alle måter Gautelis mørke kalk, men hadde ingen anomale gull-verdier. De høyeste verdier var på 3 ppb (Gau-86-414, 415 og 416).

Kjørisvann.

Aktiviteter: Fordi vi også her har en mørk karbonathorisont, som dessuten synes å være knyttet til Gautelishorisonten, ble det prøvetatt en profil tvers over kalken også her. 19 prøver ble tatt: Gautelis-86-431-339.

Resultater: Av de 19 prøvene som ble tatt her, hadde 3 en viss anrikning på gull: 436: 50 ppb, 441: 26 ppb, 449: 97 ppb.

Kalken er mørk brun med diffuse silikat-bånd, og ligner en del på den mørke Cunojavri-kalken. Den har ikke synlig py-krystaller, men har rustne spetter som trolig skyldes spredt dissemmasjon av py. Prøvene 436 og 441 er tatt i kalken, mens 449 er tatt fra en delvis overdekket, sterkt rusten, mørk grønn kalk-silikat-linse ca. 75 m øst for lite vann ved bekken. Bergarten er delvis overdekket og av begrenset utbredelse.

Kjørisvann S.

Aktiviteter: Langs Kjørisvannkalken mot syd, på høyeste punkt, før terrenget igjen faller mot svenskegrensen. Dette området var av spesiell interesse fordi det i området er funnet skarn-omvandlinger. Horisonten er dessuten sterkt breksjert, og ligger på grensen mellom den grovkornede granitt i vest, og den mer finkornede Gautelis-granitten i øst. 4 prøver ble tatt: Gau-86-458-461.

Resultater: Ingen av prøvene hadde høye gehalter av Au.

Gau-86-458: Kalk i tektonisert sone mellom granitt og tynn, rusten fylitt-sone: 2 ppb.
Gau-86-459: Rusten fyllit nevnt over: 2 ppb.
Gau-86-460: Rusten kalk under fyllit: < 1 ppb
Gau-86-461: Kvarts-karbonat "breksje": 5 ppb.

Spredte prøver nord for Gautelisvann.

Aktiviteter: To prøver ble tatt av tynn beige til mørk brun karbonat-horisont som løper mot N fra nordenden av Gautelisvann. Kalken er stedvis py-mineralisert. Gau-86-400 og 401.

En prøve ble tatt av gabbroid b.a.m. py og chp-mineralisering beliggende mellom de to ultrabasiske kroppene ved Trekakfjellet: Gau-86-402. 2 prøver ble tatt av altererte ultrabasitter i samme område: Gau-86-403-404.

Resultater: Av disse prøvene nevnes bare Gau-86.400, som ble tatt fra en 10 x 5 cm sone rik på små py-krystaller i kalkhorisonten. Prøven hadde 8 ppb Au.

Spredte prøver Gautelis.

Aktiviteter: 10 spredte prøver ble tatt i området Gautelis S. 3 av disse ble tatt i fyllittene i kanten mot Gull-kalken (Gau-86-450-452). 5 prøver tatt øverst i kalken Gautelis S, i området ved profil ONS i stikningsnettet Gautelis S. 2 prøver ble tatt i tynn

karbonat-benk hvor denne forsvinner mot nord, like ved stedet hvor bekken fra vannet forsvinner i Gautelis S.

Resultater: Av disse prøvene nevnes Gau-86-453, som hadde 28 ppb Au. Den er tatt oppe i nordvestre hjørnet av kalken i Gautelis S. Den består av grått, grovkornet karbonat med diffuse rustflekker. Prøve 454 ble tatt av samme bergart like ved og hadde 1 ppb Au.

Cainhavarre, Norddalen.

Aktiviteter: Oppmerksomheten ble rettet mot dette området etter å ha lest A. Korneliussens NGU-rapport fra området, hvor han beskriver felsiske vulkanitter med karbonat-anrikede soner som kunne være "dannet ved exhalativ-hydrotermal aktivitet". 6 prøver ble tatt øst for den store fossen som renner ned i norddalen på sørsiden av denne og øst for demningen.

Resultater:

Gau-86-464-466:	Karbonatholdig felsisk vulkanitt:	< 1 - 11 ppb Au
467:	Karbonatholdig felsisk vulkanitt med flusspat :	1 ppb Au
468:	Karbonatholdig felsisk vulkanitt:	< 1 ppb Au
469:	Felsisk vulkanitt med rustflekker:	< 1 ppb Au

Konklusjon.

Sommerens arbeider i Gautelis-området viste at de disseminerte gullmineraliseringene ikke uten videre kan knyttes til de mørke, tremolitt-rike kalkhorisontene. Prøvetakingen viste også at gull-disseminasjonen er begrenset til det allerede kjente området på Gautelis' sørvest-skråning, selv om prøvetakingen i profiler kan åpne for mindre, mineraliserte områder mellom disse. Forutsatt er at metoden som har vært benyttet en tilfredsstillende nok, kan man konkludere med at de disseminerte gull-mineraliseringene på Gautelisfjell ikke har økonomiske dimensjoner.

Sommerens prøvetaking avdekket heller ingen gull-mineraliseringer av samme type i andre kalk-horisonter i Skjomen-området.

Når det gjelder de sulfid-tilknyttede gull-anomaliene har disse hver for seg begrensede dimensjoner, men kan muligens i større skala (eks. øverst i kalkhorisonten, Gautelis, vest) danne mønstre som kan tolkes som sterkt deformerte horisonter eller gamle lineamenter. Mulighetene for økonomiske forekomster ansees i øyeblikket for små.

Det er imidlertid en kjennsgjerning at man på Gautelisfjell har funnet en type gull-mineralisering som ikke tidligere har vært kjent i Norge. Den utgjør et visst volum og har gehalter i området for det økonomiske interessante. Videre kjenner man til store, økonomiske gullforekomster av lignende type andre steder i verden (Carlin). Selv om kan kanskje ikke vil finne en drivbar forekomst på Gautelisfjell, anbefales det derfor å fortsette

undersøkelsene i området med sikte på å finne en forklaring på hvordan mineraliseringen har blitt dannet og derigjennom finne en metode å spore opp disse mineraliseringene, slik at andre potensielle områder kan undersøkes og vurderes.

Forslag til videre undersøkelser.

Ettersom vi nå trolig har greid å definere området hvor vi har disseminasjon av gull i kalken, er tiden inne til å gå inn i detalj å karakterisere dette området for å finne ut hva dette området har/ikke har til felles med andre områder i kalkhorisonten. Med dette menes å sammenligne de mørke kalkene fra dette gull-førende området med kalken fra de ikke gull-førende områder. Dette bør innbefatte:

1. Sammenligninger av innholdet av en rekke elementer, samt:
2. Mikrosonde-, mikroskopi- , diffraktometer- undersøkelser.
3. Sammenligne andre bergarter f.eks. tactitter, granittiske bergarter og amfibolitter i og utenfor det mineraliserte område (Se detaljkart, Priesemann, 1984).
4. Man bør også gjøre en detaljert undersøkelse av lineamentene i hele området, for om mulig å finne en bestemt type retning, eller kombinasjon av retninger som er spesiell for området.
5. Når det gjelder de spredte sulfid-tilknyttede gull-anomaliene, så bør også disse analyseres på flere elementer (som: S, As, Bi, Fe, W, Pb, Zn, Cu o.l.), for om mulig å kunne dele disse opp i undergrupper, eventuelt finne kriterier som gjør at vi kan si at flere anomalier tilhører samme horisont evt. "lineament".
6. Til dette hører også strukturgeologiske studier av disse forekomstene (her er mineraliseringen ved prøve P5-11 vel egnet.)
7. Forhøyede gullverdier i fyllitten over gull-anomaliene i kalken i Gautelis V. (Priesemann, fastfjellsprøver 1983) gjør at også disse bergartene bør vurderes i det videre arbeidet.
   En del prøver er allerede sendt til analyse på elementene nevnt ovenfor. Disse er bl.a. valgt ut fra gullholdig, mørk kalk, ikke gullholdig, mørk kalk, spredte kalksone-anomalier med tilgrensende prøver, - og 20 prøver fra ovennevnte fyllitt.

   Prøver ut over det som naturlig inngår i forslagene over, bør konsentreres om områdene rundt spredte anaomalier. Det bør også prøvetas profiler i forbindelse med disse, - fra kalken og et godt stykke inn i fyllit-sekvensen.

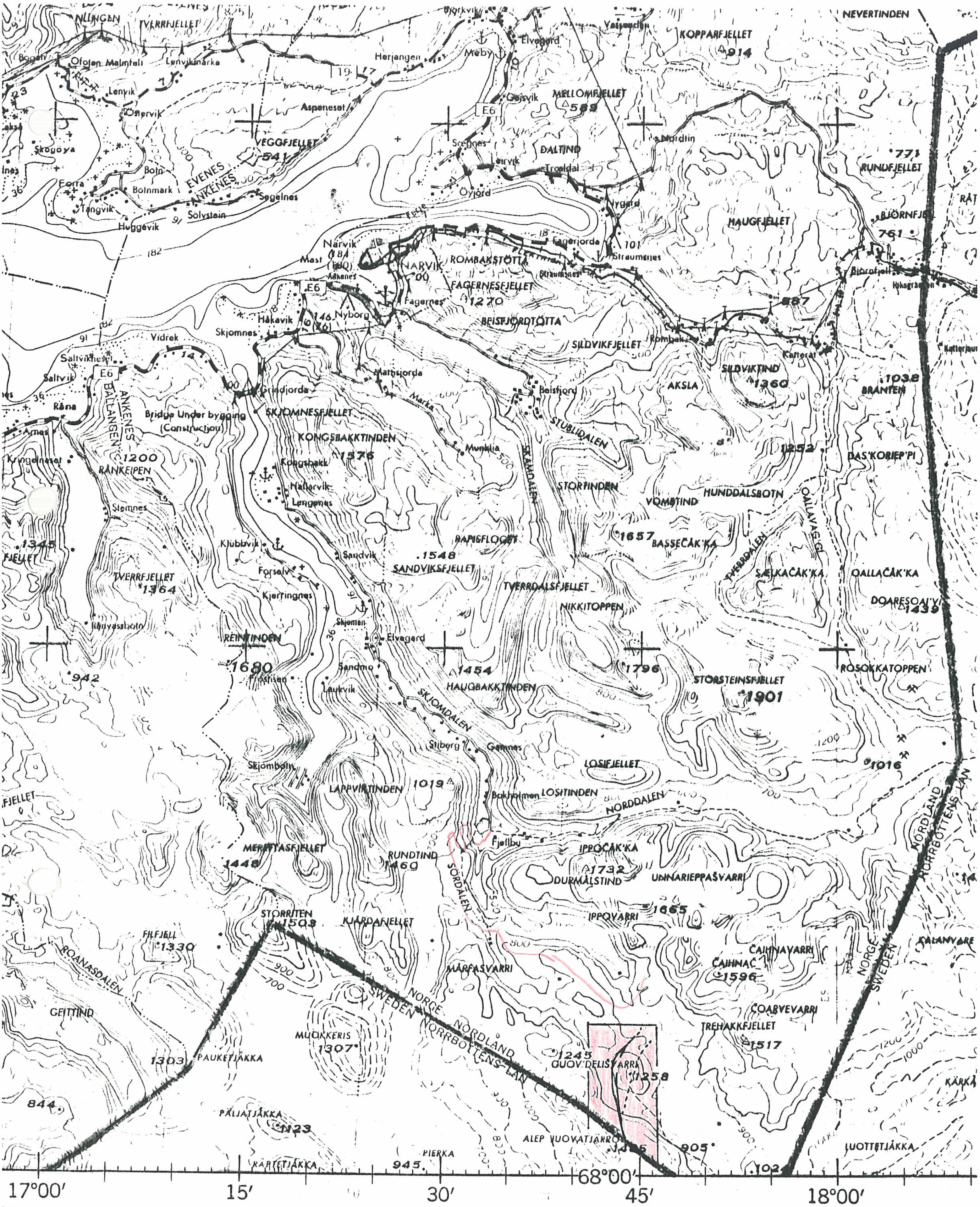
   For å sjekke prøvetagnings-metoden kan det være en fordel å sprenge ut større prøver i utvalgte områder for å sammenligne analyse-resultatene.

ROMBAK PROSJEKT (330 250)

FOLLDAL VERK A/S

DESEMBER 1985

Av prosjektleder Jan I. Tollefsrud



JOINT OPERATIONS GRAPHIC

Scale, *Målestokk* 1:250,000

5 0 5 10

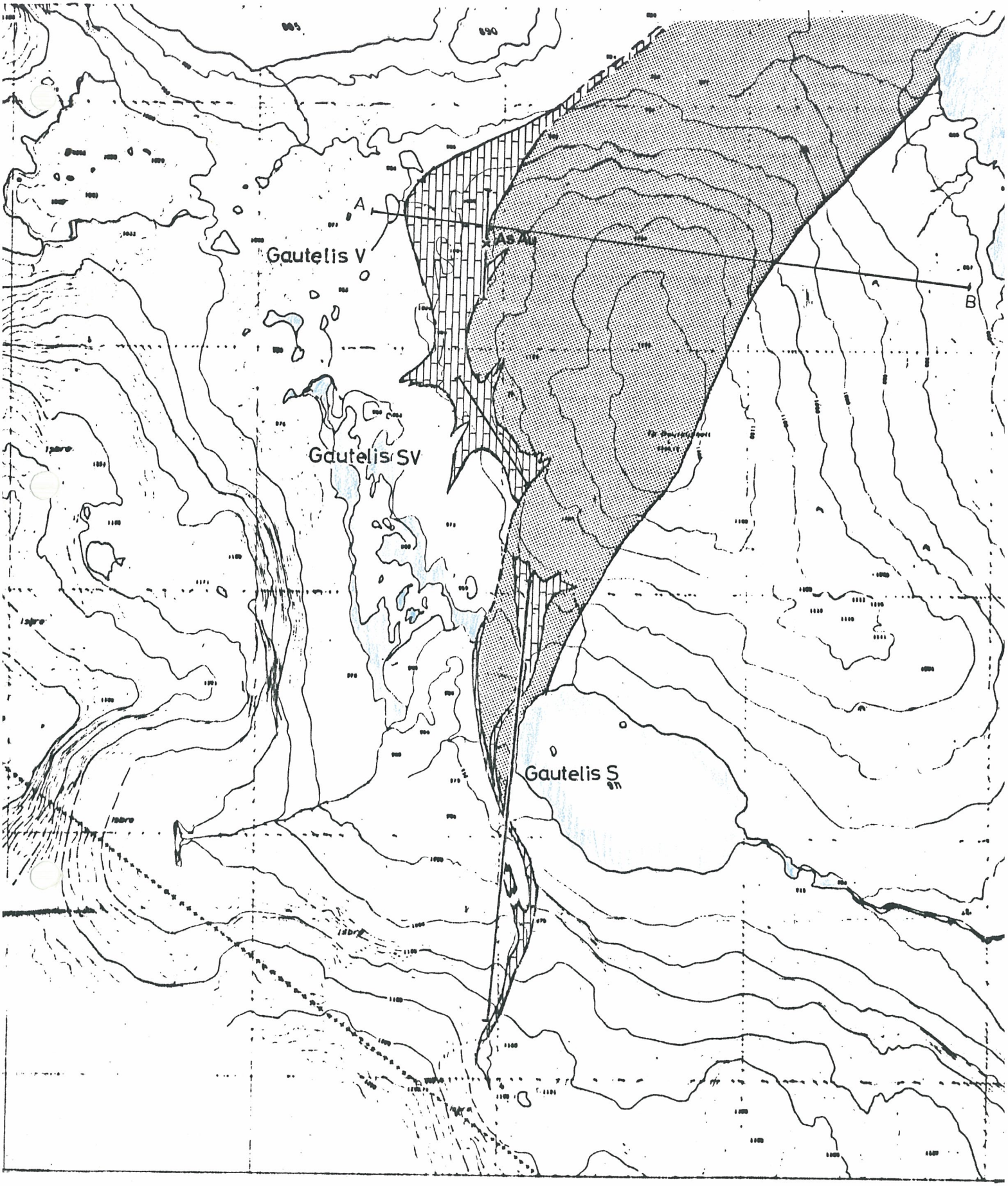
5 0 5 10 15 Km

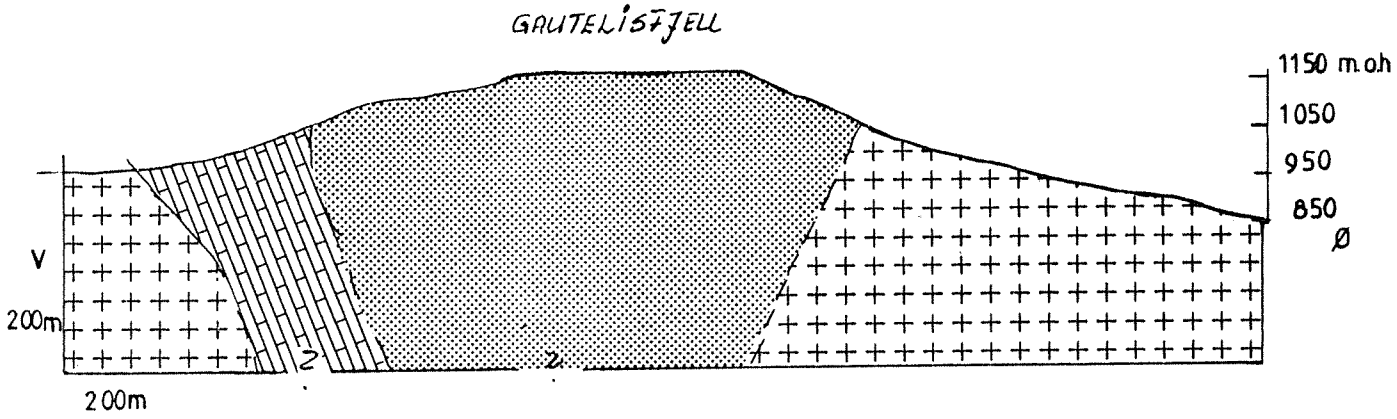
5 0 5 Nautical Miles

GAR

Motorveg

	Principal Hovedveg	Secondary Annen veg
hard surface,		
ore lanes wide / *fleire køyrebreidder*	3 LANES 3 KØYREBREIDDER E70	
wide *Ei køyrebreidd*		
loose or light surface,		
ore lanes wide / *fleire køyrebreidder*	3 LANES 3 KØYREBREIDDER	
wide *Ei køyrebreidd*		
eather, loose surface		
l veg		


A
B
Gautelis V
Gautelis SV
Gautelis S
N
MÅLESTOKK 1:20000
granittisk gneiss
metasedimenter
metavulkanitter
kalksteiner



Vertikal-snitt ø-v gjennom Gautelisfjellets suprakrustalbergarter

INNHOLDSFORTEGNELSE

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Innledning

Som resultat av en studie av gull - potensiale i Nord Norge (Krause, 1982), ble det av Folldal Verk A/S og Amoco Oil Company, som ledd i et joint venture, tatt ut mutinger i Rombaks-området. Dette området er tidligere kjent for sine arsen-gull, kobber og bly - zink mineraliseringer, og innenfor det undersøkte området finnes et arsen-gull skjerp som har gitt 400 tonn malm i løpet av en kort driftsperiode i 1920-årene.

Mineraliseringene er knyttet til prekambriske pe~~s~~terozoiske suprakrustaler som består av metasedimenter og metavulkanitter. Suprakrustal-horisontene finnes som N-S orienterte linser i prekambriske granittiske gneisser som utgjør hovedbergartene i det såkalte Rombak - grunnfjellvindu.

Folldal Verk A/S - Amoco Oil Company's feltarbeider i Sjomen / Rombak prosjektområde startet sommeren 1983 med regional fastfjells-prøvetaking, jordprøvetaking og geofysiske bakkemålinger konsentrert til de mutede områder.

I løpet av sommeren 1984 ble det gjort oppfølgingsarbeider på anomale gull-områder. Detaljert geologisk kartlegging, jordprøvetaking og geofysiske målinger ble konsentrert om stikkningsnettet Gautelis SV. Det ble også satt ut tre diamantborhull i et område med anomale gull-verdier i det samme stikkningsnettet (fig.).

Videre ble det satt ut tre diamantborhull for å undersøke forløpet av mineraliseringene i arsen-gull skjerpet mot dypet. I tillegg ble det utført en del rekognoserende undersøkelser i omliggende områder.

Mutingsstatus / Aktiviteter

Folldal Verk A/S har siden 1983 holdt 5 mutings blokker, med totalt 81 mutinger.

Disse er:

Kjørisvann	7	mutinger
Gautelisfjell	33	"
Akru	6	"
Vavrat	15	"
Ruvsot	20	"

Det ble sommeren 1985 ikke utført arbeider i regi av andre selskaper som har mutinger i området (Arco Norway Minerals Inc. , Norsk Hydro A/S, Skjangeli A/S) Norges Geologiske undersøkelse avsluttet i løpet av høsten sine undersøkelser av suprakrustal seriene i Rombaks-vinduet. Tre geologer under ledelse av Are Corneliussen utførte kartleggingsarbeider i områdene nord og vest for Gautelisfjell.

Sammendrag / Konklusjon

Det ble sommeren 1984 funnet anomale gull-gehalter både i fastfjellsprøver og i diamantborhull i kalksteinshorisonten på Gautelisfjellets sydvest - skråning. Ved diamantboring ble det også funnet at mineraliseringen ved As - Au - skjerpet på Gautelisfjellets vestskråning hadde en fortsettelse mot dypet. Resultatene ble vurdert så interessante at det også sist sommer ble foretatt undersøkelser i området.

Programmet for 1985 besto i å kartlegge hele kalksteinshorisonten ved Gautelis i målestokk 1:2600. Videre ble det diamantboret 809 meter fordelt på 6 borhull. 2 hull, hver på 180 m ble boret ved arsenkis-skjerpet, mens resten ble boret i Gautelis sydvest-skråning.

Det ble opprettet et nytt stikkningsnett på Gautelisfjellets sydside, og i dette stikkningsnett ble det tatt 330 fastfjellsprøver.

Det ble også tatt 69 prøver langs traseen av borhull 4-84.

De geofysiske undersøkelsene besto i IP- og MAG.- målinger i stikkningsnettene Gautelis V og - SV, mens det ble målt MAG. og VLF i det nye stikkningsnettet Gautelis S.

Diamantboringen ved As - Au - skjerpet viste at den mineraliserte linsen er begrenset mot dypet, og at denne mineraliseringen ikke er av økonomisk interesse.

Diamantboring og fastfjellsprøvetaking i området Gautelis SV avdekket at det her finnes et større område med anomal dissiminasjon av gull i kalksteiner. Sonen er funnet å være ca 30 m tykk, minst 70 m langs fallet og tilsynelatende minst 60 m langs strøket. Kjerne- prøver med opptil 6.6 ppm i 3-meters seksjoner ble funnet.

Kartlegging og fastfjellsprøvetaking viste at det finnes to typer mineralisering. Den ene er knyttet til små sulfidmineraliserte linser, mens den andre, som nevnt over, er knyttet til disseminasjon i kalkstein over større områder.

Kartlegging og prøvetaking viste videre at tactitt / skarn - bergarter i området ikke kan brukes som "ledere" til områder som er mineralisert med gull.

Det er ikke klarlagt hvordan mineraliseringene er kontrollert. Det ble ikke funnet struktur-elementer som kan knyttes til mineraliseringene. Det synes midlertid som om forhøyede gull verdier er

knyttet til en type urene kalksteiner. Disse er kartlagt, og befinner seg i kalksteinshorisontens vestlige kant, på grensen mot gneiss-granittene.

Sommerens undersøkelser viste at systematisk fastfjellsprøvetaking er vel egnet som middel til å plukke opp eventuelle gull anomalier. Det foreslås derfor at det neste feltsesong foretas systematisk prøvetaking langs profiler på tvers av kalksteinshorisonten i området f.o.m. stikkningsnettet Gautelis SV og nordover.

Videre bør kalksteinshorisonten ved Cunojavri (ca 20 km NNØ for Gautelis) kartlegges og prøvetas på tilsvarende måte.

Regional geologi

Prekambrium i Nordland er representert ved grunnfjellsvinduer i de kaledonske bergarter. 5 av disse ligger ute ved kysten, og 4 i innlandet, mot grensen til Sverige.

Det undersøkte område i Sjomen ligger innenfor ett av disse - det såkalte Rombak vinduet. Berggrunnen her er dominert av ortogneisser av granittisk og granodiorittisk sammensetning (1707 ± 70 mill år, Heier og Compston, 1969). Disse gneissene kan grovt inndeles i to typer. Den ene er grovkornet med cm store krystaller av pertittisk kali-feltspat, som gir bergarten en øye-gneiss textur. Den andre er finkornet og synes mer inhomogen, både i sammensetning og textur.

Spredt i disse gneissene ligger stort sett N-S gående linser av suprakrustale b.a. - serier. Disse består av metasedimenter og metavulkanitter. Den stratigrafiske og litrologiske oppbygning av disse suprakrustal-horisontene varierer fra linse til linse, og også lateralt innen samme linse. Avsetningene gir generelt utrykk av å være avsatt på grunne til midlere vanndyp. Vi finner følgende b.a.-typer (etter Priesemann, 1984), fyllitter, stedvis grafitt-holdige (meta siltsteiner), amfibolitter (meta basiske lavaer), serpentinitter, (meta ultrabasiske vulkanitter), karbonater (meta kalksteiner og dolomitter), kvarts - feltspat - biotitt skifere (meta intermediære til felsiske tuffer), grafitt-holdige kvarts - biotitt-kloritt skifere (meta tuffitter) kvarts - feltspat b.a. (felsiske metatuffer) og kvartsitter (metaarenitter).Som intrusiver finnes amfibolitter, gabbroer dioritter og dunitter som stedvis inneholder relativt mye magnetitt. Flere steder finnes bånd med sulfid - mineraliseringer, som hovedsakelig danner små stratabundne linser.

Historikk - tidligere undersøkelser

Rombak vinduet har lenge vært kjent for sone arsenkis og kobber - mineraliseringer. Senere er flere Pb-Zn mineraliseringer og noen uran indikasjoner også funnet og undersøkt.

Den tidligste malmletingsaktivitet i morådet (1916 - 1924) . foregikk i regi av privatpersoner eller mindre selskaper. Særlig ble arbeidet konsentrert om arsenkis forekomsten i Gautelisfjellets vest-helling. Mineraliseringen ligger på grensen mellom metasiltstein - serien og karbonat - horisonten, og det ble produsert ca 500 tonn malm med gjennomsnittlig 30% As og 11 ppm Au.

Også arsenkis mineraliseringer ved Kjørisvann og Ruvssot er blitt undersøkt.

Videre er det gjort mindre arbeider på kobber-mineraliseringer ved Nuorojokka og Ruvssot, og en åre-lignende Zn-anrikning i nærheten av Cunojavri.

Som del av et prospekteringsprogram på uran, foretok NGU/USB også undersøkelser i Rombak vinduet i 1975 (NGU - rapport 1369/2). I Nordalen (L051) ble det i denne forbindelse funnet to svake radiometriske anomalier.

Uran - mineraliseringen er knyttet til finkornete kvartsrike varianter av granittiske gneiss.

En annen uran - indikasjon ble funnet ved Vavrat (Cunojavri), og denne finnes i en suprakrustal bergarts-serie bestående av grønnskifere og rustne glimmer-skifere. De radiometriske bakkemålinger plukket ut en svært begrenset mineralisering med et uraninnhold på 34 ppm og nesten ikke noe Pb.

I 1976/78 foretok NGU/USB undersøkelser av Pb - Zn mineraliseringene på vestsiden av Katterat vannet (NGU-rapport 1430/5). Disse forekomstene er tidligere beskrevet av Smith, 1929 (Bergarkiv rapport 4568). De er tidligere undersøkt ved grøfting og sprenging (1890), mens arbeidene i nyere tid ble konsentrert om geologisk kartlegging og prøvetaking.

Pb - Zn mineraliseringene er knyttet til steiltstående, cm - dm tykke karbonat-årer, som bare stedvis inneholder kvarts, feltspat, epidot, noen fibrige amfiboler og flusspat. Årene løper oftest N-S, paralelt bergartens foliasjonsplan. Mesteparten av dem finnes i granittisk gneiss, men noen er også funnet i suprakrustale bergarter. Et mindre antall prøver ble analysert for Pb, Zn, Ni og Ag, men verdiene var generelt lave.

Fra samme sted er beskrevet flere sulfid - mineraliseringer. De er knyttet til gabbroide bergarter og metamorfoserte suprakrustaler. Mineraliseringene består hovedsakelig av magnetkis med mindre mengder zinkblende, kobberkis og blyglans. Lokalt kan også arsenkis finnes. Mineraliseringen er alltid av disseminert type, er stratabundet, og alltid svært begrenset i omfang.

Ingen av Katterat - mineraliseringene synes å være av økonomisk interesse. (NGU-rapport 1430/5A).

Nylig har NGU hatt flere programmer gående som særlig har vært konsentrert om suprakrustalbergartene i Rombak - vinduet. Magnetometriske og radiometriske helikopter-målinger ble foretatt i to begrensede områder (NGU-rapport 1836). Et bekkesediment - program med store prøve- avstander dekket størstedelen av vinduet. (NGU-rapport 1800/58 Bd I og II). Detaljerte geologiske undersøkelser, hovedsaklig konsentrert om USB's mutings-områder i Morfasfjell (Iptovann) ble iverksatt i 1982. Arbeidene omfattet geologisk kartlegging, tektoniske studier og bergarts-geokjemiske undersøkelser.

I de senere år er detaljert geologisk kartlegging utført på Cunojavre - Unna Alakats - Sjangeli vulkanske belte av Rolf Rømer fra Universitetet i Luleå.

Arco Norway Minerals Inc. startet prospektering i Rombaksvinduet sommeren 1983. Samme år ble det utført regional bekkesediment prøvetaking og rekognoserende undersøkelser i mutingsområdene. Geofysiske helikoptermålinger ble foretatt samtidig med felt-arbeidet.

Sommeren 1984 ble det utført detaljert geologiske undersøkelser og geofysisk bakkemålinger. 12 diamantborhull på tilsammen ca 2000 meter ble boret i Haugfjell området.

Det er ikke kjent at Arco hadde aktiviteter i området sommeren 1985.

Norsk Hydro A/S har aldri startet undersøkelser i sine mutingsområder.

SKJOMEN 1985

Sommerens aktiviteter i Rombak - området ble konsentrert om Gautelis karbonathorisont, fra Gautelisfjellets vestskråning og sydover til Svenskegrensen.

Innenfor dette området ble det foretatt:

a) Diamantboring, 809 m, fordelt på 6 hull, 65-183 m lange.

b) Geologisk kartlegging av hele karbonat-horisonten i målestokk 1:2600.

c) Opprettelse av nytt stikkningsnett fra Gautelisfjellets sørhelling til Svenskegrensen. Basislinje: 1850 m lang, rettning : N-S.

d) Fastfjellsprøvetaking, tilsammen 404 prøver.

e) Geofysiske målinger: IP, VLF og Magnetometer.

Formål:

Nærmere undersøkelser av gull-anomalier funnet ved diamantboring og fastfjellsprøvetaking sommeren 1984. Forsøke å få en oversikt over hvor og hvordan gullet opptrer, og om det er muligheter for å finne større mineraliseringer.

ad punkt a): Diamantboring

Av de 6 hullene som ble boret, ble 4 plassert i stikkningsnettet Gautelis SV, i området hvor forrige års boringer og prøvetaking ga gull-anomalier. (Bh-4-84, fastfjellsprøve: 142-84),

Hull 1-, 2- og 3-85 ble satt ut for å undersøke om anomalien i Bh-4-84 hadde noen utbredelse i lengde og dybde. Videre skulle det undersøkes om underliggende gneiss på noe sted hadde forhøyede gull-verdier som kunne knyttes til gjennomsettende sprekksystemer som har ført gull-holdige løsninger.

Hull 4 ble satt ut i retning mot anomal fastfjellsprøve fra 1984, for å undersøke om omliggende kalk hadde forhøyede gullverdier.

Hull 5 og 6 ble satt ut for å undersøke det videre forløp mot dypet og mot nord av mineraliseringene i As-kis skjerpet.

ad. punkt b): Geologisk kartlegging

Ut fra det høye innholdet av gull i granat epidot bergarten i hull 4-84, og muligheten for at gullmineraliseringen kunne knyttes til tektoniske elementer (spredte forhøyede gullverdier i gneiss granitt og kvartsitt-bånd i denne (bh-6-84)), ble det lagt vekt på disse faktorene ved den geologiske kartlegging.

ad. punkt c): Nytt stikkningsnett

Ettersom det fra Gautelisfjellets sydside og mot Svenskegrensen ble funnet flere store og små linser og boundenger med tactitter (granat - epidot - diopsid / tremolitt - bergarter), ble det besluttet å sette opp et stikkningsnett i dette området. Basislinjen er 1850 m lang, og løper N-S. Fra og med profil 565 S, til og med 1850 S, ble det satt opp tilsammen 11 profiler m. innbyrdes avstand på 75 - 225 m, avhengig av blottningsgraden.

ad. punkt d): Fastfjellsprøvetaking

Innenfor det overfor nevnte stikkningsnettet ble det tatt fastfjellsprøver hver annen meter der dette var mulig - tilsammen 330 prøver.
For å få et tredje snitt gjennom den gullholdige kalken ved Bh-4-84, ble det tatt fastfjellsprøver hver meter, i alt 69 prøver langs traseen av dette borhullet.

ad. punkt e): Geofysiske målinger

Det ble gjort IP og tette (hver 8. meter) magnetometriske målinger i utvalgte profiler i stikkningsnettene Gautelis V

og Gautelis SV. Videre ble det målt magnetometri og VLF i det nye stikkningsnettet Gautelis S. Målepunktavstand i profilene var her 25 meter.

RESULTATER

Fastfjellsprøver: Av de 330 prøver som ble tatt i det nye opprettede, sydlige stikkningsnett, hadde 4 anomale gull-gehalter; henholdsvis nr. 100 (565S/186V): 1000 ppb, nr. 150 (725S/139V): 1500 ppb, nr. 202 (1275S/67Ø): 1100 ppb, og 233 (1475 . S/85Ø): 6200 ppb. 2 prøver hadde svakt forhøyede verdier (174 (1100S/27Ø): 190 ppb, 175 (1100S/29Ø): 390 ppb). De anomale prøvene er spredt over hele stikkningsnettet, og felles for alle er at de ved siden av gull, har et høyt innhold av kobber. Dette gjør at mineraliseringens utgående i dagen er synlig med det blotte øye. Utseendet av disse mineraliseringene synes å bekrefte intrykket fra anomalimønsteret av at de har en svært begrenset utbredelse. Prøve 233 stammer f.eks. fra en 15 x 30 cm stor py mineralisert bolle, mens de andre prøvene er funnet i mer eller mindre diffust begrensede, små linser (eks. 30cm x 2m) mineralisert med malakitt og kobberkis. De samme relasjoner synes å gjelde for spredte prøver som ble tatt lenger nord i karbonat - horisonten, med den forskjell at disse stedvis synes å ha et høyere innhold av Zn.

Hverken tactitt-bergartene, eller karbonat bergarter som granset opp mot disse hadde anomale gull - verdier.

Fastfjellsprøvene som ble tatt langs traseén til borhull 4-84 ga fine anomalier som kan kobles sammen med anomaliene i borhull 4-84, 1-85 og 2-85. I disse borhullene ble det funnet soner på henholdsvis 28 + 5 m, 33- og 30 m, med karbonat bergarter som var anomale på gull, og hadde 3 meter's- seksjoner med opptil 6.6 gram gull pr. tonn. I hull 1-85 hadde hele sonen et snitt på 716 ppb gull, mens en seksmeter- seksjon hadde 1850 ppb (54 - 60 m) og en tremeter- seksjon hadde 2400 ppb (69 - 72 m). I hull 2-85 hadde hele sonen et snitt på 1133 ppb, mens to tremeters- seksjoner hadde henholdsvis 3300 ppb (44 - 47 m) og 6600 ppb (50 - 53 m). I hull 4-84 hadde den øvre 26 m's sonen et snitt på 578 ppb, med spredte meters - seksjoner på henholdsvis 1500 ppb (20.8 - 21.8 m), 1200 ppb (15 - 26 m), 4700 ppb (33 - 34 m), 1000 ppb (34 - 35 m), 2500 ppb (39 - 40 m) den nedre 5 m's sonen hadde snitt på 391 ppb og én meter- seksjon på 1500 ppb (52 - 53 m).

Tilsvarende sone ble funnet i borhull 3-85 som 2 fem-meters seksjoner, adskilt av en amfibolitt. Den øvre sone har et snitt på

920 ppb med to meters- seksjoner på 1550 ppb (71 - 73 m), mens den nedre hadde et snitt på 458 ppb, med én meters- seksjon på 1500 ppb.

Også i borhull 4-85 ble de gjennomborede karbonater funnet å ha noe forhøyede gull- gehalter, med maks innhold for metersek-sjon på 650 ppb (55 - 56 m). Forskjellen mellom disse anomali-ene og de som ble funnet lenger sør, er at de ikke kan knyttes direkte til markerte sulfid eller oksyd mineraliseringer. Det ser derfor ut til at vi i området har hatt minst to typer, eller episoder av mineraliseringer: Disse er:

a) Spredte sterkt begrensede gull-mineraliser-inger knyttet til sulfidmineraliseringer.

b) Gull-mineraliseringer i form av disseminasjon over større områder.

I det første av de utsatte borhull ved arsenkis- skjerpet (5-85), ble det funnet en sone på ca 5 m med As- mineraliser-inger i bergart av tilsvarende type som ble funnet i skjerpet og i borhull 3-85. I borhull 3-85 ble sonen funnet å være ca 14 m tykk, og ser altså ut til å tynne ut langs fallet mot dypet fra dette nivået.

Situasjonen var derfor den at vi hadde 4 borhull plassert fra og med skjerpet og nordover (fig.).

Hull 1-84 var plassert 25 m vest for skjerpet, normalt på strøkretningen, og fall 60°. Resultatet var negativt. Hull 3-84 var plassert 50 m nord for- og 50 m vest for skjerpet. Borhullsfallet var 45°. Resultatet var 14 m sone med forhøyede gull - innhold. Hull 2-84 var plassert 100 m nord for- og 50 m vest for skjerpet, og borhulls - fall 45°, gav negativt resultat.

Det var altså fortsatt en mulighet for at det kunne eksistere en As - Au - mineralisert linse med utgående i skjerpet og en lengste akse liggende i foliasjonsplanet, men med en stupning mot nord. Hull 2-84 hadde ut fra denne tanken skåret det mineraliserte plan over linsen, mens hull 1-84 hadde skåret det i underkant av linsen. Ut fra denne argumentasjon ble det besluttet å sette ut hull 6-85. Dette hullet skulle skjære kissonen 50 m nord for- og ca 10 m dypere enn i hull 5-85.

Bare rester av kvarts - feltspat bergarten - og ingen tydelige arsenkis mineraliseringer ble funnet. Sonen i begge hull ble analysert, og ga bare svakt forhøyede verdier for Au og As.

Ved den geologiske kartlegging ble det, som tidligere nevnt lagt vekt på å lete etter bergartstyper / varianter og tektoniske struktur - elementer som eventuelt kunne tenkes å brukes som ledere for å finne gull - mineraliserte områder.

Ved fastfjellsprøvetakingen langs traseén til borhull 4-84, ble det oppdaget at karbonatene stedvis hadde fått utviklet en viss skifrighet. Denne skifrigheten kunne tenkes å ha blitt dannet ved lokale shearbevegelser, og kunne representere tektoniske strukturer som hadde vært med å bestemme distribrusjonen av gullførende løsninger. Analyseresultatene viser imidlertid ingen sammenheng mellom de skifrige karbonatene og gull - anomaliene.

Det ble tatt prøver langs større lineamenter, uten at det ble funnet gull - anomalier som kunne kobles til disse strukturene.

Fordi det sommeren 1984 ble funnet skarn / tactitt bergarter (består hovedsakelig av kalksilikater, granat - tremolitt / diopsid - epidot, og dannes ved hydrotermal omvandling av kalksteiner, i et område med anomale gull - analyser i stikkningsnettet Gautelis SV- og fordi det andre steder (eks. Rosita Mine, Nicaragua, Bevans, 1973) er funnet gull - forekomster tilknyttet slike bergarter, ble det fokusert en del på forekomsten av disse i det undersøkte området.

På bakgrunn av prøvetakingen / kartleggingen i stikkningsnettet Gautelis SV, er det gitt mulighet for å sammenholde utbredelsen av skarn / tactitt - bergarter med utbredelse av anomalt innhold av gull i kalksteinene.

Ut fra gull analysene fra borhull 1-85 og fastfjellsprøvene langs traseén til borhull 4-84, ser det ut til at de forhøyede gull - innhold er begrenset til tactitt - bergarten og kalksteinene "under" denne. Hvis det var de samme hydrotermale løsninger som både førte til skarn - dannelsen og førte med seg gull, - skulle vi forvente en aura av forhøyede gull - verdier på begge sider av tactitt - bergarten.

Når det gjelder skarn - bergartene i stikkningsnettet Gautelis S, så har hverken disse - eller kalksteinene som støter opp til dem, anomale innhold av gull. Det kan ut fra dette, sluttes at skarn - bergartene i området ikke uten videre kan kobles sammen med gull - mineraliseringer, og at fenomenene trolig er knyttet til forskjellige episoder av hydrotremal aktivitet.

I en kalksteinshorisont som løper paralelt med Gautelishorisonten, ved Kjørisvann, ca 2 km vest for Gautelisfjell, ble relasjoner tilsvarende de vi finner i Gautelis observert. Også her ble det funnet linse med skarn - bergart i kalkhorisontens sydlige del, hvilket kan tyde på at skarn - omvandlingene er et regionalt fenomen.

Under den geologiske kartlegging ble det gjort forsøk på å inndele kalksteinene i forskjellige petrografisk varianter. En type, som skiller seg markert ut, er en hvit til lys- grå, ren kalkstein. Den har en kornstørrelse på 2 - 3 mm, er oftest uten tydelig foliasjon, og erosjonsflater danner oftest rundede sva. De finnes typisk i de strukturelt øvre deler av karbonathorisonten, og finnes oftest som kiler inn i de overliggende metavulkanitter og metasedimenter, som utgjør Gautelisfjellets vestflanke og topp. Under disse lyse karbonatene- ned mot grensen til gneiss granittene, finnes en serie med mer inhomogene karbonater. Typisk for disse er at de har en brun farge - med overganger til gul- brunt og rødbrunt. Videre har de 5 - 20 cm tykke årer med grovkornet lys grønn tremolitt bergart. Årene er enten paralelle foliasjoner - eller de kan skjære karbonatet på kryss og tvers og danne et nettverk i dette. Karbonatet har ellers ofte 2 - 20 cm tykke bånd med relativt høyt innhold av lys grønne til grønne og / eller lys beige til mørke brune glimmere. Det finnes flere

varianter av denne karbonattypen - fra mørke brune med tett med tremolittårer - til lyse brune varianter med spredte konkordante tremolitt årer. Generelt kan det se ut som om den mørke typen er vanligst forekommende i kalksteinshorisontens nedre del - mot grensen til gneiss - granittene.

Sammenlignes denne inndelingen av karbonatene med forekomsten av anomale gull - verdier - viser det seg at alle de høyeste gull- gehalter av den disseminerte type ble funnet i de mørke "urene" karbonatene.

Dette medfører at disse bergartene på det nåværende stadium av undersøkelsene, generelt bør betraktes som interessante med hensyn på gull - mineraliseringer. Det medfører også at det, så lenge ikke hele kalkhorisonten er systematrisk prøvetatt, er muligheter for å finne større volumer av gullmineralisert karbonat i Gautelis - området.

urene karbonater → genetisk stilling, mineralogisk forskjell.

RESUME, FELTARBEIDE, SKJOMEN 1985.

Sesongen startet 25/6, og ble avsluttet 9/8-85.

Killi med to assistenter måler IP, 2/7 - 10/7.

Lokalt engasjert assistent,Trond Baadstø, arbeidet i tiden 8/7 - 3/8 og 4/7 - 16/8. Han assisterte m.å sette opp stikkningsnett, foretok geofysiske målinger (MAG og VLF) og tok 400 fastfjells-prøver. Det ble brukt ca 10 dagsverk på å samle inn 330 prøver.

BOREPROGRAM:

9/7	Borerne ankom.
10/7	Bor-utstyr ankom.
11/7	Bor-utstyr transportert ut m. helikopter.
12/7	Riggen startes, men faller ut etter 5 min., spenning bare 110 V.
15/7	Reservedeler sendt fra Tr.hj. el.motor, ankom Narvik samme kveld.
16/7	Spenningsregulator skiftet av eletriker fra Berg i Narvik. Boring iverksatt.
18/7	Boret ferdig bh-1-85, lengde 132.5 m.
19/7	Boret 73 m, bh-2-85. Stopp mellom strøm - aggregat og bormaskin.
22/7	Bormaskin rep. kl. 13.45. Avbrendt ledning.
23/7	Bor-stopp kl. 9.20, bh-2-85, lengde 115 m. Strøm aggregat havarert, forsøkte å leie lokalt hos NVE.
24/7	Sjøfør + Ole G. på vei fra Folldal m. nytt aggregat.
25/7	Nytt aggregat ankommer m. Ole G. et.co. kl. 19.30. Henter kjerner og prøver.
26/7	Helikopter ankommer kl. 9.20. Aggregatet skiftes ut. Boring iverksettes umiddelbart. Hullet stoppes samme kveld, lengde 149.3 m.
27/7	Flytting til bh-3-85. Jordboring + 2.5 m boring i kalk.
29/7	Boring av bh-3-85 avsluttet, lengde 97.6 m.
30/7	Rigg flyttet m. helikopter til bh-4-85. Boring avsluttet samme kveld, lengde 65.6 m.
31/7	Graving av borplass bh-5-85. Helikopter - flytting. Boret ca 10 m i fjell.
4/8	Avsluttet boring av bh-5-85, lengde 181 m. Påbegynt bh-6-85. (Jordboring).
6/8	Boring avsluttes kl. 08.00, etter boring hele natten. Bh-6-85, lengde 183 m. Helikopter transporterer utstyr ut samme morgen. Borere og utstyr reiser hjem 8/8.

Rusty, sulfide-mineralized banded gneiss in un-mineralized red granite.

MoS2-mineralized, glimmerrich, finegrained gneiss floating in un-mineralized red granite.

3.2.83

ROMBAK PROSJEKT (330 250)

FOLLDAL VERK A/S

DESEMBER 1985

Jan Inge Tollefsrud

the window. Zinc and lead are of less economic interest, mainly due to low prices at the world market at present, though there is a potential for Zn-Pb deposits in the middle to northern parts of the window.

Recommended further investigations:

The Gautelisfjell disseminated carbonate-hosted gold occurrence is the only significant gold mineralization presently known in the Rombak window. Knowledge of its characteristic features is essential for directing prospecting activities for similar mineralizations elsewhere in the window as well as in other regions. Continued lithologic and structural mapping and geochemical studies of the ore mineralizations are needed to characterize its features more fully.

Then effort should be put into studies of shear zones in the window in order to establish the different generations of shear zones, and to map the distribution of those shear zones which have acted as channels for hydrothermal fluids, and investigate their relationship to ore mineralization and stream sediment anomalies.

PRECAMBRIAN VOLCANO-SEDIMENTARY SEQUENCES AND RELATED ORE DEPOSITS, WITH SPECIAL REFERENCE TO THE GAUTELISFJELL CARBONATE-HOSTED, DISSEMINATED GOLD DEPOSIT, ROMBAKEN BASEMENT WINDOW, NORTHERN NORWAY

Are Korneliussen, Jan Inge Tollefsrud, Boye Flood og Edward Sawyer

Abstract

The supracrustals in the Rombaken window consists of a complex sequence of volcanic rocks, pelitic sediments, greywackes, and lesser amounts of carbonates and quartzites. These are intruded by mafic dykes, mafic to intermediate plutons and a variety of granitoid batholites at approximately 1700-1800 Ma. The region has experienced lower amphibolite metamorphism followed by retrogression to greenschist facies along a major N-S trending lineament. Shear zones along this lineament have acted as channels for H_2O-CO_2 bearing fluids.

Various types of ore-deposits occur in distinct geological environments within basement rocks : (1) disseminated Au mineralizations in carbonate within a basic to acidic volcano-sedimentary sequence (the Gautelisfjell deposit), (2) dissemminated to massive Zn-Pb mineralizations within calc-silicate layers in tuffite/greywacke sequences and as fracture fillings in shear zones, and (3) disseminated to massive Cu-Fe mineralizations associated with mafic volcanics.

A combination of geological investigations and stream-sediment sampling has delineated anomalous target areas for both gold and zinc-lead. Potential sites for gold mineralizations are: (1) carbonate +/- sulphide horizons in rhyolites that are believed to be interbedded chemical sediments, and (2) shear zones that have acted as channels for hydrothermal fluids.

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1. INTRODUCTION

This report is based on the results from recent geological investigations by the Norwegian Geologcal Survey (NGU) and the companies Folldal Verk and ARCO Norway. Folldal Verk has consentrated its activities on gold prospecting mainly in the southern and southeastern parts of the window, while ARCO's activities have been aimed primarily at Zn-Pb in the middle and northern parts. NGU's motives have been to evaluate of the regions potential for gold, and with this in mind their activities has been consentrated on the volcano-sedimentary sequences in the southern half of the window.

The aim of the report is to give a general review of the geological features of the region and its various types of metal deposit. Special attention will be paid to the Gautelisfjell carbonate-hosted, disseminated gold deposit which is the first gold deposit of this type found in Norway. Secondly, targets for continued prospecting and geological research will be delineated.

2. PREVIOUS WORK

The southern parts of the Rombak Window have been mapped by Birkeland (1976) and the norhern parts by Vogt (1950; in Gustavson 1978), both in scale 1:100000. Rb-Sr age determinations on granitoid rocks from the northern part of the window have given 1691 Ma (Heier & Compston 1969), and 1780 Ma (Gunner 1981) from the southern part of the window. Based on the regional distribution of initial $^{87}Sr/^{86}Sr$ ratios in middle/early Proterozoic granites in North Norway and Sweden, Gunner (1981) has postulated the existence of an eastwards dipping NW-SE trending subduction zone during this period.

During the 1970's and early 1980's NGU has carried out several relatively minor investigations on Zn-Pb and U mineralizations in the window (Lindahl & Furuhaug 1977, Lindahl 1978, 1980, Singsaas 1977, Grønlie 1982, Håbrekke 1983,

Næss 1983). In 1983-1984 ARCO Norway carried out extensive investigations on Zn-Pb, and to a lesser degree gold, but their main activity consentrated on the northern parts of the window (Flood 1983, 1984). Folldal Verk A/S started a regional gold prospecting program in the southern parts of the window in 1983 (Priesemann 1983). From 1984 they have consentrated their activities to the Gautelisfjell carbonate-hosted gold deposit (Priesemann 1984, Tollefsrud 1985).

Detailed descriptions of lithology and rock-geochemistry are presented by Korneliussen & Sawyer (1986), based on NGU's resent investigations. The metamorphic and structural situation are described by Sawyer (1986) and Sawyer (in prep.) respectively.

3. LITHOLOGY

In the Rombaken basement window old supracrustal sequences are intruded by large volumes of granites and syenites with lesser amounts of basic to intermediate intrusives. The volcanic portion of the supracrustals range from ultramafic (Mg-tholeiites/komatiites) through basic and intermediate varieties to rhyolites. Some of the basic and intermediate volcanics are tuffaceous in origin. Clastic sediments are mainly greywackes. Carbonates/marbles, conglomerates and quartzites are also present, but are relatively uncommon.

A group of quartzites and pelites in the Muohtaguobla area is of uncertain age. These rocks were considered to belong to the late Proterozoic-Cambrian Dividal Group by Birkeland (1976). The stratigraphic status of these rocks is uncertain, but never the less they are cruical in determining the age of structural and metamorphic events in the window.

The composition of the different supracrustal areas or belts varies: (a) The Sørdalen supracrustal belt in the soutwestern part of the window is composed of predominantly porphyritic basic, intermediate and felsic volcanics, and a variety of pyroclastic rocks including epiclastic conglomerates (debris

flows/lahars). (b) The Stasjonsholmen-Cainhavarre supracrustals further to the east contain thick sequences of pelitic sediments with horizons of basic/intermediate, mainly tuffitic volcanics. The middle and eastern parts of this supracrustal area contains two units of rhyolite each 1 km thick. (c) East of Cainhavarre and in the Muohtaguobla area, mafic/intermediate and felsic volcanics (mainly tuffites), pelites, graphitic schists, quartzites (+/- graphite +/- carbonate) and quartz-pebble conglomerates are complexly intermixed. The complexity is at least in part of tectonic origin. In the Muohtaguobla area extensive hydrothermal activity along N-S trending shear-zones has retrograded (hydrated) lower-amphibolite facies mineral assemblages to lower-greenschist facies assemblages (Chapt. 5 and 6). (d) Towards the east the Muohtaguobla sequence gives way to the Ruvssot (-Sjangeli) sequence, which is more typical of a greenstone belt association with ultramafic (Mg-tholeiites/komatiites) and mafic volcanics, thin alternating quartzite and carbonate horizons, pelitic sediments and greywackes. The contact relations between the Muohtaguobla and Ruvssot areas are unknown. (e) The Gautelisvatn supracrustals in the southern part of the window are dominated by a greywacke sequence, but horizons of tuffitic mafic and felsic volcanics, thin conglomerates and carbonates are also present. The Gautelisfjell Au deposit is associated with a carbonate horizon in this sequence (Chapt. 10). (f) The supracrustal sequence in the Rombaken area in the northern part of the window, is dominated by greywackes and pelites with a relatively minor volcanic component (as tuffites), especially north of the Rombak fjord. South of the fjord the supracrustals contain a variety of volcanic rocks including amygdaloidal andesite flows.

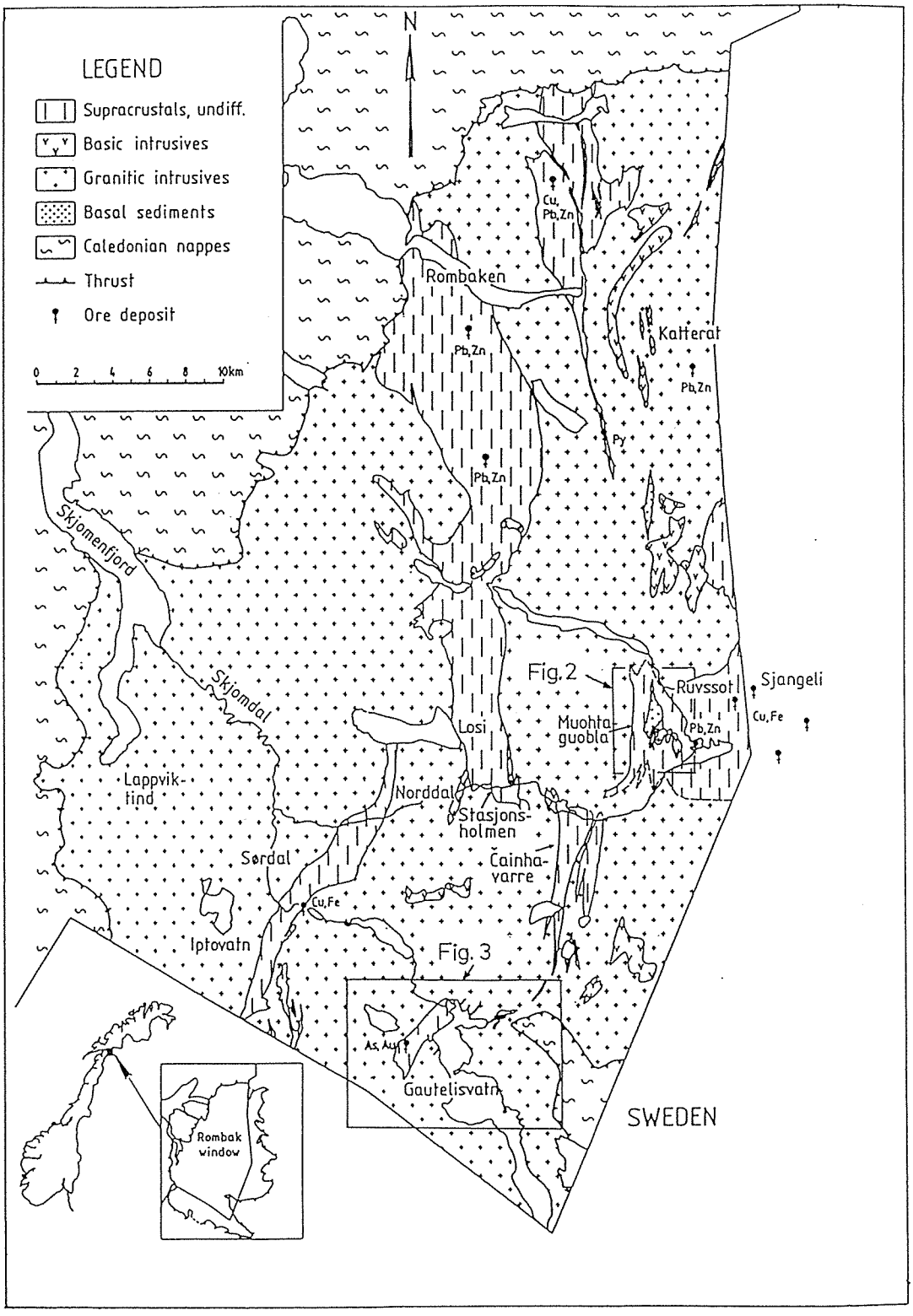

FIG. 1 Geological map, Rombak Window. Modified from Birkeland (1976) and Vogt (1950).

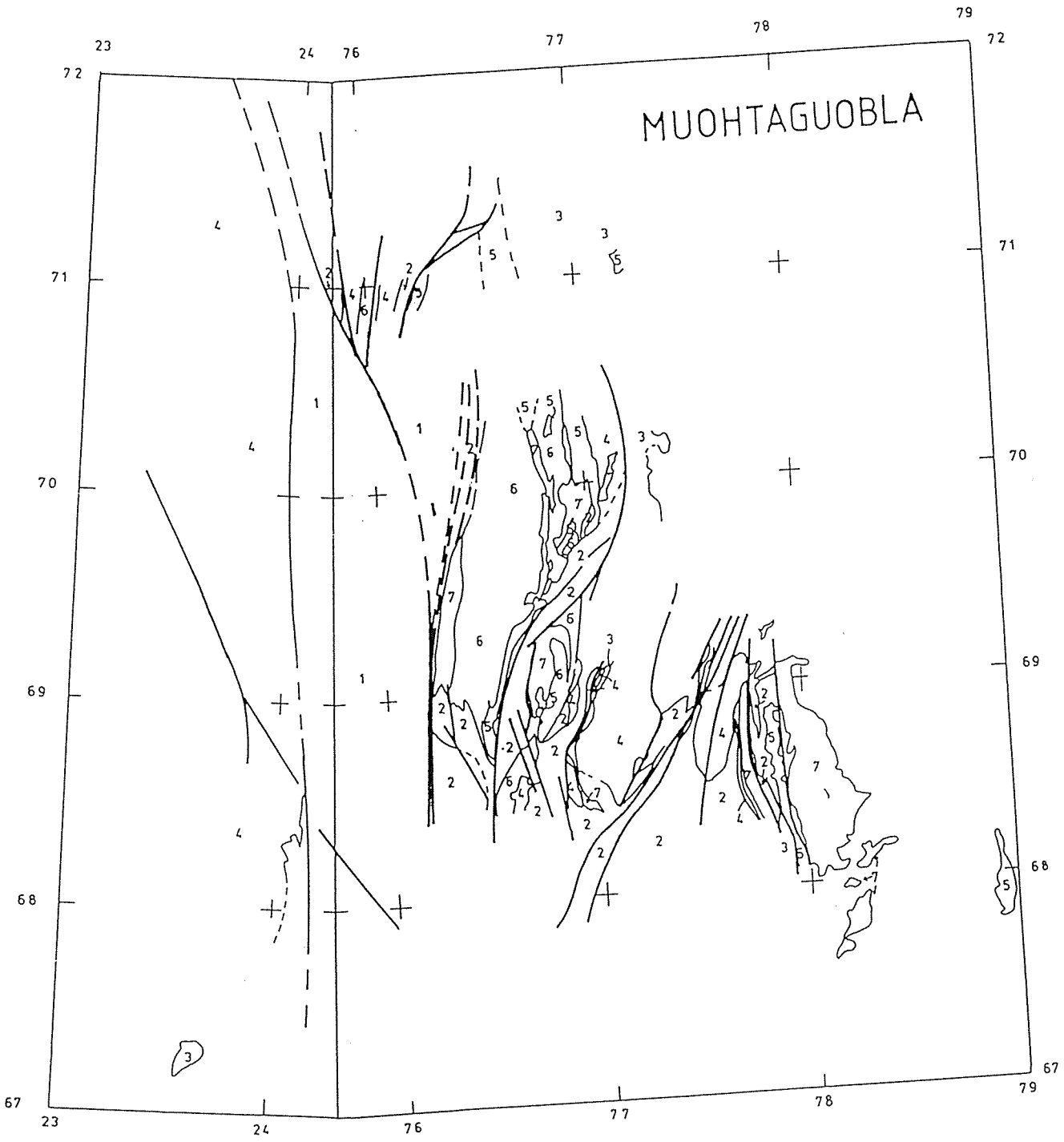

FIG. 2 Preliminary geological map, Muohtaguobla, with the pattern of shear zones indicated (thick lines).
1: Undifferentiated grey schists and psamites with minor quartzites and conglomerates.
2: Blue-grey fine grained schists and quartzites.
3: Intermediate volcanics and basic schists.
4: Coarse porphyritic granite and syenite (often foliated)
5: Pink and grey medium grained to fine grained granite "microgranite".
6: Coarse-grained porphyritic melanocratic granite.
7: Diorite, foliated near shear-zones.
See Korneliussen and Sawyer (1986) and E.Sawyer (in prep.) for further information of the area.

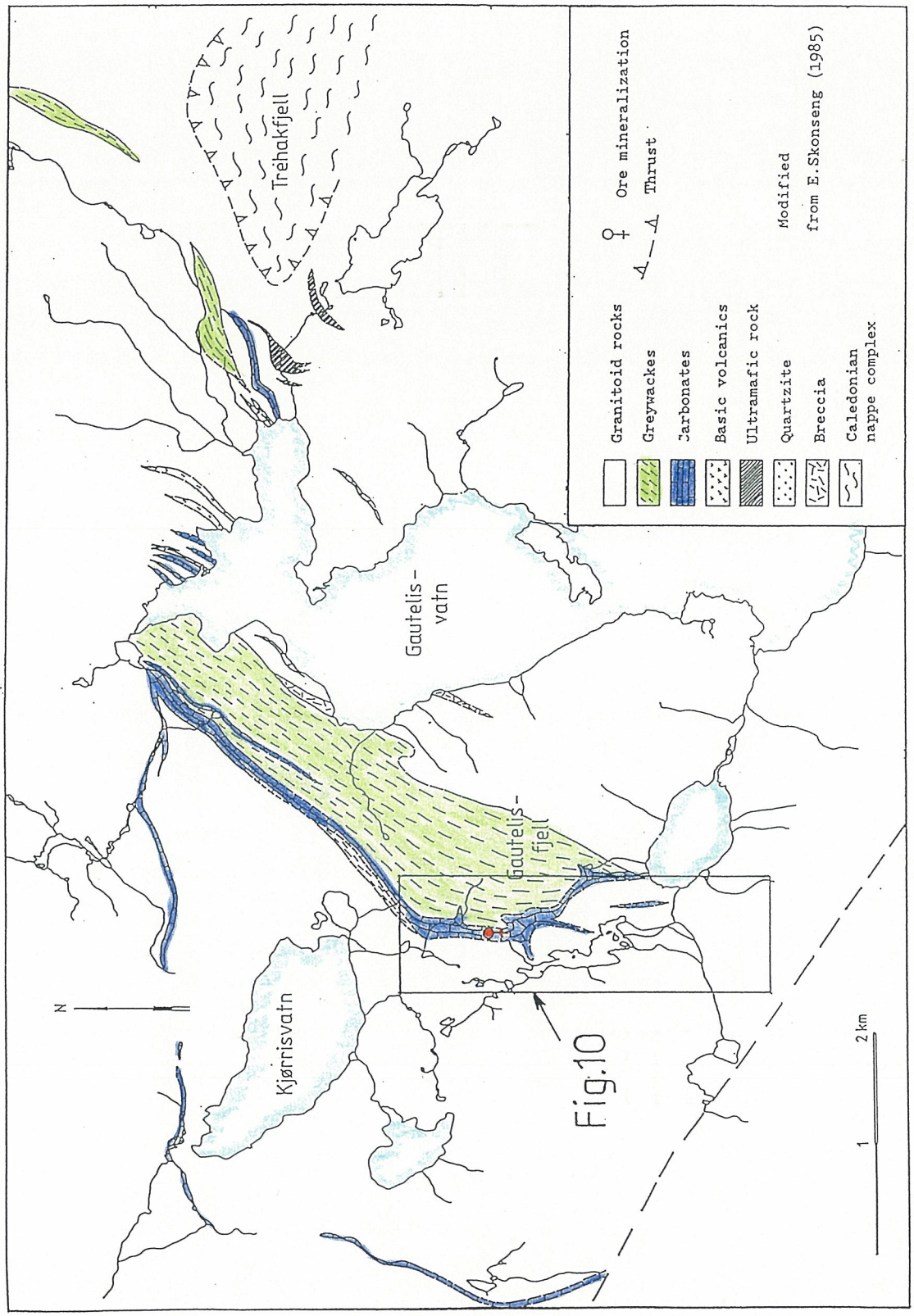

FIG. 3 Geological map, Gautelisvatn. Based on Skonseng (1985).

4. GEOCHEMISTRY - IGNEOUS ROCK-TYPES

On the basis of their petrographic and geochemical characteristics the volcanic and intrusive rocks of the window can be divided into 3 types, or series:

(1) The *Ruvssot(R)-type* Mg-tholeiites (komatiites) are characteristic of the Ruvssot - Sjangeli area.

(2) The *Sordalen-Nordalen(SN)-series* are fairly pottassic with alkaline affinities; they range from basic through intermediate (andesitic) varieties to rhyolites. Basic/intermediate varieties are often porphyritic, some are amygdaloidal flows. The acidic members of this series are chemically more-or-less identical to the abundant medium to coarse grained, porfyritic granites in the window.

(3) *Gautelisvatn(G)-type.* Felsic volcanics and acidic intrusives rocks in the Gautelisvatn area are tonalitic with their main-and trace element characteristics clearly different from the felsic members of the SN-series.

The SN-series plots along an alkali-calcic geochemical trend (Fig.4 b). The original definition of the term alkali-calcic came from Peacock's (1931) alkali-lime index; which for a related rock series showing a continuous compositional range, is the percentage of SiO_2 at which the abundances of CaO and Na_2O+K_2O are equal. Calc-alkaline rocks were distinguished as those for which this index (given as percentage of SiO_2 by weight) lies between 56 and 61; suites with an index greater than 61 are calcic, those with an index less than 56 are alkali-calcic (51-56) or alkalic (less than 51; Brown 1982). Intrusive rocks from different tectonic settings have characteristic alkali-lime indices as indicated in Fig.4 b. In Phanerozoic environments this type of sequence is characteristic for relatively mature magmatic systems, i.e. fairly continentized magmatic arcs (Brown 1982). The high K/Na-ratio also indicate a relatively continental environment (Fig.4 c). This is in good accordance with the location of these samles in the "within continent" field on various discrimination

diagrams used for both basic and acidic rocks (Fig.5). In discriminant diagrams the G-type rocks tend to plot in the volcanic-arc field, as exemplified with the (Y+Nb)/Rb-plot in Fig.5 b.

DIFFERENTIATION TRENDS FOR THE ALKALI-CALCIC VOLCANIC ROCKS

As shown in Fig. 6 a & b the Sørdalen basic/intermediate volcanics may be the product of a continuing differentiation process due to early crystallisation of Fe,Mg-rich minerals (olivine, orthopyroxene). The break in the Al_2O_3-trend probably indicates clinopyroxene fractionation.

Then the felsic volcanics from Muohtaguobla, Cainhavarre and Stasjonsholmen plot along a trend that is controlled by by plagioclase fractionation, as indicated in Fig.6 a & c. A correspondingly strong enrichment of incompatible trace elements (Rb, Ce, La, Zr, Y, Nb) in the acidic end members of the series is characteristic for the Stasjonsholmen volcanics, as exemplified by the SiO_2-Zr plot (Fig. 6 d). This is in good agreement with the REE-patterns for the Cainhavarre and Stasjonsholmen volcanics (Fig.8 d); the stronger negative Eu-anomaly for Stasjonsholmen shows that more Eu has been removed from the melt by fractional crystallization of plagioclase. The parallell patterns for LREE and HREE from the Cainhavarre and Stasjonsholmen volcanics respectively, is consistent with a close genetic relationship. The Muohtaguobla REE-pattern is a typical feldspar enriched REE-pattern, and is consistent with a hypothesis that these rocks have originated from a feldspar cumulate part of a magma-chamber.

GREYWACKES

Turbiditic greywackes with well-preserved graded bedding ere sampled in 3 areas: Rombaken (western supracrustal belt; 6 samples), Gautelisvatn (4 samples) and Ruvssot (4 samples). The greywackes from Rombaken and Gautelisvatn are of practically identical chemical composition (Table 1 & 2), while the Ruvssot

greywackes are somewhat more mafic. They were derived from a comparatively unweathered detritus (low "chamical index og alteration", Nesbitt and Young 1982) and hence have low Al_2O_3 and K_2O contents. All the greywackes are characteristically enriched in Fe, Mg, Ni, Cr and V and depleted in Ce, La, Y, Nb and Zr compared with volcanic rocks with the same SiO_2-content. This indicates that their source regions have been dominated by mafic/intermediate rock. The high Ni-content of the greywackes compared with volcanics with the same MgO-content (Fig.7 b), suggests that very Ni-rich rocks, presumably of the same type as the Ruvssot Mg-tholeiites, have been a significant Ni-source. The REE-patterns for greywackes from the different areas are very similar (Fig.8 f,g & h), which is in accordance with the interpretations presented above.

In summary:

The dominating extrusive and intrusive rocks in the window are pottassic with alkaline affinities (alkali-calcic), while Mg-tholeiites (komatiites) and tonalitic intrusive and extrusive rocks are less widespread. The chemical composition of greywackes suggest that they are derived from the volcanic rocks similar to those in the supracrustal sequences. Furthermore the greywackes relatively mafic character reflects a geological environment in which mafic volcanism was dominant at the early stage of this region's geologic history. The region has evolved to less mafic composition with time e.g. intrusion of large volumes of granites.

Table 1. Representative analyses of rocks from the Rombak Window.

	Intrusive rocks			Extrusive rocks							Greywackes		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)	(13)
SiO2	72.87	67.26	50.39	76.78	68.77	62.61	74.68	45.66	55.35	51.37	63.74	64.45	56.19
Al2O3	13.77	15.91	14.68	11.13	14.12	18.51	13.30	6.40	15.63	15.57	14.69	14.61	14.13
Fe2O3	2.50	3.35	12.96	3.05	4.47	2.47	1.43	9.38	8.05	9.79	7.90	7.39	10.82
TiO2	.27	.46	1.83	.20	.54	.74	.25	.20	1.23	1.09	.83	.76	.98
MgO	.37	1.29	5.43	.13	.51	.59	.87	26.03	4.18	6.47	3.41	3.61	6.42
CaO	1.05	2.65	7.99	.84	1.75	2.09	1.58	6.87	5.95	5.83	2.78	1.69	3.11
Na2O	3.54	6.14	2.65	1.76	3.23	5.56	5.20	.17	3.90	2.48	2.90	3.25	2.95
K2O	5.15	1.78	1.99	5.60	5.68	6.08	1.69	.02	3.49	2.78	2.75	2.98	4.06
MnO	.03	.05	.19	.06	.06	.05	.02	.17	.12	.19	.08	.06	.10
P2O5	.06	.13	.60	.01	.11	.24	.04	.02	.45	.36	.13	.13	.13
L.I.	.42	.79	.83	.58	.64	.88	.68	4.28	.84	3.60	1.01	1.04	.89
Total	100.03	99.81	99.54	100.14	99.87	99.82	99.74	99.20	99.19	99.53	100.22	99.97	99.78
Sr	83	478	383	112	180	335	291	<12	738	350	263	187	135
Rb	285	48	73	260	239	75	46	-	148	136	103	127	152
Ba	500	692	694	51	979	1680	1542	38	1289	921	835	754	650
Zn	74	32	145	49	78	<30	9	66	125	112	139	105	72
Cu	-	5	50	-	<31	-	-	19	<9	<10	<47	40	60
Pb	31	13	13	25	27	-	13	-	<18	<14	na	na	11
La	79	35	29	94	57	23	23	-	52	22	28	39	14
Ce	166	64	56	191	122	46	48	-	118	56	47	71	18
Zr	239	179	140	705	326	20	188	21	251	116	173	176	114
Y	60	17	27	85	49	9	21	27	27	21	22	22	20
Nb	19	15	8	35	17	<7	18	-	17	<7	9	12	8
Th	40	11	-	25	21	-	11	-	-	-	-	-	-
Sc	-	7	25	<4	8	<7	5	24	15	24	17	11	20
Co	-	5	42	-	<10	-	<7	85	24	35	na	na	34
Ni	-	10	42	<6	8	-	4	1334	58	45	88	81	139
V	-	42	190	<8	30	18	21	151	138	145	189	150	164
Cr	-	11	68	<12	14	-	-	2600	124	236	236	262	336
n	23	4	16	5	4	5	3	3	23	4	4	6	4

(1) Granite, SN-type
(2) Tonalite, G-type
(3) Basic intrusives
(4) Felsic volcanics, Stasjonsholmen, SN-type
(5) Felsic volcanics, Cainhavarre, SN-type
(6) Felsic volcanics, Muohtaguobla, SN-type
(7) Felsic volcanics, Gautelisvatn, G-type
(8) Mg-tholeiites/komatiites, Ruvssot, R-type
(9) Mafic/intermediate volcanics, Sørdal, SN-type
(10) Mafic volcanics (strongly altered), Muohtaguobla
(11) Greywackes, Gautelisvatn
(12) Greywackes, Rombaken
(13) Greywackes, Ruvssot

n : Number of analyses
- : More than 1/3 of the samples have values under detection limit
<27: Less than 1/3 of the samples have values under detection limit. The number (27) is average of the remaining values.
na : Not analysed

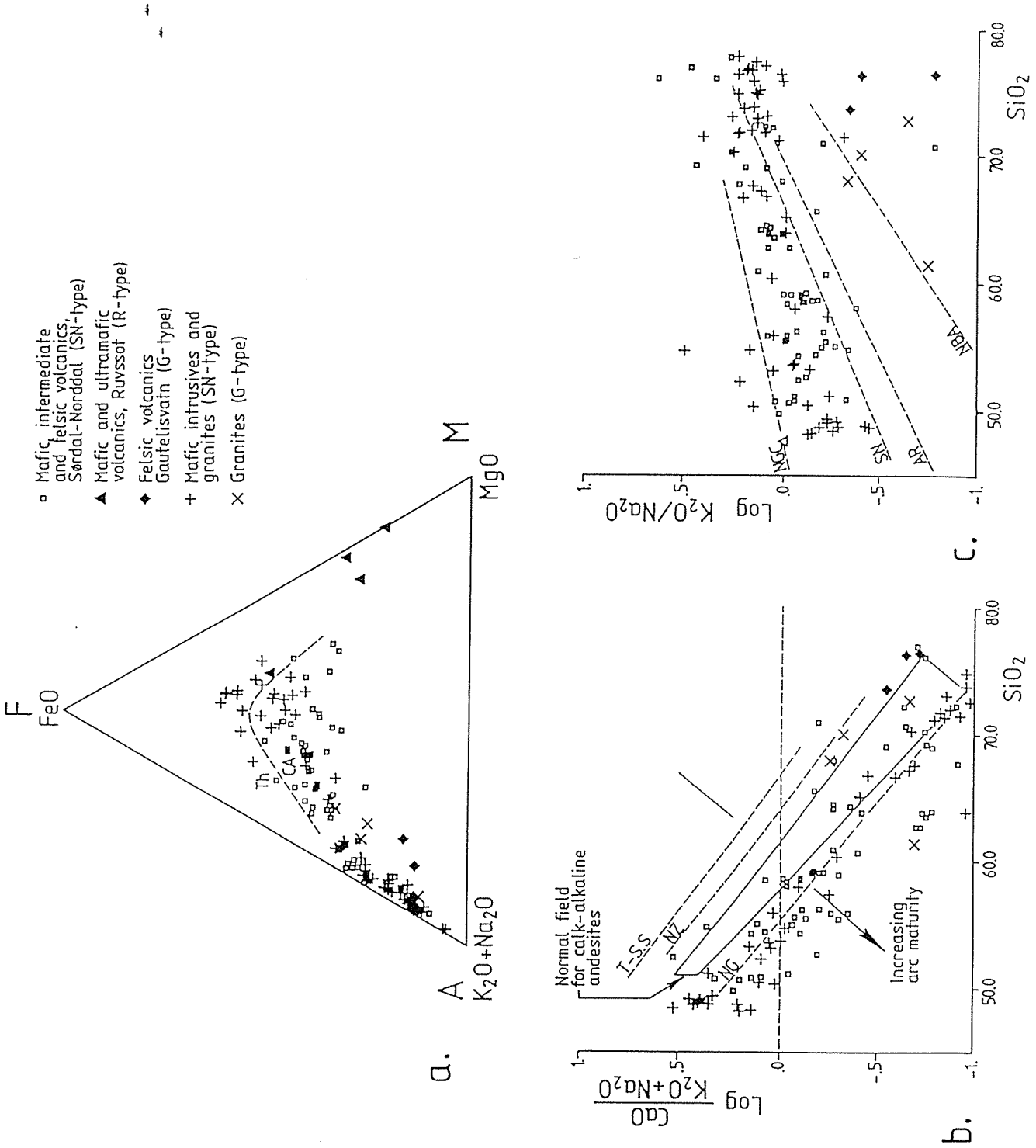

FIG. 4 Major geochemical characteristics for Skjomen-Rombaken igneous rocks. (a) AFM diagram. Th - tholeiitic; CA - calc-alkaline. (b) Calc-alkali ratio - silica plots for Skjomen-Rombaken intrusive and extrusive rocks compared with trends for volcanic suites from modern magmatic arcs showing the change from calcic to calc-alkaline (abundant) suites with increasing maturity (after Brown 1982). The alkali-lime index (SiO_2 concentration where CaO = Na_2O + K_2O) lies between 51 and 56 for alkali-calcic suites (see text). T-SS - Tonga-S.Sandwich; NZ - New Zealand; NG - New Guinea. (c) Alkali ratio - silica plots for Skjomen-Rombaken intrusive and extrusive rocks compared with trends for intrusive suites from Mesozoic and Tertiary magmatic arcs (after Brown 1982). NGC - New Guinea Continental; SN - Sierra Nevada; AR - Alaska Range; NBA - New Britain Arc.

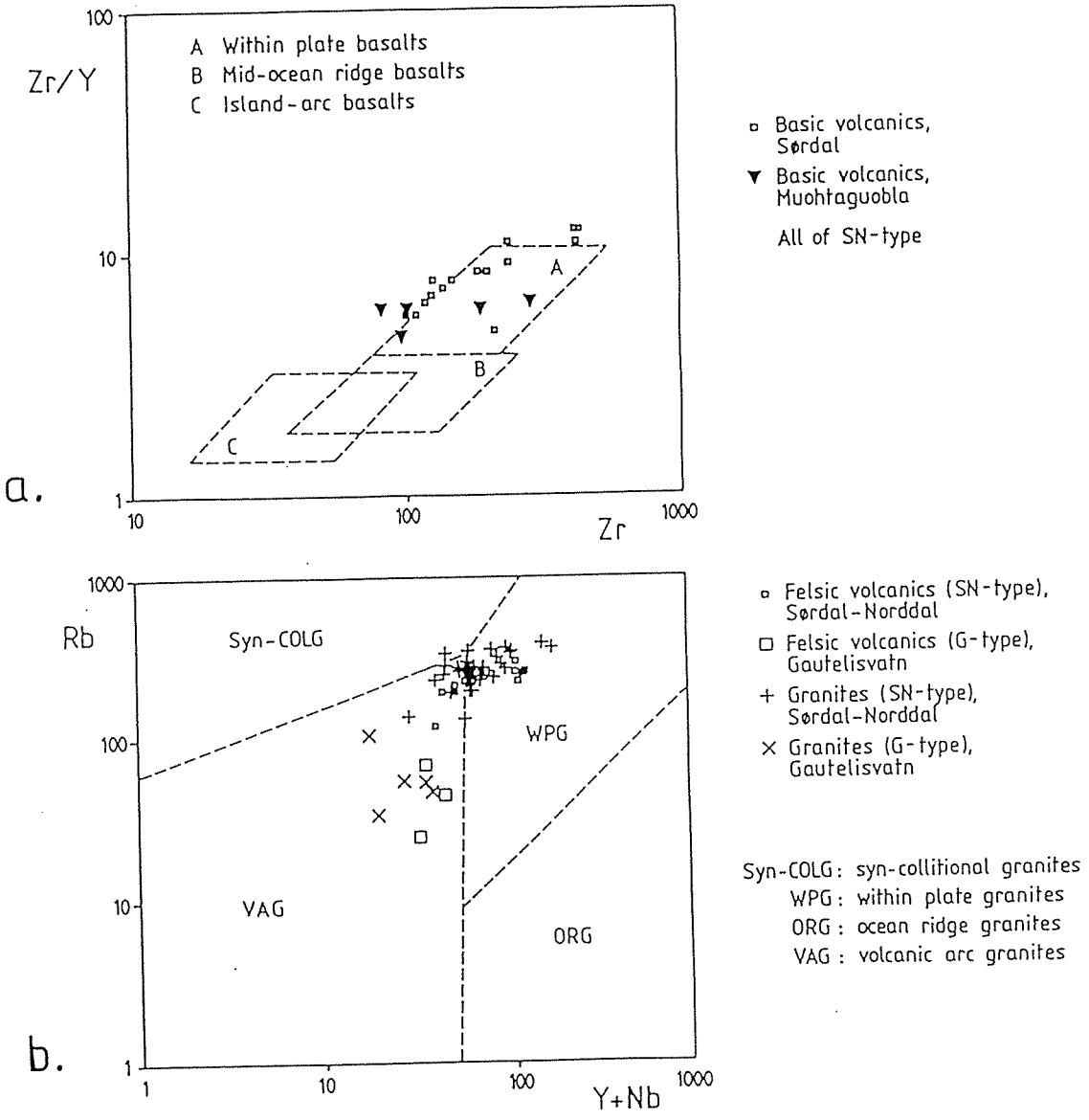

FIG. 5 Two selected discrimination diagrams for basic and acidic rocks: (a) Zr - Zr/Y relations for basic rocks (SiO_2 < 56 %). Diagram after Pearce & Norry (1979). (b) (Y + Nb) - Rb relations for acidic rocks (SiO_2 > 56 %). Diagram after Pearce et al. (1984).

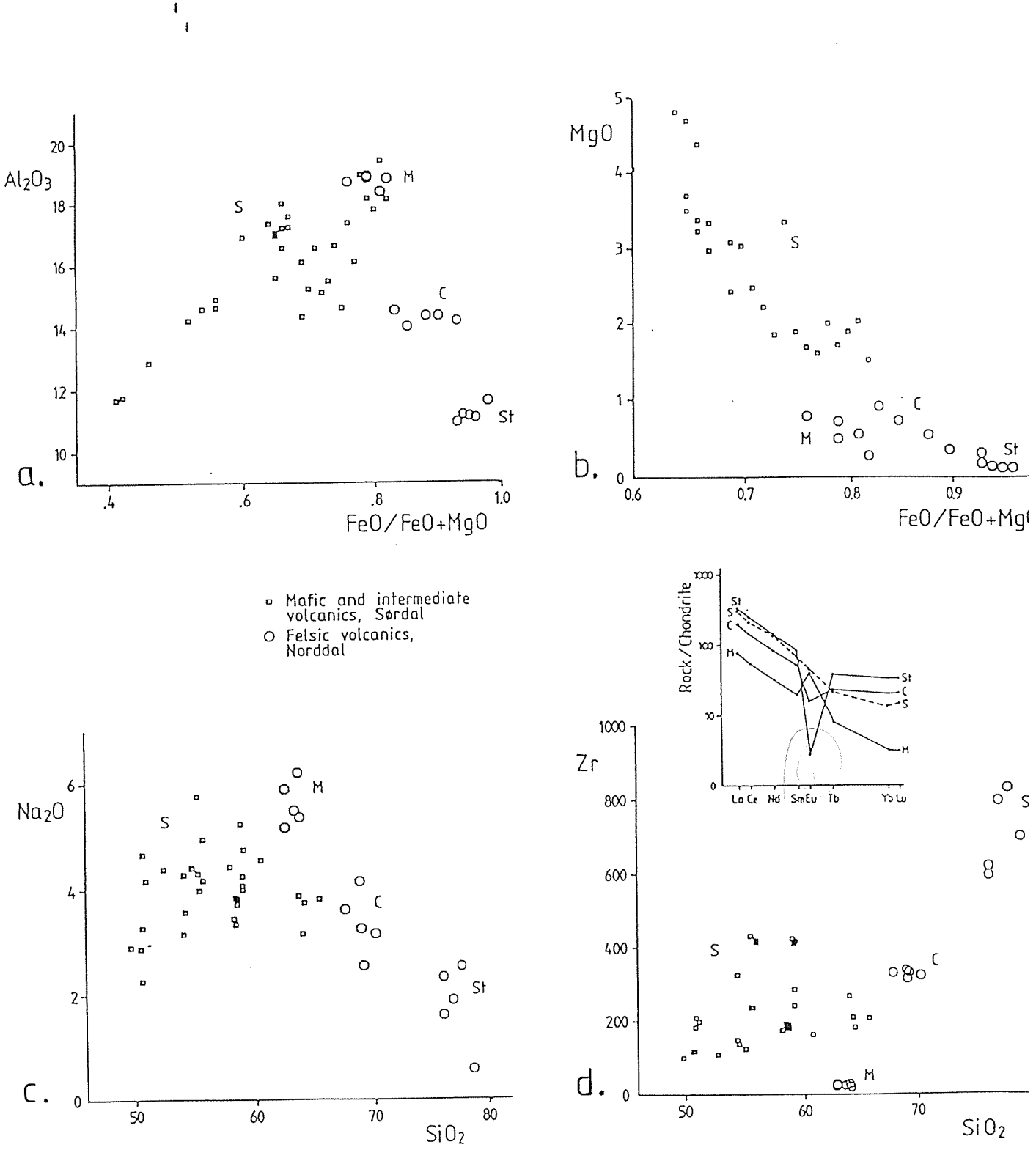

FIG. 6 Differentiation trends for Sørdalen - Nordalen volcanic rocks presented in (a) FeO/(FeO+MgO) - Al_2O_3, (b) FeO/(FeO+MgO) - MgO, (c) SiO_2 - Na_2O and (d) SiO_2 - Zr diagrams. S - Sørdalen; M - Muohtaguobla; C - Cainhavarre; St - Stasjonsholmen.

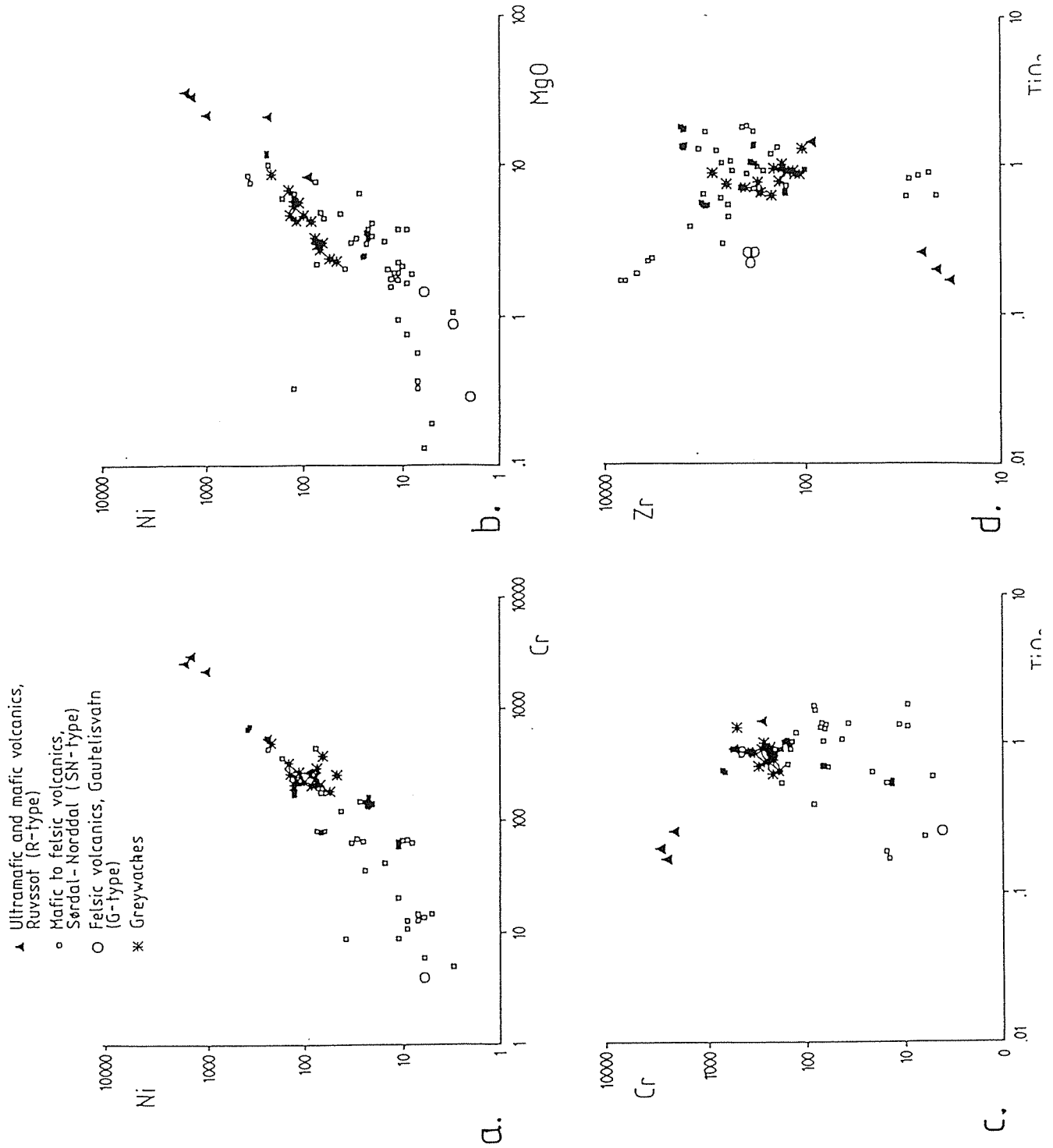

FIG. 7 The composition of greywackes compared with the volcanic rocks presented in (a) Cr - Ni, (b) MgO - Ni, (c) TiO_2 - Cr and (d) TiO_2 - Zr diagrams.

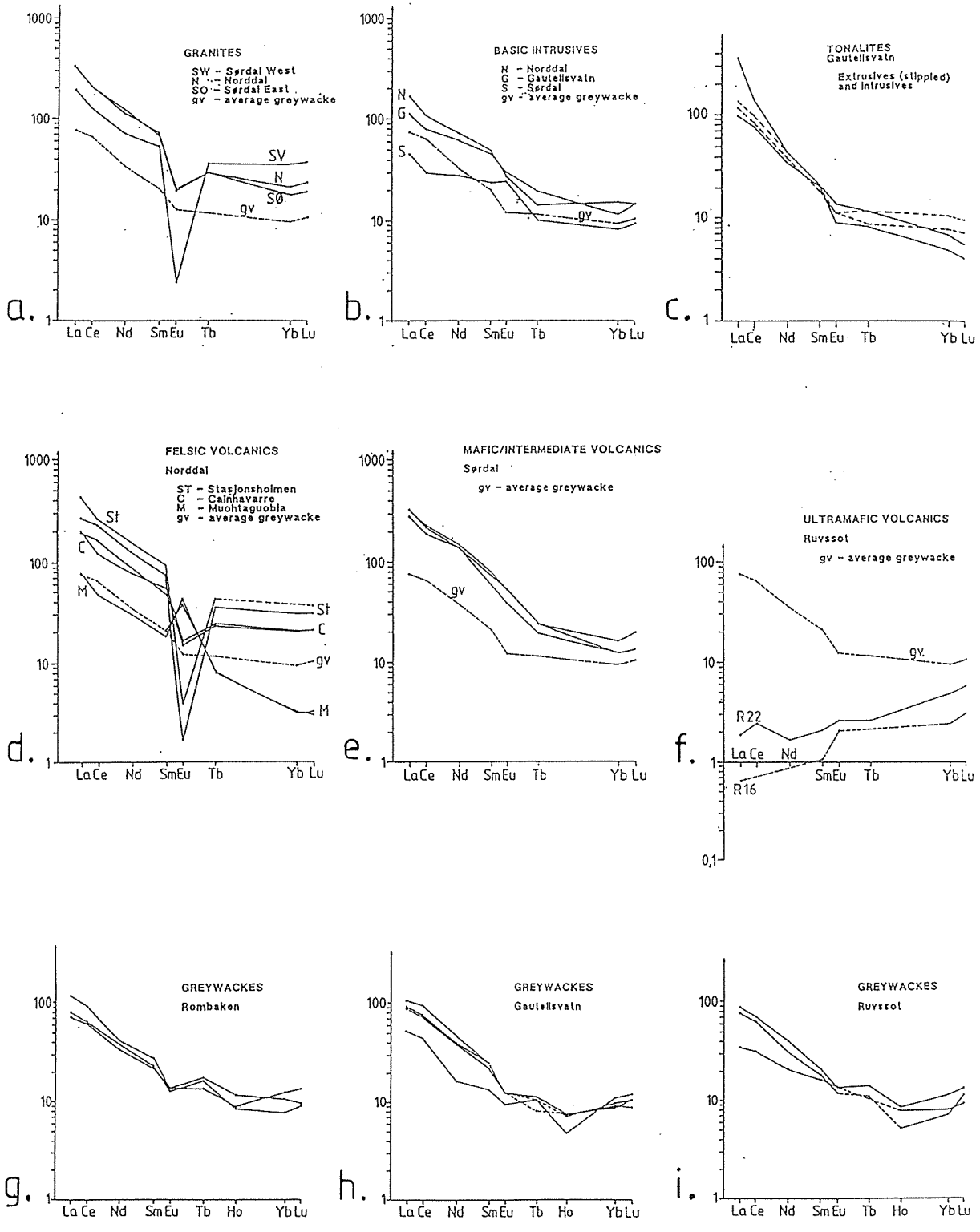

FIG. 8 Chondrite normalized REE patterns for Skjomen-Rombaken intrusive and extrusive rocks and greywackes. Chondrite values after Taylor & Gorton (1977).

5. METAMORPHISM

The Rombak Window, at least in its central, western and southwestern parts, has been metamorphosed to epidote-amphibolite/amphibolite facies grades (P>6 kb, T 575 to 600 °C; see Sawyer 1986). Evidence for this is widely preserved in the mineral zonation patterns found in the intermediate and basic volcanics. Thus basement metamorphism was of similar grade to that which affected the overlying Caledonian nappes. A later greenschist facies retrogression, possibly also of moderate to high pressure, has affected the window to varying degrees. In most places retrograde reequlibration of minerals is absent or minor. However, in the Muohtaguobla area the greenschist retrogression has virtually obliterated evidence of the earlier higher grade metamorphism. The intensity of retrogression in the Muohtaguobla area may be related to the existance of a major N-S trending structural lineament in the vicinity (Figs.2 and 9).

6. STRUCTURAL CONTROL OF FLUID FLOW.

The channelling of fluid flow along tectonic structures such as shear zones has been proposed as the means of mobilization and the potential site of the deposition of ore deposits. However, since fluid flow is from region of high to low pressure, a shear zone must contain a connected pathway to a low pressure region (it must be dilatent) before fluid flow will occur. The condition under which and the mechanism by which shear zone deformation takes place determines whether significant dilatency can occur.

Field and petrographic observations of the shear zones (early set) from the Skjomdal - Sørdal - Gautelis area indicate that they are deformed in a ductile manner with very little associated dilatency. On the microscopic scale quartz forms long ribbons typical of high-strain plastic deformation, but feldspars show low strain effects such as undulose extinction, fracturing and kinking.

This difference arises from the contrasting mechanical properties of quartz and feldspar, but since quartz is abundant strain is partitioned into quartz. Dilatency in fractured feldspars is probably transient since, in most cases, cracks are filled by quartz. On the macroscopic scale the lack of veins, tension gashes and boudinage structures all indicate little dilatency. Analysis of the shearzones from Sørdalen indicate some mobility of certain elements, but this appears to be relatively minor. Although individual shear zones in the Sørdalen area were not dilatent there is evidence to indicate that large en echelon tension fractures did develop in the less sheared rock between shear zones.

Younger, subvertical shear zones that are prevalent in the Muohtaguobla area (Fig.2) are accompanied by dilatent features such as quartz veins and tension gashes. Furthermore, there is also petrographic evidence for large scale fluid (H_2O-CO_2) flow associated with these structures. Thin sections from the Muohtaguobla area all show some degree of greenshist facies retrogression (i.e. hydration) of epidote-amphibolite or amphibolite facies assemblages. In many cases the higher grade assemblage has been completely altered to chlorite + albite + epidot + calcite + quartz greenschist assemblages. The subvertical shear zones at Muohtaguobla therefore appear to have acted as the channels for extensive fluid infiltration.

7. AGE RELATIONS

The volcano-sedimentary sequences previously described are the oldest rocks known in the Rombak Window. They are intruded by basic, intermediate and acidic plutons: the granites have been dated at 1691 +/- 90 (Heier & Comston 1969) and 1780 +/- 85 Ma (Gunner 1981). These ages are believed to represent crystallization, though the possibility that they represent early Proterozoic metamorphism cannot be ruled out. The basic and intermediate intrusives tend to

be older than the granites and syenites, though basic dykes intrude granite in a few places. The intrusive relations are complex since both the basic and acidic rock-types occur in various generations, but in general the various intrusive rocks are believed to be of more-or-less the same age i.e. early Proterozoic.

Post intrusion regional deformation is accompanied by lower amphibolite facies metamorphism, while the later retrogression to greenschist facies is significant along a major N-S trending lineament in the Muohtaguobla area. Deformation and metamorphism may be Caledonian in age but no absolute ages are available.

8. ORE MINERALIZATION TYPES

8.1. ON THE FORMATION OF GOLD DEPOSITS IN GENERAL

The formation of economic gold deposits have been episodic in the Earth's history; the majority are associated with Archaean greenstone belts either directly or indirectly, few occur in early Proterozoic rocks, they are absent in middle Proterozoic rocks, but occur again in late Proterozoic and Phanerozoic environments (Hutchinson & Burlington 1982). Important types of gold deposits are: hydrotermal quartz-veins and exhalative deposits, gold in Precambrian quartz-pebble conglomerates of Witwatersrand type, and recent placer deposits formed by erosion of gold-bearing rocks. Additionally a siginificant amount of gold is produced as by-product from a variety of sulphide deposits.

The formation of an economic gold deposit is the result of a combination of different favorable circumstances. Firstly, a source-rock is needed; this may be gold-enriched sediments or hydrated ultramafic volcanics which are generally accepted as the most favorable primary source-rock for gold. Secondly, a favorable combination of leaching, transportation and concentration/precipitation mechanisms are required.

Ultramafic rocks may be favorable source-rocks for gold primarily because they are highly susceptible to hydration/dehydration reactions; an hydrated ultramafic rock will lose gold dissolved in metamorphic fluids (mainly H_2O) as it dehydrates during progressive metamorphism (Kerrich 1980, Fyfe & Kerrich 1982). Deep-seated brittle-ductile shear zones, which can act as channels for such metamorphic fluids, represent a favorable precipitation environment at higher levels in the crust. Vein-type gold deposits may form within such shear zones. In some deposits (Carlin type) primary control of ore deposition are high-angle faults that transects a favorable host-rock type, typically a thin-bedded silty to sandy carbonaceous siltstone or carbonate rock. Gold precipitation are assosiated with replacement reactions between the gold-bearing fluids from the shear zone and the carbonate.

Alternatively, if rocks are hydrothermally altered in a sea-floor environment, gold is precipitated within a chemical sediment near the hydrotermal vents from which the fluids escape. Such exhalative deposits are often associated with acid volcanics.

Hydrothermal gold deposits tend to be distinctly enriched in rare elements such as B, As, Sb, W and Pd compared to exhalative Cu,Zn,Pb-sulphide deposits (Fyfe & Kerrick 1982). This indicates a fundamental difference in the hydrothermal mechanisms operating, and is an argument in favour of the metamorphic-fluid hypothesis for the formation of gold deposits.

Following this line of arguments two favourable environments for gold deposits occur in the Rombak Window based on the local geologial relationships: (1) chemical sediments associated with acid volcanics and, (2) shear zones which have acted as channels for hydrothermal fluids, especially where they transects carbonates.

8.2. KNOWN MINERALIZATION TYPES IN THE ROMBAK WINDOW

The following types of metal deposits/mineralizations have been found in the supracrustal sequences in the window:

A. *GOLD*. A carbonate/marble horizon at Gautelisvatn (see chapt. 10) contains 3 types of gold-bearing mineralizations: (a) one body of semi-massive arsenopyrite, (b) a variety of disseminated pyrite + arsenopyrite +/- chalcopyrite in calc-silicate lenses and layers in the carbonate, and (c) larger volumes of more or less invisible pyrite +/- arsenopyrite in impure parts of the carbonate. In all these varieties the gold grades are up to 20 ppm locally. In variety (c) which is the only one presently of economic interest, gold values over 3 m thickness may reach 6-7 ppm. Over thicknesses of 10-20 meters the grades are higly variable. Associated elements are As, W, Bi, Te and $C_{graphite}$.

The Gautelisfjell gold mineralization demonstrates that effective gold-concentration processes have been active in the region. The mineralizations at Gautelisfjell may either be related to exhalative hydrothermal activity syngenetic to the felsic volcanism in the area or it may be epigenetic and related to shear zones or the intrusions in the area. In either cases there exists a potential for large volumes of ore. The primary features are obscured by later tectono-metamorphic events.

B. *COPPER*. (a) Exhalative disseminated and massive bornite + chalchopyrite +/- magnetite are associated with mafic volcanics in the Ruvssot-Sjangeli area in the southeastern part of the window, (b) low-grade, disseminated chalcopyrite + pyrite occur in the Gautelisvatn area within a rock believed to be an acid volcanic, and (c) minor, disseminated chalcopyrite +/- bornite +/- magnetite in mafic/intermediate volcanics in Sørdal. The gold content in these mineralizations is generally in the range 0.2 to 0.5 ppm. Copper deposits in the window are relatively rich in copper, but since they are also relatively

10. THE CARBONATE-HOSTED, DISSEMINATED GOLD MINERALIZATION ON GAUTELISFJELL

10.1. INTRODUCTION

The potential of gold mineralizations in the Gautelisfjell area were first recognized by Folldal Verk A/S after their reinvestigation og a semi-massive gold-bearing arsenopyrite mineralization in 1983 (Priesemann 1984). In 1984-1985 1500 m of diamond drilling were carried out which lead to the discovery of a variety of disseminated gold-bearing mineralizations in carbonates. These mineralization types have not previously been reported in Norway.

10.2. GENERAL GEOLOGICAL CHARACTERISTICS

The area is charcterized by a supracrustal sequence dominated by greywackes with intercalations of (1) basic and acid volcanics in the western parts, (2) conglomerates some of which are interpreted as debris flows, (3) breccias, and (4) carbonates.

The supracrustals are generally trending N-S vith vertical dip, though large variations occur in detail scale due to foldings. In general graded bedding in the greywackes indicate up towards the east. They are intruded by subparallell (N-S) porfyric basic dykes and minor bodies, and granitoid intrusives. In general the basic dykes are older than the acidic intrusions though they do occationally intrude the granitoid rocks. Probably the basic dykes occur in at least two generations. Pebbles in the conglomerates are composed of finegrained basic and felsic volcanic rocks of ~~presumable volcanic origin~~ and tonalitic-granodioritic rocks equivalent to granitoids west of Gautelisfjell. The contact relations between the Gautelisvatn tonalites and the supracrustals

is cruical in determining the areas geologic evolution, and may also be important for the interpretation of the geneses of the ore-mineralizations.

10.3. ROCK DISCRIPTIONS

Carbonates: In the Gautelisfjell area (Fig.3) two main-sequences are dominating: greywackes and volcanics to the east and a thick carbonate horizon to the west. The carbonate rocks are subdivided into two main varieties: pure, white carbonate and impure, brownish carbonates. The carbonate type 2 which is marked on the geological map og the deposit area (Fig.10) is a variety of the impure carbonates. The pure carbonate is found in the eastern and structurally upper parts of the carbonate horizon, preferentially where the carbonates are folded into the metasedimentary/metavolcanic sequence. It consist of coarse-grained calcite and dolomite, and weather into smoth, white to greywhite slabs. Internal structures are insignificant. The impure carbonates which predominate structurally below this unit constituting the dominating part of the carbonate horizon, have a more or less banded appearance due to light greenish bands and veins of coarse-grained tremolite. They are from 1 cm to 1m wide and occur in both cross cutting and concordant situations. In places they are intensely folded.

The impure, relatively silica-rich carbonate has dark brown to beige color when weathered. The brownish weathered surface is due to alteration of pyrite. The intensity of the color is strongest in the western part of the horizon towards the contact to the granitoid rocks. Some muscovite and chloride in places give it a diffuse, banded appearance.

Calc-silicate rocks: Layers or benches of a green rocktype with diopside, tremolite, garnet (grossular) and epidot are up to a few meters wide. This rock may represent primary layers of impure limestone that has been altered to calc-silicate rocks (skarn). Various types have been found: In the

Gautelisfjell-area the skarn has a rather chaotic texture with masses or cluts of finegrained aggregates of the various minerals in a dissordered manner. Further to the south towards the swedish border, the skarn-rocks occur as lenses or boudins up to a few meter wide. In places the lenses show zoning with a rim of diopside/tremolite and a core of garnet and epidot in between. Aggregates of coarse-grained garnet occationally contains magnetite on fractures as a late mineralization face. The skarn lenses are generally tightly folded.

Fragmental rocks: Various types of "fragmental rocks" occur along the border between the carbonate rocks and the tonalitic rocks. The fragmental rock is next to the tonalite composed of rounded to subrounded fragments (< 15 cm) of quartzite and tonalite in a chlorite-rich matrix. The contact to the underlaying tonalite is gradational. Occationally there is a distinct graded bedding showing upwards away from the tonalite. This graded sequence grades into a 1-3m well layered sequence with small quartz-pebbles (up to a few cm) in a chloritic matrix. This layered sequence is characterized by alternating bands of finegrained tremolite-skarn and quartz-pebbled fragmental rock. The quartzitic fragments contains polygonal quartz-grains that generally lack optical strain features. Due to these arguments the fragmental rocks are believed to represent a sedimentary sequence formed after the erosion of the tonalite.

Amphibolites: The rocks consideres here are cross cutting dikes of various generations. Some of them cut both granites and the supracrustals. They are porphyritic amphibolites sometimes relatively rich in magnetite.

Granitoid rocks: The granitoid rocks in the Gautelisfjell-Gautelisvatn area are of two main types: (1) The by volume dominating type is middle to coarse-grained porfyric K-rich granites which is similar to the common type of granites elsewhere in the Rombak Window. These granites are believed to be the intrusive equivalents of the SN-type K-rich volcanics (Chapt.4). (2) The other

type is tonalitic-granodioritic. It occur in middle to coarse-grained quartz-porphyric varieties. The contact relations between the different granitoid rocks have not been mapped. Felsic volcanic rocks (not mapped) next to the carbonate unit west of Gautelisvatn are chemically more or less equivalent to the tonalite. Pebbles of similar tonalitic rocks are frequent in conglomerates in the supracrustals. For this reason the tonalitic rocks are believed to be subvolcanic intrusions that have been eroded during the volcano-sedimentary period. This is in good accordance with the above interpretation of "the fragmental rocks" as being the product of erosion of the tonalite.

Table 3. Main element analyses of carbonate and calc-silicate rocks.

	White carbonate	Brown, impure carbonate		Calc-silicate rock
Sample	84-04-2-3	84-51	84-04-60	84-45
SiO_2	3.00	24.30	19.40	40.70
Al_2O_3	0.72	2.24	1.94	6.99
CaO	46.90	25.90	29.10	28.90
MgO	6.84	16.60	16.60	3.83
Na_2O	0.04	0.07	0.06	0.16
K_2O	0.07	0.06	0.16	0.47
Fe_2O_3	0.80	6.90	3.04	15.00
MnO	0.10	0.21	0.25	0.59
TiO_2	0.05	0.17	0.14	0.53
P_2O_5	0.03	0.10	0.05	0.09
LOI	42.00	19.80	29.20	2.00
Total	100.60	96.40	100.00	99.30

10.4. ORE MINERALIZATIONS

The gold-mineralizations associated with the carbonate rocks on Gautelisfjell can be subdivided into three main types:

1. Au assosiated with semimassive to massive arsenopyrite.
2. Au associated with rich impregnations and semi-massive mineralizations of other sulfides, mainly pyrite and chalchopyrite.
3. "Invisible" disseminations of gold in large areas of the carbonate horizon.

The *type 1* arsenopyrite-gold mineralization is located in the northern part of the western slope og the Gautelisfjell. It is situated at the boundary between the metasedimentary/metavolvanic series and the carbonate horizon. It has a lensoid geometry 50m long and maximum 2.5m wide, based on drill-cores. Massive/banded arsenopyrite dominate the central part of the orebody while disseminations and veins (distorted bands ?) occur at the rim. The host-rock is a light grey, fine grained, tremolite-bearing quartz-feldspar rock with subordinate sericite, apatite, sphene and clinozoisite. Brecciation with infiltration of arsenopyrite-mineralized carbonate is common. The mineralization is suggested to be of exhalative-hydrothermal origin deposited in a proximal position to a hydrothermal vent (Priesemann 1984).

The semimassive arsenopyrite have up to 25 % As with the corresponding gold up to 11 ppm Au. Two samples with 4.16 and % As contain 2.1 and 1.8 ppm Au and 7.1 and 7.2 ppm Sb respectively. The mineralization was mined for arsenic during a short period around 1916-1920. Approx. 400 tons of ore were produced.

The *type 2* mineralization is generally less than a few meters long and a few dm wide, and is easily seen because of a relatively high content of sulfides (5-25 %). The sulfides are most often pyrite and/or chalchopyrite (/malachite). Pyrrhotite, sphalerite, galena and magnetite occur in variable but minor amounts. The host rock may be either of (a) a quartzphyllitic type as fragments in the carbonate rocks or (b) as relatively diffuse, flat lenses of tremolite-rich carbonate. in tremolite. This type of mineralization can be

found everywhere in the impure carbonate but most often in the upper (eastern) part. They are strongly tectonized.

The *type 3* mineralization is the only one that may have an economic potential. It occur within impure, dark carbonates in the lower, western part of the carbonate unit. Characteristically well-developed cubic and octahedral crystals of pyrite occur unevenly distributed in tremolite veins (distorted layers ?) and carbonate. Scheelite is also recognized macroscopically.

A variety of minerals have been identified by electron microprobe investigations (Krause 1985): (1) Small grains (<0.01 mm) of the Pb,Bi-sulfosalt cosalitt ($Pb_2Bi_2S_5$; which may have formed by alteration of galenabismutite, $PbBi_2S_4$). (2) Some grains of hessite (Ag_2Te, < 10 mm) occur assosiated with cosalite. (3) Argentite (Ag_2S) is closely assosiated with galena. (4) Native Bi occur along fractures and on grain boundaries of pyrite. (5) Barite ($BaSO_4$) occur on fractures, on grain-boundaries of amphibole and assosiated with sulfides. (6) Thorianite and uraninite have also been identified. Pyrite, native Bi and chalchopyrite have been examined by electron microprobe for gold without the element being detected (detection limit 1000 ppm). Only one very small, dusty grain of native gold have been observed in polished section. This grain was not directly associated with sulfides or any of the native elements mentioned.

Samples have been analysed for As, Sb, W and S (Table). The As-grades in the gold-mineralized carbonates (type 3 mineralization) vary from 2 to 28 ppm, Sb is less than 0.3 ppm. W is generally less than 10 ppm although values up to 0.2% have been detected. There is no direct connection between high values of Au and W in the rock. The sulfur content is also highly variable from under detection limit (0.01% S) to 2.43% S. There is no close correlation between the high gold and high sulfur values. For example do one sample with 4.7 ppm Au

contains 2.14 % S, another 1 ppm Au and 2.43% S, while a sample with a content of 1.7 ppm Au did not have detectable amounts of sulfur.

Two samples were analysed for Te, Bi, B and graphitic carbon:

sample	B	Bi	Te	$C_{graph.}$	Au
	ppm	ppm	ppm	%	ppm
84-51	-10	154	10	0.17	4.7
84-60	<10	0.2	0.1	0.75	5.7

In a broad sence the carbonate rocks that are enriched in gold are also enriched in elements such as As, W, Bi, Te and S, though in detail scale there is no clear correlation. A large portion of the gold is believed to occur as free, very small grains not directly assosiated with sulfide minerals.

10.5. CONCLUSION

The type 3 mineralization that is the only one presently believed to have an economic potential, is pyrite-gold with generally less than 2 % S. The gold grades are strongly variable. Average gold grades may reach 6-7 ppm over 3 m drill-core. The economic potential of the mineralization has not yet been fully investigated. Further diamond drilling of the impure carbonates is needed to define the economic potential more precisely.

The geneses of the Gautelisfjell gold mineralization is unknown; it may be of exhalative-hydrothermal origin assosiated with the felsic volcanism in the area, as suggested by Priesemann (1984), or it may be epigenetic and associated with later shear-zones or with the intrusive rocks. In any case the primary depositional characteristics are obscured by later tectono-metamorphic events.

However, the stratabound dissemination in carbonate, the "invisible" gold, the high Au/Ag ratio, and the low content of sulfide, are characteristic features which are broadly similar to those of the Carlin-type hydrotermal-replacement gold deposits (see Bonham 1985). Primary control of ore deposition in Carlin-type deposits are high-angle faults that transect a favorable host-rock type, typically a thin-bedded silty to sandy carbonaceous siltstone or carbonate rock.

Continued lithologic and structural mapping in both detail and regional scales and geochemical studies of the ore mineralization and the related rock-types, is needed to determine the source of and depositional mechanism of the gold. Special attention is required on the comparison with the Carlin-type deposits.

11. GEOLOGICAL EVOLUTION

Some main features of this regions's geological evolution are:

The volcano-sedimentary sequence are the oldest rocks known in the window. These are intruded by different generations of basic and acidic plutons at about 1700-1800 Ma. The different intrusive rocks are believed to be more or less syngenetic. The chemical composition of greywackes from different sub-areas gives a strong indication that their source-regions consists of rocks of similar types to the volcanic rocks presently found in the window. This indicates that these rocks have evolved during a continuous large-scale geologic process with volcanism, erosion, sedimentation, new volcanism, etc.

The dominating volcanic and intrusive rocks are alkali-calcic and relatively pottassic (the SN-series), ranging continuously from mafic through intermediate to acidic varieties. The granites and rhyolites especially, are geochemically practically identical and may represent intrusive and extrusive eqvivalents derived from the same magma-source. In Phanerozoic environments similar magma-series are believed to have originated at deeper levels in the mantle than tholeiitic or calc-alkaline source-magmas, and have, in addition, experienced both fractional crystallization and crustal contamination (see Petro et al. 1979). A similar evolution is suggested for the Skjomen-Rombak alkali-calcic igneous rocks. An extensional environment is nessecary for this type of petrogenesis (Brown 1982).

Another type of felsic extrusive and intrusive rocks are tonalitic and calc-alkaline in character (G-type). Similar rocks are frequent in Archaean and Phanerozoic volcano-sedimentary regions elsewhere in the world. A third type (R-type) of igneous rocks are Mg-tholeiites

INTRODUCTION

Geological and geophysical follow up work and diamond drilling was conducted to the Rombak project area during the summer months of 1984, and has been done in response to anomalous gold isolated from rock and soil samples of the previous year survey.

The project area hosts a massive arsenopyrite-gold mineralization from which it was produced 400 mt of ore during a short mining period in the 1920s. The area is further known for copper and/or bornite occurrences and a sphalerite mineralization. A number of uranium indications have been reported.

The mineralizations are hosted by proterozoic supracrustals featuring a distinctive series of metavolcanics and metasediments of predominantly shallow to medium deep water deposition. The series is part of the granitic gneiss terrain of the Rombak window.

Besides Folldal Verk A/S - Amoco Norway Oil Company JV two other companies are involved in the Rombak area mainly prospecting for gold. ARCO Norway Minerals Inc. has concentrated its activities around the Haugfjellet. The area is centered 45 km north of the Gautelis property. Norsk Hydro A/S is holding two small claim groups within the Gautelis area of Folldal Verk A/S.

LOCATION a. ACCESS.

The Romabk project area is located in Nordland fylke, Northern Norway, centered at 68°05' N and 18°00' E (Fig. 1,2). It is situated within the Rombak - Skjomen mountain region what lies east and southeast of the town of Narvik. This region borders to the Norrbottens Län of Sweden.

The area is a typical high mountain region with variable heights from 700 m to 1800 m a.s.l.. Extensive glacial erosion is responsible for the relative soft appearence of the landscape. There exists normally a very good outcrop situation. However the flat, u-shaped valleys are often covered by glacial residues. Scattered patches of névé and huge glacers are mostly restricted to the higher elevations. The vegatation is very scarce. It comprises gras, mosses, some kinds of berries and plants and lichen.

The project area covers a narrow seam which extends from the southeastern corner of the region (Gautelisfjell) 20 km to the north (Cunojavri). It lies very close to the Swedish border. The area comprises about 80 km^2.

Only the southern part of the area is easy in access. A gravel road of good standard continues from the Skjomen valley to the damning at the Gautelis lake. The northern parts can be reached on trails or by helicopter or waterplane.

The nearest supply centers are Elvegård (Skjomen valley) and Narvik (Ofotfjord), approximately 30 km and 70 km respectively.

The town of Narvik is the seat of the local government. The town is serviced by daily propeller flights from Oslo

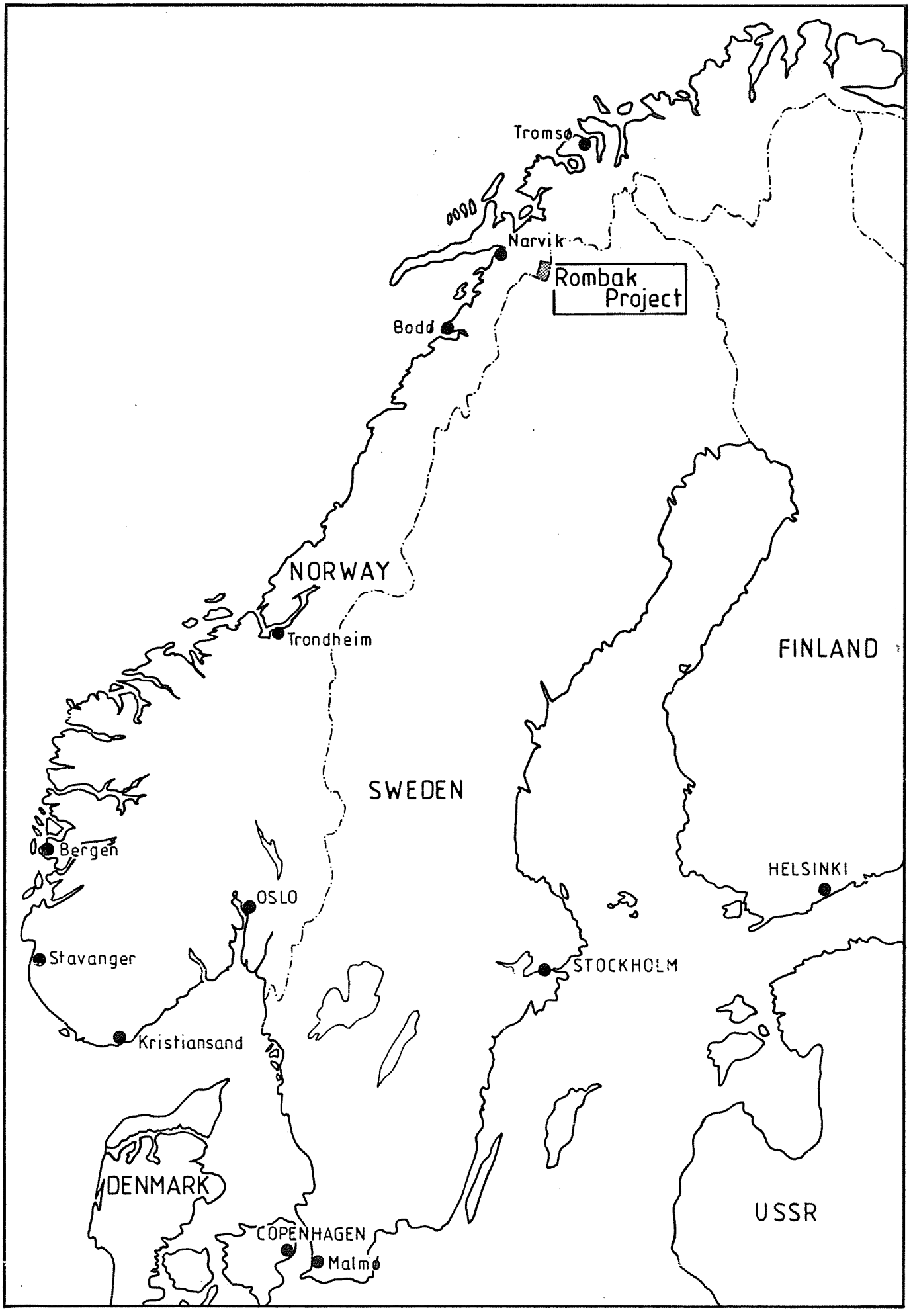

Fig. 1: Project location map, Rombak Project

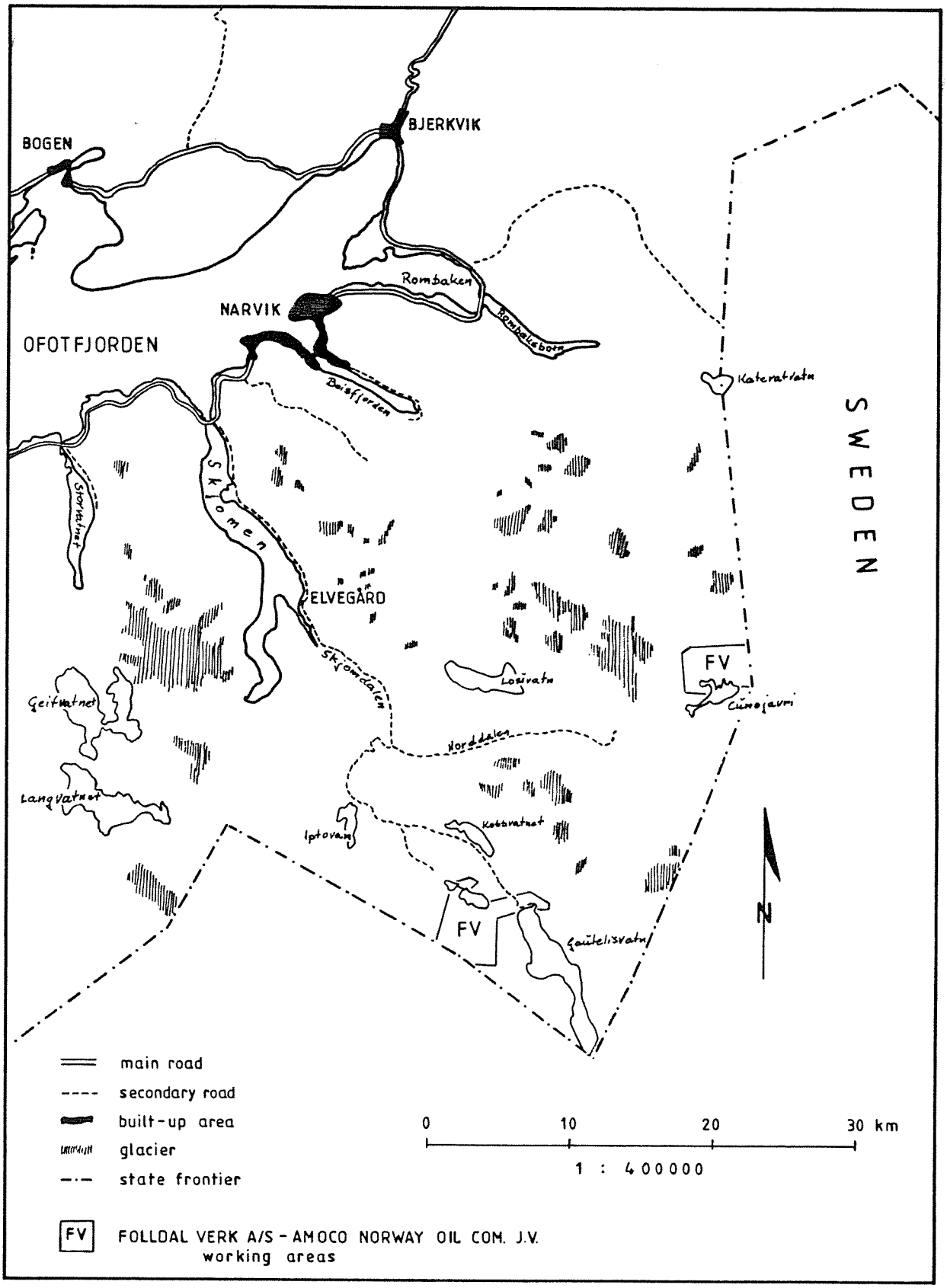

Fig. 2: Location of the working areas, Rombak Project.

and Trondheim. The main airport of the district is Evenes, about 80 km by road from Narvik. It is serviced by daily jet flights from all sites of the country.

Helicopter service is available from Bardufoss (Lufttransport A/S), 110 km distance by air.

LAND STATUS

Presently Folldal Verk A/S holds 5 claim blocks amounting to 81 claims. No new claims have been staked within the 1984 prospecting period.

The breakdown of claims in claimgroups is as follows:

	number of claims
KJØRISVANN	7
GAUTELISFJELL	33
AKSU	6
VAVRAT	15
RUVSSOT	20

Our major competitor is Arco Norway Minerals Inc.. The company runs a very agressive claim policy. It owned large areas of land throughout the Rombak window already by the end of 1983. Additional claims were patented in 1984. Just recently the company took pocession of an USB claim block which lies close to the Aksu-property of Folldal verk A/S. Within late fall Arco optioned three claims of Terje Karlsen which are located in the nearea of the Haugfjell area.

Norsk Hydro A/S holds one claim group in the Gautelisfjell and the Kjørisvann area respectively. Skjangeli Norske A/S (lawyer Ernst Roman, Kongensgt, 50, Narvik) has 7 claims in good standing within the Cunojavri area. The NGU/USB has one property at Iptovann conducting a low-grade uranium occurrence. Terje Karlsen owns one claim on the Katterat Pb-Zn mineralizations.

The definate locations of all these claims can be taken from the Grid Location Map.

HISTORY a. PREVIOUS EXPLORATION

The Rombak-window has been previously noted for its arsenpyrite and copper mineralizations. More recently several Pb - Zn occurences and some uranium indications were part of investigation.

The early prospecting was done either privately or by small explorating companies. These works were concentrated between 1916 and 1924. The investigations encluded sampling, trenching and pitting. Today several smaller showings and shafts and tunnels point from these activities. The mining works were concentrated mainly around one arsenopyrite mineralization what occures at the western slope of the Gautelisfjell. This mineralization of massive and partly disseminated ore is restricted to the junction of a metasiltstone series and a carbonate section. The occurence is very limited. While the mining operations a 13 m deep shaft was put down following the arsenopyrite lode. In addition several smaller showings and one trench were established. About 500 tonns of ore with an average of 30 % As and 11 ppm Au were produced under the test period.

Further arsenopyrite mineralizations were investigated at different locations (Kjørisvann: 611320 7554050, Ruvssot: 380900 7569650). Copper and bornite mineralizations all of spotty occurence were tested at Nuorjojokka (615430 7554170, 615470 7554340, 615300 7554280) and at Ruvssot (380460 7550540). One vein-like Zn enrichment located near Cunojavri (37900 7568500) was investigated by trenching.

The Rombak-window was part of a brief prospecting program on uranium carried out by the NGU/USB in 1975 (NGU-rapport 1389/2). Within the Norddalen (Losi) two weak radiometric anomalies were found. The uranium minerali-

zation is bound to fine grained quartz-rich varieties of a granitic gneiss. Another uranium indication was picked up at Vavrat (Cunojavri). It occures here within a supracrustal rock sequence consisting of greenschists and rusty mica schists. The ground radiometric measurements pointed out a very limited mineralization with an uranium content of 34 ppm and nearly no Th.

In 1976/78 the NGU/USB (NGU-rapport 1430/5) investigated the Pb - Zn mineralizations centered around the western side of the Katterat lake. These occurences are prior described by Smith, 1929 (Bergarkiv rapport 4568). They are partly tested by trenching, pitting and tunneling (1890). The more recent works included geological mapping and rock sampling.

The Pb - Zn mineralization is bound to steep dipping carbonate veins of variable - cm to dm - thickness. They only in places do carry quartz, feldspar, epidot, some asbestors and fluorite. The veins are mostly N - S orientated following the main foliation plan. The majority of them occures in granitic gneiss but some do even exist in supracrustal rocks. A small number of rock samples were assayed for Pb, Cu, Zn, Ni and Ag. The values remained generally low.

From the same location a number of sulphide mineralizations are reported. They are bound to gabbroic rock types and metamorphosed supracrustals. The ore contains mainly of pyrrhotite with minor constituents of sphalerite, chalcopyrite and galena. Very local is the occurence of arsenopyrite. The mineralization is always of a disseminated type and very limited and formes strata-bound bodies.

Both types of the mineralization located at the Katterat lake seem to be not economic (NGU-rapport 1430/5 A).

Recently the Geological Survey of Norway (NGU) started several new programs mainly subjecting the supracrustal rock suite of the Rombak window. An airborne helicopter survey comprising Mag. and radiomatric measurements conducted two smaller areas (NGU-rapport 1836). A stream sediment program of widely scattered sample locations covered the main part of the window (NGU-rapport 1800/58 Bd I a. II). Detailed geological investigations concentrated mainly on the USB claim block at Morfasfjell (Iptovann) were started in 1982. The works performed geological mapping, tectonical inquiry and whole rock geochemistry.

Within the last years detailed geological mapping which affected the Cunojavri-Unna Alakats - Sjangeli volcanic belt was carried out by Rolf Rømer, University of Luleå. A previous geological map as well as a principle stratigraphical profil of the region was presented while a field trip in summer 1984 (profil sketch later this report).

Arco Norway Minerals Inc. started prospecting within the Rombak window in 1983. The same year they carried out a regional stream sediment program and did reconnaissence works within some of their claim groups. An airborne geophysical survey was done simultaneously with the field works. The thisayears activities involved a follow up program consisting detailed geological studies and ground geophysical surveys. A 12 hole diamond drilling program, totalling approx. 2000 m, affected the Haugfjell area.

Norsk Hydro A/S and the other individuals never started any prospecting within their properties.

SUMMARY REPORT

ROMBAK PROJECT

(330 270)

FOLLDAL VERK A/S - AMOCO NORWAY OIL COMPANY J.V.

DECEMBER 1984

Prepared by:

Dr. Frank-Dieter Priesemann

1985 PROSPEKTERINGS BUDSJETT

ROMBAKEN

			(NOK 1000)
Lønn:	Fast:	2 geologer i 10 mnd	502
		Feltgodtgjørelser	45
	Midlertidige:	5 geologer i 6 mnd inkl. diett	780
		3 feltassistenter i 4 mnd inkl. diett	240
		1 geofysiker i 6 mnd inkl. diett	156
Biler:	2 biler i 3½ mnd		28
	Kjøregodtgjørelse privatbiler		10
Reiser:	Fly		100
	Land		80
Utstyrsleie:	Geofysikk		125
Helikopter			350
Feltutstyr			50
Mobiltelefoner			8
Konsulenttjenester			80
Kart og publikasjoner			10
Kontorleie Narvik			25
Mutingsgebyr			150
Analyser 600 prøver			111
Frakt			25
Landmåling			100
Røsking			50
Borring 1500 m			975
Data			40
Administrasjon 15%			606
		Løpende utgifter totalt	4.646
Fast utstyr:		1 Moelvenbrakke 12m^2	40
		2 Kontortelt	30
		1 Botelt	10
		Totalt	80
Totale prospekteringsutgifter			4.726

30/1/85

SHLH2/7*

KLUBBVATN

Geologisk Kartlegging 1:20.000 (30 km^2)

Fullfør karleggingen av de sedimentære og vulkanske bergartene mellom Leirv. og Rombaksbotn.

Konsentrer arbeidet rundt bekkesediment og/eller DIGHEM EM anomalier.

Basislinjer - 10 km

Opprettelse av basislinjer mellom 0.5 og 3 km lange på anomale områder.

Geologisk Karlegging 1:5000 (10 km^2)

De ovenfor nevnte anomale områder detaljkartlegges før utførelse av bakkegeofysikk og bergarts- geokjemi.

Bekkegeofysikk oppfølgning EM & MAG (30 linje km)

De ovenfor nevnte områder kontroleres med MAG og EM målinger, med det formål å utvelge diamantborrings-objekt.

Bergartsgeokjemi - 300 prøver

Prøvetakning på det lokale stikkningsnett, og langs profiler med samme formål som ovenfor.

Røskning - 150m

Tilsvarende som på Haugfjellet.

Diamantborring - 500m

Testing av de 2 beste objektene.

Januar '85
Boye Flood

SHLH2/7*

12. CONCLUSION

Geologic environment:

It is concluded that the volcano-sedimentary and intrusive rocks are formed in an early Proterozoic continental environment, presumably either within a rift-controlled intra-continental basin or at a continental margin. The environment may be comparable to fairly mature stages in Phanerozoic ocean-continent collisions with rifting, magmatism and sedimentation on the continental side of a subduction zone, accompanied by basic to acidic plutonism. The window have then experienced epidot-amphibolite to amphibolite facies metamorphism. Strong retrogression to greenschist facies is related to shear zones within a N-S trending lineament which have acted as channels for hydrotermal fluids.

Ore mineralizations:

The Gautelisfjell stratabound, disseminated carbonate-hosted gold deposit demonstrates that effective concentration mechanisms for gold has been active in the region. This mineralization are believed to be of a type, either exhalative ~~-syn-volcanic~~ or epithermal Carlin-type, which could lead to a economic deposit. The potential of the Gautelisfjell area is not yet fully investigated. Stream sediment anomalies including visible gold in heavy mineral fractions, elsewhere in the window show that gold mineralizations outside the Gautelisfjell area do occur also. Potential sites for gold mineralizations are shear-zones that have acted as channels for hydrotermal fluids, carbonate beds similar to those at Gautelisfjell, and carbonate+/- sulfide-bearing horizons in acid volcanics that are believed to be interbedded chemical sediments. Of particular interest is the N-S trending lineament in the eastern part of

(komatiites); such rocks are common in Archaean greenstone belts around the world.

Initial $^{87}Sr/^{86}Sr$ ratio of 0.700 +/- 0.006 for Skjomen-Rombaken granite is reported by Gunner (1981), which indicate that the granites were derived from the mantle or from an isotopically similar region without significant incorporation of sialic material. Furthermore, based on the distribution of published initial ratios for crystalline rocks in North Norway and Sweden dated between 1845 and 1535 Ma, Gunner postulated the existence of an eastward-dipping NW-SE trending subduction zone beneath the area during this period.

The window has experienced epidote-amphibolite to amphibolite facies metamorphism (P > 6 kb, T 575 to 600 °C). A greenschist facies retrogression has affected the window to varying degrees. Strong retrogression in the Muohtaguobla area is related to shear zones within a major N-S trending lineament.

A typical feature for many archaean volcano-sedimentary regions in the world is bimodal tonalitic-trondhjemitic and basaltic magmatism, while post-Archaean magmas may form a continuous sequence from basic to acidic types due to assimilation of crustal materials in mantle-derived magmas (Barker et al. 1981). The continuous variation from basic to acidic for Skjomen-Rombaken alkali-calcic igneous rocks is, according to this argument, a post-Archaean feature. The relatively high K/Na-ratio and the strong fractionation of REE, supports this interpretation (see Windley 1983). Alternatively if the the volcano-sedimentary sequence is Archaean then the Rombak area represent a stage of Archaean crustal evolution not recognized elsewhere in the world. Precise age determinations are needed to solve this problem.

General statement:

Since the geological evolution of a region in all scales, including the formation of ore-deposits, are parts of a continuous geologic process, it is our principal opinion that further investigations in the Rombak Window should include different aspects of geology, i.e. lithologic and structural mapping, geochemistry (including isotopes), age determinations, as well as detailed ore investigations. If coordinated, this will most certainly lead to a significant increase in the the possibilities of finding the different, and often practically invisible, ore-types. Valuable information that may be essential for investigations in similar terrains elsewhere in Norway, will also be obtained. This last aspect should not be underestimated.

Acknowledgements:

We are indebted to the companies Folldal Verk A/S and ARCO Norway for their permission to include the results from their investigations in the Rombak Window in this report. Their cooperative attitude is gratefully acknowledged.

13. REFERENSES

Bonham, H.F. 1985: Characteristics of bulk-minable gold-silver deposits in cordilleran and island-arc settings. In Tooker, E.W. (ed.): Geologic characteristics of sediment- and volcanic-hosted disseminated gold deposits - search for an occurrence model. U.S. Geol. Surv. Bull. 1646, 71-77.

Barker, F., Arth, J.G. & Hudson, T. 1981: Tonalites in crustal evolution. In Morbath, S. & Windley, B.F. (eds.), The origin and evolution of the Earth's continental crust. Philosophical Transactions Royal Society of London Series A, A 301, 293-303.

Birkeland, T. 1976: Skjomen, berggrunnsgeologisk kart N10 - M 1:100000. Nor. geol. unders.

Brown, G.C. 1982: Calc-alkaline intrusive rocks: their diversity, evolution, and relation to volcanic arcs. n Thorpe, R.S. (ed.), Orogenic andesites and related rocks, 437-61. Wiley, London.

Flood, B.1984: The Rombak Project Area, North Norway. Summary of work done 1983 and work programme proposal for 1984. ARCO Norway, Inc., Hard Mineral Section. Report no. 84-670-19, 18 pp + 9 figs.

Flood, B. 1985: The Rombak Project Area, North Norway. Summary of work done 1984. ARCO Norway, Inc., Hard Minerals Section. Report no. 85-67-47, 14 pp + 15 figs.

Fyfe, W.F. & Kerrick, R. 1982: Gold: natural concentration processes. In R.P. Foster (ed.), Gold'82: The geology, geochemistry and genesis of gold deposits. geol. Soc. Zimbabwe, Spec. Publ. 1, 99-128.

Gunner, J.D. 1981: A reconnaissance Rb-Sr study of Precambrian

certain whether the two anomalies form one mineralization or not. The present state of investigation leaves a lot of questions open especially concerning type as well as size and grade of the gold mineralization. More diamond drilling has to be done in order to test the occurrence properly. It is assumed, however, based on the drilling data that there is little potential for a gold occurrence of larger tonnage within the location.

The Gautelis arsenopyrite/gold occurrende has been traced out with drill hole GAU -84-03 to a depth of 35 m, the mineralized zone bearing distal vein-type arsenopyrite ore grading 1.8 ppm Au over a true thickness of 3.85 m. Drill hole GAU-84-02 which is located 100 m north (striking length) of the arsenopyrite/Au prospect intersected marginal pyrrhotite-chalcopyrite ore at 47 m depth, the section carrying slightly anomalous Au (max. 190 ppb within 1 m samples). The drilling data give little support to a deposit of somewhat higher tonnage. The mineralization, however, is still open towards depth and should be drilled off carefully.

The remaining Folldal Verk A/S properties at Kjørisvann and Cunojavri have been proved negative, their claims should be dropped completely.

SUMMARY AND CONCLUSION

Prospecting for gold within the Rombak window (68°15' lat., 17°45' long.) started in summer 1983 with a program of regional rock sampling, soil sampling and ground geophysical surveys, the works having been confined to Folldal Verk A/S - Amoco Norway Oil Company JV properties. The claims had been staked in response to a study about Au - potential in northern Norway (KRAUSE, 1982).

The Rombak window is previously known by its arsenopyrite - gold, its copper and its lead - zinc occurrences. The mineralizations are bound to precambrian - proterozoic supracrustals that consist of metasediments and metavolcanics.

The 1984 field program involved follow - up work on anomalous Au - areas. Detailed geological mapping as well as soil sampling and geophysical works were concentrated around the Au anomaly of rock sample NR-15-83 within the Gautelis south-slope area. A 3 hole diamond drilling program was conducted tc an area of high anomalous gold within the Gautelis south-slope grid. The Gautelis arsenopyrite/Au prospect was tested towards depth by 3 hole of diamond drilling. Reconnaissance works affected additional land.

The gold mineralization of the Gautelis south-west slope grid was assayed containing average 0.6 oz/t Au (samples NR-15-83 and NR-129-84), the hostrock being a sulphide bearing amphibolite of certainly ultrabasic composition (tremolite-, anthophyllite-rock). The mineralization is of spotty occurrence (0.3 m x 0.5 m). The diamond drilling gave evidence of anomalous Au only with drill hole GAU-84-04 which tested the area 30 m north of the gold mineralization. An average content of 2.8 ppm gold over two meter was assayed from a sulphide rich zone within a marble layer , the lithology of the mineralization being quite different to that of the gold enriched rock from the outcrop. It is un-

M A P S

1. Geological Map Rombak Window
2. Rombak Window Claim Map
3. Gautelis Area: Rock Samples, Geology
4. Cunojavri Area: Rock Samples, Geology
5. Gautelis southwest-slope grid
   - Geology Map, Drill Sites
   - Geochemical Map: Soils Au contour
   - Geochemical Map: Soils Zn contour
   - Geophysical Map: VLF
   - Geophysical Map: C.E.M.
   - Geophysical Map: Mag.
   - Geophysical Maps: IP
   - Drill Holes GAU-84-04/05/06
6. Gautelis arsenopyrite-gold prospect
   - Geology a. Sample Locations, Drill sites.
   - Drill Holes GAU-84-01/02/03.

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Oslo 29/8-1985

ROMBAKEN PROSJEKTET, NARVIK

Forslag til søknad om tillatelse til å danne et A/S med DU-avsetningsmidler

Søknaden ber om tillatelse til å danne et aksjeselskap med DU-avsetningsmidler. Det er ønskelig med en aksjekapital på min. 6 mill. kr., maks. 10 mill. kr.

Midlene skal brukes til oppfølgende prospektering, inklusive diamantboring på sink, bly, sølv-mineraliseringer, samt gullundersøkelser i Rombaken-området, Narvik kommune. Aksjeselskapet vil på denne måte tilegne seg en andel på minst 50 % i de felt som er mutet og tidligere undersøkt av ARCO Norway,Inc.

Bakgrunnsinformasjon

ARCO utførte i løpet av 1983-84 et omfattende prospekteringsarbeide i det aktuelle området.

Arbeidet var et ledd i selskapets fastlands industrisamarbeide, men samtidig et orienterende arbeide for ARCO's metallselskap Anaconda.

Etter omfattende litteraturundersøkelser og feltrekognosering i Norge, utpekte Rombaken seg som det beste prosjektet. Det har deretter blitt utført direkte prospekteringsarbeider i dette området for ca. 6 mill. kr.

Arbeidet har omfattet regional og detaljert geologisk kartlegging, omfattende geokjemiske prøvetakinger, geofysiske

målinger fra helikopter og på bakken, samt grøfting og diamantboring (1750 m).

Disse arbeidene definerte en metallogenetisk provins m.h.t. sink, bly, sølv, og påviste også et potentiale for kopper og gull. Fritt gull ble påvist ved vasking i et flertall bekker.

Prosjektet tiltrakk seg stor interesse og anerkjennelse fra Anaconda hvorfra den videre finansiering skulle komme.
Pr. 29. april 1985, i en restruktureringsprosess avviklet ARCO Anaconda som et metall-grubeselskap, og da industrisamarbeidspengene er oppbrukt er Rombaken-prosjektet henvist til ekstern finansiering.

En rekke fremstøt er blitt gjort fra ARCO's side overfor andre nasjonale og internasjonale grube-prospekteringsselskap m.h.t. samarbeid. Interesse har blitt vist og fremstøtene vil fortsette, men har et langtidsperspektiv.

Det ble i mars 1985 søkt Industridepartementet (Prospekteringsstøtte i Nord-Norge) om finansieringshjelp til diamantboring på Haugfjellet som ligger i den nordlige del av prosjektområdet. Totalkalkylene for dette programmet var kr. 830.000,-. I et brev av 13/5-85 meddelte Departementet at det var bevilget kr. 353.00,- til støtte for borprogrammet under forutsetning at de resterende midler skaffes til veie, og at arbeidet utføres innen utgangen av 1985. Det vil nå bli søkt om å få disse midlene overført til 1986.

Det ble i januar, 85 også søkt om 2 mill. kr. i tilskudd fra Nord-Norge bevilgningen "Støtte til kartlegging og undersøkelser av drivverdigheten av ressurser" vedrørende et program i den sørlige del av prosjektområdet (Klubbvatn). Nordland Fylkeskommune rekommenderte et tilskudd på 300.000,- kr., men i brev fra Landsdelsutvalget for Nord-Norge av 4/7-85 ble søknaden avslått.
I avslaget sies det bl.a. at "Off. tilskudd til prospektering

bør primært søkes fra industridepartementets prosjekterings-bevilgning og DU.

Arbeidsplan og budgettering

Bil. 1 og 2 viser ARCO's arbeidsplan og budgett basert på full finansiering fra Anaconda, d.v.s. et max. budgett for 1985 på 4.7 mill. kr. Det var her tatt sikte på å avslutte prospekteringsfasen i Rombaken over en 2-årsperiode. Et min. budgett på mellom 0.8 og 1 mill. kr. var vist i det ovenfor nevnte diamantboringsprogram. Dette releterer til de borobjekt som fremkom ved arbeider i 1984, og som i bil. 1 er oppført som Diamantboring 1000-1500 m. Positive resultat fra et eller flere av disse hull ville dog raskt øke behovet for mere boring.

Utvelgning og boring av andre objekt vil i stort være avhengig av utførelse og resultat fra de øvrige arbeider vist i bil. 1.

Det er viktig å merke seg at det innom prospekteringsindustrien er vanskelig å legge frem detalj-program for flere år fremover. Hvert steg i prospekteringsprosessen må fortløpende vurderes og resultatet er bestemmende for neste steg.

Erfaringsmessig kan man si at rundt 40 % av et prospekteringsbudgett bør brukes til boring for å teste de positive resultat (anomalier) som de andre metodene har indikert.

Et prospekteringsprogram av denne størrelsesorden (10 mill. kr.) bør utføre boring for minst 4 mill. kr, spesielt da de innledende og regionale arbeider allerede er utført. D.v.s. at videre prospektering utover det som er vist og budgetert i bil. 1 og 2 bør inkludere diamantboring for minst 3 mill. kr. Forøvrig vil et videre program for det meste bestå i detaljarbeider for utvelgning og nøyaktig bestemmelse av

borlokaliteter.

Vi vil til slutt presisere at ARCO's arbeidsprogram for 1985 ikke nødvendigvis behøver utføres over ett år. Arbeidet kan utføres metodisk og rasjonelt også over en periode på 2-3 år.

Sysselsetting.

Under en prospekteringsfase vil det arbeidet som skal utføres ha relativt liten innvirkning på den lokale arbeidssituasjon.

Bemanningen vil for det meste bestå av høyt spesialisert personell og eksterne entrepenører (geofysikk og diamantboring).

Gir prospekteringen de resultater som vi håper på, nemlig en grubeindustri, vil dette få betydelig og langsiktig innvirkning på sysselsettingen i Narvik kommune.

Generelt.

Den primære bakgrunn for å starte et prospekteringsprogram er at de rent geologiske betingelser (mineraliseringspotentiale) foreligger i det aktuelle område.

Et slikt potentiale for sink, bly, sølv, kopper og gull er ved to års intens prospektering av ARCO blitt påvist i Rombakenområdet, Narvik.

Skulle man måtte velge mellom områder med samme potentiale vil forhold vedørende infrastruktur og arbeidsstokk (sysselsetting) spille en stor rolle.

En mineralisering (uøkonomisk) i et avsidesliggende område med store investeringskrav kan være malm (økonomisk) i et område

med eksisterende infrastruktur.

Ingen av undersøkelsesfeltene i Rombaken prosjektet ligger mere enn 20 km (luftlinje) fra Narvik by , eller 6 km fra eksisterende vei og/eller jernbane. Kraftutbyggingen i dette område turde også være velkjent.

Dette betyr at all infrastruktur for en eventuell bergverksdrift i Rombaken allerede eksisterer. Investeringer kan stort sett begrenses til adkomstveier, grube og oppredningsverk.

Boye Flood
Geologiske Tjenester a.s.

PROSPEKTERINGSPROGRAM 1985

ROMBAKEN

HAUGFJELLET

Geologisk Kartlegging 1:20.000 (20 km^2)

Avslutte karleggingen av de sedimentære og vulkanske bergartene, inkl. Muting: Bruvatnet.

Ekstra kontroll rundt bekkesediment og tungfraksjons anomalier, samt den magnetiske (MAG) anomalien ved 1. Haugfj.

Geologisk Kartlegging 1:5000 (4 km^2)

Utvid detaljområde fra 1984 til områder med ukontrolerte DIGHEM elektromagnetiske (EM) anomalier.

Bakkegeofysikk oppfølgning EM & MAG (15 linje Km)

1. Avslutte målingene ved Varden N og Høyde 708.
2. Forleng linjer fra 1984 så de dekker granittkontakten mot nordøst med DIGHEM EM anomalier.
3. Utvid målingene syd og nord for eksisterende stikkningsnett hvor det fortsatt finnes ukontrolerte DIGHEM EM anomalier.

Bergart geokjemi - 200 prøver

1) Tettere prøvetakning rundt potensielle borringsobjekt innom stikkningsnettet.
2) Prøvetakning av nye områder med EM anomalier og tiltrekkende geologi.

Røsking - 100m

Et antall korte røsker (5m) ved potensielle borrobjekt, og andre områder med synlig mineralisering.

Diamantborring 1000 - 1500m

Boring av sansynligvis 7 hull på minst 3 objekt innom Haugfjellets stikkningsnett.

rocks from the Skjomen-Rombak Window and the pattern of initial $^{87}Sr/^{86}Sr$ ratios from northern Scandinavia. Nor. Geol. Tiddskr. 61, 281-290.

Heier, K. & Compston, W. 1969: Interpretation of Rb-Sr age pattern in high-grade metamorphic rocks, North Norway. Nor. Geol. Tidskr. 49, 257-283.

Hutchinson, R.W. & Burlington, J.I. 1982: Some broad characteristics of greenstone belt gold lodes. In R.P. Foster (ed.), The geology, geochemistry and genesis of gold deposits. Geol. Soc. Zimbabwe, Spec. Publ. 1, 339-371.

Håbrekke, H. 1983: Geofysiske målinger fra helikopter over to områder - Ballangen og Skjomen, henholdsvis vest og syd for Narvik, Nordland fylke. NGU report 1836, 13 pp + 20 maps.

Kerrick, R. 1980: Archaean gold bearing chemical sediments and veins: a synthesis of stable isotope and geochemical relations. Gold sypphosium, Waterloo. Ontario geol. surv. open file report 5293, 137-211.

Korneliussen, A. & Sawyer, E. 1986: Sydlige deler av Rombakvinduet, Nordland; berggrunns- og malmgeologi med særlig vekt på gullproblematikk. Nor. geol. unders. NGU report 86.xxx.

Lambert, I.B. 1983: The major stratiform lead-zinc deposits in the Proterozoic. Geol. Soc. America Mem. 161, 209-226.

Lindahl, I. & Furuhaug, L. 1977: Uranundersøkelser i Skjomen-området sommeren 1976. NGU report 1416/2, 9 pp.

Lindahl, I. 1978: Diamantboringer, geologiske- og geokjemiske undersøkelser ved ytre Sildvikskar Zn-Pb forekomst, Narvik,

Nordland. NGU report 1430/4B, 20 pp.

Lindahl, I. 1980: Katteratvatn Pb-Zn forekomst, Narvik, Nordland. NGU report 1430/5A, 16 pp.

Nesbitt, H.W. and Young, G.M. 1982: Early Proterozoic climate and plate actions inferred from major element chemistry of lulites. Nature (London) 299, 715-717.

Næss, G. 1983: Geokjemisk undersøkelse i Skjomen og Ballangen (1980). Vol. I & II. NGU report 1800/5A & B, 6 pp + 26 maps.

Peacock, M.A. 1931: Classification of igneous rock series. J. Geol. 39, 54-67.

Pearce, J.A. & Norry, M.J. 1979: Petrogenetic implications of Ti, Zr, Y and Nb variation in volcanic rocks. Contr. Miner. Petrol. 69, 33-47.

Pearce, J.A., Harris, N.B.W. & Tindle, A.G. 1984: Trace element discrimination diagrams for the tectonic interpretation of granitic rocks. Journ. Petrol. 25, 4, 956-983.

Petro, W.L., Vogel, T.A. & Wilband, J.T. 1979: Major-element chemistry of plutonic rock suites from compressional and extensional plate boundaries. Chem. Geol. 26, 217-35.

Robyn, T.L., Flood, B. & Thomassen, B. 1985: A comparison of geophysical data and geological mapping, Rombak Precambrian window, northern Norway. 47'th. E.A.E.G. meeting in Budapest, manuscript 26 pp.

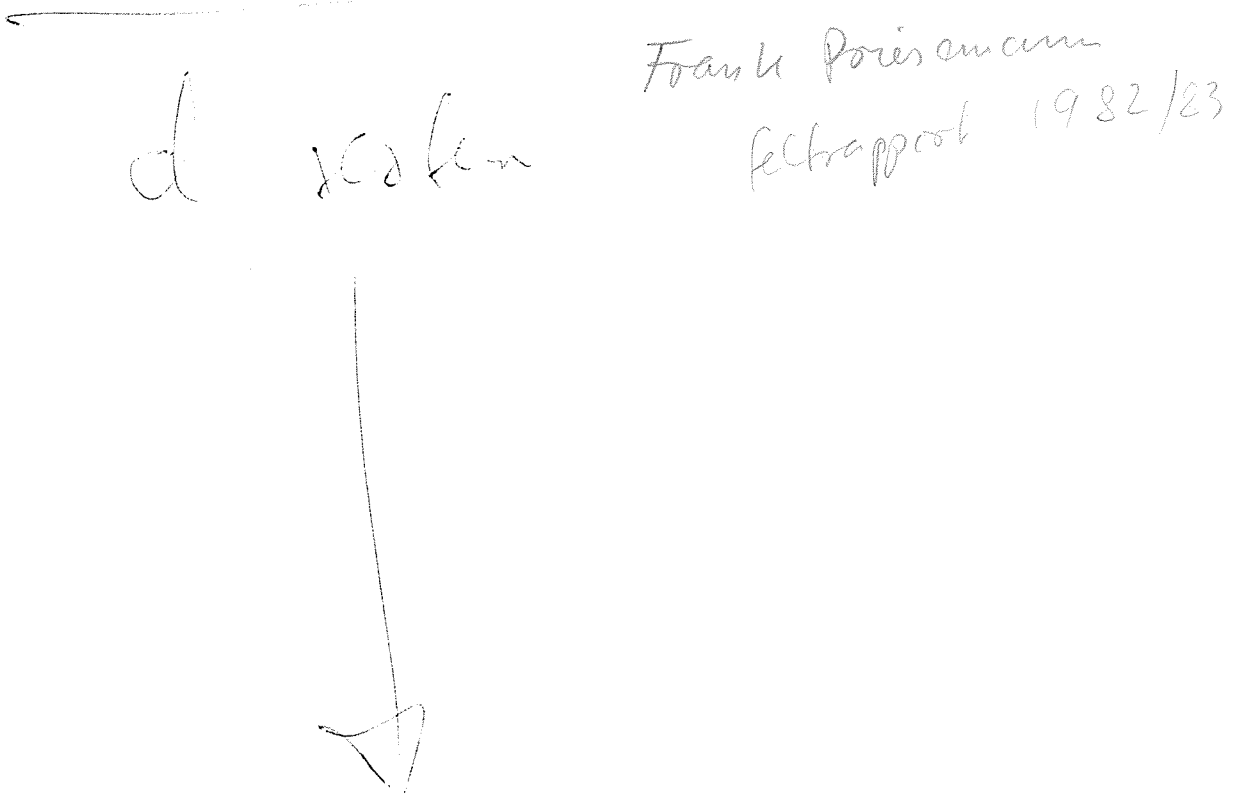
Sawyer, E. 1986: Metamorphic assemblages and conditions in the Rombak basement window. NGU-report no. 86.xxxx

Skonseng, E. 1985: Berggrunnsgeologisk kartlegging i Gautelisområdet, Skjomen, Nordland. Feltrapport. NGU report 85.214, 16 pp.

Taylor, S.R. & Gorton, M.P. 1977: Geochemical application of spark source mass spectrography - III. Element sensitivity, precision and accuracy. Geochem. Cosmoch. Acta 41, 1375-1380.

Vogt, T. 1950: Geologisk kart Narvik (1:100000). Nor. geol. unders.

Windley, B.F. 1983: A tectonic review of the Proterozoic. Geol. Soc. America Mem. 161, 1-9.



Appendix

Neutron activation analysis of rock-samples (values in ppm).

Analysed by IFE, Norway and Berquerel Lab., Canada.

Greywackes, Gautelisvatn.					Greywackes, Rombaken.					Greywackes, Ruvssot.			
Sample	ES 57	ES 58	ES 61	$\bar{x}$	ES 68	ES 69	ES 70	ES 72	$\bar{x}$	ES 131	ES 132	ES 134	$\bar{x}$
La	36.0	25.0	22.3	27.8	33.1	28.7	16.4	28.0	26.6	10.8	23.9	27.3	20.7
Ce	73.9	52.1	49.6	58.5	77.3	62.4	36.7	59.3	58.9	26.0	50.8	57.8	44.9
Nd	24.8	22.4	19.0	22.1	28.0	23.9	10.0	22.8	21.2	12.0	19.0	24.0	18.3
Sm	5.30	4.42	4.18	4.63	4.91	4.82	2.64	4.34	4.18	3.20	3.60	4.12	3.64
Eu	1.00	0.92	1.00	0.97	0.92	0.93	0.69	0.90	0.86	1.00	0.86	1.00	0.95
Tb	0.87	0.8	0.67	0.78	0.57	<0.53	0.51	<0.40	<0.50	0.70	<0.54	<0.52	<0.59
Yb	2.21	1.62	2.57	2.13	1.91	2.07	2.32	1.85	2.04	2.37	1.49	1.67	1.84
Lu	0.31	0.29	0.44	0.35	0.29	0.34	0.39	0.34	0.34	0.44	0.37	0.30	0.37

Granites				Mafic intrusives				
	Sørdal		Norddal	Sørdal	G.vatn	Norddal	Ultramafic volcanics, Ruvssot	
Sample	KS5.3	KS36.3	K272.3	KS11.3	K152.3	K273.3	R16.3	R22.3
La	63	105	106	14	35	53	0.2	0.6
Ce	104	172	170	25	65	88	<2	2
Nd	43	73	67	17	37	44	0.1	1.0
Sm	10.3	13.1	14.2	4.7	8.9	9.6	0.2	0.4
Eu	0.17	1.4	1.5	1.8	2.2	2.0	0.15	0.19
Tb	1.8	1.5	1.5	0.51	1.00	0.72	<0.05	0.13
Yb	7.4	3.7	4.4	1.7	2.5	3.3	0.5	1.0
Lu	1.23	0.61	0.76	0.31	0.50	0.50	0.10	0.19

Felsic volcanics								Mafic/intermediate volcanics, Sørdal		
	Sørdal	Stasj.h.	Stasj.h.	Cainhav.	Cainhav.	Muohtaguobla				
Sample	KS19.3	K269.3	K101.4	K104.4	K254.3	K301	K302	KS9.3	KS12.3	KS17.3
La	80	135	86	61	63	25	24	104	105	91
Ce	134	220	191	132	98	38	38	176	187	156
Nd	56	92	73	53	46	17	18	84	88	68
Sm	12.1	18.3	14.3	8.8	10.7	3.7	3.3	14.8	15.4	11.5
Eu	0.97	0.29	0.12	1.10	1.2	2.8	3.2	3.9	3.7	2.8
Tb	1.4	2.1	1.84	1.20	1.2	0.41	0.39	1.2	1.2	0.97
Yb	5.1	4.7	6.63	4.19	4.5	0.65	0.66	3.3	2.6	2.6
Lu	0.85	1.18	1.04	0.71	0.68	0.10	0.11	0.67	0.46	0.45

REGIONAL GEOLOGY

The Rombak window is underlain by precambrian rocks of supposely proterozoic age (1707 ± 70 Ma, granite) (HEIER a. COMPSTON, 1969). The sequence consists of at least two main rock groups, designated as first the Rombak granite or granitic gneiss and second the assemblage of supracrustal rocks. The chronological relationships between these two groups are still uncertain. The geological patterns indicate a somewhat older age for the supracrustal rocks.

The Rombak granite is the dominating rocktype within the precambrian window (Geological map). It is described as a mostly coarse grained, grey to slightly reddish coloured rock which often occures with a marked "eye texture"

The most common type is a quartzo-feldspatic gneiss of slightly foliation containing biotite, potash feldspar - of the "patch perthite" type - and quartz in various proportions. Accessory constituents are commonly ilmenite and titanite.

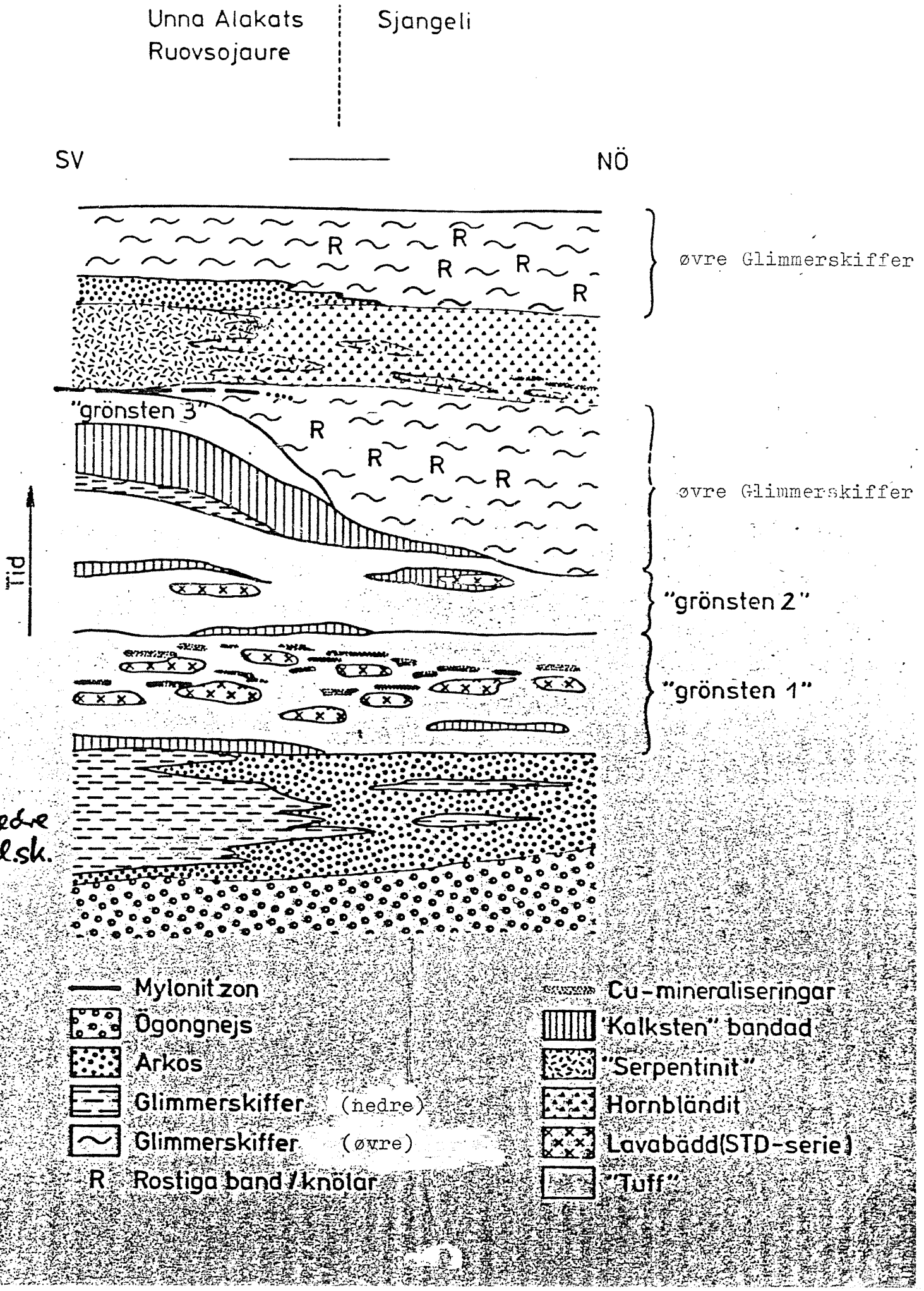
The mostly very homogeneous looking Rombak granite is locally intruded by allochtonous granites and syenites.

The supracrustals are found forming isolated lenses and sheets of up to several km length within the Rombak granite. They predominately are N - S oriented, their internal fabric generally following the same orientation and showing a frequent steep (70° to 80°) westward dip. The genetic relationships between the granitic gneiss and the supracrustals are still uncertain. However, the granitic gneiss or even parts of it are favoured to be younger than the supracrustal rock suite. The contacts between the two rock "groups" are often sharp, but they can be graduell too. Tectonical contacts do exist in places, they develop thick shear zones which sporadically contain tectonic breccias.

The supracrustals mainly consist of epiclastic sediments with frequent volcanic related intercalations, the rocks being metamorphosed in lower to middle amphibolite facies. Each isolated body exhibits a rather unique stratigraphy, the succession of rocks grading upwards towards the west. Most of the strata are of stratigraphically and/or laterally variable lithologies. A good example for that is given by the stratigraphic profil from the Unna Alakats - Sjangeli area introduced by R. Rømer (Fig. 3). However, a relative continuous lithostratigraphy is developed with the Gautelis supracrustal series. The formations give evidence of being of subaqueous origin. A shallow to medium water deposition environment is indicated for the majority of them. The supracrustal rock suite contains rocks of the following lithologies: phyllites sporadically graphite bearing (meta-siltstones), amphibolites (meta-basic lava), serpentinites (meta-ultrabasic flows), carbonates (meta-limestones or dolomites), quartz-feldspar-biotite schists (supposely meta-intermediate to felsic tuffs), graphite bearing quartz-biotite-chlorite schists (meta-tuffites), quartz-feldspar rocks (supposely felsic metatuffs) and quartzites (meta-arenites) and conglomerates. As intrusive bodies do exist gabbros and diorites and dunites with significant amounts of magnetite.

The series contain several bands of sulphide mineralizations, they in the majority form strata-bound bodies.

Fig.3. PRINCIPIELL STRATIGRAFISK PROFIL (R.Rømer,Luleå)



Eocambrian sediments are found discontinuously overlying the precambrian basement. The geological map of Foslie (1915) indicates several isolated eocambrian cluts being scattered over the Rombak window. A considerable number of them have newly been found belonging to the supracrustal rock suite.

Tectonical studies related to the Rombak rocks are under operation.

1984 PROGRAM

The 1984 prospecting season for the Rombak project commenced approx. mid. June and ended in October. The program consisted geological follow-up work and ground geophysical surveys, as well as geochemical soil sampling the investigations having been concentrated around the Gautelisfjell. Diamond drilling was introduced in order to test two areas anomalous in gold. Reconnaissance field work conducted areas adjoined to the Folldal Verk A/S properties.

A combined geochemical - geophysical grid has been established covering the gold anomaly isolated from rock sample NR-15-83 at the Gautelis south-slope. A grid pattern of 25 m line spacing and 25 m profile reading/sampling stations properly links the rather complex geology. Detailed geological mapping was applied in order to line out directions of drilling.

A number of 32 rock samples were taken in addition to the 227 specimen from the previous year survey. The sampling was concentrated around the Gautelis area. A total of 8 rock samples (sample number TK-1-84 to TK-8-84) originates from two claims held by Terje Karlsen. The claims are located within or near the Arco Haugfjell claimgroup.

Soil sampling was confined to the Gautelis south-west slope grid, exceptional 4 soil samples (SR-370-84 to SR-373-84) which have been placed around a felsic volcanic interlayer within the metasedimentary/metavolcanic sequence of the Gautelis supracrustals. The soil samples were taken from a commonly 0.2 to 0.5 meter overburden of normally good "Bo" horizon. Sometimes C-horizon has been taken instead.

A 6 hole diamond drilling program totalling 538.20 m affected the Gautelis claim group of Folldal Verk A/S. A number of 3 holes conducted the arsenopyrite-gold prospect. Three further drill-holes were put down in order to test the gold anomaly within the Gautelis south-slope grid. The drill holes varied in length between 79.60 m and 98.30 m. A total of 77 samples - mainly comprising 1 m sections - were taken totalling approx. 122.65 m of core.

Soils, rock samples and core material were analysed for Au, Cu, Zn, As, (Ag), Pb. Only geochemical methods were required. Some samples from the drill holes GAU-84-04/06 are still waiting.

The ground geophysical survey applied consisted of CEM horizontal shootback and IP (both Crone Geophysics Ltd. Mississauga, Ontario, Can), APEX Max-Min (APEX Parametrics Limited, Ont, CAN), protonmagnetometer (Geo Metrics INC., California, USA) and VLF (S. Paulsen, Trondheim, Norway) measurements.

The results of geological mapping and geochemical and geophysical surveys are presented on maps attached to the report. The diamond drill holes have been plotted in a scale of 1 : 500.

Within two years of prospecting a total of 259 rock samples, 14 chip samples and 401 soil samples have been taken. The ground geophysical survey amounts to 18 725 profile meters for each of the applied systems. IP was done only on some of the lines of the Gautelis south-west slope grid. A number of 6 boreholes were put down totalling 538.20 boremeters.

STAFF a. ACCOMODATION

Most of the prospecting work was carried out by the project geologist. Three guys from the Masi-project helped with two weeks of the working period. They carried out all of the instrumental works and did most of the sampling. Folldal Verk A/S geophysics I. Killi was mainly involved with one week IP measurements.

While the field season Folldal Verk A/s rented a house within the Skjomdalen about 30 km by gravel road from the Gautelis area.

RESULTS OF PROSPECTING

Gautelis south-west slope.

The Gautelis south-west slope area was found to be highly anomalous in gold as a result of soil samples and rock samples taken during the 1983 field program. A follow-up prospecting program consisting geological mapping, ground geophysical surveys, soil sampling and subsequently diamond drilling was carried out within this season.

The Gautelis south-west slope area is underlain by the carbonate series of the Gautelis supracrustal belt (Rombak project summary report 1983). The series mainly consist of marble with minor intercalations of amphibolites (metabasic flows) and quartzites which form strongly folded often truncated bands within the marble layers. The rock unit is closely intersected by plugs, veins or layers of granitic gneiss. At one location a qtz-fspar rock has been found which develops a stockwork of epidote-qtz veins which sporadically are filled by sulphide.

The series is of 8^g strike within most parts of the grid. The southeastern grid area is characterized by a highly disturbed carbonate series with rotating strike directions the individual

layers being strongly foliated and often truncated by cross-cutting granitic gneiss.

The series is intersected by a fault system of paralleling reverse slip faults which strike E - W and dip 45° to 75° N. Intense drag folding and foliation which is best developed within marble layers indicate a westerly slip of the northern uplifted parts respectively. The prominant fault system is overlapped by second rank reverse faults of 150g strike and 65° northeasterly dip.

The carbonate series is surrounded in the south as well as in the northwest by granitic gneiss which in places develops intercalations of partly assimilated supracrustal rocks, it further contains dolerite veins and plugs of amphibolite. The contacts between the two rock groups are always sharp, foliation is present within supracrustal as well as within granitic gneiss. The field relationship give evidence of an intrusive stata of the granitic rock suite. The easterly border of the carbonate series is formed by the metasedimentary/metavolcanic sequence which in this part is considerably finer grained - more silty - than it is in the more northern extension of the belt.

The ground geophysical survey gave no support to any further investigation within the Gautelis south - slope grid.

Anomalous gold soils and rocks are broadly confirmed to the southeastern part of the grid, the anomalies irregular distributed and of normally spotty occurrence, with Au-contents varying generally between 100 and 200 ppb within soils and 100 to 300 ppb in rocks. A distinctive lensoid Au-halo of 100 x 30 m size indicated from soils is centered around a small (0.3 x 0.5 m) Au-occurrence which assayed average 0.6 oz/t Au from a sulphide bearing rock of supposely ultrabasic composition (samples NR-15-83, NR-129-84). The anomaly appears to be discontinuously surrounded by anomalous Zn soils, the 200 ppm Zn contour occupying an area of considerable square dimension. The zone encloses several smaller, isolated bodies of considerable higher Zn, the contents may grade up locally to 1500 ppm

Zn in soils, which partly trace out faults. The area under consideration is slightly anomalous in Cu based on geochemical soil data, it further shows indeed sporadically somewhat higher Pb-values.

The gold mineralization of sample NR-15-83/NR 129-83 is located at coordinate 375 E/009 S of the Gautelis south-west slope grid. The mineralization occurs on the junction of a marble layers and an amphibolite horizon (meta-basic flow), the series being truncated by granitic gneiss just south of the gold occurrence. No further exciting gold from rocks has been found in the surrounding. The Au-mineralization is however closely connected to a qtz-fspar rock* which is slightly enriched in gold (max. 460 ppb) and develops a stockwork of qtz-epidote with sulphides.

* tactite

A three hole diamond drilling program was initiated in order to test the gold anomaly in the surrounding at the gold mineralization. The drill holes were lined up with a 30 m spacing parallel to the long axis of the anomaly. (Fig. 4).

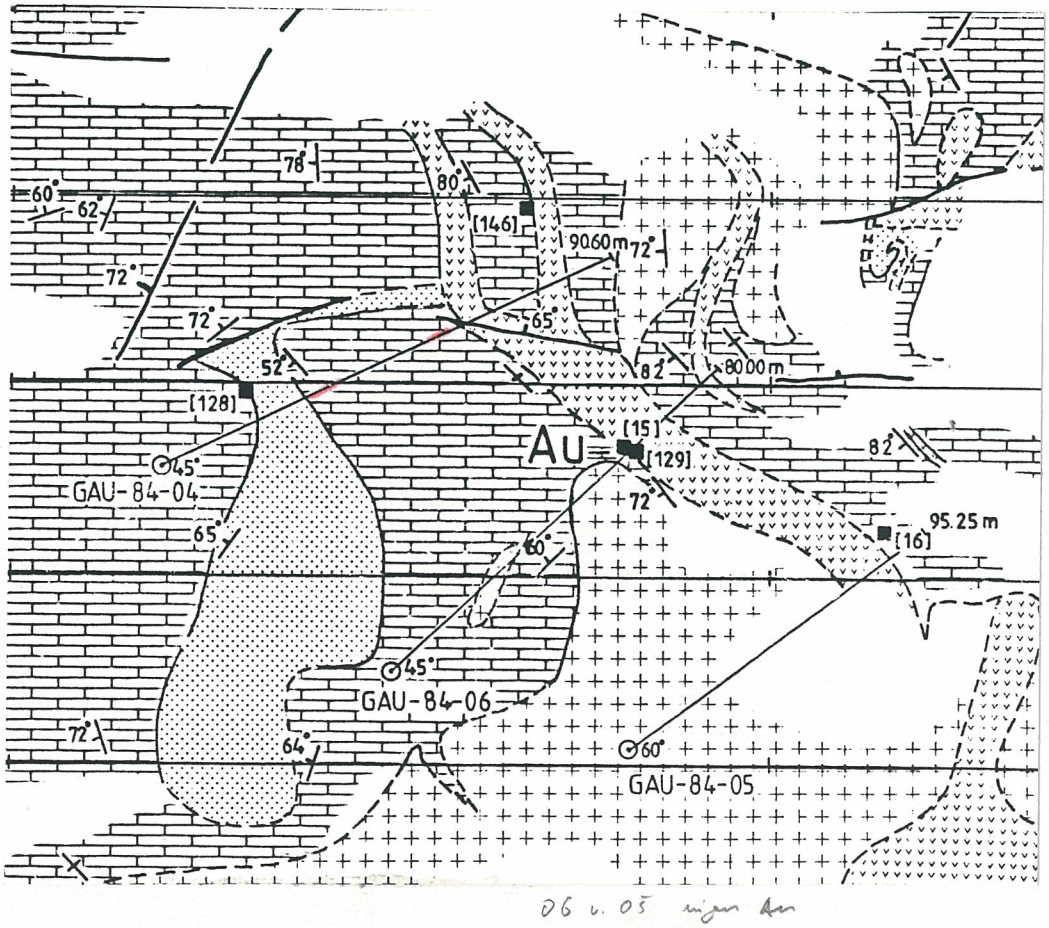


Fig.4: Drill site Gautelis south-west slope grid.

The drill holes GAU-84-04 and GAU-84-05 affected the northern and the southern end of the gold anomaly respectively. The third hole, GAU-84-06, tested the Au-occurrence located at 375 E/ 009 S towards depth. There is strong evidence of that the supracrustal series is closely underlain by granitic gneiss. No indications of any gold have been found in the drill holes GAU-84-05 and GAU-84-06. The results involve that the gold -mineralization from outcrop 375 E/009 S does not continue towards the south neither extends down depth. A promissing gold enrichment was intersected by GAU-84-04 within 33.00 m to 35.00 m, the gold content being 4.7 ppm and 1.0 ppm assayed from one meter samples. The gold is bound to a 1.2 m thick sulphide enriched zone (po, py, cp) which occurs within a uniform layer of pure marble. The sulphide enrichment seems to be conformable with the internal fabric of the country rock, its connexion with the outcropping sulphide-gold mineralization is not proved. No rock alteration has been found, apparently involving a syngenetic enrichment of the gold. However a primary gold deposition seems to be very unlikely. Environmental studies and field observations favour an epigenetic origin of the gold being produced from a geothermal system or being concentrated while the tectonic history of the rock series.

At the present time there is too little evidence about the mode and style of the gold mineralization. More diamond drilling has to be done in order to test the mineralization properly. The thisayears diamond drilling program however gives little promise to a gold occurrence of higher tonnage.

Gautelis arsenopyrite-gold prospect.

The arsenopyrite-gold occurrence is located at the western slope of the Gautelisfjell. The mineralization is found at the boundary of the metasedimentary/metavolcanic series and the carbonate section. It lies close to a 60° striking reverse slip fault of easterly slip movement which dips northwards with 55° to 70° towards the ore body. (Fig. 5). It

supposely terminates the most southern parts of the occurrence towards depth. The mineralization gives strong evidence of being of hydrothermal origin, the arsenopyrite suggested being deposited in a local pod in proximal position to the volcanic vent.

The deposit has a lensoid outcrop of not more than 50 m length and max. 2,5 m width. The body contains massive and banded arsenopyrite ore in a central position and a disseminated type ore as well as a vein-type mineralization as a distal facies. A sulphide zoning is evident from field observation and diamond drilling. Arsenopyrite in general contains subordinate pyrrhotite and chalcopyrite within the orebody, it is however normally absent from a marginal pyrrhotite-chalcopyrite mineralization.

The most prominant hostrock of the ore is a light grey, fine grained qtz-fspar rock which contains considerable amounts in light amphibole as well as subordinate sericite, apatite, titanite and clinocoisite. The rock is always crudely laminated and may be interlayered by mm bands - often as boudinage - of marble and qtz-phyllite (metapelite). Brecciation with subsequent infiltration of carbonate is obvious sporadically, the features apparently involving catastrophic events such as volcanic activity. Mode and textural appearence give evidence of a volcanic origin of the rock. The mineral association of qtz, k-fspar and light amphibole however excludes it from to be a metamorphosed silicate sinter. The further hostrocks are marble and - minor abundant - qtz - phyllite which normally carry a low - grade dissemination or a cross-cutting vein-type mineralization of arsenopyrite.

The occurrence was tested towards depth by 3 holes of diamond drilling (fig. 5). The holes were located at coordinate 000/025 W (GAU-84-01), 100 N/050 W) (GAU-84-02) and 050 N/050 W (GAU-84-03) of the Gautelis arsenopyrite/Au prospect grid. Distal arsenopyrite ore was intersected with GAU-84-01 and GAU-84-03 at 60 m and 35 m from surface respectively, the gold content being 1.8 ppm over 1.0 m (0.25 m true thickness)

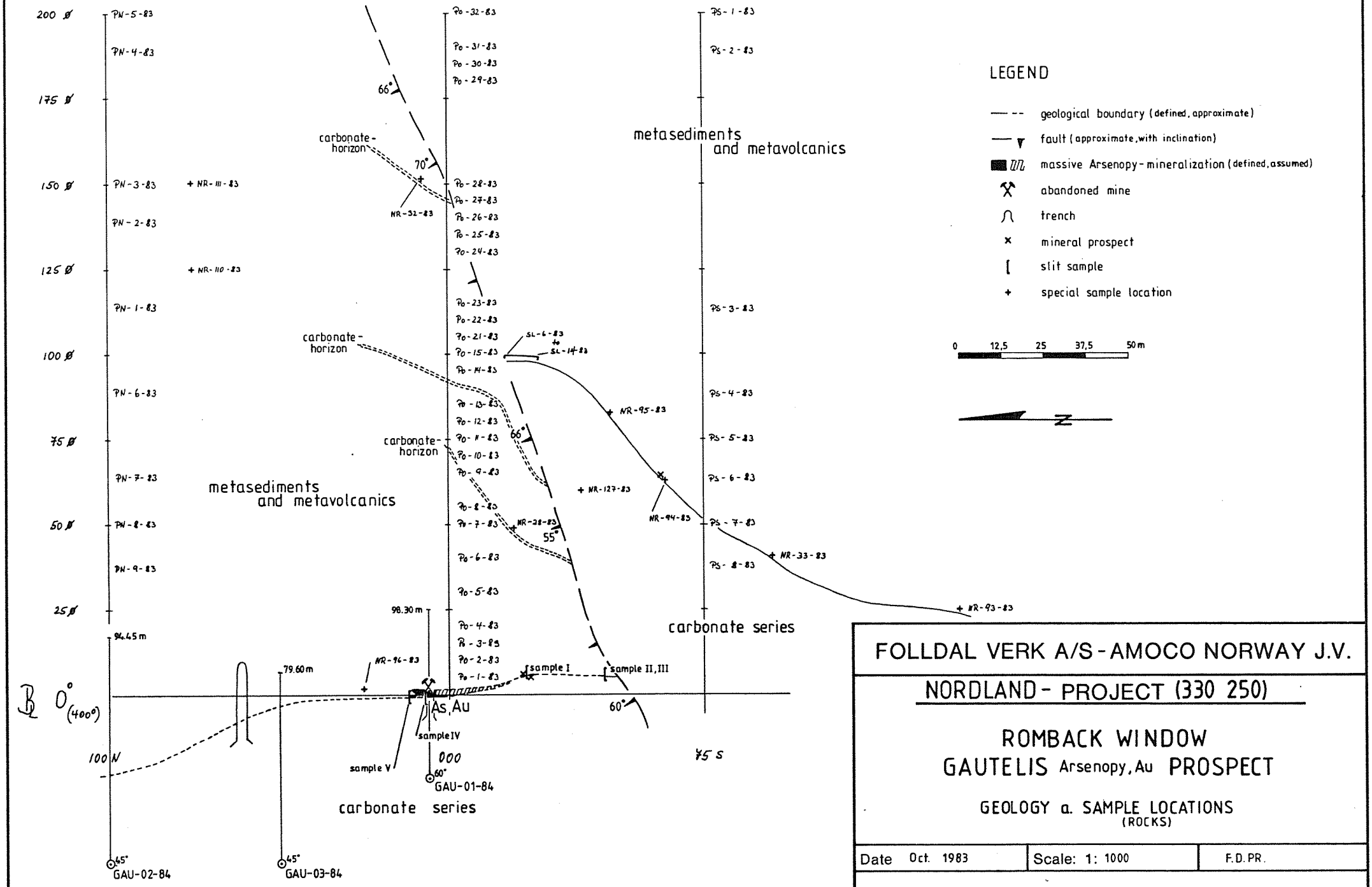
within GAU-84-01 and 1.8 ppm over 5 m (3.85 m true thickness) within GAU-84-03. The drill hole GAU-84-02 penetrated only marginal pyrrhotite-chalcopyrite ore, the 1 meter samples carrying slightly anomalous gold (max. 190 ppb).

The diamond drilling gives strong evidence of that the massive arsenopyrite ore from the outcrop immediately runns out after a few meters down depth. The distal arsenopyrite ore has been traced out at least to a depth of 35 m. Its further continuation is not proved.

From the present state of investigation the occurrence seems to be of smaller tonnage and not economically. However, the deposit should be tested by diamond drilling towards depth.

Kjørisvann-area, Cunojavri-area.

The Kjørisvann-area and Cunojavri-area have been investigated carefully without any purpose for further exploration. Their claims should be dropped.



FOLLDAL VERK A/S - AMOCO NORWAY J.V.

NORDLAND - PROJECT (330 250)

ROMBACK WINDOW
GAUTELIS Arsenopy, Au PROSPECT

GEOLOGY a. SAMPLE LOCATIONS (ROCKS)

Date Oct. 1983	Scale: 1: 1000	F.D.PR.

A.S TØRRKOPI

REFERENCES

HEIER, K.S. a. COMPSTON, W., 1969: Interpretation of Rb - Sr age patterns in high grade metamorphic rocks, North-Norway, Norsk geol. Tidsskr., Vol. 49, pp 257-283

ASSAY RESULTS ROCK SAMPLES

ROMBAK PROJECT

1 9 8 3/8 4 .

TABLE OF ABBREVIATIONS

stone:	slst	= siltstone
	volc	= volcanic
	carb	= carbonate
minerals:		
	qtz	= quartz
	fspar	= feldspar
	chl	= chlorite
	musc	= muscovite
	bio	= biotite
	trem	= tremolite
	hbl	= hornblende
	mic	= mica
	serp	= serpentine
	graph	= graphite
	cy	= chalcopyrite
	aspy	= arsenopyrite
	py	= pyrite
	po	= pyrrhotite
	mt	= magnetite
	sph	= sphalerite
etc.	f	= felsic
	mass	= massive
	diss	= disseminated

ASSAY RESULTS ROCK SAMPLES - ROMBAK PROJECT,KJØRISVANN AREA.

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-1-83	qtz-fspar rock (f.volc)	< 2	130	23,0	1,0	0,5	26
NR-2-83	"	6	280	25,0	5,9	0,5	10
NR-3-83	"	6	57	6,5	2,1	< 0,5	6
NR-4-83	bio-qtz-fspar rock	81	140	88,0	0,7	1,0	10
NR-5-83	qtz-fspar-bio schist	< 2	270	30,0	0,5	0,5	4
NR-6-83	fspar-hbl gneiss	2	120	57,0	0,7	0,5	8
NR-7-83	qtz-fspar rock (f.volc)	3	170	7,5	0,2	0,5	12

		Au oz/t	Cu %	Zn %	As %	Pb %
83-ROM-R-13	qtz vein	0,001	0,06	+	0,01	-
83-ROM-R-14	"	-	0,02	-	+	+
83-ROM-R-15	"	+	0,08	+	+	0,01
83-ROM-R-16	amphibolite	-	0,03	0,01	-	+
83-ROM-R-17	"	-	+	0,02	0,03	-
83-ROM-R-18	"	-	-	0,02	-	+

ASSAY RESULT ROCK SAMPLES ROMBAK PROJECT, GAUTELIS AREA

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR- 8-83	qtz-fspar rock	2	110,0	12,0	10,0	1,5	150
NR- 9-83	qtz-fspar rock (f.volc)	170	100,0	510,0	1,5	4,5	1500
NR-10-83	phyllite	150	1900,0	97,0	1,8	4,0	14
NR-11-83	qtz-fspar gneiss	32	75,0	25,0	5,6	0,5	12
NR-12-83	qtz-fspar pegmatite	2	320,0	21,0	4,3	< 0,5	12
NR-13-83	metaslst	3	33,0	23,0	3,8	0,5	8
NR-14-83	py-ore	57	2000,0	25,0	18,0	2,0	10
NR-15-83	serpentine amphibolite	> 10000	310,0	30,0	3,0	1,0	200
NR-16-83	metaslst	4	210,0	45,0	8,5	1,0	12
NR-17-83	slate, ± graphite	20	150,0	73,0	11,0	1,0	14
NR-28-83	cy-po ore	200	3000,0	30,0	31,0	4,0	32
NR-29-83	metaslst	< 2	130,0	57,0	2,3	1,0	350
NR-30-83	metaslst	10	220,0	99,0	4,6	1,0	12
NR-31-83	qtz-fspar rock	6	190,0	24,0	5,4	0,5	12
NR-32-83	metaslst	110	150,0	12,0	6,6	0,5	16
NR-33-83	metaslst	96	110,0	1300,0	200,0	2,0	550
NR-75-83	qtz-rich metaslst	310	69,0	47,0	13,0	1,0	8
NR-76-83	amphibolite	37	37,0	81,0	13,0	1,0	8
NR-77-83	metaslst	86	56,0	120,0	20,0	1,0	8
NR-78-83	carb.,amphibolite, metaslst	80	67,0	73,0	13,0	1,0	2
NR-79-83	metaslst	55	75,0	100,0	10,0	1,0	10
NR-80-83	metaslst	27	61,0	110,0	14,0	1,0	10
NR-81-83	metaslst	250	2,5	120,0	14,0	1,0	20

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-82-83	metaslst	13	88,0	95,0	12	1,0	8
NR-83-83	metaslst	83	90,0	100,0	29	1,0	12
NR-84-83	metaslst	21	72,0	66,0	18	0,5	6
NR-85-83	metaslst	15	95,0	97,0	16	0,5	10
NR-86-83	metaslst	8	120,0	130,0	40	0,5	12
NR-87-83	metaslst	< 2	180,0	130,0	5,7	0,5	10
NR-88-83	metaslst	< 2	100,0	93,0	140	0,5	10
NR-89-83	qtz-fspar rock	< 2	210,0	32,0	0,4	0,5	6
NR-90-83	amphibolite, metaslst	46	130,0	79,0	16	0,5	10
NR-91-83	metaslst	15	69,0	49,0	11	< 0,5	8
NR-92-83	metaslst	56	110,0	14,0	9,1	< 0,5	6
NR-93-83	metaslst	150	79,0	1900,0	18	1,0	48
NR-94-83	metaslst	15	88,0	760,0	7,1	1,0	170
NR-95-83	metaslst	52	240,0	54,0	0,8	0,5	6
NR-96-83	metaslst	32	840,0	67,0	1,3	1,0	18
NR-97-83	metaslst	3	17,0	76,0	13,0	0,5	8
NR-98-83	serpentinite	< 2	1,5	28,0	4,6	< 0,5	8
NR-99-83	metaslst,qtz-fspar rock	13	260,0	63,0	6,0	0,5	6
NR-100-83	metaslst	9	44,0	26,0	12,0	< 0,5	8
NR-101-83	metaslst	< 2	140,0	43,0	6,6	0,5	8
NR-102-83	metaslst	2	190,0	190,0	7,1	1,0	14
NR-110-83	qtz-rich metaslst	1400	1200,0	96,0	57,0	1,5	18
NR-111-83	metaslst	8	210,0	68,0	2,6	0,5	10

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-113-83	metaslst	< 2	68,0	29,0	18,0	0,5	4
NR-114-83	serpentine bearing carb	5	380,0	14,0	0,9	1,5	2
NR-115-83	qtz-fspar rock	< 2	10,0	10,0	0,8	< 0,5	6
NR-116-83	qtz-fspar rock	< 2	150,0	33,0	0,5	1,0	10
NR-117-83	metaslst	< 2	63,0	36,0	1,4	0,5	4
NR-118-83	metaslst	< 2	86,0	85,0	0,5	1,0	8
NR-119-83	metaslst	< 2	200,0	48,0	1,7	0,5	6
NR-120-83	metaslst	8	140,0	86,0	8,6	0,5	10
NR-121-83	graphite bearing f.tuff	< 2	300,0	63,0	1,7	1,0	8
NR-122-83	amphibolite	< 2	4,5	140,0	3,7	1,0	12
NR-123-83	breccia	11	54,0	99,0	11,0	1,0	28
NR-124-83	phyllite	7	38,0	140,0	83,0	1,0	16
NR-125-83	metaarenite	44	210,0	160,0	2,9	1,0	18
NR-126-83	cy-po ore (Nuorjojåkka)	32	1400,0	70,0	0,7	1,0	4
NR-127-83	cy-po ore (carb)	600	1100,0	21,0	> 1000,0	2,5	10

		Au oz/t	Cu %	Zn %	As %	Pb %
83-ROM-R-7	sulphide contact carb	0,007	2,04	0,06	0,14	-
83-ROM-R-8	mass mt	-	0,01	0,07	0,04	+
83-ROM-R-9	mass po	-	0,06	0,06	0,01	+
83-ROM-R-10	mass po	-	0,08	0,07	0,01	-
83-ROM-R-11	cy	0,005	0,57	0,08	0,03	+
83-ROM-R-12	mass py	-	0,18	0,05	+	+

Sample		Au	Cu	Zn	As	Ag	Pb
		Au oz/t	Cu %	Zn %	As %		Pb %
83-ROM-B-1	carb	0,003	-	0,01	0,01		+
83-ROM-B-2	mass aspy (dump mat)	0,180	+	0,01	22,2		-
83-ROM-B-3	slst	-	+	0,02	0,04		+
83-ROM-C-1	carb	0,004	0,03	+	0,01		-
83-ROM-C-2	carb	-	-	+	0,01		+
83-ROM-C-3	amphibolite	0,003	0,03	0,01	-		+
83-ROM-C-4	amphibolite	-	-	0,02	+		+
83-ROM-E-1	carb	-	-	+	+		+
83-ROM-E-2	qtz slts	+	0,02	0,02	0,03		-
83-ROM-E-3	qtz slts	+	0,01	0,02	+		+
83-ROM-E-4	amphibolite	+	0,01	0,03	-		+
83-ROM-E-5	slst	0,001	0,03	0,05	0,02		0,01
samples from As, Au-rpspect Gautelisfjell							
83-ROM-A-1	limestone	-	-	0,01	-		+
83-ROM-A-2	slst with sulphides	0,010	+	0,02	0,02		+
83-ROM-A-3	mass aspy	0,400	+	0,01	18,3		-
83-ROM-A-4	almost mass aspy	0,720	0,04	0,01	22,7		0,01
83-ROM-A-5	mass aspy	0,081	0,02	0,01	25,3		+
83-ROM-A-6	qtz slst with aspy	0,048	0,01	0,02	0,61		+
83-ROM-A-7	slst with sulphides	+	-	0,02	0,07		+

Sample		Au oz/t	Cu %	Zn %	As %	Ag %	Pb %
83-ROM-A-9	slst	0,002	-	0,01	0,04		+
samples from the dump							
83-ROM-R-2	mass aspy	0,049	0,06	0,01	28,4		-
83-ROM-R-3	mass aspy + po	0,010	0,21	+	1,59		-
83-ROM-R-4	diss aspy	0,360	+	0,01	25,8		+
83-ROM-R-5	mass aspy	0,047	0,07	0,01	25,1		-
83-ROM-R-6	mass aspy	0,130	0,05	0,01	23,3		+
samples from showing 25 m south of the As, Au - prospect							
83-ROM-D-1	carb	-	-	+	-		-
83-ROM-D-2	qtz slst, diss aspy	0,003	+	0,01	0,26		+
83-ROM-D-3	qtz slst, vein aspy	0,066	0,02	0,01	16,4		-
83-ROM-D-4	qtz slst	0,021	0,01	0,03	0,06		+
83-ROM-D-5	slst	0,002	0,04	0,02	0,02		+

		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
samples from the Grid at the As, Au-prospect							
PN-1-83	metaarenite	< 2	16,0	130,0	0,9	0,5	10
PN-2-83	metaslst	8	100,0	53,0	150,0	0,5	8
PN-3-83	metaslst	< 2	180,0	58,0	1,9	1,0	16
PN-4-83	metaslst	5	93,0	68,0	3,7	1,0	8
PN-5-83	metaslst	10	100,0	32,0	12,0	0,5	6

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
PN-6-83	metaarenite	3	56,0	12,0	12,0	< 0,5	8
PN-7-83	metaslst	8	180,0	45,0	7,9	0,5	6
PN-8-83	quartzite	< 2	40,0	7,5	0,3	0,5	6
PN-9-83	metaslst	< 2	34,0	97,0	2,7	1,0	8
PO-1-83	metaslst	25	180,0	150,0	170,0	1,0	18
PO-2-83	metaslst	9	120,0	210,0	38,0	1,0	16
PO-3-83	metaslst	< 2	120,0	120,0	8,5	1,0	14
PO-4-83	amphibolite	< 2	30,0	110,0	2,4	1,0	44
PO-5-83	amphibolite	< 2	18,0	120,0	1,0	1,0	14
PO-6-83	metaslst	< 2	110,0	160,0	17,0	1,0	14
PO-7-83	metaslst	7	190,0	120,0	37,0	1,0	32
PO-8-83	metaslst	< 2	120,0	220,0	64,0	1,0	34
PO-9-83	mica-rich quartzite	14	250,0	110,0	89,0	1,0	12
PO-10-83	metarhyolite	< 2	110,0	28,0	18,0	< 0,5	8
PO-11-83	metarhyolite	3	100,0	52,0	37,0	1,0	18
PO-12-83	metaslst	1200	670,0	95,0	400,0	6.5	14
Po-13-83	metaslst	8	130,0	47,0	64,0	0,5	24
PO-14-83	metaslst	24	87,0	100,0	320,0	1,5	12
PO-15-83	metaslst	5	45,0	110,0	3,3	1,0	12
PO-21-83	phyllite	9	100,0	110,0	52,0	1,0	12
PO-22-83	qtz phyllite	23	110,0	97,0	18,0	1,0	10
PO-23-83	qtz phyllite	63	240,0	90,0	> 1000,0	1,0	10

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
PO-24-83	qtz phyllite	3	160,0	120,0	68,0	1,0	14
PO-25-83	qtz phyllite	< 2	95,0	18,0	14,0	0,5	14
PO-26-83	qtz phyllite	4	140,0	24,0	9,9	1,0	18
PO-27-83	carb	< 2	47,0	170,0	6,1	1,5	170
PO-28-83	metaslst	5	110,0	170,0	35,0	2,0	150
PO-29-83	metaslst	4	620,0	38,0	3,5	1,0	10
PO-30-83	metaslst	4	78,0	83,0	8,2	1,0	6
PO-31-83	metaslst	4	59,0	82,0	38,0	0,5	8
PO-32-83	metaslst	< 2	100,0	50,0	1,0	0,5	14
PS-1-83	amphibolite	< 2	23,0	85,0	2,6	1,0	12
PS-2-83	granite	< 2	8,5	50,0	0,8	0,5	8
PS-3-83	metaslst	< 2	100,0	61,0	0,9	0,5	6
PS-4-83	amphibole -qtz - fspar rock	< 2	110,0	97,0	96,0	1,0	8
PS-5-83	metaslst	5	120,0	55,0	8,5	0,5	8
PS-6-83	carb	5	49,0	58,0	12,0	1,0	24
PS-7-83	carb	< 2	240,0	62,0	0,7	1,0	140
slit samples near the As, Au - prospect							
I		1700	130,0	86,0	> 1000,0	< 0,5	10
II		8	290,0	100,0	240,0	0,5	14
III		11	370,0	110,0	260,0	1,0	32
IV		4200	86,0	48,0	> 1000,0	0,5	22
V		8	63,0	61,0	600,0	0,5	14

Sample	Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
SL-6-83	8	100,0	180,0	74.0	1,0	170
SL-7-83	20	200,0	95,0	16,0	1,0	120
SL-8-83	8	130,0	210,0	100,0	1,0	110
SL-9-83	6	120,0	140.0	39,0	1,5	280
SL-10-83	7	100,0	39,0	56,0	1,0	68
SL-11-83	11	140,0	53,0	16,0	1,5	96
SL-12-83	7	150,0	40,0	31,0	1,0	48
SL-13-83	8	120,0	34,0	33.0	1,0	32
SL-14-83	35	210,0	54,0	9,4	1,5	52

ASSAY RESULTS ROCK SAMPLES ROMBAK PROJECT, CUNOJAVRI AREA

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-18-83	qtz-fspar rock	19	65,0	9,0	45,0	5,0	16
NR-34-83	quartzite	< 2	160,0	270,0	12,0	1,0	430
NR-35-83	bio-chl-qtz-fspar rock	< 2	21,0	31,0	5,4	1,5	120
NR-36-83	qtz-fspar rock	21	190,0	49,0	6,6	1,0	8
NR-37-83	qtz-fspar rock	< 2	21,0	10,0	4,0	1,0	16
NR-38-83	qtz-fspar rock	2	60,0	53,0	16,0	1,0	26
NR-39-83	qtz-fspar rock	< 2	230,0	51,0	2,3	1,0	12
NR-40-83	qtz-fspar rock	< 2	140,0	88,0	5,1	1,0	10
NR-41-83	qtz-fspar rock	< 2	48,0	36,0	1,3	1,0	14
NR-42-83	qtz-fspar rock	4	200,0	66,0	3,7	1,0	30
NR-43-83	gtz-fspar rock	7	110,0	48,0	1,0	1,0	28
NR-44-83	qtz-fspar rock	< 2	460,0	110,0	0,9	1,5	12
NR-45-83	mass po, cy	7	3700,0	82,0	4,5	1,5	12
NR-46-83	qtz-fspar rock	1500	480,0	37,0	> 1000,0	1,5	42
NR-47-83	qtz-fspar rock	4	34,0	17,0	140,0	<0,5	12
NR-48-93	qtz-fspar rock	15	23,0	18,0	110,0	<0,5	8
NR-49-83	qtz-fspar rock	16	15,0	90,0	45,0	1,0	780
NR-50-83	bio-chl schist	< 2	170,0	140,0	46,0	1,0	12
NR-51-83	qtz-fspar rock	8	240,0	110,0	15,0	1,5	12
NR-52-83	qtz-fspar rock	< 2	250,0	71,0	0,5	1,0	10
NR-53-83	qtz-fspar rock	< 2	120,0	95,0	0,5	1,0	10
NR-54-83	qtz-fspar rock	210	150,0	65,0	800,0	2,0	20
NR-55-83	qtz-fspar rock	3	110,0	110,0	4,6	1,0	10

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-56-83	chl-musc-qtz-fspar rock	< 2	39,0	96,0	19,0	1,0	10
NR-57-83	qtz-fspar rock	20	94,0	25,0	10,0	1,0	10
NR-58-83	musc-trem-qtz-fspar rock	< 2	54,0	55,0	4,9	1,0	6
NR-59-83	metaarenite	< 2	120,0	72,0	63,0	1,0	14
NR-60-83	metaslst	< 2	19,0	7,0	1,6	0,5	6
NR-61-83	qtz-fspar rock	34	130,0	200,0	> 1000,0	3,5	520
NR-62-83	metaarenite	3	130,0	240,0	> 1000,0	2,0	44
NR-63-83	metaarenite	5	440,0	20,0	77,0	1,0	6
NR-64-83	hbl-musc-qtz-fspar rock	< 2	250,0	44,0	2,9	0,5	6
NR-65-83	chl-hbl-qtz-fspar rock	< 2	160,0	130,0	0,7	1,0	14
NR-66-83	hbl-qtz-fspar rock	< 2	320,0	94,0	0,7	1,0	10
NR-67-83	hbl-chl-qtz-fspar rock	15	180,0	1000,0	11,0	2,0	1700
NR-68-83	hbl-musc-qtz-fspar rock	< 2	130,0	85,0	8,6	1,0	18
NR-69-83	hbl-chl-qtz-fspar rock	< 2	73,0	30,0	6,9	0,5	16
NR-70-83	dunite	< 2	2,0	37,0	21,0	0,5	8
NR-71-83	qtz-fspar rock	< 2	27,0	31,0	4,6	0,5	14
NR-72-83	amphibolite	< 2	140,0	59,0	16,0	0,5	58
NR-73-83	amphibolite	3	420,0	40,0	3,3	1,0	8
NR-74-83	metagraywacke	11	240,0	47,0	7,4	2,0	4
NR-103-83	qtz-fspar-bio schist	< 2	55,0	1200,0	71,0	1,0	110
NR-104-83	qtz-fspar-bio schist	< 2	84,0	1100,0	17,0	1,0	78
NR-105-83	qtz-fspar-bio schist	< 2	50,0	440,0	100,0	1,0	34
NR-106-83	mass sph	22	160,0	> 4000,0	> 1000,0	5,0	640

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-107-83	bio-hbl-qtz-fspar rock	< 2	100,0	1700,0	6,9	1,0	86
NR-108-83	mass sph	14	170,0	> 4000,0	> 1000,0	4,5	780
NR-109-83	graph-musc-qtz-fspar	< 2	210,0	980,0	7,1	1,0	92
samples from profiles at Vavrat							
PI-1-83	graph-qtz phyllite	4	65,0	110,0	0,9	0,5	6
PI-2-83	qtz-fspar rock	< 2	9,5	20,0	0,7	< 0,5	56
PI-3-83	mic-qtz-fspar rock	2	130,0	25,0	1,1	1,0	14
PI-4-83	qtz-fspar gneiss	13,0	7,5	25,0	2,1	< 0,5	210,0
PI-5-83	qtz phyllite	< 2	55,0	170,0	11,0	1,0	86,0
PI-6-83	qtz-fspar-bio schist	3	66,0	170,0	3,4	1,0	82,0
PI-7-83	mic-chl-qtz-fspar rock	2	25,0	140,0	16,0	1,0	94,0
PI-8-83	mic-chl-qtz-fspar rock	6	39,0	190,0	22,0	1,0	240,0
PI-9-83	qtz phyllite	< 2	51,0	240,0	2,0	1,0	210,0
PI-10-83	qtz phyllite	< 2	40,0	54,0	3,1	1,0	36,0
NSR-PI-125 E		6			600		
NSR-PI-200 E		3			290		
P2-1-83	mic-qtz-fspar rock	< 2	43,0	38,0	0,9	0,5	8.0
P2-2-83	rhyolite vein	< 2	8,0	190,0	8,6	< 0,5	46,0
P2-3-83	mic-qtz-fspar rock	11	18,0	130,0	37,0	1,0	34,0
P2-4-83	qtz-fspar gneiss	3	56,0	140,0	4,2	1,5	670,0
P2-5-83	mic-qtz-fspar rock	< 2	42,0	180,0	1,1	0,5	86,0

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
P2-6-83	qtz-fspar gneiss	5	28,0	50,0	1,7	0,5	18,0
P2-7-83	mic-qtz-fspar rock	< 2	55,0	120,0	15,0	1.0	10,0
P2-8-83	mic-qtz-fspar rock	< 2	33,0	84,0	0,8	1,0	20,0
P2-9-83	rhyolite vein	< 2	26,0	14,0	1,1	< 0,5	16,0
NSR-P2-150 E		< 2			18,0		
P3-1-83	mic-qtz-fspar rock	5	18,0	79,0	14,0	1,0	18,0
P3-2-83	mic-qtz-fspar rock	6	27,0	100,0	13,0	0,5	22,0
P3-3-83	mic-qtz-fspar rock	5	31,0	92,0	15,0	1,0	12,0
P3-4-83	bio-qtz-fspar rock	25	34,0	96,0	4,0	1,0	48,0
P3-5-83	mic-qrz-fspar rock	2	9,0	140,0	22,0	1,0	26,0
P4-1-83	qtz-fspar-bio schist	< 2	17,0	150,0	3,1	1,0	16,0
P4-2-83	qtz-fspar-bio schist	< 2	29,0	130,0	0,3	1,0	24,0
P4-3-83	musc-qtz-fspar rock	< 2	16,0	83,0	0,6	1,0	10,0
P4-4-83	musc-qtz-fspar rock	< 2	13,0	23,0	0,5	< 0,5	24,0
P4-5-83	musc-qtz-fspar rock	< 2	10,0	5,5	2,1	< 0,5	40,0
P4-6-83	qtz phyllite	6	31,0	130,0	20,0	1,0	270,0
P4-7-83	graph-chl-mic schist	< 2	160,0	170,0	1,0	1,5	16,0
P4-8-83	qtz phyllite	15	62,0	140,0	5,1	1,0	10,0
P4-9-83	mic-qtz-fspar rock	< 2	33,0	79,0	19,0	0,5	10,0
P4-10-83	qtz-fspar-bio rock	9	70,0	240,0	48,0	1,0	68,0
P4-11-83	qtz phyllite	2	39,0	150,0	63,0	1,0	160,0

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NRS-P4-150 E		9			0,7		
NRS-P4-175 E		< 2			0,8		
NRS-P4-175 E		8			0,7		
NRS-P4-200 E		2			0,5		
NRS-P4-200 E		3			0,7		
P6-1-83	qtz phyllite	< 2	26,0	140,0	17,0	1,0	56,0
P6-2-83	carb	< 2	3,5	14,0	0,6	1,0	44,0
P6-3-83	qtz-fspar-bio schist	< 2	10,0	110,0	1,6	1,0	34,0
P6-4-83	rhyolite vein	< 2	4,0	39,0	0,5	< 0,5	20,0
P6-5-83	qtz-fspar-bio schist	< 2	19,0	160,0	1,1	1,0	16,0
P6-6-83	qtz-fspar-bio schist	< 2	17,0	120,0	0,9	1,0	10,0
P10-1-83	qtz-fspar gneiss	13	15,0	340,0	7,6	1,0	170,0
P10-2-83	bio-chl-hbl-qtz-fspar	2	170,0	110,0	4,5	1,0	12,0
P10-3-83	qtz- phyllite	< 2	170,0	140,0	1,2	1,0	16,0
P10-4-83	qtz fspar gneiss	< 2	8,0	140,0	0,5	0,5	16,0
P10-5-83	qtz fspar gneiss	< 2	14,0	100,0	0,5	0,5	10,0
P10-6-83	musc-qtz-fspar rock	< 2	380,0	160,0	0,9	1,0	8,0
P10-7-83	qtz-fspar gneiss	< 2	4,5	7,5	0,3	< 0,5	4,0

ASSAY RESULTS ROCK SAMPLES - ROMBAK PROJECT, CAINHAVAGGE.

Sample		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-19-83	qtz-fspar rock	20	11,0	17,0	45,0	0,5	16,0
NR-20-83	qtz-fspar rock	8	200,0	52,0	66,0	1,0	88,0
NR-21-83	qtz-fspar-chl schist	< 2	26,0	50,0	2,0	< 0,5	6,0
NR-22-83	serp-chl-qtz schist	< 2	16,0	7,0	1,5	< 0,5	14,0
NR-23-83	qtz-fspar rock	< 2	16,0	34,0	2,5	< 0,5	6,0
NR-24-83	qtzrhyolite	13	9,0	32,0	12,0	< 0,5	6,0
NR-25-83	qtz-fspar-bio-chl schist	< 2	30,0	33,0	0,4	< 0,5	4,0
NR-26-84	phyllite	< 2	28,0	13,0	34,0	0,5	6,0
NR-112-83	qtz-fspar rock	5	8,5	19,0	1,1	< 0,5	16,0

ASSAY RESULTS ROCK SAMPLES-ROMBAK PROJECT, GAUTELIS-AREA

Sample :		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
NR-128-84	qtz-fspar rock (metaarenite)	460	90	8	11		20
NR-129-84	chlorite amphibolite	0.580 oz/t	-	-	-	-	-
NR-130-84	chlorite amphibolite	110	62	14	2.3	-	8
NR-131-84	metasiltstone, greywacke	15	220	100	2.5	-	8
NR-132-84	sericite-qtz-rich marble	300	41	7	0.8	-	18
NR-133-84	metasiltstone	3	150	86	0.2	-	8
NR-134-84	metasiltstone	7	140	140	130	-	10
NR-135-84	massive mt ore						
NR-136-84	amphibolite	2	70	53	1.2	-	12
NR-137-84	amphibolite	5	140	120	1.6	-	14
NR-138-84	greywacke	< 2	110	92	0.7	-	12
NR-139-84	metasiltstone	5	30	110	0.8	-	10
NR-140-84	metasiltstone	22	570	150	38.0	-	20
NR-141-84	metasiltstone	< 2	150	75	4.4	-	8
NR-142-84	metasiltstone	1400	2400	110	7.4	-	20
NR-143-84	metaarenite	110	17	29	19.0	-	14
NR-144-84	metaarenite	17	150	140	0.8	-	14
NR-145-84	metaarenite	< 2	210	72	1.6	-	10
NR-146-84	amphibolite	4	130	16	0.6	-	8
NR-147-84	metaarenite	40	550	69	3.6	-	18
NR-152-84	qtz-fspar rock (felsic volc.)	55	3600	2100	6.0	-	1.09%
NR-153-84	qtz-fspar rock	160	1000	10	6.8	-	26
NR-154-84	mica-rich qtz-fspar rock (felsic volc.)	25	630	96	5.0	-	26
NR-155-84	mica-rich qtz-fspar rock (felsic volc.)	6	200	99	3.3	-	22
NR-156-84	qtz-fspar rock (felsic volc.)	61	>4000	38	5.0	-	64
NR-157-84	qtz-fspar rock	44	1200	56	3.0	-	14
NR-158-84	qtz-fspar rock	48	3400	65	5.8	-	14
NR-159-84	amphibolite	20	1800	83	0.6	-	12

ASSAY RESULTS ROCK SAMPLES - ROMBAK WINDOW

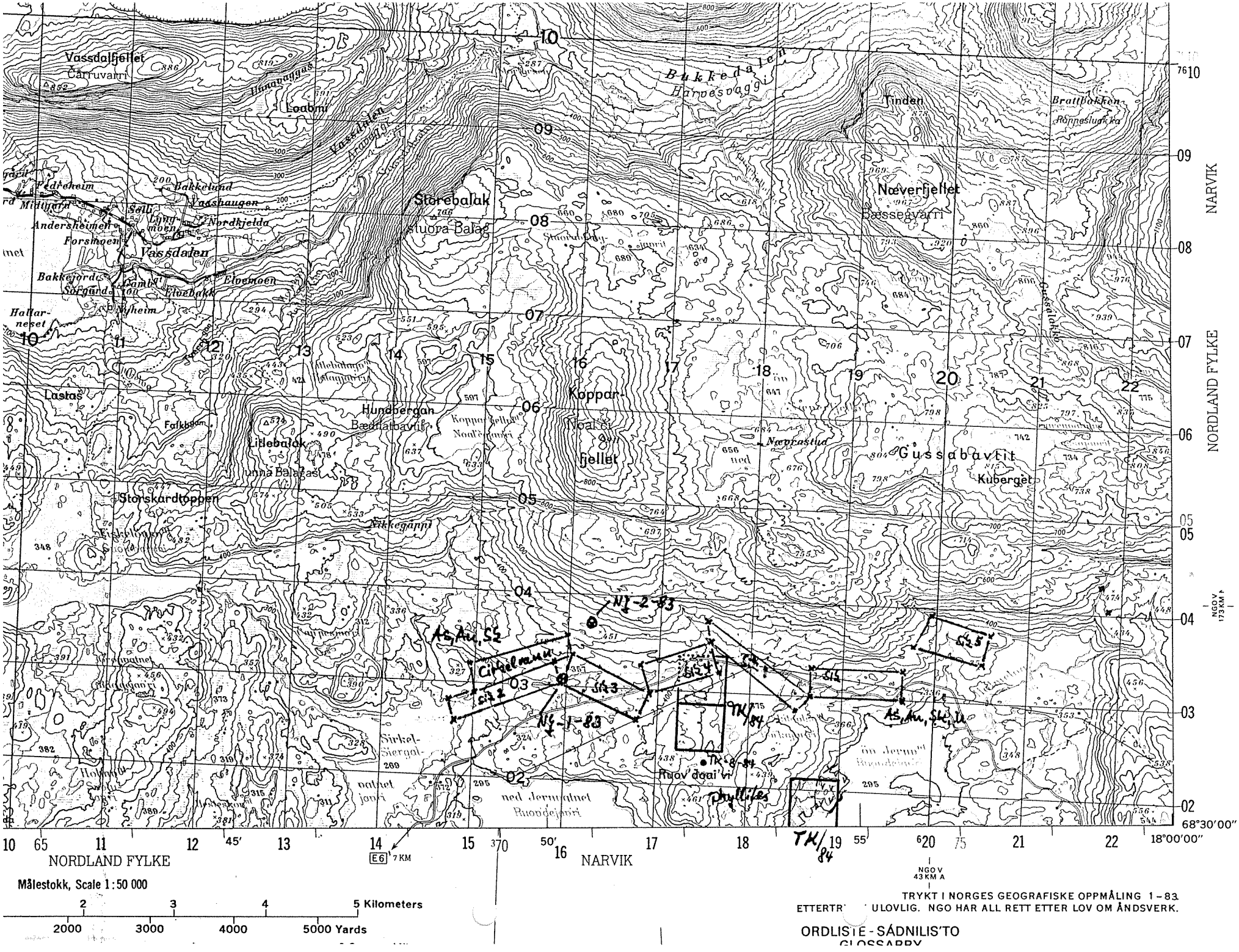
CUNOJAVRI AREA

Sample :		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Pb (ppm)
NR-148-84	magnetite-bornite ore	360 *	> 4000 analyse ?	68	6.5	22
NR-149-84	magnetite-bornite-chalcopyrite ore	890 *	> 4000	280	3.6	18
NR-150-84	qtz-mica schist	8	170	69	0.2	10
NR-151-84	talc-serpentine rich conglomerate	5	53	6	0.5	6

ASSAY RESULTS ROCK SAMPLES - ROMBAK WINDOW

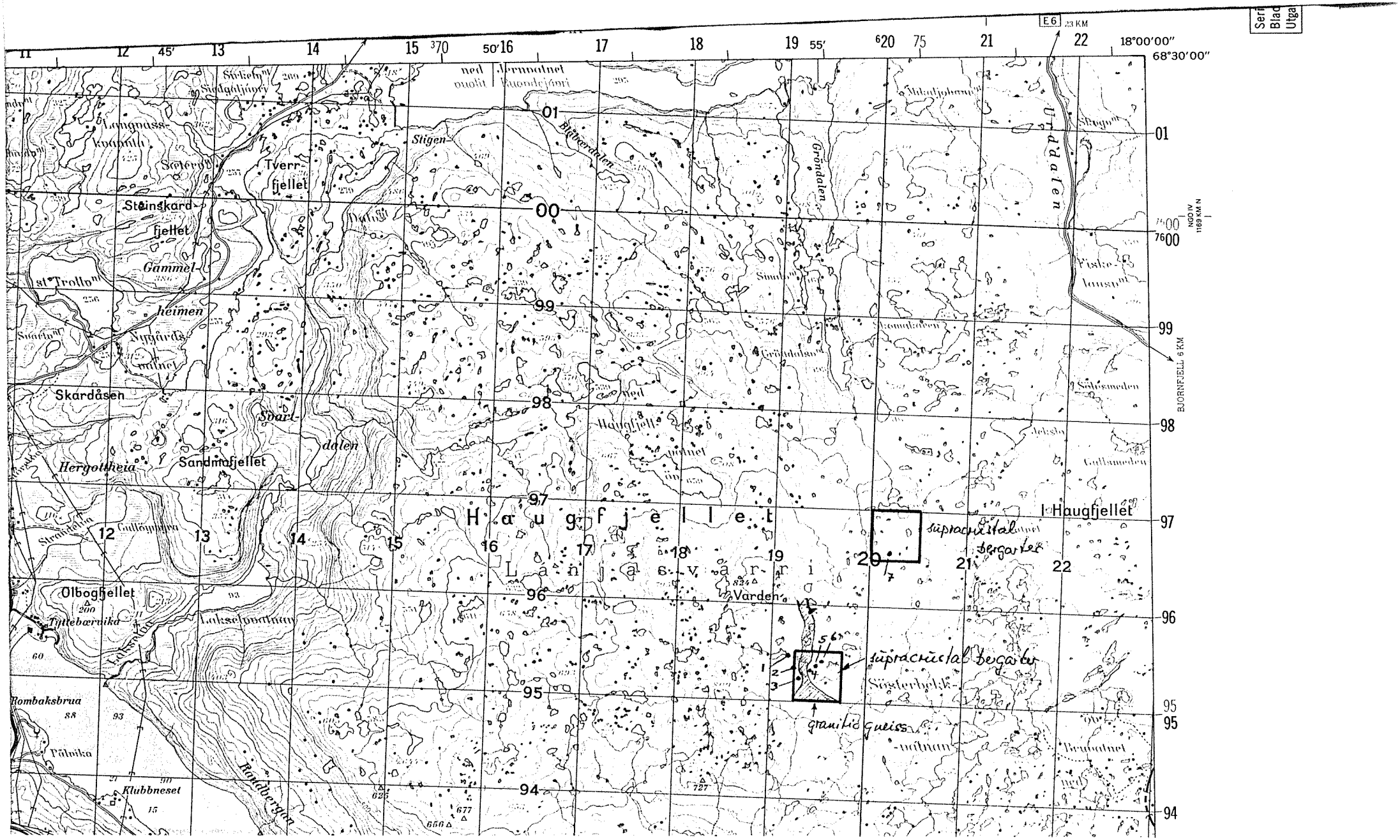
Terje Karlsen Mutinger Haugfjellet.

Sample:		Au (ppb)	Cu (ppm)	Zn (ppm)	As (ppm)	Ag (ppm)	Pb (ppm)
TK-1-84	qtz-fspar rock (felsic volc.)	9	78	750	38.0	-	490
TK-2-84	-- " --	29	190	400	400.0	-	120
TK-3-84	mica bear. qtz-fspar rock (felsic volc.)	16	75	200	330.0	-	140
TK-4-84	--- " ----	13	200	1200	33.0	-	420
TK-5-84	quartz phyllite	15	240	180	6.2	-	110
TK-6-84	slightly graphitic quartz phyllite	30	140	1200	540.0	-	240
TK-7-84	graphite schist	12	57	94	6.4	-	30
TK-8-84	qtz-fspar rock (felsic volc.)	12	870	64	1.5	-	12



TRYKT I NORGES GEOGRAFISKE OPPMÅLING 1-83.
ETTERTR ULOVLIG. NGO HAR ALL RETT ETTER LOV OM ÅNDSVERK.

ORDLISTE - SÁDNILIS'TO
GLOSSARY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Skardåsen
Sandmafjellet
Hergottheia
Soartdalen
Olbogfjellet
Tverrfjellet
Steinskardfjellet
Gammelheimen
Stigen
Grøndalen
Uddalen
Rombaksbrua
Pålvika
Klubbneset
Raudbergan
Lakselvbrua
Varden
Haugfjellet
supracrustal bergarter
granitid gneiss
Fiske-
Gullaugneset
Strandheia
Tyttebærvika
Sjøsterbekk
Brenndalsnet
BJØRNFJELL 6 KM
E 6
23 KM
18°00'00"
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DRILL LOGS

ROMBAK PROJECT

1 9 8 4

Heim

ANG. VIDERE UNDERSØKELSER I ROMBAKVINDUET

Møte hos Geologiske Tjenester 30/10-1986.

Deltakere: B.Flood (Geologiske Tjenester), J.Heim, I.Killi og J.I.Tollefsrud (Folldal Verk) og I.Lindahl og A.Korneliussen (NGU).

Formål med møtet: Diskutere eventuelt samarbeide i 1987 m.h.p. gull i Rombakvinduet.

Et notat "Forslag til videre undersøkelser m.h.p. gull i Rombakvinduet, Nordland" av Tollefsrud/Korneliussen ble sendt til deltakerne på forhånd.

Resultater:

(1) Alle parter var interessert i et samarbeide om videre gull-undersøkelser. Problemet er hvordan dette kan la seg finansiere.

(2) Det ble inngått en avtale om å behandle ARCO's rappportmateriale konfidensielt ut 1987. Folldal Verk og NGU forpliktet seg til ikke å ta ut nye mutinger i de aktuelle områder i denne perioden.

(3) En EF-gullprosjekt rapport som er basert på materiale fra Folldal verk, ARCO og NGU, skal behandles konfidensielt til 1/4-1987.

(4) Forslaget til videre undersøkelser omarbeides. Folldal Verk og Geologiske Tjenester utarbeider hvert sitt kortfattede forslag til videre undersøkelser av Gautelisfjell gull-forekomst (Folldal Verk) og ett eller to av ARCO's gull-anomale områder (Geologiske

Tjenester). Forslagene sendes Korneliussen innen 30/11, og vil bli inkorporert i et samlet forslag.

(5) UTGIFTER. NGU v/USB-prosjektet kan med stor sannsynlighet benytte noe midler til undersøkelser i Muohtaguobla og tilgrensende områder. Omfanget vil være avhengig av den innsatsen som kan gjøres av de andre partene. NGU's budsjettfordeling vil bli endelig avgjordt 2/2-1987. Lønnsutgifter kommer i tillegg (ett årsverk).

Folldal Verk og Geologiske Tjenester får klarlagt sine budsjettrammer henholdsvis ca 1. og 15. desember i år.

Den endelige utforming av samarbeidet for 1987 foretas når alle budsjettrammer er klare, d.v.s. i februar 1987.

NGU 11/11-86

Are Korneliussen

FORSLAG TIL VIDERE UNDERSØKELSER M.H.P. GULL I ROMBAKVINDUET, NORDLAND.

Bakgrunn: Rombaken grunnfjellsvindu har i perioden 1983-1985 vært gjenstand for omfattende malmundersøkelser av ARCO Norway, Folldal verk A/S og NGU. Tilsammen er det investert ca. 10 mill. kr i disse undersøkelser som har skaffet til veie et interessant geologisk bakgrunnsmateriale. Utgangspunktet er usedvanlg gunstig for - gjennom videre undersøkelser, å påvise økonomisk interessante gullforekomster.

NGU-rapport 86.193 (delrapport til EF-gullprosjekt) "Precambrian volcano-sedimentary sequences and related ore deposits, with special reference to the Gautelisfjell carbonate-hosted disseminated gold deposit, Rombaken basement window, Northern Norway" av A.Korneliussen, J.I.Tollefsrud, B.Flood og E.Sawyer, gir en oppsummering av de resultater som foreligger.

Det er helt klart at prosesser som har ført til effektiv oppkonsentrering av gull har vært aktive i vinduet. Gautelisfjell gullforekomst viser dette. Gullet i forekomsten er usynlig og assosiert med svake sulfidmineraliseringer (<2% S) disseminert i en uren kalkstein i en vulkanitt/sediment sekvens. Gull-mineraliseringene opptrer uregelmessig over 10-20 m mektighet i en uren, metamorfosert (amfibolitt-facies) og sterkt deformert kalkstein. Gullgehaltene er opptil 20 ppm lokalt. Over 3 m mektighet i borhull er det påvist gjennomsnittsgehalter på opptil 7 ppm Au. Bare deler av den mineraliserte kalken er undersøkt med borhull (totalt 1500 m er boret). Forekomsten er helt klart av økonomisk interesse. Like viktig er det at forekomsten er en ny type for Norge, og kunnskap om dannelse og opptreden vil være av overordentlig stor betydning for videre undersøkelser etter gull i Rombakvinduet såvel som i andre

grunnfjellsområder i landet.

I tillegg er det påvist en rekke gull-anomalier (0.5-15 ppm Au) i bekksesedimenter og vaskekonsentrater i andre deler av vinduet. Disse anomalier er så godt som ikke fulgt opp i felt.

Hypotese som må testes:

(1) Gautelisfjell gullforekomst er av Carlin-type og er dannet fra relativt lavtemperatur løsninger som har strømmet langs skjærsoner. Gullet er utfelt i karbonat der hvor skjærsonen(e) treffer karbonathorisonten.
(2) Skjærsoner også andre steder i vinduet har virket som kanaler for hydrotermale løsninger som har gitt gullmineraliseringer der hvor disse treffer karbonathorisonter.

Følgende undersøkelser foreslås:

(1) Gautelisfjell.
- Eksisterende prøver (bl.a. borkjerner) både med og uten gull, re-analyseres på S, Bi, Te, As, grafitt m.m., for å få fram et bilde av elementkorrelasjoner og fordelingen i kalken.
- Mineralogien undersøkes i detalj gjennom mikroskopering og mikrosondeanalyser.
- Skjærsoner kartlegges og tolkes, bl.a. markerte N-S gående breksjesoner i suprakrustalene ved Gautelisvatn 2 km fra forekomstområdet.
- Relasjonene mellom granodiorittiske og granittiske intrusiver i forekomstområdet undersøkes i detalj.
- Det foretas en detaljert sammenlikning med Carlin-type forekomster ellers i verden.

(2) Skjærsoner og karbonater utenfor Gautelisområdet.
- En flyfototolkning av hele vinduet utføres m.h.p. skjærsoner.
- Dette etterfølges av detaljert oppfølging i delområder som har (a) karbonater, (b) interessante strukturer og (c) er anomale på gull i løsmasser.

Deltakere:

Jan Inge Tollefsrud, Folldal Verk A/S
Boye Flood, Geologiske Tjenester
Are Korneliussen, NGU

Utgifter:

Feltutgifter (3 mann i 8 uker):		kr 200.000,-
Lønn (3 mann i 9 nd.)		kr 700.000,-
	Totalt:	kr 900.000,-

Finansiering:

NGU:
Andre:

Prosjektvarighet: April 1987 - des. 1987 (9 mnd.)

Bergrettigheter:

Resultatene behandles konfidensielt i prosjektperioden og i 1/2 år etter at avsluttende rapport foreligger.

De innvolverte selskaper må løse mutings-problemet seg imellom.

NGU/Staten vil ikke mute i området i den tid materialet behandles konfindensielt.

J.I.T/A.K.

Til Johann Helm,
- formål med møtet 28/10:
(1) diskutere det samarbeide
(2) forbedre vedl. notat / forslag.
(3) diskutere finansieringsmuligheter.

sr87

Vennlig hilsen
Ane Korneliussen.

FORSLAG TIL VIDERE UNDERSØKELSER M.H.P. GULL I ROMBAKVINDUET, NORDLAND.

Bakgrunn: Rombaken grunnfjellsvindu har i perioden 1983-1985 vært gjenstand for omfattende malmundersøkelser av ARCO Norway, Folldal verk A/S og NGU. Tilsammen er det investert ca. 10 mill. kr i disse undersøkelser som har skaffet til veie et interessant geologisk bakgrunnsmateriale. Utgangspunktet er usedvanlg gunstig for - gjennom videre undersøkelser, å påvise økonomisk interessante gullforekomster.

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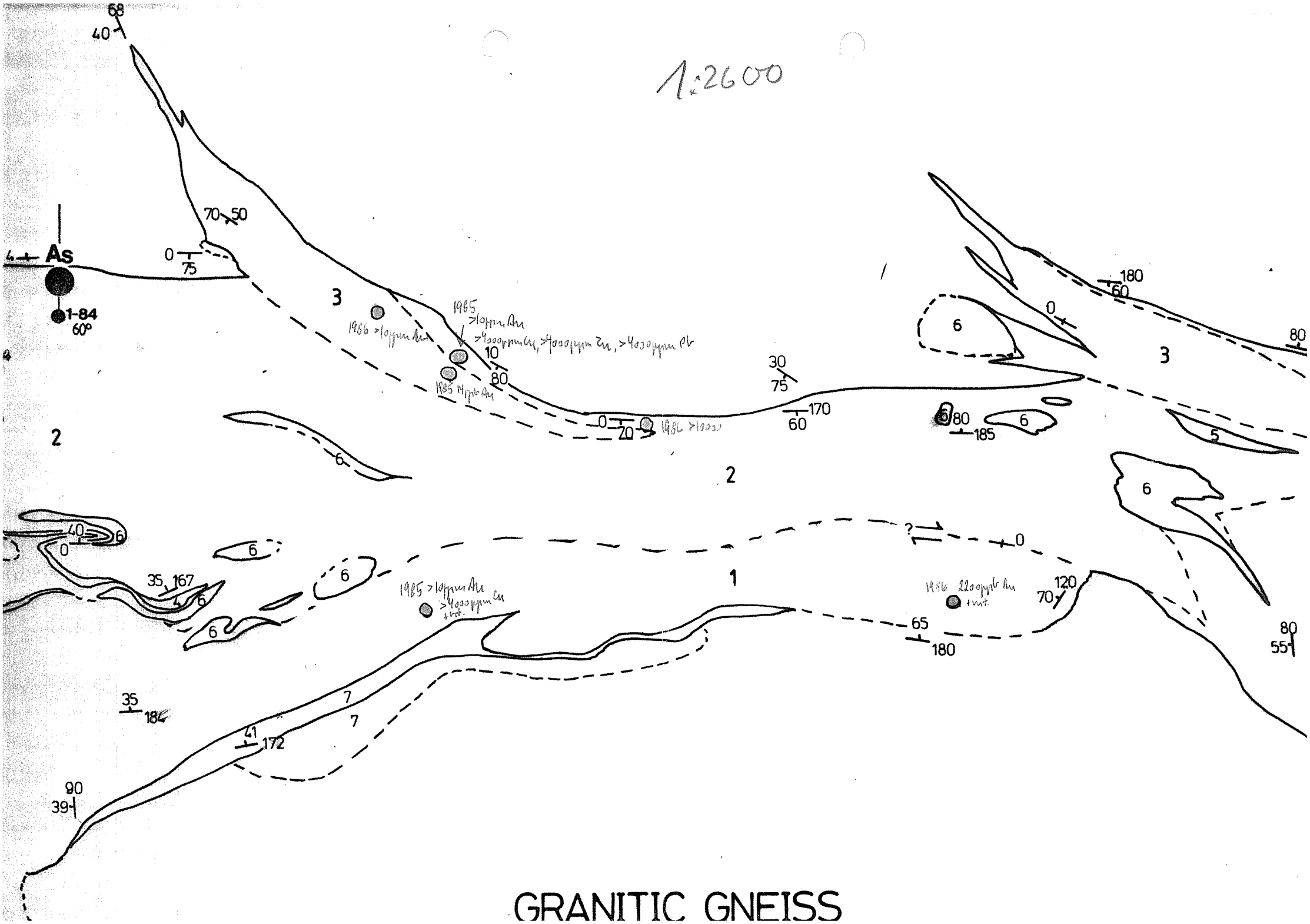
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68
40
70
50
As
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75
1-84
60°
3
1985 >10ppm Au
1986 >10ppm Au
>4000ppm Cu, >4000ppm Zn, >4000ppm Pb
10
80
1985 >10ppb Au
30
75
0
70
1986 >10000
170
60
2
6
180
60
0
80
3
6
80
185
6
5
2
6
40
6
0
6
35
167
4
6
6
6
1985 >10ppm Au
>4000ppm Cu
+mt.
1
?
0
1986 220ppb Au
+mt.
70
120
65
180
80
55
35
186
7
7
41
172
90
39
GRANITIC GNEISS

Kjære Heim,

- EF-rapport så godt som ferdig
- Jeg har klippet ut ARCO-resultater som jeg har lånt i holde lengstidsvilt inntil videre.

Arc K.

NGU-rapport nr. 86.193.
Precambrian volcano-sedimentary sequences and related ore deposits, with special reference to the Gautelisfjell carbonate-hosted, disseminated gold deposit, Rombaken basement window, northern Norway.

Delrapport til EF/NTNF-prosjekt "Gold in Early-Proterozoic volcano-sedimentary belts".

86.193

Precambrian volcano-sedimentary sequences and related ore deposits, with special reference to the Gautelisfjell carbonate-hosted, disseminated gold deposit, Rombaken basement window, northern Norway.

Are Korneliussen,
Jan Inge Tollefsrud,
Boye Flood,
Edward Sawyer

NTNF/EF

Nordland

Narvik

~~Skjomdal~~ Narvik

1431 I-II

Bjørnefjell, Cannavarre, Skjomdal, Rombaken

Gautelisfjell 135510

1983-85

12/10-86

Morten Often

I på norsk:

Suprakrustalene i Rombakvinduet består av en komplekst serie med vulkanske bergarter, pelitiske sedimenter, grovkorn og mindre mengder karbonater og kvartsitter. Disse intruderes av mafiske ganger, mafiske til intermediære gluteter og granitoide batolitter med alder i størrelsesorden 1700-1800 millioner år. I de sydlige deler av vinduet har gjennomgått amfibolitt-fasies metamorfose etterfulgt av retrogradering til grønnskifer-fasies langs et større N-S gående lineament. Skjærsoner langs dette lineamentet har virket som kanaler for H_2O- CO_2 førende løsninger.

Følgende hovedtyper av malmforekomster opptrer: (1) disseminerte ~~stratiforme~~ gull-mineraliseringer i grønne kalker ~~(Gautelisfjell)~~ i en vulkanitt-sediment sekvens (Gautelisfjell forekomst), (2) disseminerte til massive Zn-Pb mineraliseringer i ~~karbonat~~ kalk-silikat horisonter i tuffitt/grovakke-sekvenser og som sprekkefyllinger i skjærsoner og (3) disseminerte til massive Cu-Fe mineraliseringer assosiert med basiske vulkanitter.

En kombinasjon av geologiske undersøkelser og bekkesediment prøvetaking har skilt ut ~~favorable~~ lovende områder for både gull og sink-bly. Lovende ~~miljø~~ miljø for gull-mineraliseringer er: (1) karbonat ± kvartsrike horisonter i rhyolitter som er tolket som subaerisk-sedimentære kjemiske sedimenter, og (2) skjærsoner som har virket som kanaler for hydrotermale løsninger. ~~spesielt~~

gull

Malmgeologi

fagrapport

prekambrium

GAU-84-01

DIAMOND DRILL LOG

FOLLDAL VERK A/S

D.D.H. No.	Azimuth	Started
GAU - 84 - 01	200g	11/08-1984
Property	**Angle**	**Finished**
Gautelisfjell	60°	17/08-1984
Co-ord.	**Depth**	**Logged by**
L 000 / 025 W	98.30 m	FDPr

Directional surveys					
Depth	Azim.	Dip.	Depth	Azim.	Dip.

From	To	Description	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
0.00	69.00	carbonate series								
		marble horizons interlayered by bands of biotite								
		schist, quartzite and qtz-fspar gneiss								
		0.00-11.68: marble								
		grwh., massive with in places slightly								
		layered sections, lamination here by								
		phyllosilicates, locally flaser or len-								
		ticular texture, occasionally bands of								
		biotite schist always showing disharmonic								
		borders to enveloping marbel: 8.62-8.72,								
		9.85-9.93,11.15-11.22,11.40-11.46,11.56-								
		11.57,11.64-11.68.								
		11.68-12.80!biotite qtz-fspar gneiss								
		lightgr., massive, slight foliation,por-								
		phyric K-fspar surrounded by a mesostasis								
		of qtz and biotite. Finest disseminated								
		py and po (≪1 Vol.-%)								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 01	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		12.80-14.20: marble								
		same as: 0.00-11.68, biotite schist at:								
		12.80-12.83								
		14.20-14.65: biotite qtz-fspar gneiss								
		same as: 11.68-12.80, slightly reworked								
		contact at 11.20m, 45° cax								
		14.65-15.14: marble								
		same as: 0.00-11.68								
		15.14-15.42: biotite qtz-fspar gneiss								
		same as: 11.68-12.80								
		15.42-21.81: marble								
		same as: 0.00-11.68								
		21.81-22.64: quartzite								
		gr.,massive,irregular borders with								
		surrounding marbel, mineralization of								
		po as stringers and lenses (< 1 Vol.-%)								
		22.64-24.00: marble								
		same as: 0.00-11.68								
		24.00-24.21: quartzite								
		gr., massive,strongly reworked,inter-								
		fingered by carbonate, often biotitic								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 01	Interval From	Interval To	Assays Cu ppm	Mo	Pb ppm	Zn ppm	Au ppb	Ag	As ppm
		matrix, irregular borders with surrounding									
		carbonate									
		24.21-57.66: marble									
		same as: 0.00-11.68, 52.00m: 45° cax									
		57.66-58.05: quartzite									
		gr., massive, small veinlets filled with									
		carbonate and biotite									
		58.05-67.08: marble									
		same as: 0.00-11.68, biotite schist at:									
		61.58-61.66, 65.90-66.00. 63.00m: 80° cax									
		67.08-67.33: quartzite									
		darkgr., massive to slightly laminated,									
		mm nodules of carbonate often rimmed									
		by muscovite, rare spots of po and cpy									
		67.33-69.00: marble	GAU-84-01 68.50	69.50	190		44	57	1800		1.98%
		same as: 0.00-11.68									
69.00	74.00	Qtz-fspar rock -supposely felsic volcanic- inter-	GAU-84-02 69.50	70.50	250		22	23	220		480
		layered by bands of marble. Arsenopy mineralization	GAU-84-03 70.50	71.50	230		18	29	260		350
		of variable grade and appearence. Highly brecciated	GAU-84-04 71.50	72.50	180		40	33	320		0.25%
		sequence, supposely due to faulting	GAU-84-05 72.50	73.50	140		40	34	330		0.47%

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 01	Interval		Assays						
			From	To	Cu	Mo	Pb	Zn	Au	Ag	As
		69.00-69.15: qtz-fspar rock	GAU-84-06 73.50	74.50	ppm 210		ppm 26	ppm 33	ppb 45		ppm 120
		gr.,massive to crudely layered,orienta-	GAU-84-07 74.50	75.50	340		14	75	100		520
		tion of light amphibole,brecciation,	GAU-84-08 75.50	76.50	130		12	49	63		42
		irregular carbonate veining, sometimes									
		fillings of biotite. Arsenopy forms									
		disharmonic bands of cm thickness,									
		granular ore with euhedral arsenopy									
		crystals									
		69.15-71.68: qtz-fspar rock									
		lightgr.,laminated,intense foliation									
		with local brecciation, in places irr.									
		carbonate veining. Occasionally spots									
		of idiomorphic arsenopy and po and cpy									
		71.68-72.50: marble									
		grwh.,biotite forming stringers and									
		smaller lenses indicating a slight									
		layering,strong foliation with local									
		brecciation									
		72.50-72.52: arsenopy ore									
		nearly massive granular ore with euhedral									
		arsenopy									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 01	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	
		72.52-74.00: marble									
		grwh.,massive,close alternation with									
		dm thick layers of qtz-fspar rock,									
		partly folded,sometimes some brecciation.									
		Rare spots or stringers of arsenopy,									
		cpy,py and po									
74.00	76.35	metasedimentary section									
		74.00-76.35: quartz phyllite									
		gr.,laminated,some small lenses and									
		stringers of carbonate,30° cax.									
		Finest dissemination of po									
76.35	98.30	carbonate series									
		marble with interlayers of quartzite and granitic									
		gneiss									
		76.35-76.70: marble									
		wh. to grwh.,massive,sometimes laminated									
		by phyllosilicates, 45° cax. Occasionally									
		spots or stringers of po,py or cpy									
		76.70-77.72: quartzite									
		lightgr.,massive,in places crudely									
		layered,crosscutting carbonate - mm									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 01	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		veinlets. Very sporadically spots of								
		arsenopy.								
		77.72-91.00: marble								
		same as: 76.35-76.70								
		91.00-92.26: quartzite								
		gr. to darkgr.,laminated,in places								
		massive,some lamina of biotite phyllite,								
		single lenses of carbonate,often irregular								
		carbonate veining, 60° cax. Rare spots								
		of po always bound to carbonate								
		92.26-92.62: marble								
		same as: 76.35-76.70								
		92.62-94.78: quartzite								
		same as: 91.00-92.26								
		94.78-98.30: qtz-fspar gneiss								
		gr.,homogeneous,only sometimes mm car-								
		bonate veining,rare spots of cpy and po								
		98.30 m end of DDH								

ДАЙ-84-02

DIAMOND DRILL LO

FOLLDAL VERK A/S

D.D.H. No.	Azimuth	Started
GAU - 84 - 02	200g	12/08-1984
Property	**Angle**	**Finished**
Gautelisfjell	45°	20/081984
Co-ord.	**Depth**	**Logged by**
L 100 N/ 050W	94.45 m	FDPr

Directional surveys					
Depth	Azim.	Dip.	Depth	Azim.	Dip.

From	To	Description	Interval From	Interval To	Cu	Mo	Pb	Zn	Au	Ag
0.00	67.50	carbonate series								
		marble with interlayers of mica schists, quartzites								
		and granitic gneiss								
		o.00- 7.30: marble								
		wh.,stringers and lamina of light mica,								
		45° cax,occasionally idiomorphic py								
		7.30- 7.85: biotite-mucovite schist								
		lightgr.,slightly laminated but homo-								
		geneous, conformable borders with								
		enveloping carbonate								
		7.85-13.02: marble								
		same as: 0.00-7.30								
		13.02-13.15: biotite-muscovite schist								
		same as: 7.30-7.85								
		13.15-29.95: marble								
		same as: 0.00-7.30, layers of biotite-								
		muscovite schist:15.65-15.68,20.00-								
		23.70 (close alternation of marble and								

Scheelit ?

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 -02	Interval From	Interval To	Cu	Mo	Pb	Zn	Au	Ag
		mica schist). Generally no py								
		29.95-33.60: quartzite								
		lightblshgr.,massive,crosscutting car-								
		bonate often with spots of po and cpy,								
		besides that sulphides as accumulates								
		with up to 1 cm Ø								
		33.60-39.40: marble								
		wh. to grwh.,flasers,stringers and la-								
		mina of light and dark mica -flaser-								
		texture -, 45° cax								
		39.40-41.00: quartzite								
		darkgr.,massive,crosscutting carbonate,								
		nerve like features of biotite locally								
		mineralized by po and/or py								
		41.00-44.50: marble								
		same as:33.60-39.40								
		44.50-45.75: amphibole-qtz-fspar rock								
		gr.,homogeneous,mm needles of amphibole								
		randomly orientated,very little cpy and								
		po as stringers and flasers								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 02	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
		45.75-46.25: marble			ppm		ppm	ppm	ppb		ppm
		same as: 33.60-39.40									
	fault	46.25-48.10: amphibole bear. qtz-fspar rock									
		gr.,stressed,granulation,crosscut by									
		several fine fracture planes,some cm									
		thick interlayers of marble and mica									
		schist.Rare spots of po and cpy									
		48.10-67.5o: marble									
		wh. to grwh.,fine grained with sections									
		more coarser grained,flasers,stringers									
		and bands of light mica,locally enrich-									
		ment of biotite,some dm thick intersec-									
		tions of pure marble,sometimes with									
		homogeneous distribution of light mica,									
		mainly 45° cax									
67.50	71.54	contact zone between carbonate series and metasedi-	GAU-84-09 67.00	68.00	57		22	150	190		45
		mentary and metavolcanic section	GAU-84-10 68.00	69.00	130		18	160	16		180
		alternation of marble and quartz phyllites, po and	GAU-84-11 69.00	70.00	180		58	150	49		94
		cpy as the only sulphides occuring as disseminations,	GAU-84-12 70.00	71.00	810		18	150	21		42
		bands and unconformable layers	GAU-84-13 71.oo	72.00	190		20	150	11		7

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 02	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		67.50-68.50: quartz phyllites								
		gr.,laminated,homogeneous,some cross-								
		cutting carbonate,mainly as mm veinlets,								
		latter locally filled by po, 45° cax								
		68.50-68.74: marble								
		wh.,medium grained,with scattered flakes								
		of light mica,occasionally stringers of								
		po often accompanied by cpy								
		68.74-69.13: quartz phyllite								
		same as: 67.50-68.50								
		69.13-69.58: qtz-fspar rock								
		lightgr.,layered, 45° cax,gradual passing								
		into carbonate,conformable bands of po,								
		sometimes together with some cpy,some								
		crosscutting carbonate accompanied by po								
		69.58-70.38: quartz phyllite								
		same as: 67.50-68.50								
		70.15-70.16:conformable band of po								
		70.25-70.38:fragmented qtz phyllite								
		interfingered by carbonate,								
		rich po min with spots of cpy								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 02	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
		70.38-70.65: marble			ppm		ppm	ppm	ppb		ppm
		wh.,medium grained,flasers andstringers									
		of qtz phyllite embedded,very dishar-									
		monic po and cpy mineralization,irregular									
		flasers and stringers (1 Vol.-%)									
		70.65-71.35: quartz phyllite									
		same as: 67.50-68.50,irregular bands and									
		folded layers of carbonate									
		70.70-70.72: band of massive po with									
		minor spots of cpy									
		71.35-71.45: marble									
		same as: 70.38-70.65									
71.45	94.45	metasedimentary and metavolcanic sequence	GAU-84-14 73.00	76.00	120		22	170	6		76
		metapelites occasionally interlayered by metabasalts									
		71.54-94.45: quartz phyllite									
		gr. to darkgr.,laminated,sometimes cm									
		thick interbeds of felsic mat.(light									
		amphibole,qtz,fspar), 60° cax,very									
		rarely crosscutting veins of carbonate,									
		scarce disseminations of po,sometimes									
		py or even cpy									
		94.45 m end of DDH									

Scheelite?

ДАП-84-03

DIAMOND DRILL LOG

FOLLDAL VERK A/S

D.D.H. No.	Azimuth	Started
GAU - 84- 03	200°	19/C8-1984
Property	**Angle**	**Finished**
Gautelisfjell	45°	22/C8-1984
Co-ord.	**Depth**	**Logged by**
L 050 N/ 050 W	79.60 m	FDPr

Directional surveys					
Depth	Azim.	Dip.	Depth	Azim.	Dip.

From	To	Description	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
					ppm		ppm	ppm	ppb		ppm
0.00	1.50	overburden									
1.50	53.57	carbonate series									
		1.50-2.00: marble									
		grwh,massive,some accumulates of light									
		mica,sporadically spots of idio. py									
		2.00-4.10: plagioclase amphibolite	GAU-84-27 2.00	4.10							
		grgn,fine to medium grained,slightly									
		layered, partly high grade saussuriti-									
		sation,close interfingering of carbonate									
		with epidote,occasionally py fillings,									
		py also as mm big crystals irregular									
		distributed									
		4.10-8.90: marble									
		wh.,medium grained,occasionally inter-									
		layered by sericite schist,45° cax									
		8.90-37.30: marble									
		wh. to grwh.,medium grained,lamina									
		or flasers and stringers sometimes									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 03	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		lenses of dark mica,in places close								
		alternation of light and dark mica,								
		sections of white pure marble: 11.20-								
		12.90,1295-1315,13.50-15.50,16.80-17.60,								
		17.75-22.40,23.60-24.95. marble with								
		distinct flaser texture of light and								
		dark mica:17.60-17.75. here some spots								
		of spl,py and cpy								
		37.30-37.80: biotite-rich quartzite								
		brgn.,fine to slightly medium grained,								
		massive with crudely development of								
		bedding,crosscutting carbonate sometimes								
		accompanied by biotite,rare spots of								
		po and py								
		37.60-37.80:disharmonic zone of car-								
		bonate with fragments of biotite-rich								
		quartzite,band of massive po with some								
		spots of cpy								
		37.80-37.90: marble								
		see:8.90-37.30								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

GAU - 84 - 03

From	To	Description	Interval From	Interval To	Cu	Mo	Pb	Zn	Au	Ag
		37.90-38.15: Biotite-rich quartzite								
		see: 37.30-37.80m								
		38.15-42.90: marble								
		grwh.,flasers or lamina of dark mica,								
		sometimes cm thick accumulates of biotite,								
		biotite also as idio. crystals homogeneous								
		distributed, 85° cax								
		42.90-45.70: granitic gneiss								
		gr.,massive to slightly schistose,								
		locally brecciation, very rarely some								
		spots of py or even cpy								
		45.70-47.75: marble								
		see: 8.90-37.30m								
		47.75-50.70: quartzite								
		gr.,massive,only very rarely orientation								
		of mica flakes (muscovite), 85° cax,								
		very sporadically some po accompanied								
		by finest spots of cpy								
		50.70-50.95: marble								
		see: 8.90-37.30m								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 03	Interval		Assays						
			From	To	Cu	Mo	Pb	Zn	Au	Ag	As
		50.95-51.40: quartzite			ppm		ppm	ppm	ppb		ppm
		gr.,massive,sporadically some flasers									
		or even lamina of dark mica									
		51.40-53.57: marble	GAU-84-15 53.50	56.40	190		22	77	34		180
		wh. to grwh.,normally carriing light									
		mica, in places flasers and lenses of									
		biotite, sometimes even cm layers of									
		biotite schist,disharmonic layering,									
		sharp boundary with following mica									
		bearing quartzite									
53.57	67.00	Felsic unit,mineralization zone	GAU-84-16 56.40	57.40	130		10	120	160		0.3%
		Predomination in qtz-fspar rock - possibly felsic	GAU-84-17 57.40	58.40	110		10	130	330		680
		volcanic. Some minor sections of marbel. Locally	GAU-84-18 58.40	59.40	210		12	96	820		0.97%
		brecciation and carbonate veining(remobilization ?).	GAU-84-19 59.40	60.05	120		16	120	370		0.96%
		Sulphides: arsenopy, po, cpy, spl. Arsenopyrite as	GAU-84-20 60.05	60.60	650		28	19	40		35
		stockwork and disseminated ore showing variable	GAU-84-20 60.60	61.60	53		10	91	380		0.80%
		concentration	GAU-84-21 61.60	62.60	36		10	110	2100		4.16%
		53.57-56.50: qtz-fspar rock	GAU-84-22 62.60	63.60	110		24	60	1800		4.16%
		gr.,massive to crudely layered,finest	GAU-84-23 63.60	64.60	1500		18	72	1800		1.44%
		needles of light amphibole strongly	GAU-84-24 64.60	65.60	610		16	120	1400		1.23%
		aligned with schistosity,sometimes mm	GAU-84-25 65.60	66.60	360		200	0.41%	2000		82

DIAMOND DRILL LOG

FOLLDAL VERK A/S

GAU - 84 - 03

From	To	Description	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
					ppm		ppm	ppm	ppb		ppm
		bands or small lenses of carbonate									
		mostly conformable with schistosity,	GAU-84-26 66.60	67.60	87		26	2700	82		80
		very little po and/or cpy									
		56.50-57.10: qtz-fspar rock									
		same as: 53.57-56.50, rare spots of									
		arsenopy (<1 Vol.-%) often as idio.									
		crystals									
		57.10-58.10: qtz-fspar rock									
		same as: 53.57-56.50, no sulphide min.									
		58.10-59.10: qtz-fspar rock									
		same as: 56.50-57.10									
		59.10-60.00: qtz-fspar rock									
		same as: 53.57-56.50, conformable bands									
		- mm thickness - and mm to cm aggregates									
		of arsenopy (1 Vol.-%), additinal some									
		spots of po and cpy.									
		60.00-60.65: qtz-fspar rock									
		same as:53.57-56.50, irregular layers									
		or veins of carbonate.Flasers of po,									
		some clusters with additional cpy,									
		(2 Vol.-%).									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 03	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		60.65-60.90: qtz-fspar rock								
		same as: 59.10-60.00, minor amount in								
		arsenopy								
		60.90-61.34: marble								
		grwh., fragments of qtz-fspar rock,								
		veins and/or layers of dark mica								
		61.34-63.68: qtz-fspar rock								
		same as: 53.57-56.50, crosscutting car-								
		bonate. Stockwork and disseminated								
		arsenopy ore, often idiomorphic crystals,								
		(1 - 2 Vol.-%), sometimes accumulates								
		of po accompanied sporadically by cpy								
		62.54-62.72: arsenopy as layers, veins								
		or bigger aggregates,								
		always grainy appearence,								
		(7 Vol.-%).								
		63.68-64.00: partly brecciated qtz-fspar rock								
		gr.,very inhomogeneous, rounded to sub-								
		rounded fragments of qtz-fspar rock								
		cemented by carbonate. High sulphide								
		content (7 - 10 vol.-%), po forming								

analyse

DIAMOND DRILL LOG

FOLLDAL VERK A/S

GAU - 84 - 03

From	To	Description	Interval From	Interval To	Cu	Mo	Pb	Zn	Au	Ag
		nerve-like features, spotty cpy min.								
		64.00-64.10: qtz-fspar rock								
		same as: 53.57-56.50, some mm to cm bands								
		of arsenopy (1 Vol.-%)								
		64.10-64.55: partly brecciated qtz-fspar rock								
		same as: 63.68-64.00, minor sulphides								
		64.55-65.10: qtz-fspar rock								
		same as: 59.10-60.00, only arsenopy								
		(<< 1 Vol.-%)								
		65.10-67.00: qtz-fspar rock								
		lightgr., massive, more feldspatic than								
		normal, smaller lenses of carbonate,								
		sometimes slightly reworked, here mm								
		carbonate veining. Spotty po, cpy and								
		spl mineralization.								
67.00	79.60	Metasedimentary - metavolcanic series								
		Mainly qtz-biotite schist (metapelite), some m bands								
		of amphibolite. Low grade sulphide mineralization								
		within metasedimentary rocks.								
		67.00-67.50: quartz phyllite								
		darkgr.,laminated,sporadically mm layers								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 03	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		of carbonate, locally crosscutting car-								
		bonate, finest dissemination of sulphides								
		possibly po, py, very rare spots of cpy								
		or even arsenopy, total sulphide amount								
		≪1 Vol.-%.								
		67.50-72.05: biotite bear. amphibolite (basalt flow)								
		brshgr., medium grained, mainly massive,								
		very homogeneous. Some rare spots of								
		py and cpy								
		72.05-72.52: quartz phyllite								
		same as: 67.00-67.50								
		72.52-72.70: marble								
		gr., slightly layered, flasers and lenses								
		of qtz phyllite interbedded, 75° cax								
		72.70-73.25: amphibolite (basalt flow)								
		gr., medium grained, massive, slight								
		foliation, sometimes veinlike po min								
		73.25-73.80: quartz phyllite								
		same as: 67.00-67.50, 75° cax								
		73.80-78.10: amphibolite (basalt flow)								
		same as: 72.70-73.25								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 03	Interval From	Interval To	Cu	Mo	Pb	Zn	Au	Ag
		78.10-79.60: quartz phyllite								
		same as:67.00-67.50, locally slightly								
		reworked,								
		79.60m end of DDH								

ВАЙ-84-04

DIAMOND DRILL LOG

FOLLDAL VERK A/S

D.D.H. No.	Azimuth	Started
GAU - 84 - 04	120g	28/08-1984
Property SW-slope Gautelisfjell	**Angle** 45°	**Finished** 07/09-1984
Co-ord. P 320 E/ 012 S	**Depth** 90.60 m	**Logged by** FDPr

Directional surveys					
Depth	Azim.	Dip.	Depth	Azim.	Dip.

From	To	Description	Interval From	Interval To	Assays Cu ppm	Mo	Pb ppm	Zn ppm	Au ppb	Ag ppm	As ppm
0.00	2.60	overburden									
2.60	66.93	carbonate series									
		marble with interlayers of qtz-fspar rock and									
		amphibolites. Stocks and bands of granitic gneiss.									
		2.60-14.90: marble	GAU-84-43 13.80	14.80	88		48	10	280	1.5	13
		grwh.,medium grained,mainly pure car-									
		bonate,locally banded by phyllosilicates,									
		60° cax									
		14.90-21.15: qtz-fspar rock	GAU-84-44 14.80	15.80	180		28	14	310	1.5	9.8
		gnshgr.,medium grained,massive,intensive	GAU-84-45 15.80	16.80	24		20	10	160	1.0	9.1
		veining of epidote accompanied by py	GAU-84-46 16.80	17.80	140		26	16	140	1.0	12
		and rare spots of po,carbonate as clots	GAU-84-47 17.80	18.80	400		40	32	370	2.0	16
		and fissurs,often highly altered -seri-	GAU-84-48 18.80	19.80	300		32	15	230	1.0	15
		citization and saussuritizatin.	GAU-84-49 19.80	20.80	170		32	25	120	1.0	15
		21.15-40.67: marble	GAU-84-50 20.80	21.80	280		36	18	1500	1.5	28
		gr.,medium grained,only sporadically									
		pure marbel,in general some amounts in	GAU-84-51 33.00	34.00	650		60	34	4700	2.0	27
		phyllosilicates and dusty graphite, some-	GAU-84-52 34.00	35.00	350		32	40	1000	1.5	5.9

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 04	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		timesin addition needles of light								
		amphibole,flaser and lenticular texture,								
		in places slight brecciation								
		33.40-34.60: some stringers or spots								
		of po and cpy,some idio-								
		morphic py								
		40.67-49.00: plagioclase amphibolite								
		gn.,medium grained,massive,ophitic								
		texture,distinctly finer grained at								
		the contacts to surrounding marble,								
		very rare spots or idiomorphic crystals								
		of py								
		49.00-53.48: marble								
		gr. to blshgr.,medium grained,subordi-								
		nate amounts in phyllosilicates,suppo-								
		sely some dusty graphite								
		53.48-54.44: amphibolite								
		gn.,fine grained to slightly medium								
		grained, massive,some finest spots of								
		py								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 -04	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	AS
		54.44-60.83: marble			ppm		ppm	ppm	ppb	ppm	ppm
		gr. to blshgr.,medium grained,develop-									
		ment of flaser and lenticular texture,									
		in places supposely slightly brecciated									
		60.83-66.93: amphibolite	GAU-84-53 60.50	61.50	21		13	74	32	0.5	13
		gn.,fine to slightly medium grained,	GAU-84-54 61.50	62.50	400		12	110	6	1.5	36
		mainly massive,only locally foliated,	GAU-84-55 62.50	63.50	11		10	110	2	1.0	2.4
		locally mm carbonate veining, py min.	GAU-84-56 63.50	64.50	25		10	130	2	1.0	7.6
		at: 61.00,61.10-61.40 some spots,61.77,	GAU-84-57 64.50	65.50	14		22	59	2	1.0	14
		62.32-62.42 dotted lines of idiomorphic	GAU-84-58 65.50	66.50	24		10	140	2	1.0	24
		py (3 Vol.-%)									
		64.68-65.00: carbonate-rich amphibolite									
66.93	90.60	granitic gneiss									
		predomination in granitic gneiss,bands of amphibolite									
		66.93-70.00: granitic gneiss									
		gr.,medium grained,homogeneous,eye textu-									
		re due to porphyric potasch fspar.									
		70.00-78.95: amphibolite									
		gn.,mainly fine grained sometimes slightly									
		coarser grained,homogeneous,idioblasts									
		of plagioclase (cm size) prsent through-									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 04	Interval		Assays						
			From	To	Cu	Mo	Pb	Zn	Au	Ag	
		out,border sections typical fine grained									
		and slightly schistose									
		78.95-83.20: granitic gneiss									
		gr.,medium grained in places coarse									
		grained,varying biotite amount,some-									
		times saussuritization,finest dissemina-									
		tion of py									
		83.20-83.95: amphibolite									
		gn.,fine grained,homogeneous,some rare									
		spots of py									
		83.95-84.27: granitic gneiss									
		gr.,medium grained,homogeneous,locally									
		strong foliation,some rare spots of py									
		84.27-86.80: amphibolite									
		same as:83.20-83.95									
		86.80-87.00: granitic gneiss									
		same as:83.95-84.27									
		87.00-87.38: amphibolite									
		same as:83.20-83.95									
		87.38-88.73: granitic gneiss									
		same as:83.95-84.37									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 04	Interval		Assays						
			From	To	Cu	Mo	Pb	Zn	Au	Ag	
		88.73-90.60: amphibolite									
		same as: 83.20-83.95									
		90.60 m end of DDH									

50-48-046

DIAMOND DRILL LOG

FOLLDAL VERK A/S

D.D.H. No.	Azimuth	Started
GAU - 84 - 05	120g	27/08-84
Property SW-slope Gautelisfjell	**Angle** 60°	**Finished** 04/09-84
Co-ord. L o50 S/ 380 E	**Depth** 95.25 m	**Logged by** FDPr

Directional surveys					
Depth	Azim.	Dip.	Depth	Azim.	Dip.

From	To	Description	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
0.00	36.04	granitic gneiss								
		granitic gneiss with dm to m interlayers of meta-								
		supracrustals and plugs and veins of metagabbro.								
		The appearance of layered sections within the								
		granitic gneiss, they are composed of dense biotite								
		schist and qtz-fspar rocks, is restricted to zones								
		with high foliation or even shearing.								
		0.00-17.32: granitic gneiss								
		gr.,fine to medium grained depends on								
		the grade of granulation,only locally								
		coarse grained,homogeneous with in								
		places flasers or layers of biotite								
		schist; 4.80-5.00,5.10-5.85,6.87-7.20,								
		9.00-9.50. Rare spots of py,mainly re-								
		stricted to 13.20-17.32								
		17.32-31.35: plagioclase amphibolite								
		grgn.,medium grained,homogeneous,								
		ophitic texture,envelope of fine grained								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 05	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
		material, spots of py throughout, locally			ppm		ppm	ppm	ppb	ppm	ppm
		some bigger accumulates									
		31.35-32.55: qtz-fspar rock									
		gr., fine grained, homogeneous, some irre-									
		gular stringers and bands of biotite									
		schist									
		32.55-36.04: biotite schist	GAU-84-41 32.35	34.35	65		12	160	400	1.0	3.1
		br., strongly foliated and disharmonic	GAU-84-42 34.35	36.35	110		12	180	55	1.0	1.7
		folded, very heterogen in places									
		35.58-35.77: wild aggregates of po and									
		cpy									
36.04	36.63	marble									
		grwh., medium grained, flasers and stringers of phyllo-									
		silicates, 45° cax									
36.63	95.25	granitic gneiss									
		same as above									
		36.63-44.04: granitic gneiss									
		gr., medium to slightly coarse grained,									
		homogeneous.									
		40.50-41.90: biotite schist to qtz-rich									
		biotite schist									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 05	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		gnshbr.,partly homogeneous								
		partly very wild and dis-								
		turbed,some minor sections								
		qtz-fspar rich,here mainly								
		flaser texture, 45° cax								
		44.04-51.62: plagioclase amphibolite								
		gn. to grgn.,medium grained,homogeneous,								
		massive only in places slightly schistose,								
		sharp upper wall,gradual lower wall								
		51.62-61.40: granitic gneiss								
		gr.,fine grained to coarse grained,								
		varying amount in biotite and muscovite,								
		gradual changes from nearly phyllosilicate								
		pure rock to biotite schist								
		61.40-64.91: amphibolite								
		gn.,fine grained only sporadically								
		slightly medium grained,homogeneous,								
		rare pophyroblasts of plagioclase,								
		sharp boundaries								
		64.91-69.73: granitic gneiss								
		gr.,medium grained with sections even								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 05	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		coarse grained,homogeneous,very little								
		changes in the amount of phyllosilicates								
		69.73-73.50: amphibolite								
		gn.,fine grained with a tendency to								
		medium grained,homogeneous,mostly massive								
		but locally clear schistose (45° cax),								
		locally ophitic texture,sharp and foli-								
		ated boundaries,spots of py concentrated								
		within 71.40-73.50 m								
		73.50-78.90: granitic gneiss								
		gr.,medium grained,homogeneous,occasionally								
		cm bands of biotite schist, 60° cax								
		78.90-84.40: amphibole schist								
		gn.,medium grained,sometimes slightly								
		layered, 60° cax,transgoing into biotite-								
		rich amphibole schist,here often lenses								
		of carbonate and/or quartz								
		84.40-85.50: granitic gneiss								
		gr.,heterogeneous and distorted, wild								
		accumulates of carbonate,some layers								
		of biotite-amphibole schist								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

GAU - 84 - 05

From	To	Description	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		85.50-86.92: amphibolite								
		gn.,medium grained,slightly schistose,								
		50° cax,homogeneous but locally some								
		crosscutting carbonate								
		86.56: some aggregates of py								
		86.92-87.40: granitic gneiss								
		gr.,strogly foliated, 50° cax,some mm								
		bands of biotite schist								
		87.40-87.62: amphibole schist								
		gn.,fine to slightly medium grained,								
		homogeneous,sharp contacts								
		87.62-90.40: amphibole schist								
		gn.,fine grained,homogeneous,some rare								
		spots of py, 45° cax								
		90.40-95.25: granitic gneiss								
		gr. to gnshgr.,medium grained,locally								
		strongly folded,varying amounts in								
		phyllosilicates,sometimes grading into								
		biotite schist								
		95.25 m end of DDH								

GAU-84-06

DIAMOND DRILL LOG

FOLLDAL VERK A/S

D.D.H. No.	Azimuth	Started
GAU-84-06	120°	04/09-1984
Property	**Angle**	**Finished**
SW - slope Gautelisfjell	45°	07/09-1984
Co-ord.	**Depth**	**Logged by**
P 350 E/037 S	80.00 m	FDPr

Directional surveys					
Depth	Azim.	Dip.	Depth	Azim.	Dip.

From	To	Description	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
					ppm		ppm	ppm	ppb	ppm	ppm
0.00	46.84	carbonate series	GAU-84-28 8.75	9.84	25		20	62	2	1.0	18
		marble with interlayers of amphibolite and qtz-fspar	GAU-84-29 9.84	10.50	7.5		34	63	2	1.0	4
		rock and plugs and bands of granitic gneiss	GAU-84-30 12.65	14.65	31		8	38	2	0.5	2.2
		0.00- 7.70: marble	GAU-84-31 14.65	16.65	33		8	54	15	0.5	6.6
		wh.,medium grained sometimes somewhat	GAU-84-32 16.65	18.65	5.5		8	46	2	0.5	7.4
		finer grained,in general with stringers,	GAU-84-33 18.65	20.65	6.5		6	54	2	0.5	3.4
		lenses and flasers of phyllosilicates-	GAU-84-34 20.65	22.65	23		10	65	2	0.5	12
		mainly biotite-,sections of pure marble	GAU-84-35 22.65	24.65	18		8	50	600	0.5	5.7
		are very scarce,occasionally reworked,	GAU-84-36 24.65	27.10	2.5		6	60	7	0.5	12
		60° cax varying									
		7.70- 7.90: amphibolite									
		gn.,medium grained,homogeneous									
		7.90- 8.75: marble									
		grwh. in places darkgr.,medium grained,									
		mainly pure marble,only sporadically									
		some amounts of phyllosilicates,here									
		normally with flaser texture, 45° cax,									
		8.00: rare spots of py									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 06	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		8.75- 9.84: amphibolite								
		gn. to grgn.,medium but sometimes slightly								
		coarse grained,crudely bedded,cloudy								
		contact to surrounding marbel layers,								
		45° cax, mm crystals of py								
		9.84-11.84: marble								
		gr. to gnshgr.,medium grained,bottom								
		part with phyllosilicates and occasionally								
		some amphibole,here flaser texture,								
		mm spots of py: 10.05,10.49-10.55,11.53.								
		10.50-11.85: pure marble								
		11.84-12.65: biotite-rich amphibolite								
		brshgr.,medium grained,homogeneous,								
		sometimes crudely development of layer-								
		ing, 45° cax,								
		12.65-16.74: qtz-fspar rock								
		gr. to bnshgr.,medium grained in places								
		fine grained,varying amounts in phyllo-								
		silicates and amphibole,grading from								
		flaser texture to layered rock,in places								
		nearly massive ,here highly enriched in								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 06	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		amphibole, 80° cax								
		14.38-14.75: stringers filled with po								
		16.74-17.30: granitic gneiss								
		gr.,coarse grained,homogeneous								
		17.30-17.95: qtz-fspar rock								
		gnshgr.,fine grained,laminated,rich in								
		phyllosilicates, 80° cax								
		17.95-21.70: granitic gneiss								
		gr. to slightly gnshgr.,coarse grained,								
		homogeneous,in places granulated								
		21.70-27.10: qtz-fspar rock								
		gnshgr.,fine grained,laminated,often								
		with flaser or lenticular texture,								
		60° to 80° cax								
		27.10-29.90: amphibolite								
		gn.,medium grained,homogeneous,sometimes								
		porphyric plagioclase (o.3 mm size),								
		sharb boundaries								
		29.90-32.07: quartzite								
		lightgr.,fine grained,subordinate								
		amounts of phyllosilicates often occurring								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 06	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag
		in clots or flasers, po and cpy in								
		fissures								
		32.07-41.90: plagioclase amphibolite								
		grgn.,medium grained,ophitic texture,								
		homogeneous,more finer grained towards								
		the borders,occasionally spots of py,								
		some stringers of py								
		41.90-43.35: quartz phyllite to phyllosilicate-rich								
		quartz-fspar rock								
		gr. to lightgnshgr.,fine grained,homo-								
		geneous with sometimes flaser texture,								
		70° to 80° cax								
		43.35-46.36: carbonate-rich phyllite								
		lightgn.,fine grained,homogeneous,mm								
		carbonate lenses,nerve-like features								
		filled with carbonate								
		46.20: some spots of py								
		46.36-46.84: qtz-fspar rock								
		same as: 41.90-43.35								

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 06	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
46.84	80.00	granitic gneiss			ppm		ppm	ppm	ppb	ppm	ppm
		granitic gneiss with plugs and veins of metagabbro.									
		Sporadically sulphide veining and alteration of									
		the wallrock.									
		46.84-54.35: granitic gneiss									
		gr.,coarse grained,homogeneous,rare spots									
		of py									
		54.35-61.67: amphibolite									
		gn. to grgn.,medium grained,homogeneous,									
		fine grained contact zones,disseminated									
		py (<< 1 Vol.-%)									
		61.67-71.70: granitic gneiss									
		same as: 46.84-54.35, in places slightly									
		foliated									
		71.36-71.70: stringers,flasers and nerve-									
		like features of py and									
		po (7 Vol.-%)									
		71.70-72.25: biotite-rich amphibolite	GAU-84-37 71.00	73.00	830		12	110	5	2.5	5.3
		brgn.,fine grained,squeezed and highly									
		schistose,sharp borders with granitic									
		gneiss, 45° cax									

DIAMOND DRILL LOG

FOLLDAL VERK A/S

From	To	Description GAU - 84 - 06	Interval From	Interval To	Assays Cu	Mo	Pb	Zn	Au	Ag	As
		72.25-78.60: granitic gneiss	GAU-84-38 73.00	75.00	ppm 53		ppm 16	ppm 80	ppb 2	ppm 1.0	ppm 4.5
		same as: 46.84-54.35, mm spots,locally	GAU-84-39 75.00	77.00	43		16	75	2	1.0	4.2
		lager accumulates,irregular veins of py,	GAU-84-40 77.00	79.00	22		14	81	2	1.0	2.2
		total sulphide < 1 Vol.-%,in places									
		strong epidote enrichment -alteration									
		78.60-80.00: amphibolite									
		gn.,fine grained,homogeneous									
		80.00 m end of DDH									

METASEDIMENTS AND METAVOLCANICS
GRANITIC GNEISS
GRANITIC GNEISS
GRANITIC GNEISS
1050m.a.s.
955m.a.s.
1030m.a.s.
913m.a.s.
940m.a.s.
1100m.a.s.
N
THE CARBONATE ROCKS
Gautelisfjell
Scale: 1:2600
LEGEND:
1 Dark,brown carb. rock w. green tremolite veins
2 Light——— » ——— few trem. veins
3 Clean,white carb. rock
4 Skarn rocks
5 Amphibolites
6 Gneisses
7 Fragmental rocks
Baseline in grid "Gautelis S"
Position,number,dip and direction of diamond drillholes
Strike / dip of rock foliation
Geological boundary
Fault w. proposed relative movement
Small arsenopyrite mine

SVERIGE

SVERIGE

RUVSSOT ULTRA-BASITTER

PROFIL 1
PRØVER: CUNO-86-1 t.o.m. 160

CUNO-86-P1-	1	22ppb Au	CUNO-86-P1-	70	2ppb Au
	2	2		71	1
	3	3		76	31
	5	2		77	1
	6	2		78	4
	7	2		80	4
	8	6		81	4
	9	6		84	1
	10	22		85	2
	11	1		86	1
	13	2		89	2
	14	2		92	1
	21	1		93	2
	22	3		94	1
	23	3		95	1
	24	3		96	9
	25	2		97	3
	26	3		98	1
	27	1		104	2
	28	2		105	1
	30	1		108	2
	31	2		110	2
	32	2		113	5
	34	1		114	2
	35	21		115	1
	37	1		119	6
	38	1		120	2
	39	1		122	2
	40	4		126	2
	41	1		128	5
	42	2		130	1
	43	2		134	17
	45	2		135	2
	46	1		137	1
	48	2		142	5
	50	1		144	2
	56	3		146	2
	60	5		148	1
	63	2		154	2
	64	10	Andre prøver:		< 1ppb Au

PROFIL 2
PRØVER CUNO-86-1 t.o.m. 57

CUNO-86-P2-4		3ppb Au
	5	9
	13	2
	14	9
	20	2
	30	1
	32	3
	46	3
	47	2
	49	4
	50	3
	56	2
Andre prøver:		<1ppb Au

PROFIL 4
PRØVER: CUNO-86-1 t.o.m. 37

CUNO-86-P4-1		2ppb Au
	10	8
	11	1
	12	2
	13	1
	14	2
	15	36
	34	2
	36	13
Andre prøver:		< 1ppb Au

VANN

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FOLLDAL VERK A/S

PROJECT

FASTFJELLSPRØVER, KARBONAT-HORISONTEN, ČUNOJAVRI
1986

o PRØVER M. <1ppb Au
● " " >1 " "

METASEDIMENTER
METAVULKANITTER

Date nov.-86	Scale: 1: 2600	J.I.T.

A/S TERRACH

PRÖVER: GAU-86-431-449

GAU-86-431	1ppb Au
432	1
433	2
436	50
438	3
439	2
440	1
441	26
442	4
443	2
449	97
Andre pr.<	1

PRÖVER: GAU-86-405-430

GAU-86-412	1ppb Au
414	1
415	3
416	3
Andre pr<	1

PRÖVER: GAU-86-458-461

GAU-86-458	2ppb Au
459	2
461	5
460	< 1 ppb Au

KJØRISVANN

886

1032

913

GAUTELISVANN

GAUTELISFJELL

Δ

Las Au

VEI TIL FJELLBU

SVERIGE

405

430

448

449

431

458

461

403: <1 ppb Au

404: <1

402: <1 ppb Au

400: 8ppb Au

401: <1

KARBONAT-B.A.

METASEDIMENTER
METAVULKANITTER

ULTRA-BASITTER

BASISK-INTERMED. VULK.
STEDVIS M. KONGLOM. (Skonseng, 1985)

N

75 50

FOLLDAL VERK A/S

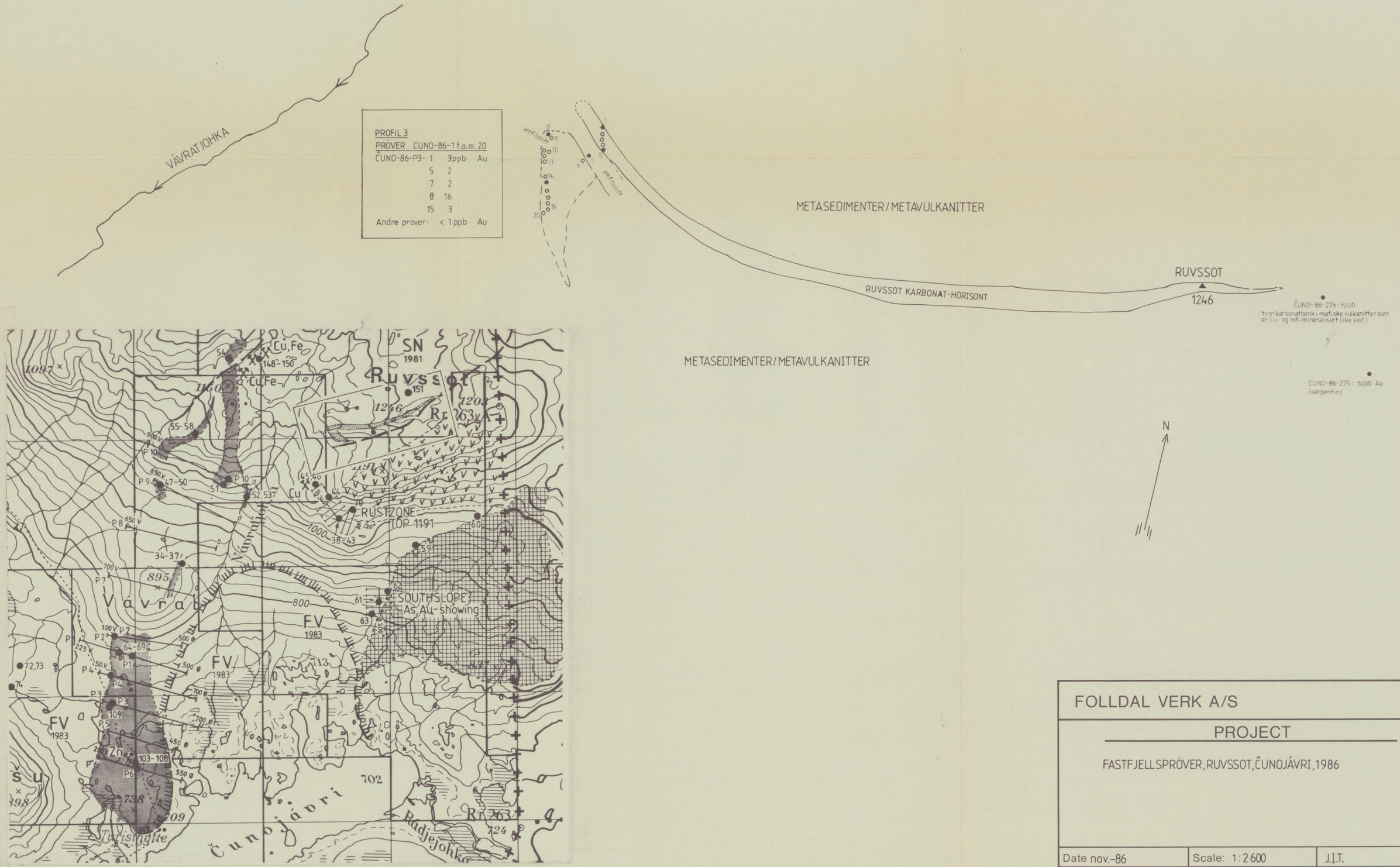
PROJECT

FASTFJELLSPRÖV., GAUTELISVANN-KJØRISVANN
1986

(Geoloien skjematisk fremstilt. Delvis etter Skonseng, NGU, 1985)

Date: nov.-86	Scale: 1: 20000	J.I.T.

A.S TORRKOPI



FOLLDAL VERK A/S

PROJECT

FASTFJELLSPRÖVER, RUVSSOT, ĈUNOJÁVRI, 1986

Date nov.-86	Scale: 1:2 600	J.I.T.