



Bergvesenet

Postboks 3021, N-7441 Trondheim

Rapportarkivet

Innlegging av nye rapporter ved: Peter

Bergvesenet rapport nr 5906	Intern Journal nr Kasse nr. 61	Internt arkiv nr	Rapport lokalisering	Gradering
Kommer fra ..arkiv Folldal Verk AS	Ekstern rapport nr	Oversendt fra Folldal Verk a.s.	Fortrolig pga	Fortrolig fra dato:
Tittel AN ECONOMIC EVALUATION OF THE SELVÅG MAGNETITE DEPOSIT				
Forfatter Søyland, Johannes		Dato År 1988	Bedrift (oppdragsgiver og/eller oppdragstaker) Vesterålen Bergindustri A/S	
Kommune Bø	Fylke Nordland	Bergdistrikt	1: 50 000 kartblad 11321	1: 250 000 kartblad Svolvær
Fagområde Geologi	Dokument type		Forekomster (forekomst, gruvefelt, undersøkelsesfelt) Selvågen, Senja, Heindalen mfl.	
Råstofgruppe Malm/metall	Råstofftype Fe			
Sammendrag, innholdsfortegnelse eller innholdsbeskrivelse rapporten omhandler hovedsaklig forekomsten i selvågen i Bø i Vesterålen. Den omfatter en god del kart og skisser og har følgende hovedinndeling (på engelsk): General facts about Norway, Market study, Ore reserves, selvåg deposit, Mine plan, Equipment, Concentrator, Products, Economic analysis, Environment. Det er videre lagt ved endel dokumenter som omhandler andre jernmalmsforekomster i Norge. Rapporten gir en inngående beskrivelse av forekomsten og mulighetene for igangsettelse.				



VBI *Vesterålen Bergindustri A/S*

Narvik
29 Mars 1988

Dr. Johann G Heim
Chief Geologist
Morsulfid
Brøsetveg 168
7000 Trondheim

HEINDALEN

Det ser ut som malmen fra Heindalen inneholder betydelig mer koppar, nikkel og kobolt. Jeg sender nå prøver til USA.

SENJA PROSJEKTET

Deminex er interessert i å være med. De er mest interessert i skjellsand, kvartssand og glimmer som mikronisert fyller. De ønsker en orienteringsmøte fra du og jeg på slutten av April. Jeg skal lage en utkast til en presentasjon og sende det ned.

De vil komme med Nkr. 100.00 plus en uttalelse fra Frank & Schulte om at de er interessert i produktene, hvor mye de kan selge og til hvilken pris.

Sverre Svindal ved Bergmesteren i Trondheim er orientert om prosjektet og venter en mer detaljert presentasjon fra oss.

Fylkesgeologen i Troms og DUF er også orientert. Jeg fikk avslag på det første søknad men regner med at det går bedre med den neste.

Det er også fortsatt mulig å få amerikanerne med.

SELVÅG

Deminex ser videre på prosjektet etter ønske fra Kruger.

Andre finansieringsmuligheter har nå også viste seg. Grunneieren er interessert i å investere 20 million i pukkverket. Kommunen regner med kanskje å skaffe ca. 20 million igjennom grunnlagsinvesteringer. Partneren min kan skaffe kanskje 5 million igjennom egeninnsats (maskinarbeid). Jeg kan dekke en god del av designarbeidet (ca. 10 million).

Dersom vi for DUF til å gi oss 25% har vi langt over 50% egenkapital.

Med Hilsen

Johannes Søyland

Trondheim
10 Sept. 1988

Seal Bay Minerals A/S
Anders Tvereggensveg 10
7000 Trondheim

Bernhard Kruger, Director
Frank & Schulte, GmbH.
PO Box 101255
D-4300 Essen 1
West Germany

Dear Bernhard:

As agreed during our meeting in Oslo 28 Aug. 1988, I am enclosing the updated analysis of the current magnetite production situation in Scandinavia. I am also enclosing a revised sales and production costs budget that calls for the sales of 100.000 tpy. of Heavy Media and 80.000 tpy. of RBC.

I'm sure you know that there are as many theories about how one should conduct an economic evaluation as there are people who conduct them. I believe that an economic evaluation should include an evaluation of the projects development potential over time. In this regard, I am still convinced that a good deal of both the RBC and Superslig production and sales could be, in time, overtaken by "our" project.

The necessary mining rights are secured and will be presented as such during our future meetings and for the formal presentation to both the Norwegian government and future investors. I agree that we should present only one company, the name of which is open for discussion.

I am also enclosing a summary of the various investment options for your evaluation. The aspects of the various options are quite involved. The least expensive option will not have as many advantages as the most expensive. The options will be explained in detail during discussions with the investors.

As I have often stated, I am very interested in a bilateral sales agreement that will secure our mutual best interests.

I am looking forward to receiving your written confirmation of what you feel our initial sales quantities should be.

Sincerely,



Johannes Søyland
President

DRIFTSBUDSJETT

PRODUKSJON / SALG FOB GRUVA

NKR. x 1000

Magnetitt

Heavy Media (100.000 x 200)	18.000
RBC (Briqueter) (80.000 x 400)	32.000
Pukk & Grus (200.000 x 35)	<u>7.000</u>
SUM	57.000

PRODUKSJONSKOSTNADER

Materialer

Sprengestoff	1.200	
Borestål	300	
Møllekuler, Kjemikaljer	3.600	
Kraft	1.800	
Reservedeler	<u>1.000</u>	7.900

Kajutgifter	5.000
Transport (Andørja - Selvåg)	5.625
Lønn	6.900
Markedsføring	2.000
Administrasjon	3.000
Renter	<u>2.500</u>

PROD. KOST.	32.925
BRUTTO FORT.	24.075
AVSKRIVNINGER	<u>13.675</u>

NETTO OVERSKUDD	10.400
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SCANDINAVIAN MAGNETITE PRODUCTION - UPDATED 9 SEPT 1988

PRODUCERS

SYDVARANGER

Sydvaranger plans to continue production indefinitely. Production will include about 1 million tpy. of pellets and 70,000 tpy. of Superslig. They do not intend to produce Heavy Media or RBC (Refractory Blocks Concentrate - heat storage blocks conc.). (Ref. Dr. Heim and Mr. Husås of Sydvaranger)

LKAB

LKAB intends to continue but plans are still somewhat indefinite. The need to have the new 1000 meter production level finished by about 1993 is a large problem which has not yet been solved.

They will produce about 12-13 million tpy. of iron ore, mostly as pellets. They intend to continue to produce and sell about 100,000 tpy of RBC. They do not intend to produce Heavy Media because extra production, shipment and storage costs will eliminate the possible increased sales value.

LKAB also produces about 70,000 tpy of direct reduction pellets (Superslig) for Hugaås. At some time in the future LKAB will be forced to go over to production of only pellets. (Ref. Tord Hansen, Narvik)

RANA GRUBER

Current plans call for immediate cessation of all iron ore production. (Ref. Information Secretary, Norsk Jernverk)

FOSDALEN

Fosdalen has cut back to half of it's previous production level. They are currently producing only Heavy Media but intend to cease all mining operations in 1991 when current reserves run out. (Ref. Fr. Foladal, Fosdalen A/S)

RØDSAND GRUBER

Rødsand will cease all magnetite production by the end of 1988. (Ref. Bernhard Kruger and Kjell Olav Sjøli of Rødsand Gruber)

SSAB

SSAB intends to cease all mining of magnetite by the winter of 1991-1992. (Ref. Information Secretary SSAB)

TITANIA

Titania will continue production of about 35,000 tpy of Heavy Media as long as their ilmenite production is profitable. Their product is considered of very poor quality. (Ref. Dr. Heim, Bernhard Kruger)

PRODUCT SUMMARY:

HEAVY MEDIA

Titania will produce 35,000 tpy. indefinitely.

Fosdalen will produce about 100,000 tpy. until 1991 when all mining will cease.

SSAB will produce about 200,000 tpy until 1991-1992 when all mining will cease.

After 1992 there will only be a production of 35,000 tpy. of Heavy Media in all of Scandinavia.

RBC

LKAB intends to continue the production and sales of 100,000 tpy. of RBC. However, all of this goes to Ferguson Wild (Frank & Schulte) and some of this production could be directed to a new operation. If LKAB goes over to only pellets, this production of RBC will cease.

PCC (PIPE COATING CONCENTRATE)

This product has ceased to exist due to uneconomical costs.

SUPERSLIG

Current demand of 140,000 tpy. is currently covered by Sydvaranger and LKAB. However, if a new, more reliable source were to enter the market, it should be able to capture some of this production.

The Japanese currently sell reground MPRD pellets from LKAB to Italy as Superslig.

Johannes Søyland

MAGNETITE PROJECT INVEST OPTIONS

	Million NKR
Full Development - Andørja - Selvåg	200
Selvåg only - portable concentrator	150
Selvåg only - portable concentrator open pit only	141
Andørja only - portable concentrator	100
Andørja only - portable concentrator contractor mining	85
Andørja only - purchase of Fosdalen contractor mining	25 - 40

DRIFTSBUDSJETT

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NKR. x 1000

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KOLBJØRN HANSEN

ING. MNIF

NEDRE SLOTTSGT. 11, OSLO 1, TELEFON 42 02 49 — 42 16 16

CHR. BANK & KREDITKASSE

BANKGIRO 6001.06.16584

POSTGIRO 21 12 58

Vesterålens Bergindustri A/S
Fagernesveien 1,
Boks 416
8501 Narvik

YOUR REF. A.D. Johs. Søyland MY REF. KH/bh
DERES REF. MIN REF.

OSLO, DEN 16.3.88

Ad: Oppberedningsverk for Selvågforekomsten.

Jeg viser til tidligere telefonsamtaler angående dette prosjekt, og vedlegger et meget preliminært kostnadsoverslag som er basert på et anlegg bygget i fjell, plasert omtrent som vist på kartutsnittet.

Det er forutsatt at alt tungt maskineri og utstyr som knuser, møller, møllemotorer, filtre og tørkeovn, kraner og tildels utstyr for transportbånd kjøpes som brukt materiell til en pris på rundt 2 x skrapprisen.

Lasteapparatet er basert på forhaling, hvorved kaikostnadene holdes på et minimum. Plasing av tunnelpåhugg og kai er valgt for å komme unna den rasfarlige del av området som omfatter helling betegnet som "Ur". Såvidt jeg kan tolke kotene, er det fast fjell i området over kaien.

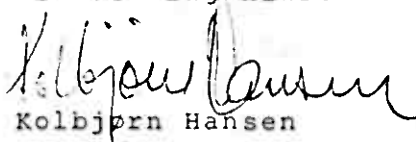
For knuseriet har jeg regnet med samme løsning som vi gjorde for Norsk Nefelin på Stjernøy, og lasteapparatet vil være svært likt det vi bygget for Norcem, Visnes på Møre.

Et forprosjekt som viser layout, anleggsutsnitt av knuseri, siloer, møllehall og lasteapparat med mere pålitelige enhetspriser og volum for fjellsprenning, bygningsmessig, stålkonstruksjoner og elektroopplegg, samt kostnader for det tyngre maskineri, vil ligge på ca 150.000,-

For komplett detaljprosjektering vil på dette stadium ca 10.-mill. være et realistisk tall.

Jeg håper dette kan være til noen hjelp så langt, og hører gjerne fra Dem for evt. videre bearbeidelse av prosjektet.

Med vennlig hilsen


Kolbjørn Hansen

Selvågforekomsten, preliminært kostnadsoverslag.

Fjellarbeider, ekskl. stoller og sjakter for åpning av forekomsten:

Knuse- og Møllehall, transportstoller og siloer..... 40,000.000,-

Betongarbeider:

Kai, silobunner, såler, dekker og maskinfundamenter 25,000.000.-

Maskiner:

Lasteapparat, Grovknuser, Møller, Separatorer,
Filtre, Tørkeovn, Kraner, Pumper, Sykloner
og transportørutstyr 25,000.000,-

Stålkonstruksjoner:

Platformer, sumper, renner og bokser, stativer og
omlastinger for transportører, stål f.ø. 20,000.000,-

Vann og ventilasjon: (trykkvann levert tunnellåpn.)

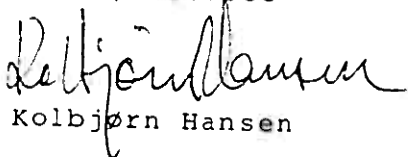
Oplegg for møller og sep.spyling og brann samt avgang. 5,000.000,-

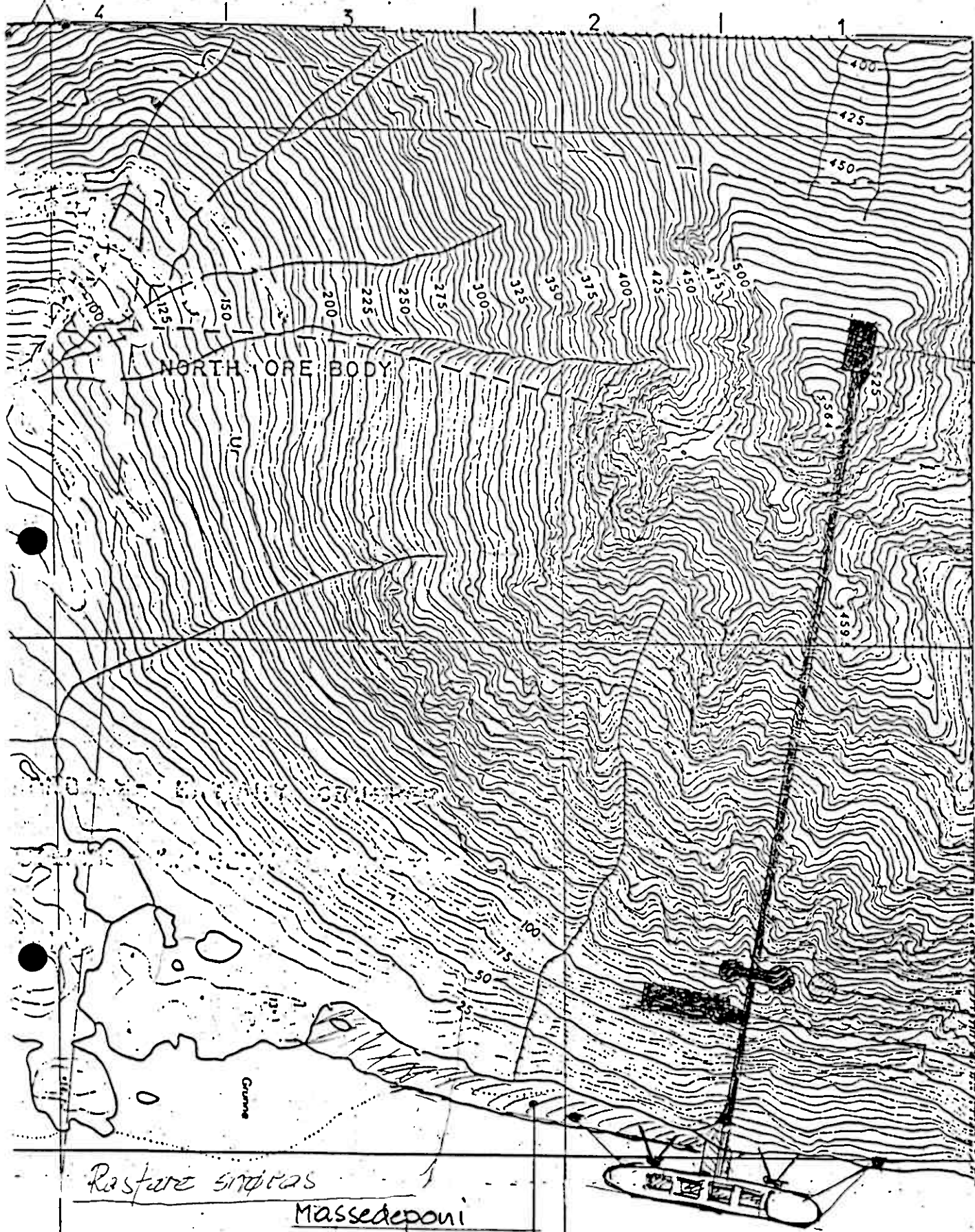
El. innstallasjoner ekskl. startapp. for møller 15,000.000,-

Konsulenthonorarer maskin, bygg og elektro 10,000.000,-

Sum (Antatt slingringsmonn -10%, + 20%) 140,000.000,-

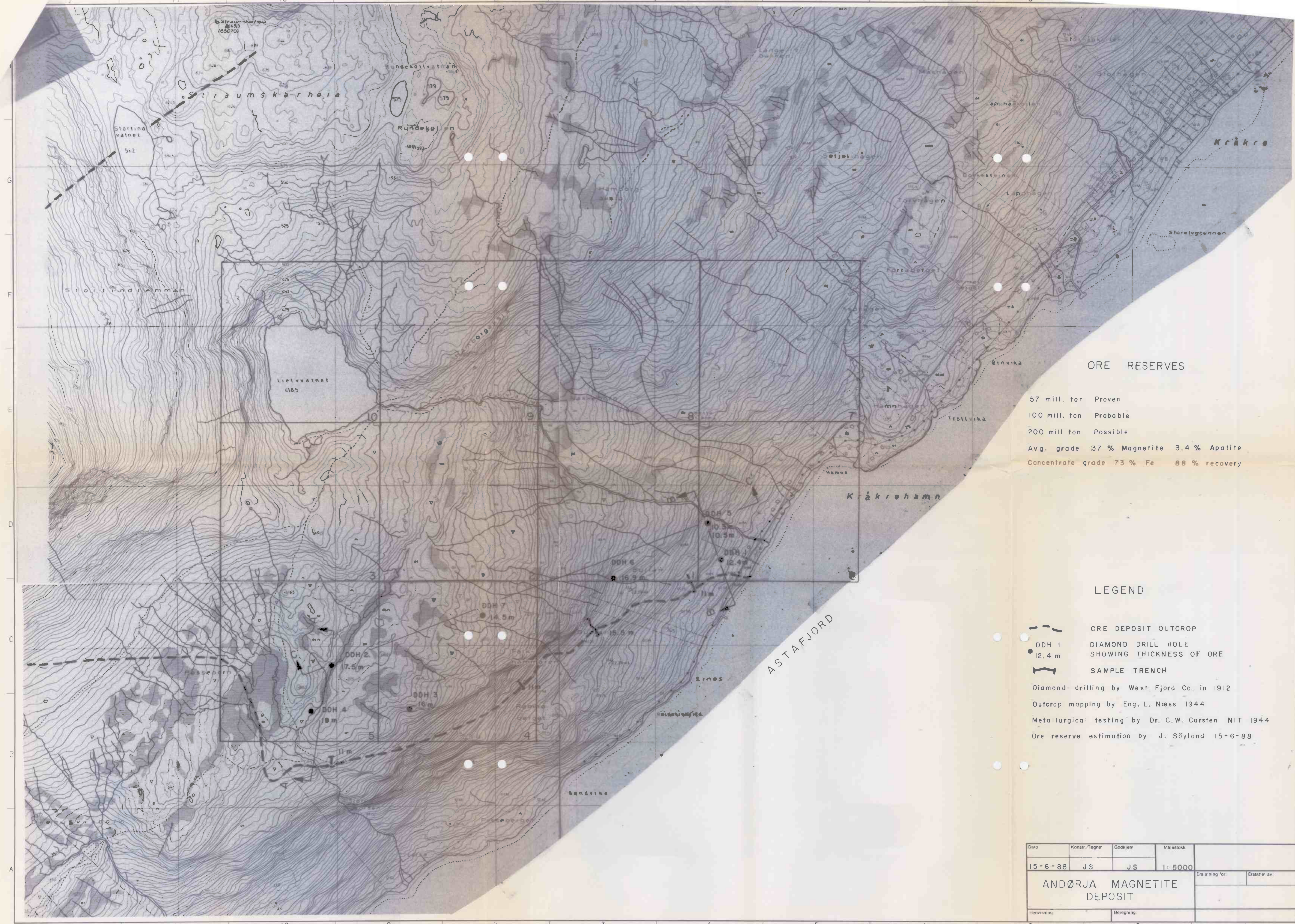
Asker, 16.3.88


Kolbjørn Hansen



Grovnuseverk 11/110
Siber for grovnuseverk og konsentrat
Opparbeid. verk

Utsnitt av kartskisse av 25.8.87 - 1:5000
Asker, 15.3.88 Volghansen



ORE RESERVES

57 mill. ton Proven
100 mill. ton Probable
200 mill. ton Possible
Avg. grade 37 % Magnetite 3.4 % Apatite
Concentrate grade 73 % Fe 88 % recovery

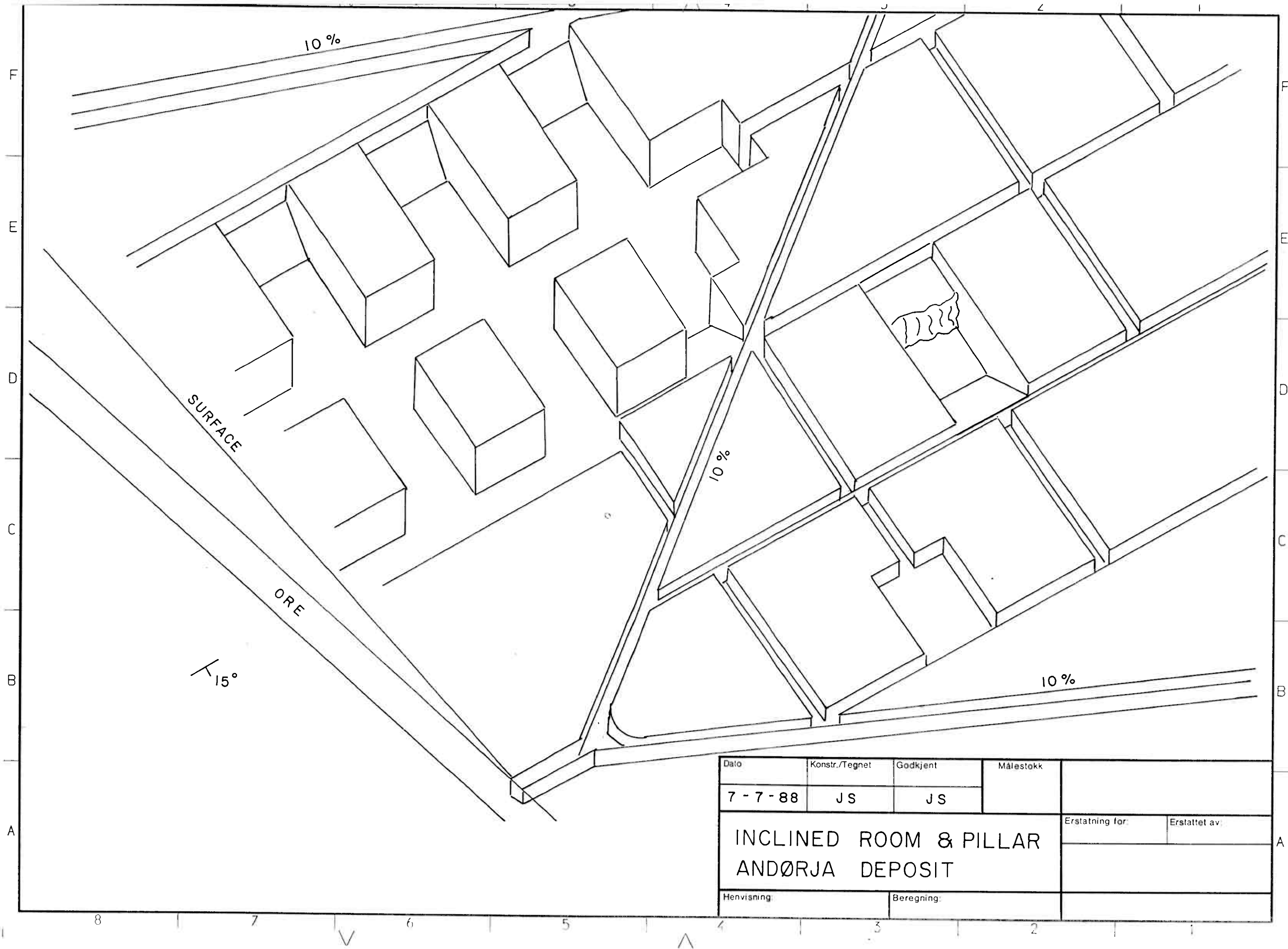
LEGEND

- ORE DEPOSIT OUTCROP
- DIAMOND DRILL HOLE
SHOWING THICKNESS OF ORE
- SAMPLE TRENCH

Diamond drilling by West Fjord Co. in 1912
Outcrop mapping by Eng. L. Næss 1944
Metallurgical testing by Dr. C.W. Carsten NIT 1944
Ore reserve estimation by J. Søyland 15-6-88

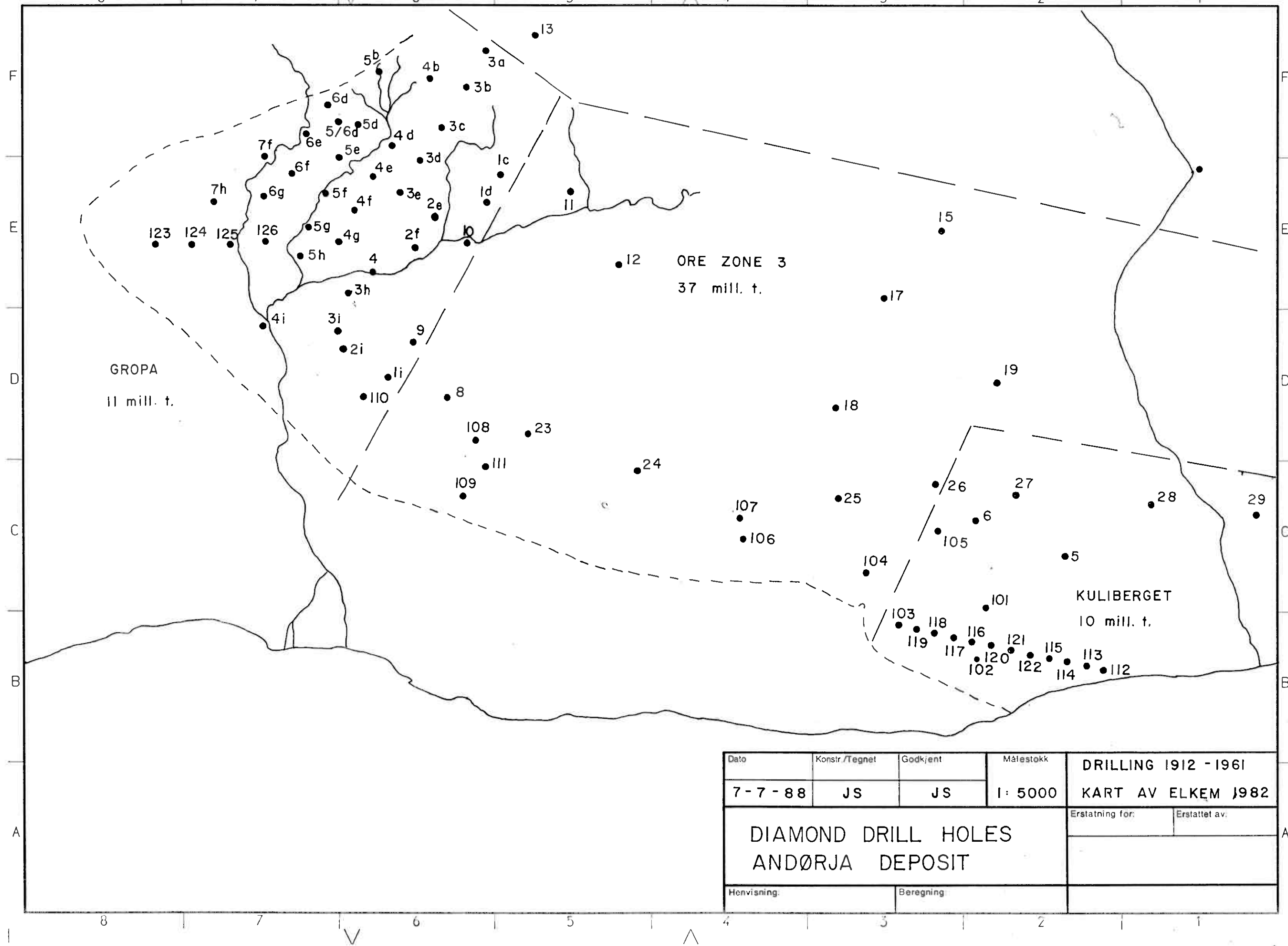
Dato	Konstr./Tegnet	Godkjent	Målestokk		
15-6-88	JS	JS	1:5000	Erstattet for:	Erstattet av:
ANDØRJA MAGNETITE DEPOSIT					
Revisjon:		Beregning:			

TORRKOPI HD 2 / NS 1402, NS 1417, NS 1415



Dato	Konstr./Tegnet	Godkjent	Målestokk	
7 - 7 - 88	JS	JS		
INCLINED ROOM & PILLAR ANDØRJA DEPOSIT			Erstatning for:	Erstattet av:
Henvisning:		Beregning:		

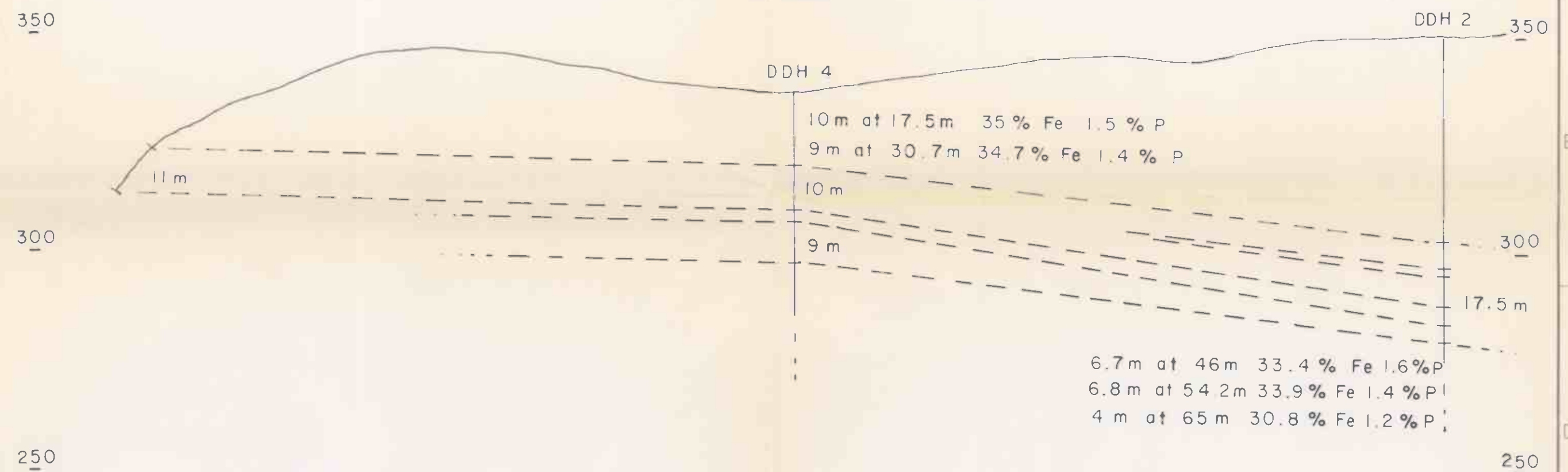
A.S. TORRKOPI HD 2/NS 1402, NS 1417, NS 1415



Dato	Konstr./Tegnet	Godkjent	Målestokk	DRILLING 1912 - 1961	
7-7-88	JS	JS	1: 5000	KART AV ELKEM 1982	
DIAMOND DRILL HOLES ANDØRJA DEPOSIT				Erstattet for:	Erstattet av:
Henvising:		Beregning:			

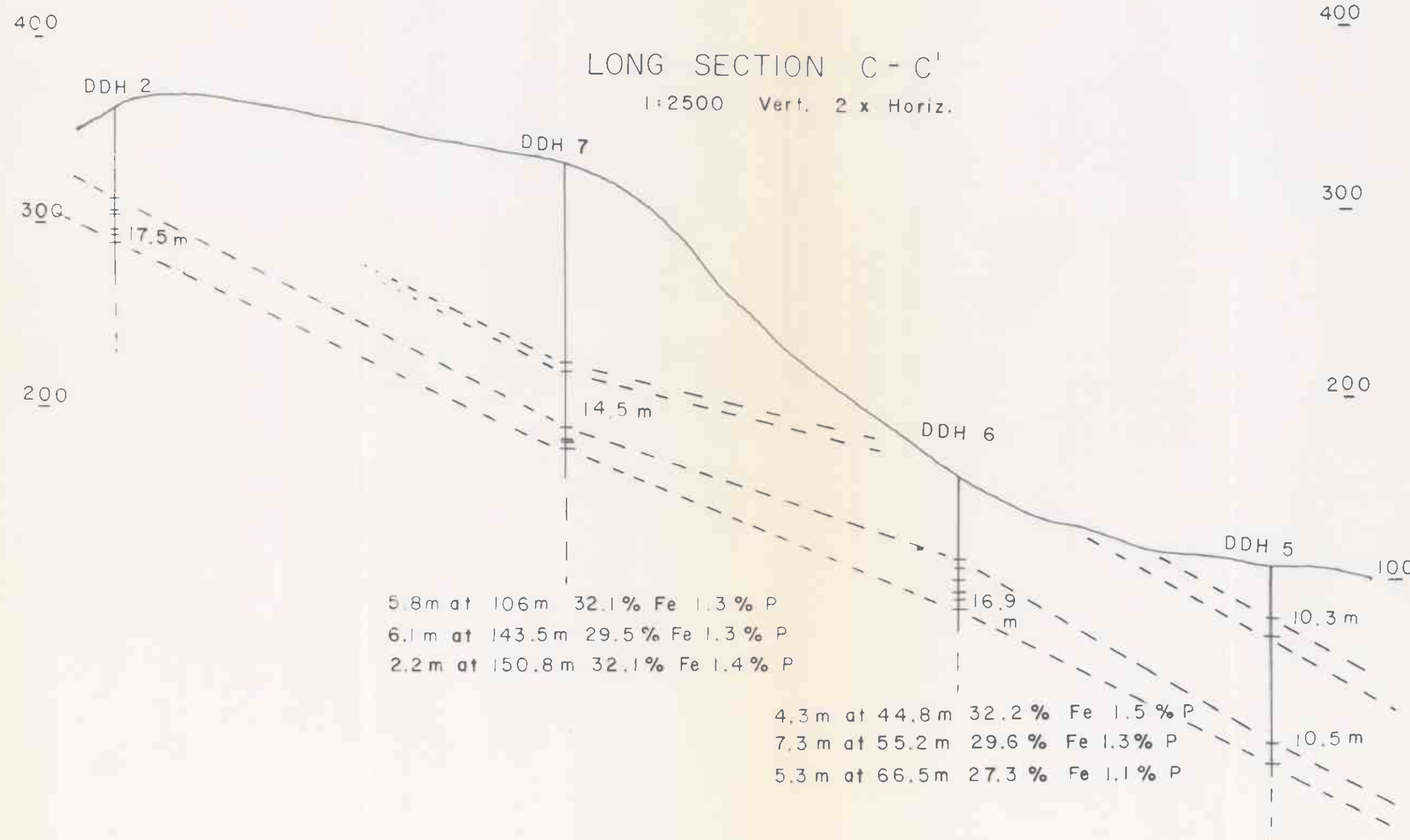
CROSS SECTION A - A'

1:1000



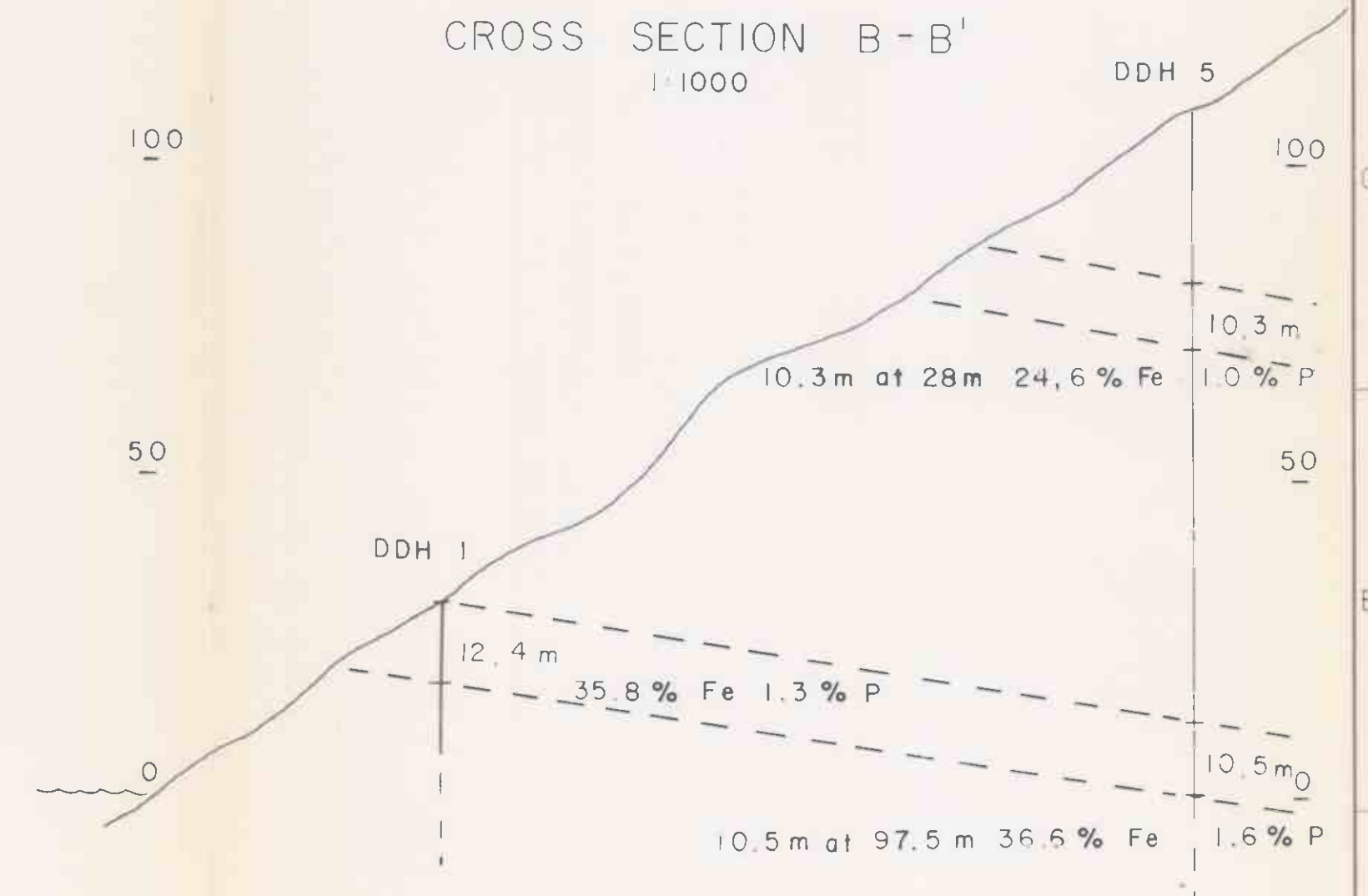
LONG SECTION C - C'

1:2500 Vert. 2 x Horiz.



CROSS SECTION B - B'

1:1000



Dato	Konstr./Tegnet	Godkjent	Målestokk		
21-6-88	JS	JS		Ersattning for:	Ersattlet av:
CROSS SECTIONS OF THE ANDØRJA DEPOSIT					
Henviisning		Beregning			

GEITSKAR -- BOTNSKAR

SULFIDMINERALER

KOPPER

NIKKEL

KOBOLT

SJELDNEJORDARTER

INDUSTRIMINERALER

MIKRONISERT

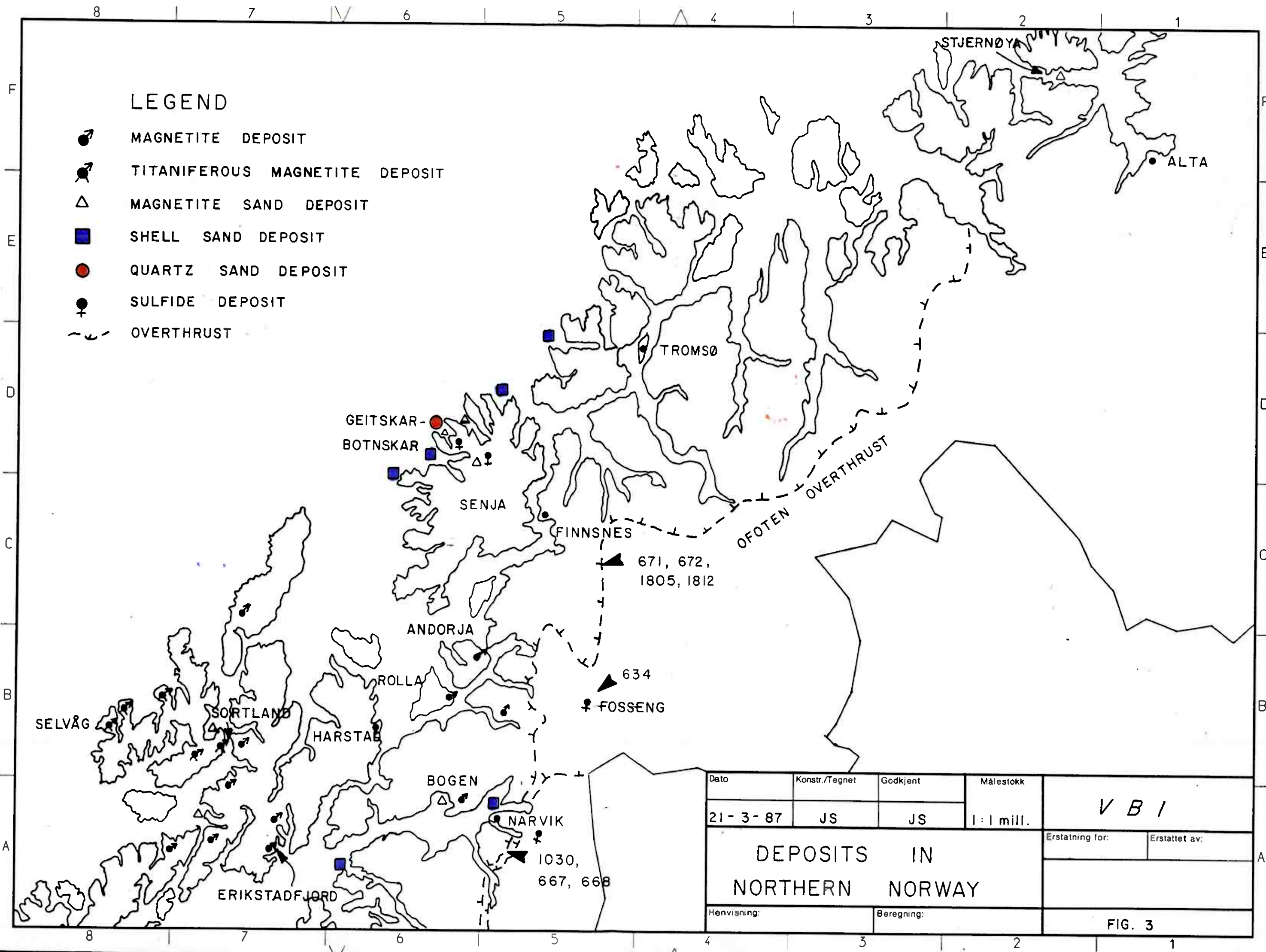
SØJELLSAND

KVARTSSAND

GLIMMER

GULL

A.S. TORRISØPI HU 2/NS 1402, NS 1417, NS 1415



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
21 - 3 - 87	JS	JS	1 : 1 mill.		
DEPOSITS IN NORTHERN NORWAY				Erstatning for:	Erstattet av:
Henvising:				Beregning:	
				FIG. 3	

GEOLOGISK TEGN

RIKTIG GEOLOGISK MILJØ FOR GULL

GRØNNFJELL & MAGNETITT & GRAFITT

VELDIG STERK NORDVEST GÅENDE STRUKTUR

STERK MAGNETISK ANOMOLI PARALLELT MED STRUKTUREN

GEOKJEMISK ANOMOLIER AV:

KOPPER

NIKKEL

KOBOLT

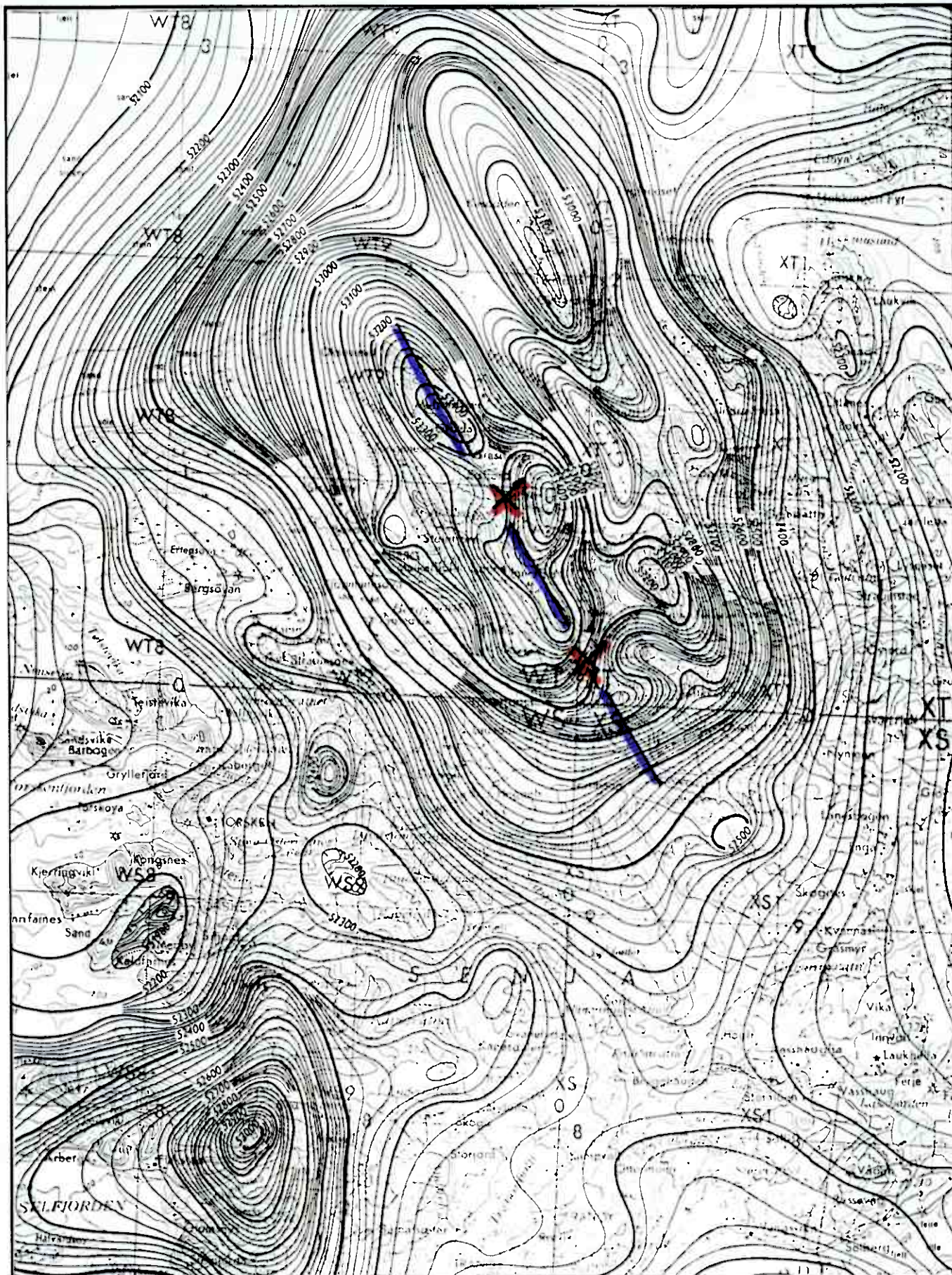
SJELDNEJORDARTER

GULL

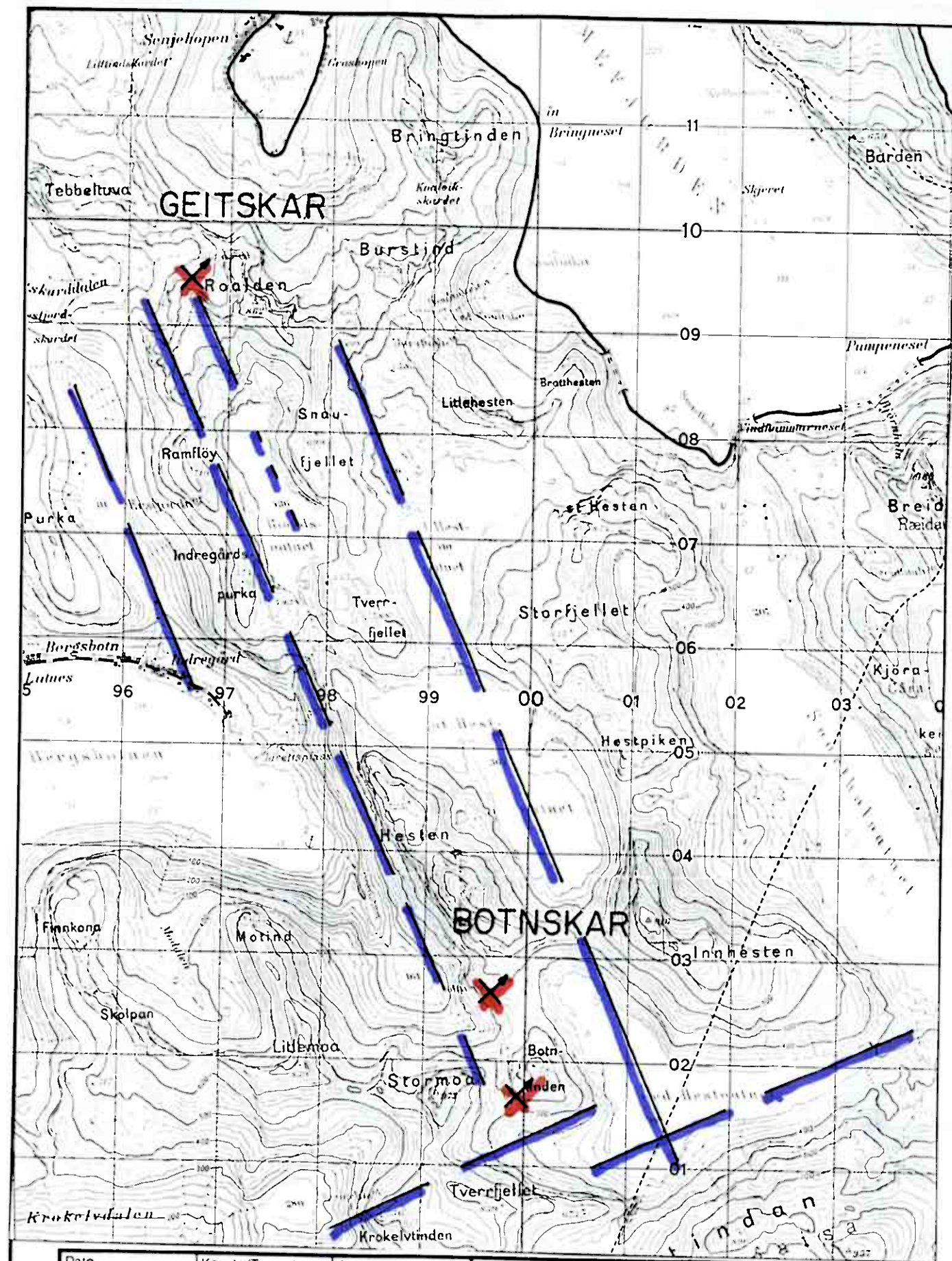
3 KJENT UTGÅENDE LENSER AV SULFIDMINERALISERING

1 SOM ER 70m x 300m

FOREKOMSTER AV SKJELLSAND OG KVARTSAND



Dato	Konstr. / Tegnet	Godkjent	Målestokk	V B I	
28 - 9 - 87	JS	JS	1:250 000		
AEROMAGNETIC MAP OF SENJA				Erstattet for:	Erstattet av:
				NGU - TROMSØ	
Henvising:		Beregning:		FIG. 9	



Dato	Konstr / Tegnet	Godkjent	Målestokk	V B I	
28 - 9 - 87	JS	JS	1:50 000	Erstatning for:	Erstattet av:
GEITSKAR - BOTNSKAR AREA WITH STRUCTURAL TRENDS				MEFJORDBOTN 1433 IV	
				FIG 7	

ANALYSERAPPORT

Materiale : Stein og sandprøver.
Prøver mottatt 25.09.85

Oppdragsgiver : J. Søyland, Tana

Oppdragets art. : Elementbestemmelser (Co, Ni, Li, V, Fe) i
samtlige prøver.
Magnetittandel i sandprøvene.

Prøve mrk.	Fe %	Fe ₃ O ₄ %	Ni %	Co %	Li %	V %
1 Steinprøve fra Bergsbotn I	14.8	-	0.36	0.040	0.001	0.048
2 " " " II	15.8	-	0.21	0.13	< 0.001	0.050
3 " " " III	8.8	-	0.61	0.030	< 0.001	0.028
4 " " " IV	17.5	-	0.14	0.048	< 0.001	0.057
5 Sandprøve, 85 I	11.1	0.85	1.03	0.004	0.001	0.009
6 " " " II	7.1	0.60	0.36	0.003	0.002	0.009
7 Sandprøve, Botnvatten	8.8	1.95	0.69	0.003	0.001	0.011
8 " Eidsfjord	2.7	0.83	0.21	0.002	< 0.001	0.004
9					:	

Merknader :

Uttrekt magnetisk jern (uten videre nedknusing) ga et ureint produkt og lavt utbytte. Materialet ble derfor fri-malt før magnetseparasjon.
Sikteanalyse ble derfor ikke utført.

Mo i Rana, 16.12.85

T. Juliussen

CORTÉZ GOLD MINES

TIME: . . .

Specials for Osmanson CERTIFICATE OF ASSAY

DATE 10/7/86

Norway

SAMPLE NO.	SAMPLE IDENTIFLCATION	1/2 AT Fire			
1	1801	.004	Krokely		
2	1802	TR			
3	1803	TR			
4	1804	TR			
5	1805	.004	Sprriesa		
6	1806	TR			
7	1807	TR			
8	1808	TR			
9	1809	TR			
10	1810	TR			
11	1812	.004	Sprriesa		
12	1813	TR			
13	1814	TR			
14	1815	TR			
15	1816	TR			
16	1817	TR			
17	1824	TR			
18	1825	TR			
19	1826 1827	TR			
20	1828	TR			
21	1832	TR			
22	1838	TR			
23					
24					
25					
26					
27					
28					
29					
30					
31					
32					
33					
34					

TABELL 1

Sample#	Lab#	Au, ppm	Ag, ppm	Cu, ppm	Co, ppm	Ni, ppm	Zn, ppm	Ba, %	Fe, %	Ti, %	Li, ppm	Sr, ppm	Se, ppm
613	7H02-1	<0.010	<0.5	240	78	58	190	<0.02	27.	3.10	4	64	1
614	2	<0.010	<0.5	120	110	50	170	<0.02	24.	2.60	3	80	1
615	3	<0.010	<0.5	160	120	64	160	<0.02	24.	2.70	3	35	1
616	4	<0.010	<0.5	130	84	34	180	<0.02	24.	2.70	3	59	1
617	5	<0.010	<0.5	190	60	15	160	<0.02	24.	2.90	3	47	1
618	6	<0.010	<0.5	93	86	25	190	<0.02	28.	3.10	3	39	<1
619	7	<0.010	<0.5	55	88	12	180	<0.02	27.	3.00	2	32	1
620	8	<0.010	<0.5	86	84	21	180	<0.02	26.	2.90	3	58	1
621	9	<0.010	<0.5	55	110	24	180	<0.02	27.	3.40	6	44	1
622	10	<0.010	<0.5	52	100	15	180	<0.02	28.	3.20	3	33	<1
623	11	<0.010	<0.5	72	83	15	200	<0.02	27.	3.10	4	37	<1
624	12	<0.010	<0.5	56	93	17	180	<0.02	26.	2.90	4	30	1
625	13	<0.010	<0.5	44	82	10	150	<0.02	25.	3.00	3	47	<1
626	14	<0.010	<0.5	45	73	9	160	<0.02	24.	3.10	3	53	1
627	15	<0.010	<0.5	43	87	11	190	<0.02	28.	2.70	3	26	<1
628	16	<0.010	<0.5	360	100	110	170	<0.02	25.	3.10	3	48	1
629	17	<0.010	<0.5	380	88	100	170	<0.02	26.	2.80	4	67	1
630	18	<0.010	<0.5	110	100	51	160	<0.02	24.	2.60	3	57	1
631	19	<0.010	<0.5	79	68	14	170	<0.02	23.	2.70	4	67	1
632	20	<0.010	<0.5	300	95	110	170	<0.02	24.	2.70	3	50	1
633	21	0.010	0.5	32	5	20	18	0.05	6.0	0.44	22	55	4
634	22	<0.010	<0.5	240	100	190	80	0.03	15.	1.30	23	109	<1 Fossan
635	23	<0.010	<0.5	72	12	42	91	0.06	4.0	0.71	52	230	<1 Stein
1858	24	<0.010	<0.5	71	4	3	13	<0.02	1.3	0.09	6	49	2
1859	25	<0.010	<0.5	13	<1	<1	3	<0.02	0.25	0.03	12	240	<1
1860	26	<0.010	<0.5	130	17	39	77	<0.02	4.8	0.10	21	100	2 } Geit
1861	27	<0.010	<0.5	65	3	<1	3	<0.02	1.1	0.02	7	91	1
1862	28	<0.010	<0.5	110	9	9	38	0.08	3.7	0.57	9	340	5
1863	29	<0.010	<0.5	12	1	<1	15	0.03	0.95	0.06	7	120	<1

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TABELL 1

Sample#	Lab#	Sc, ppm	La, ppm	Ce, ppm	Nd, ppm	Sa, ppm	Eu, ppm	Yb, ppm	Lu, ppm	U, ppm	Th, ppm
613	7H02-1	69	1.3	<3	<5	1.3	0.4	0.6	0.11	<1	<1
614	2	79	1.4	<3	<5	1.5	0.4	0.9	0.13	<1	<1
615	3	76	1.4	<3	<5	1.4	0.5	0.9	0.14	<1	<1
616	4	79	1.5	3	<5	1.5	0.6	1.1	0.11	<1	<1
617	5	84	1.6	<3	<5	1.6	0.5	0.8	0.14	<1	<1
618	6	73	1.3	4	<5	1.4	0.4	0.9	0.11	<1	<1
619	7	74	1.4	6	<5	1.4	0.4	0.9	0.14	<1	<1
620	8	76	1.6	8	<5	1.5	0.4	0.8	0.11	<1	<1
621	9	65	1.2	6	<5	1.2	0.3	0.7	0.14	<1	<1
622	10	74	1.4	3	<5	1.5	0.4	0.9	0.13	<1	<1
623	11	66	1.1	4	<5	1.2	0.3	0.6	0.10	<1	<1
624	12	79	1.6	4	<5	1.6	0.5	0.9	0.12	<1	<1
625	13	58	1.2	4	<5	1.2	0.3	0.6	0.07	<1	<1
626	14	93	2.0	4	<5	1.8	0.6	0.9	0.15	<1	<1
627	15	61	1.2	<3	<5	1.2	0.4	0.6	0.10	<1	<1
628	16	59	1.2	6	<5	1.1	0.4	0.6	0.06	<1	<1
629	17	65	2.4	7	<5	1.4	0.3	0.9	0.12	<1	<1
630	18	70	1.3	4	<5	1.3	0.5	0.8	0.12	<1	<1
631	19	64	1.2	<3	<5	1.1	0.4	0.9	0.12	<1	<1
632	20	63	1.2	6	<5	1.3	0.4	0.9	0.10	<1	<1
633	21	18	29.	40	20	3.7	0.7	2.2	0.32	5	6
634	22	29	16.	<3	<5	4.2	0.6	1.8	0.25	2	<1
635	23	15	28.	43	23	4.4	1.2	1.5	0.27	3	7
1858	24	1	3.6	4	<5	0.1	0.3	0.3	0.10	<1	<1
1859	25	<1	11.	8	<5	0.1	0.4	<0.2	<0.05	<1	<1
1860	26	46	39.	56	<5	5.1	0.4	1.6	0.27	<1	2
1861	27	<1	3.2	3	<5	<0.1	0.2	<0.2	<0.05	<1	<1
1862	28	14	92.	170	8	17.	1.2	3.6	0.43	2	7
1863	29	<1	34.	26	<5	0.3	0.3	<0.2	<0.05	<1	11

Fossens
Steinkjer

Geitzkar

Sample#	Lab#	As, ppm	Sb, ppm	Mo, ppm	N, ppm	Ta, ppm	Cr, ppm
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613	7H02-1	<2	<0.2	<5	<3	<1	70
614	2	<2	<0.2	<5	<3	<1	45
615	3	<2	<0.2	<5	<3	<1	46
616	4	<2	<0.2	<5	<3	<1	36
617	5	<2	<0.2	<5	<3	<1	40
618	6	<2	<0.2	<5	<3	<1	56
619	7	<2	<0.2	<5	<3	<1	30
620	8	<2	<0.2	<5	<3	<1	27
621	9	<2	<0.2	<5	<3	<1	22
622	10	<2	<0.2	<5	<3	<1	23
623	11	<2	<0.2	<5	<3	<1	20
624	12	<2	<0.2	<5	<3	<1	31
625	13	<2	<0.2	<5	<3	<1	21
626	14	<2	<0.2	<5	<3	<1	20
627	15	<2	<0.2	<5	<3	<1	17
628	16	<2	<0.2	<5	<3	<1	54
629	17	<2	<0.2	<5	<3	<1	86
630	18	<2	<0.2	<5	<3	<1	35
631	19	<2	<0.2	<5	<3	<1	30
632	20	<2	<0.2	<5	<3	<1	56
633	21	18	1.5	<5	<3	<1	100
634	22	16	<0.2	<5	<3	<1	95
635	23	<2	<0.2	<5	<3	1	64
1858	24	<2	<0.2	190	<3	<1	8
1859	25	<2	<0.2	<5	<3	<1	2
1860	26	<2	<0.2	<5	<3	<1	120
1861	27	<2	<0.2	<5	<3	<1	2
1862	28	<2	<0.2	<5	<3	1	32
1863	29	<2	<0.2	<5	<3	<1	<2

CORTEZ GOLD MINES

TIME: . . .

CERTIFICATE OF ASSAY

DATE 11-8-1986*Bob's Specials Pure*

SAMPLE NO.	SAMPLE IDENTIFICATION	Ass			
		01T			
1	# 1007	TR			
2	1016	TR			
3	1017	.014	Berg Foss		
4	1019	.006	Skr		
5	1020	.006	Tennevoll		
6	1022	TR			
7	1023	TR			
	1025	TR			
9	1027	.009	NAF		
10	1030	.006	Skulvatne		
11	1833	TR			
12	1836	TR			
13	1013	TR			
14					
15					
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32					
33					
34					

ASSAYER

Wayne Mc. B. Jr.

LETEPROGRAM

1. BEFARING AV OMRÅDET - MAI - JUNI
GO - NO GO AVGJØRELSE

2. PRØVETAKING

3. GEOFYSISKE MÅLINGER

4. GEOKJEMISK & GEOBOTANISK PRØVETAKING

5. GEOLOGISK KARTLEGGING

6. OPPREDNINGSFORSØK

MIKRONISERT

KALK

KVARTS

GLIMMER

7. ØKONOMISK ANALYSE

8. RAPPORT SKRIVING

PRODUCTER

KOPPER

NIKKEL

KOBALT

SJELDNEJORDARTER

MIKRONISERT

KALK

KVARTS

GLIMMER

TIDSPLAN

	Juni	Juli	Aug	Sept	Okt	Nov	Des	Jan	Feb
Befaring	X								
Go - No Go Avgjørelse	X								
Feltarbeider									
Prøvetaking	XXXXXXXX								
Geofysik		XXXXXX							
Geokjemi			XXXXXX						
Geobotani				XXXXXX					
Kartlegging		XXXXXXXXXXXXXXXXXXXX							
Oppredningsforsøk			XXXXXXXXXXXXXXXXXXXX		XXXXXXXXXXXX	XXXXXXXXXX			
Analysering		XXXXXXXXXX				XXXXXXXXXX			
Økonomisk Analyser				X X X X	X X X	XXXXXXXXXX	XXXXXXXXXX		
Rapport Skrining					X X	X X X X	XXXXXXXXXX	X X X X	X X X

BUDSJETT

FELTARBEID

3 mann x 3 måneder	300.000
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OPPREDNINGSFORSØK

SKJELLSAND	50.000
------------	--------

KVARTSSAND	50.000
------------	--------

LIMMER	50.000
--------	--------

ANALYSERING	50.000
-------------	--------

REISEUTGIFTER	100.000
---------------	---------

ØKONOMISK ANALYSER	100.000
--------------------	---------

SUM	700.000
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FINANSIERING

NORSULFID	100.000
DEMINEX	100.000
VBI	100.000
NICOLIASSEN	100.000

DUF	200.000
KOMMUNE	100.000

SUM	700.000
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VBI *Vesterålen Bergindustri A/S*

An Economic Evaluation of the Selvåg Magnetite Deposit

An Economic Evaluation of the Selvåg Magnetite Deposit Located in
the Vesterålen District of Norway.

A Prefeasibility Study

by

Johannes Søyland

Dec. 1987

EXECUTIVE SUMMARY

The purpose of this prefeasibility study is to examine the technical and economic factors involved with proposed mining of the Selvåg magnetite deposit. The primary product and targeted market is heavy media magnetite for the European and American coal industries.

The study is now completed and shows that Selvåg is a very promising project. At the lowest level of production (600,000 Mtn Ore per year), the project has a present worth of 77,4 million Norwegian Kroner and an internal rate of return of 31%.

The main factors influencing the project are:

1. The eminent closure of mining operations of SSAB and the very probable conversion of LKAB to production of only pellets creates a very favorable market situation.
2. The size, geometry, location and byproduct values of the Selvåg deposit make possible a very economical operation. Selvåg could very likely be one of the most economical producers of magnetite in the world. Although the expected average sales price for magnetite is Nkr. 200,- per mtn., the operation should be able to compete with prices as low as Nkr. 30,- per mtn. for the heavy media sold.

ELEMENTS OF THE STUDY

The major elements of the study were:

1. Surface sampling to confirm ore grades.
2. A laboratory scale pilot plant study to determine plant requirements and product quality.
3. A marketing study and customer contacts to present the product and possibly obtain sales agreements.

4. A technical and economic evaluation of the proposed operation.

SURFACE SAMPLING

The surface sampling was completed in August 1987 and confirmed the previously reported ore grades (average grade 25% Fe) and the presence of higher ore grades (50 - 60% magnetite) in the banded sections of the deposit. The sampling also confirmed the presence of significant values of copper, nickel, cobalt and scandium.

PILOT PLANT STUDY

The pilot plant study was completed in November at the Mineral-dressing Laboratory of the Norwegian Institute of Technology. The testing was successful producing concentrates of magnetite, ilmenite, sulphides and apatite. Analysis shows that the concentrates are acceptable and that scandium goes with the tailings and is not recoverable.

MARKET STUDY

The present condition of the market was evaluated in the period from September through November 1987 and the market-situation was found to be very favorable. The exiting of SSAB and probably LKAB from this segment of the magnetite market were the most significant factors.

Potential customers were contacted in the period from December through January. Samples of the magnetite concentrate were sent to Frank & Schulte in West Germany, British Coal in England and Reise-Viking (Koch Industries) in the USA. Frank & Schulte and Koch Industries were visited. Everyone stated that the product was excellent and that they were interested in doing business. No sales contracts were signed at the time.

Possible joint-venture partners, Outokumpu Oy of Finland and Miller and Associates of Denver were also visited. Outokumpu is interested in a more detailed evaluation of the project.

TECHNICAL AND ECONOMIC EVALUATION

The technical aspects of the proposed operation were examined during the period from September through November 1987. Investment costs, manning levels and production costs were evaluated. Detailed planning was not included.

The proposed production level is 600,000 mtn. of ore per year, the manning level is 35 persons and the capital requirements lie between 80 and 144 million Norwegian Kroner.

After the successful completion of the market study, the economics were evaluated and summerized at the end of January 1988 and this report was published.

If an agreement can be reached with Reise-Viking whereby they purchase all their magnetite from VBI, a production level of 1,2 million mtn. of ore per year could be reached. This would give the project a better result through "economics of sale". The present worth for this alternative is 181 million Nkr. and the ROR is 41 %.

N O T A T

Møte med Johannes Søyland den 7. september 1987 i Oslo angående
Selvåg jern-titan forekomst, Vesterålen, Nordland.

Deltakere: Johannes Søyland

Dr. Heim

Dr. Priesemann

Ofoten Invest, Narvik

tlf. 082-42545

Folldal Verk A/S

Folldal Verk A/S

Innledning.

Johannes Søyland er amerikansk statsborger med utdanning som bergingeniør. Han har vært bosatt i Norge i 5 år. Under ansettelsen hans ved Elkem A/S var han stasjonert ved Rødsand gruve. Han var senere involvert i Tana-kvartsitt saken. For tiden er han ansatt i Ofoten Invest. Firmaet er hovedaksjonær i Vesterålen Bergverksselskap (45 %-andel). Resten av aksjene fordeles ulikt på selve J. Søyland (35 %) og E. Jensen (20 %). Vesterålen Bergverksselskap holder bergrettighetene på Selvåg-forekomsten, Vesterålen, Nordland. Selskapet har planer om å sette i drift Selvåg-forekomsten. Utvinningen skal primært gå på magnetitt, som skal brukes på industrimineral-sektoren. I denne sammenheng ønsker Vesterålen Bergverksselskap et samarbeid med en partner fra den norske bergverksindustrien.

SELVÅG FOREKOMST.

Selvåg forekomsten er kjent for å være en av Norges største jern-titan forekomster. Den ligger i Bø kommune, Vesterålen, Nordland. Forekomsten er plassert 800 m fra Malnesfjorden. Selvåg-malmen består av to malmarealer (syd- og nord-linse) som er tilknyttet en lagdelt gabbrointrusjon. På grunnlag av diamant-boring (gjennomført i 1956) anslåes reservene til det nordlige malmarealet til 44 Mt ved brytning inntil havets nivå. Malmens sammensetning er 25 % Fe, 2,5 % Ti og 0,15 % V. Totale reserver til forekomsten ansees å ligge langt over de mulige reservene. Den sydlige linsen er oppbygd av malm med mindre malmverdi. Den er allsidig begrenset av forkastninger. De geologiske forholdene tilsier at sydlinsen kiler ut mot dybden.

Christiania Spigerverket og Elkem A/S holdt mutinger på forekomsten fra 1933 og frem til 1982. I dette tidsrommet ble det utført en rekke geologiske, mineralogiske og geokjemiske undersøkelser, og det ble gjennomført oppredningsforsøk på malmen. Fasiten av undersøkelsene var, at jern-titan malmen ved Selvåg har for lave gehalter for å nytte råstoffet til stålproduksjonen. Forekomsten er heller ikke drivverdig med hensyn til titandioxid-utvinning og vanadiumkonsentrasjonen er for lav for å kunne gi noen ekstrainntekt.

Selvåg-forekomsten som råstoffkilde for industrimineralsektoren.

Johannes Søyland har gjennomført en økonomisk kalkyle med Selvåg-malmen som råstoff for industrimineralsektoren. Selvåg favoriseres overfor andre norske Fe - Ti forekomster p.g.a. sin beliggenhet og kornstørrelse til magnetitten som er spesielt egnet for å produsere et grovkornet magnetittkonsentrat som kan brukes i varme magasineringsovner. Magnetitten er da bedre egnet enn olivin p.g.a. sin høyere spesifikke varme. Tilsynelatende spiller det ingen rolle om det foreligger en titanomagnetitt (tett sammenvoksing av magnetitt og ilmenitt) eller en ren magnetitt.

Ved siden av den grove magnetitten skal det produseres finkornet magnetitt som nyttes i hydrosykloner til rensing av kull (heavy media mt.).

I tillegg til magnetitt er det planlagt å utvinne ilmenitt (andre trinn i magnetittseparasjon) og sulfider (flotasjon) som i gjennomsnitt utgjør henholdsvis 3,6 % og 1,5 % av malmen.

Salg av pukkk og sand skal gi noe ekstrainntekt.

Det er planlagt å produsere 800.000 tonn råmalm fra to dagbrudd (sydlinse og nordlinse ligger ca. 500 m fra hverandre). I tilfelle nordlinsen vil man senere må gå over til en underjordsdrift. Produksjonen på 800.000 tonn vil resultere i 200.000 tonn mt-konsentrat (50.000 t mt-gravel til en salgspris FOB 400 kr/t, 150.000 t finkornet magnetitt til en salgspris FOB 140 kr/t) og 5.000 t il-konsentrat til FOB 170 kr/t. 100.000 t pukkk til 100 kr/t er antatt å utvinnes uten tilleggskostnader, dessuten skal det selges 50.000 t sand til 50 kr/t fra oppredningsverket.

Levetiden på gruva anslåes med 10 til 20 år. Kalkulasjonen baseres på en levetid på 10 år. Arbeidsstokken er prosjektert til å holde ved 33 personer (staben og arbeidere for gruva er ikke inkludert). Oppredningsanlegget skal delvis plasseres på et skip ute i Malnesfjorden. Dette vil muliggjøre det å flytte produksjonen til andre kystnære produksjonssteder.

Selvåg-malmen blir for tiden undersøkt mineralogisk på NTH, der det også gjennomføres oppredningsforsøk. Råmalmprøver fra nord- og sydlinsen ble analysert på Au, Ag, Cu, Co, Ni, Zn, Li, Sr og Se. Analysene for Pt og REE ventes tilbake snart. Prøvene varierer mellom 43 og 380 ppm Cu (Ø 127 ppm), 5 til 120 ppm Co (Ø 83 ppm) og 9 til 190 ppm Ni (Ø 44 ppm). Zn ligger ved 170 ppm i gjennomsnitt mens gehaltene i Au og Ag er lavere enn påvisningsgrensen som er henholdsvis 0,01 ppm og 0,5 ppm. Det finnes bare spor av Se og Li mens Sr-innholdet svinger jevnt rundt 30 ppm.

Diamantboring (5 til 10 hull med en lengde på mellom 300 og 500 m) skal foretas på sydlinsen sommeren 1988.

Markedssituasjonen for magnetitt som industrimineral ser ut til å være svært positiv. Det ventes en avknapping i anbudet på magnetitt på verdensbasis i den nærmeste fremtid. Skandinaviske produsenter som SSEB, LKAB, Fosdalen og Rødsand vil enten innstille produksjonen eller gå over til å produsere kun pellets. Med sikte på US-markedet ville Selvåg-magnetitten være billigere enn de innenlandske produktene. Her konkurreres særlig mot magnetitt fra Brasil og Argentina.

KOMMENTARER:

J. Søylands utredninger vedrørende Selvåg-forekomsten baserer på den antagelse at malmen til nord-linsen inneholder 30 % magnetitt i gjennomsnitt. Videre blir det konstatert at store mengder av forekomsten er oppbygd av malm med en andel på 50 til 60 % magnetitt. Dette står i strid med det som er funnet ut i tidligere gjennomførte undersøkelser. (PRIESEMANN, 1978-1980, Selvågrapport 1981, Doktorarbeid 1982, Publ. NGU 402, 1985). Bergartene i nordlinen inneholder gjennomsnittlig 25 % magnetitt, 3,6 % ilmenitt og 1,4 % sulfider (pyrrhotitt, bravoitt, pentlanditt, pyritt, mackinavitt, chalcoppyritt). Den høyeste konsentrasjonen av magnetitt er målt med 31 Vol-%.

Malmverdien på nord- og sydlinsen er forskjellig. Sydlinsen består av bergarter med lavere konsentrasjoner på oksider. Her vil de driftsmessige resultatene være verre.

Tar man utgangspunkt i de aktuelle gehaltene vil en produksjon på 800.000 tonn råmalm resultere i 200.000 tonn magnetittkonsentrat, 28.800 tonn ilmenitt-konsentrat og 11.200 tonn sulfider ved en teoretisk mulig men usannsynlig 100 %-utvinning av verdistoffene. Ved en 65 % utvinning, som ansees å være normalt for denne forekomsten, vil man da kunne produsere 130.000 tonn magnetitt og 18.720 tonn ilmenitt. Det er 70.000 tonn mindre i magnetitt og 13.700 tonn mer i ilmenitt enn beregningen av J. Søyland baseres på.

Når det gjelder sulfider vil konsentratet inneholde 0,9 % Cu, 0,6 % Co og 0,3 % Ni ved antagelse at alt Cu, Co og Ni er bundet til sulfider hva som ikke er tilfelle. Konsentratet er neppe salgbart. Det er også synlig at kostnadene for flotasjonsprosessen vil overstige inntektene ved eventuelt salg av sulfider.

Kalkulasjonen går ut fra at det utvinnes 50.000 tonn magnetitt/år - det er 25 % av den årlige totalte magnetittproduksjonen - til bruk i varme magasineringsovner. Bruksområdet krever en grovkornet magnetitt med en kornstørrelse mindre enn 10 mm. Nærmere opplysninger om de spesielle krav til kornfordelingen og kornstørrelsen til magnetitten til dette bruksområdet mangler dessverre i rapporten. Det ble imidlertid henvist til, at kun de forekomster er egnet til å produsere en tilstrekkelig mengde magnetitt til det o.n. formålet som inneholder store mengder malm med 50 til 60 % magnetitt. Det er ikke tilfelle ved Selvåg. (s.o).

Mellom 50 og 75 % av magnetitten til Selvåg er mindre enn 0,2 mm. Det maksimum til kornfordelingskurven til magnetitten fra nordlinsen er litt forskjøvet mot større korn sammenlignet med det fra sydlinsen. Generelt sett er 85 % av magnetitten mindre enn 0,4 mm. Kornfordelingsanalysene gir lite håp for at det kan produseres den anslåtte mengden grovkornet magnetitt.

Oppredningsverket er konsipert for 800.000 tonn rågods/år. Konstruksjonstegningen tar ikke hensikt til en produksjon på 100.000 tonn pukk/år, der det kreves en hydrosyklon for å separere "gråberg" fra malm. "Gråberg" anslåes å utgjøre 12,5 % av produksjonsmengden. På grunnlag av de mineralogiske studiene vil tape av materiale med god mineralisering være stor når man setter andelen på "gråberg" så høyt. I forbindelse med pukk synes det at den antatte salgsprisen (100 kr/t.) er alt for høy. Follidal Verk A/S leverer en kubikk grus (ca. 2,7 t) for ca. kr. 30,-. En ulempe for forekomsten med hensyn til leveranse av pukk er at den ligger langt fra forbrukere.

For sand er det ikke sagt hvilket formål den skal brukes til.

Når det gjelder brytningsmetodikk finnes det ingen innvendinger mot en dagbruddoperasjon på sydlinsen. De terrengmessige forholdene ved nordlinsen krever imidlertid omfattende sikringsarbeider og brytning av gråberg når det innrettes et dagbrudd her (helning på fjellveggen forekomsten ligger i er 60° . Mineraliserte bergarter faller med 75° - 85° mot skråningen). En underjordisk malmutvinning vil være en adskillig tryggere og bedre løsning, men da vil produksjonskostnadene være mye høyere.

I kalkulasjonen er det ikke tatt noe hensyn til eventuelle miljømessige tiltak. Avgangene kan antageligvis ikke deponeres fjorden. Det er derfor aktuelt med et landdeponi av avgangene.

Konklusjon.

Som påpekt går Søyland i kalkulasjonen sin ut fra alt for gode malmkonsentrasjoner, dessuten fra alt for gunstige brudds- og driftsbetingelser. Under disse idielle forholdene ville ei Selvåg industrimineral magnetitt gruve være tilsynelatende konkurranse-dyktig. Men under de reelle forholdene vi har vil dette målet neppe bli oppnådd.

Tverrfjellet, 18.09.1987.

Frank D. Priesemann
Frank D. Priesemann

(1)

GENERAL STATISTICS ABOUT NORWAY

GOVERNMENT

Norway has a constitutional monarchy. The King has a fair amount of influence but the main power lies with the "Storting" or parliament. The government is quite stable but the administration can change several times between elections.

Norway is a "sosialistic" country but the politics tend to be a mixture of socialism and capitalism.

The government has been involved with a great many state owned industries but the current trend is to divest itself of all money losing operations.

The country is divided into 19 "Fylker" or counties. These are then divided into "Kommuner" or communities and independent "Byer" or cities. The Kommunes are perhaps like our township and can include several villages and towns.

FINANCE

GOVERNMENT SUPPORT

The government gives monetary support to investment in both older and new operations. The support is not guaranteed but one can expect a grant of as much as 25% of the investment for a new operation.

AVAILABLE LOANS

The government is also willing to provide loans for up to 25% the investment. Interest rates are around 13% and you can put off initial payments for up to 3 years.

In general, any economically sound project involving products for export trade can obtain 100% financing in Norway. All one needs is a firm sales commitment.

The government also allows for the setting aside of funds tax free for later investment in new facilities or environmental protection. This is similar to the depletion allowance in the US.

TAXES

Individual income tax is very high in Norway. Corporate income tax is at the same level as in the US (50%). The value added tax is 20%. There is little or no property taxes.

ECONOMY

Norway's economy is essentially quite stable. It is, however, very dependent on the North Sea oil industry which is currently somewhat depressed.

Because of the oil industry, inflation is fairly high in relation to the rest of the world. It stands currently at about 8%.

Interest rates are also fairly high, currently about 13%.

Unemployment is quite variable. In southern Norway it is quite low but in the northern districts it is fairly high, up to 20% in some outlying communities.

INFRASTRUCTURE

COMMUNITIES

Both the Heindalen and the Selvåg deposits are located in rural areas. The Heindalen deposit lies in Nettet Kommune with a population of about 10,000 inhabitants. The nearest village, Eidsvåg, has about 600 inhabitants. The selvåg deposit lies in Bø Kommune on the island of Langøya. The kommune has a population of about 3000 people.

WORKFORCE

AVAILABILITY

The primary industries in the area are fishing and farming. Although the areas are fairly isolated, there are enough potential workers within commuting distances of both areas.

TECHNICAL COMPETENCE

At Heindalen, a completely trained workforce is available.

At Selvåg, the potential employees are fairly well educated. Fairly well qualified mechanics and equipment operators are available. Miners and mill operators will probably require some training.

WAGES

The wage rates are similar to those in the US. The current wage statistics for the mining industry are presented in Table 1. (BVLI, 1987)

UNIONS

The level of organization and the associated union powers vary throughout the country. The government operations are usually heavily organized; whereas, the situation in private industry is much more variable.

Norway has what's called "Arbeidsmiljøloven" or Work Environment Law which gives all employees the same rights regardless of union involvement.

The "Arbeidsmiljøloven" requires that a company informs and consults its employees regarding all proposed operational changes. Management is, however, not required to accept the employee's recommendations.

PRODUCTIVITY

Productivity in Norway is also quite variable. The government owned operations have notoriously low productivity. The productivity levels in private companies is again more variable. Norway has also some of world's most productive operations. It is reported to have the world's most productive underground mine, Norsk Nefelin on the island of Stjernøya.

TABLE 1 WAGE SCALES FOR NORWEGIAN MINES
(BVLI 3RD QUARTER 1986)

MINE	HOURLY WAGE NKR		TOTAL HOURLY EARNINGS NKR	
	HIGH	LOW	HIGH	LOW
Folldal	70.39	61.09	80.02	63.70
Titania	69.32	61.47	82.97	67.34
Fjordstein	62.38	62.37	71.00	66.15
Killingdal	61.20	61.20	62.16	62.16
Fosdalen	61.05	53.96	70.69	55.50
Orkla	65.01	53.89	70.13	55.60
Grong	70.29	61.03	81.77	67.72
Skaland	53.05	53.05	53.05	53.05
Nord-Norge	68.72	56.37	71.68	57.08
Sydvaranger	68.91	61.97	86.58	65.55
Bleikvasli	72.30	61.00	76.77	61.90
Nefelin	85.41	71.22	93.74	76.88
Bidjovagge	60.64	59.75	71.54	63.21
Sulitjelma	67.92	56.13	74.05	59.69
Finneid	50.48	50.48	87.56	87.56

SUPPORT ORGANIZATIONS

The availability of mechanical/welding shops, equipment dealers, contractors and supply organizations is somewhat better at Heindalen than at Selvåg, but it is acceptable at both locations. Heindalen has a complete mechanical/welding shop on site.

Repair parts must usually come from either Oslo, Stavanger or Trondheim. Delivery times for some items can be fairly long.

TRANSPORTATION

SURFACE

The surface highway net is fairly well developed. The roads are normally two lane and at times quite narrow. Truck transportation can at times be the most efficient means.

Rail transportation is available as far north as Narvik. At Heindalen the nearest railhead is at Åndalsnes about 50 km. away. At Selvåg the nearest railhead is at Narvik about 200 km. to the east.

SEA

Both Heindalen and Selvåg are located at the seashore and therefor have ocean shipping readily available. The shipping industry is very well developed in Norway.

AIR

Airfields and the airline industry are also very well developed; however, in northern Norway one can experience the fact that fresh vegetables are prioritized and therefor, air freight of repair parts may not be the best alternative.

At Heindalen, the nearest airport is located at Molde, approximately 60 km. away. For Selvåg, the nearest airport is a field for small planes at Stokmarknes about 70 km. away.

GEOGRAPHY

The geography at most locations in Norway is fairly rugged. The mountains usually rising steeply from the fjords to an elevation of up to 1000 meters. Terrain will not seriously affect any of the proposed operations.

CLIMATE

Norway lies in an arctic or subarctic environment. Winter temperatures can reach + 40° C at some locations. Summer temperatures usually lie between + 20° and + 30° C. Since both Heindalen and Selvåg are located at the seashore, the winter temperatures are somewhat milder, usually not below - 10° C.

The main periods of heavy precipitation are the summers and winters. Because of alternating rain and snow during the winter months, the main winter-problem is the development of ice on the roads.

Indoor storage of concentrates is almost a necessity if one is to maintain shipments during the winter months.

WATER SUPPLY

Fresh water is readily available at most locations. At Heindalen a sizeable stream divides the deposit. At Selvåg, fresh water can be obtained from a lake 2 km. away.

POWER SUPPLY

At Heindalen power is also available from the local power company for about 2 cents per Kwh.

The established power net at Selvåg is small and the nearest power is about 2 km. away. The local power rate is about 4 cents per kwh.

PRODUCTION COSTS OF NORWEGIAN MINING

The production costs of Norwegian mining companies are again, very variable. Some of the government owned operations are very costly while other operations are quite efficient. Table 2 shows a comparison of production costs from some of the Norwegian companies.

ENVIRONMENTAL RESTRICTIONS

Norway does have environmental protection laws that must be taken into account. They require essentially that all new operations and their associated potential pollution be reviewed and approved by the Dept. of Environment.

A simplified environmental impact statement must be presented. The regulations are, however, somewhat more lenient than those in the US. Most of the mines in Norway dump their tailings into the fjords.

TABLE 2 PRODUCTION COSTS FOR NORWEGIAN MINING COMPANIES 1983

MINE	MINING METHOD	MILLING METHOD	PRODUCTION COST NKR/mtn	CAPITAL COST NKR/mtn	TOTAL COST NKR/mtn	PRODUCTION mtn/MANSHIFT	TOTAL PRODUCTION
Breivik	openpit	crushing	163.09	40.60	203.69	3.6	10,000
Ringknuten	openpit	crushing	35.85	4.05	39.90	57.2	151,000
Grong	room & pillar	flotation	94.63	13.91	108.54	17.8	482,738
Olivin	openpit	crushing	60.92	4.65	65.57	29.5	1,200,000
Vinterbro	openpit	crushing	26.88	5.28	32.16	96.9	319,664
Fjordstein	openpit	crushing	40.26	6.78	47.04	76.1	770,000
Skaland	open stope	flotation	320.00	123.20	443.20	2.6	52,370
Mofjellet	open stope	flotation	137.05	22.64	159.69	10.3	152,363
Killingdal	magazine	flotation	462.05	46.89	508.94	2.5	36,517
Fosdalen	open stope	magnetic	89.82	3.54	93.46	9.5	525,000
Bleikvasli	sandfill	flotation	148.50	31.25	179.75	8.9	173,692
Orkla	open stope	flotation	37.59	5.84	43.43		336,921

MARKET STUDY

The total market for magnetite as an industrial mineral is very difficult to establish. Magnetite is of course mainly used as an iron ore. There are no separate statistics as to its use as an industrial mineral. A large amount of the magnetite is taken from iron ore supplies. Some of the speciality products of magnetite are controlled by minerals agents and statistics as to quantity and price are closely guarded secrets.

However; after working in the field for some time, one can get a fairly accurate picture of the size of the total market and the quantities and prices of the major products.

PRODUCTS AND PRICES

The total industrial market for magnetite appears to be about 1.5 to 2 million tons per year. The major users are the oil, coal and electric heating industries and the quantity used will course vary according to the needs of these industries.

The major products are:

1. Heavy Media
2. Pipe Coating Concentrate (PCC)
3. Refractory Block Concentrate (RBC)
4. Ballast

1. HEAVY MEDI \$ 20 to \$ 50 per mtn. FOB

Here magnetite is utilized for both its fairly high specific gravity and its magnetic properties. It is used to make a dense slurry (specific gravity about 2) which is used to clean coal or separate ore from gangue materials. The magnetic properties are then used to separate the magnetite and return it to the circuit.

Heavy media is divided into numerous grades of varying grain sizes. Generally speaking, the coarser products command the highest prices. The grain size distributions of the various grades are approximately as follows:

Coarse magnetite	85% - 0.2 mm + 0.06 mm
Semi coarse magnetite	75% - 0.2 mm + 0.06 mm
Fine magnetite	50% - 0.06 mm
Very fine magnetite	85% - 0.06 mm

For all grades the specific gravity must be between 4.8 and 5.0 and the magnetitic constituency must be 95% or better. Chemical analysis plays a very minor role.

This appears to be the largest market for industrial mineral magnetite. The US appears to have a need of from 300,000 to 500,000 stn. per year dependent on fluctuations in the cleaned coal market. Europe utilizes from 150,000 to 250,000 mtn. per year.

2. PIPE COATING CONCENTRATE \$ 30 to \$ 40 per mtn. FOB

Here one uses a very coarse (0-10 mm) magnetite gravel which is used to coat oil and gas pipelines that are to be laid on the ocean floor. The primary consideration here is that of the bulk density of the final product (magnetite cement) which should be about 4.

The product demands a fairly good price because not all magnetite deposits can produce a product that has this coarse of a grain distribution and still hold density of +4.

The product is of course dependent on activity in the offshore oil industry. Current demand is quite low; however, expected development of the gas fields in the Barents Sea (Northern Norway) would create a strong demand for this product in the future.

3. REFRACTORY BLOCK CONCENTRATE \$ 50 to \$ 100 per mtn. FOB.

This material is used by the producers of electric heaters to make a magnetite briquet which is used to store heat energy during periods of cheaper electrical power. The heaters heat the briquets at night and they store enough heat to warm the houses during the daytime periods of higher electrical rates.

The primary properties of magnetite which are utilized here are its relatively high specific heat and specific gravity. The grain size distribution is 0 - 6.3 mm and the bulk density must again be +4.

The primary market is England and Europe and the total market appears to be about 200,000 mtn. per year.

Again, not all deposits can produce this product, therefore the higher prices.

4. BALLAST \$ 20 to \$ 40 per mtn. FOB

This again is a coarse magnetite gravel (0 - 10 mm), bulk density +4.

Some finer magnetite is used occasionally as ballast in ships; however, the main market is as ballast for the larger concrete oil platforms.

Here the market is totally dependent on the construction of such platforms. Each concrete platform can use as much as 200,000 mtn. of magnetite.

The major market is the North Sea.

PRODUCTION OF RBC - PCC

To produce these products one must be able to produce a concentrate with a grain size up to 10 mm and still maintain a fairly pure concentrate. The ability to do this is dependent on the size and distribution of the magnetite grains in the ore. To be able to effectively produce these products, a deposit must contain substantial amounts of ore with a grade of 50 - 60% magnetite. Not all deposits have enough of this high grade ore.

Of the deposits investigated, the only one that appears to be able to produce a substantial amount of this product is the Selvåg deposit.

Another factor that affects RBC - PCC production is the fact that the receiving port facilities can only handle up to 3000 ton boats. The product must therefore be produced in Europe.

MAGNETITE PRODUCERS - COMPETITION

As previously stated, magnetite is primarily produced as an iron ore and there appear to be no accurate statistics as to the total amount of magnetite produced in the world. A fairly accurate guess would be around 100 million tons per year.

It appears; however, that the production of magnetite is decreasing in favor of hematite. Many older, non-competitive magnetite producers have been closing and the newer, competitive iron ore producers (Australia and Brazil) produce primarily hematite.

Norway and Sweden currently produce about 30 million mtn. of magnetite per year. The current producers are shown in Fig. 1. Aside from Rødsand and Titania, which are minor producers, all are government owned operations. They are all very bureaucratic and inefficient, all losing money and all under strong pressure to rationalize or close down. Production costs of some of them compared to operations in Canada, Afrika and Brazil are shown in Fig. 2.

When private companies such as Kennecott and Anaconda could not manage to rationalize sufficiently and were forced to close, it can easily be understood that these government owned bureaucracies will have a very difficult time doing it.

One example of the inefficiencies of these companies is Sydvaranger, which recently required a government subsidy of \$100.000 per employee per year. A statement by the president of LKAB that it might have to close is shown in the newspaper article presented as Fig. 3.

All the government owned mines all the following problems:

1. Heavily organized bureauracracies.
2. Low productivity.
3. Mines that have extended beyond the economic limits of their orebodies.

TRANSPORTATION

Transportation costs play a very important role for the entire iron ore industry. However, due to the extremely high cost of US rail transportation, it is an even more important factor for the US heavy media users. A marketing study conducted in 1984 shows that it can be cheaper to ship magnetite from Norway to Pittsburgh via the Mississippi River than from upstate New York by rail. These figures are presented in Table 3.

Table 3 COST COMPARISONS FOR US MAGNETITE SUPPLIERS

	Elkem A/S Rødsand	Beckley	Reise-Viking
Sales price FOB mine	\$18/stn		\$22/stn
Transport to US	\$6 to \$12		
Crushing & screening	\$3		\$3
Port unloading	\$2.50		
Barge transportation	\$6		
Rail Transportation			\$22
Price CIF W. Va.	\$38.50	\$48	\$47

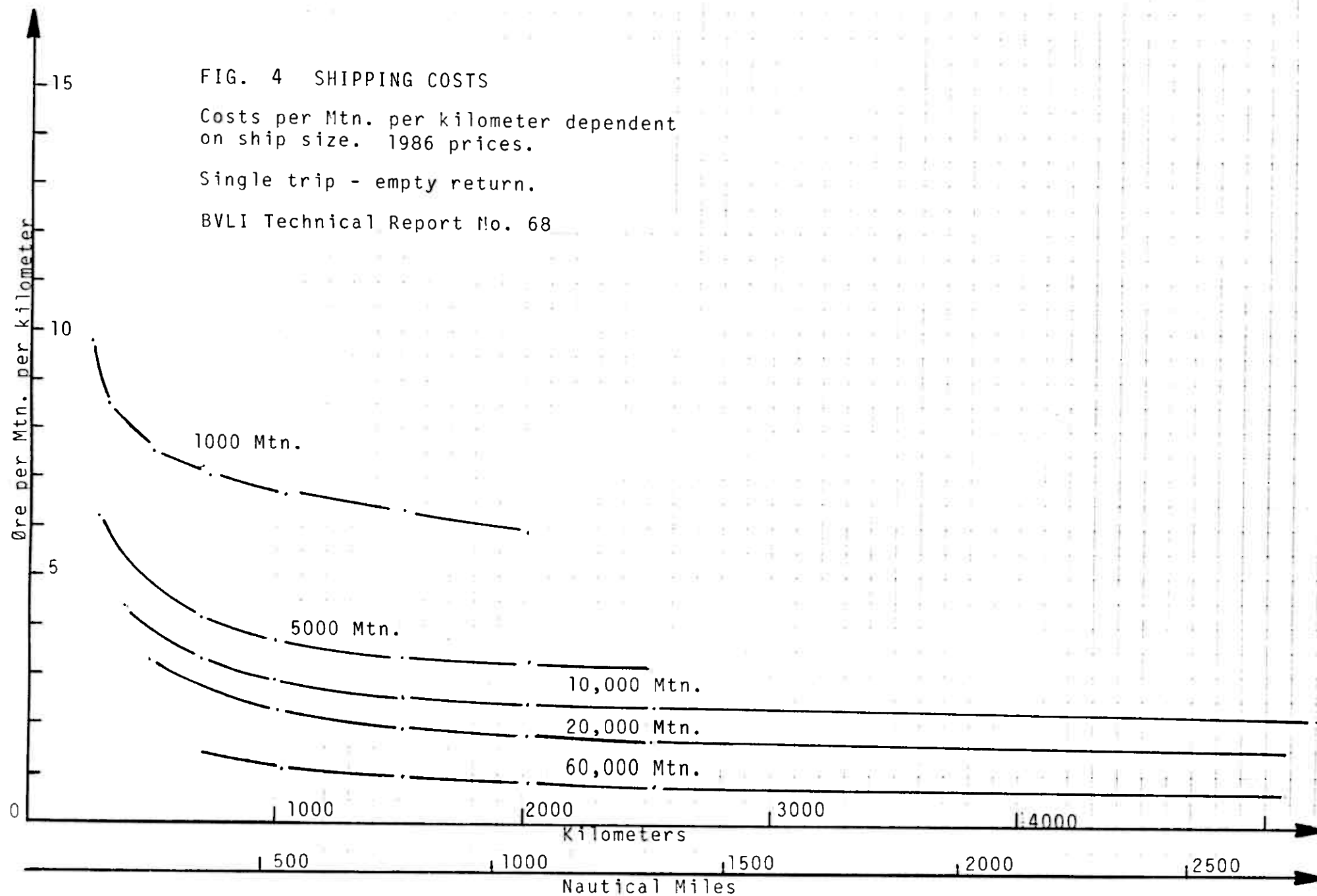
A comparison of shipping rates for varying ship sizess is presented in Fig. 4.

FIG. 4 SHIPPING COSTS

Costs per Mtn. per kilometer dependent
on ship size. 1986 prices.

Single trip - empty return.

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SCANDINAVIAN PRODUCERS

The current Scandinavian producers of magnetite are:

1. LBAB	Sweden	15.000.000 mtn./yr.
2. SSAB	Sweden	10.000.000 mtn./yr.
3. Sydvaranger	Norway	1.000.000 mtn./yr.
4. Rana Gruber	Norway	1.000.000 mtn./yr.
5. Fosdalen	Norway	300.000 mtn./yr.
6. Rødsand Gruber	Norway	35.000 mtn./yr.
7. Titania	Norway	50.000 mtn./yr.

The locations of these operations are shown in Figure 1.

LKAB

Currently sells about 100.000 mtn. per year of magnetite as RBC. They will probably soon construct a fourth pellet plant and then reduce ore production to only supply its own pellet production.

SSAB

Currently is the major world producer of "industrial mineral magnetite". They have recently announced the closure of their two largest mines and are therefor expected to disappear from the market within the next 4-5 years. (World Mining Equipment, June 1987).

SYDVARANGER

Sydvaranger has recently cut back their magnetite production from 2 million mtn. to 1 million mtn. per year which is just enough to supply one of their two pellet plants. They are, however, currently trying to enter the "Heavy Media" field, but, their high costs should limit their existance in the market.

RANA GRUBER

Rana Gruber has also recently cut back production and intend to produce only enough ore to supply Norsk Jernverk's smelter in Mo i Rana. They to are trying to sell heavy media but are expected to close down soon.

FOSDALEN

Fosdalen has a very deep mine and high costs but have been making money. They don't have much economically produceable ore left and are expected to go out of production soon.

RØDSAND GRUBER

Rødsand is currently producing heavy media from spill ore purchased from LKAB. They have about 16 million tons of proven reserves in their old underground mine that was closed in 1982 and is now flooded. They are currently attempting to get the government to finance an opening of the mine but it would be an expensive producer and they can easily be driven from the market.

TITANIA

Titania produces heavy medi as a byproduct of their ilmenite production. Their operation is fairly profitable and they have extensive reserves. They are the only current magnetite producer in Scandinavia that is expected to remain in the market. Their heavy media product is however of poor quality and their production will remain at the current level.

OUTLOOK FOR SCANDINAVIAN PRODUCERS

One can easily see, therefore, why of a total of about 30 million tons of magnetite production per year, there will soon remain only about 50.000 mtn. per year.

POTENTIAL CUSTOMERS

Our primary targets will be Europa, England and the USA. There is also a potential market in the East Block Countries but this part of the market is only vaguely known and, therefor, will not be discussed here. An additional market could be developed here at a later date. In the mean time, there is enough room in the European, English and American markets to accomidate our production.

The marketing strategy for each area may differ from the others. In Europe one would be forced to rely on mineral agents. In England and the USA, one could either utilize mineral agents or sell directly to users.

EUROPE

The best choice here would be to utilize Frank Schulte GmbH. They are also marketers of magnetite in England and the USA and it could be advantageous to utilize them overall. The other alternative in Europe would be to go into a joint venture with a company that has a sales network in Europe, such as Outokumpu Oy of Finland. This contact is already established and Outokumpu has stated an interest.

Direct sales to users in Europe would not be feasible, at least at this point.

ENGLAND

The only user here is British Coal and sales can easily go direct to the user. The user has its own port facilities. It might, however, be an advantage to use Frank & Schulte here also. F & S has controll of the RBC market which will give us our best prices.

USA

Here can one sell directly to the users such as Island Creek Coal Co. These contacts have already been made and many of the companies are interested in a more direct supply route. Or, one can sell through primary agents such as Reise-Viking (Koch Industries) who deliver magnetite directly to the mines in specially built trucks. Or, one can sell to secondary agents, Frank & Schulte, who again sell to the primary agents (Reise-Viking).

OVERALL STRATEGY

To obtain the largest possible share of the overall market, it might be best to obtain an agreement with Frank & Schulte where they would act as our sales agent. Another possibility would be Outokumpu Oy. We can, however, sell direct in both the USA and England and this gives us a good deal of leverage.

LIST OF CONTACTSMAGNETITE

Frank & Schulte GmbH
 P.O. Box 101255
 Alfredstrasse 154
 4300 Essen 1
 Vest Tyskland
 201438-248 eller 4381

Koch Karbon Inc.
 P.O. Box 2219
 Wichita, Kansas 67201
 USA
 (316) 832-6673

Ferguson & Wild
 England

National Coal Board
 England

TITANIUM

Titanium Ent.
 Box 1036
 Green Cove Springs, FL 32043
 USA (904) 264-9546

Titanium Metals Corp of America
 1140 Bloomfield Ave
 W. Calwell, NJ 07006
 (201) 575-9500

E.I. Dupont de Nemours & Co. Inc.
 1007 Market St.
 Wilmington, DE 19898
 (302) 774-1000

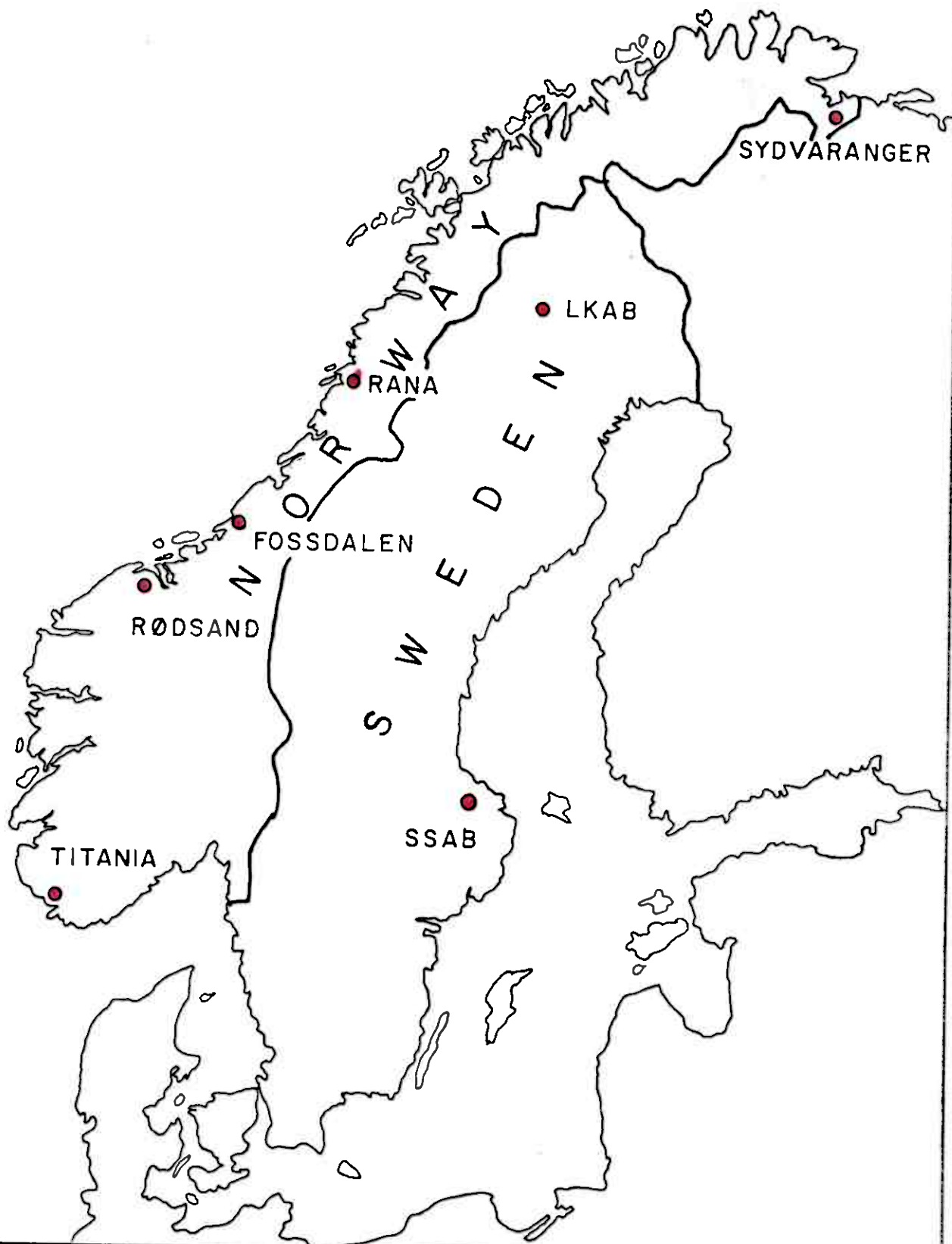
Titanium Minerals Ltd.
 Ferry Rd. Southport, Qnld W.
 AA40380 42
 Australia

Kerr-McGee Chemicals
 Kerr-McGee Bldg. Box 25861
 Oklahoma City, OK 73102
 (405) 236-1313

NL Minerals
 1230 Ave of the Americas
 New York, NY 10020
 (212) 399-9400

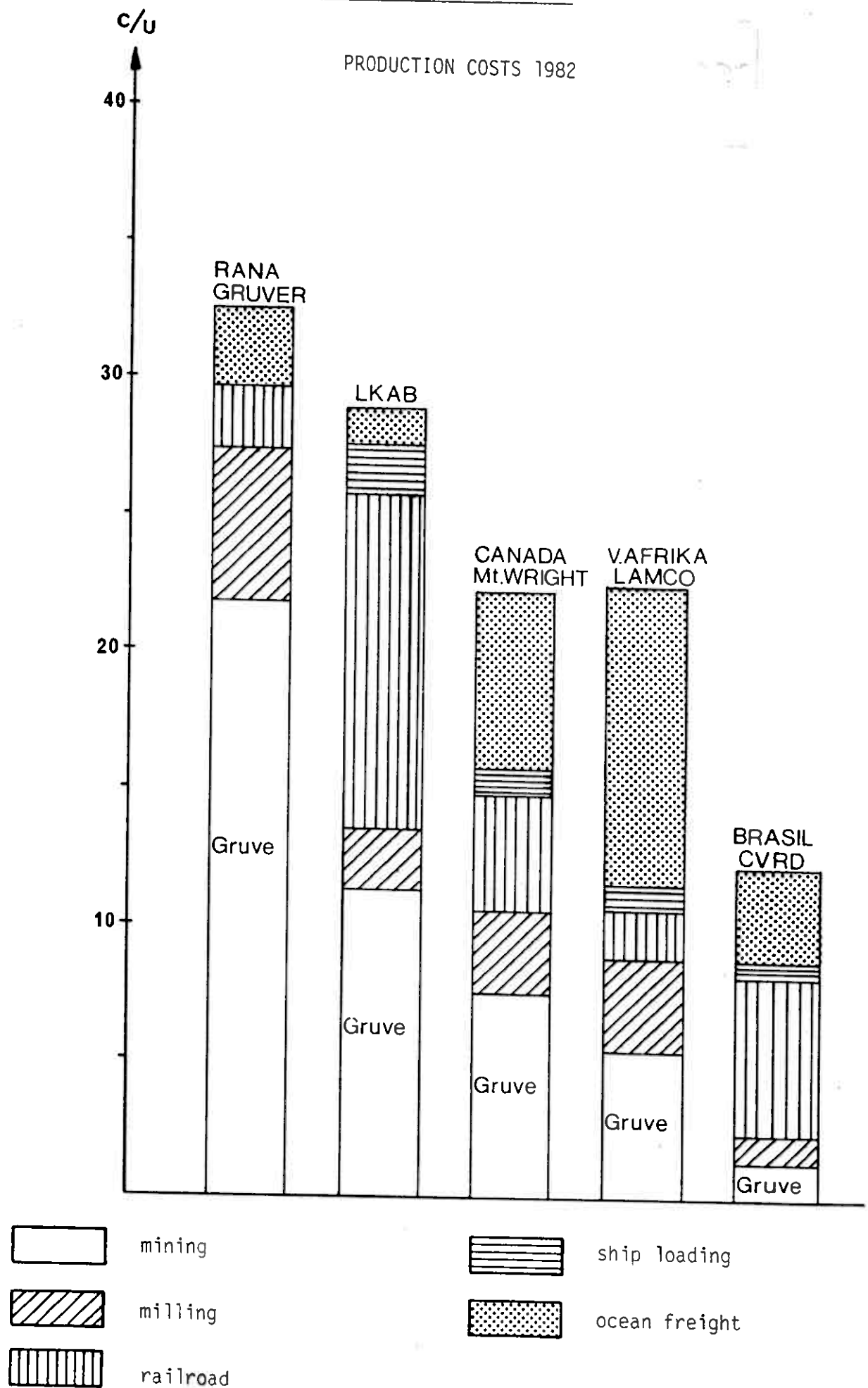
American Cyanamid
 859 Berdan Ave
 Wayne, NJ 07470
 (201) 831-1234

Sachtleben Bergbau GmbH
 D-5940 Lennestadt
 Northrine - Westphali 17
 Vest Tyskland 02721-8351

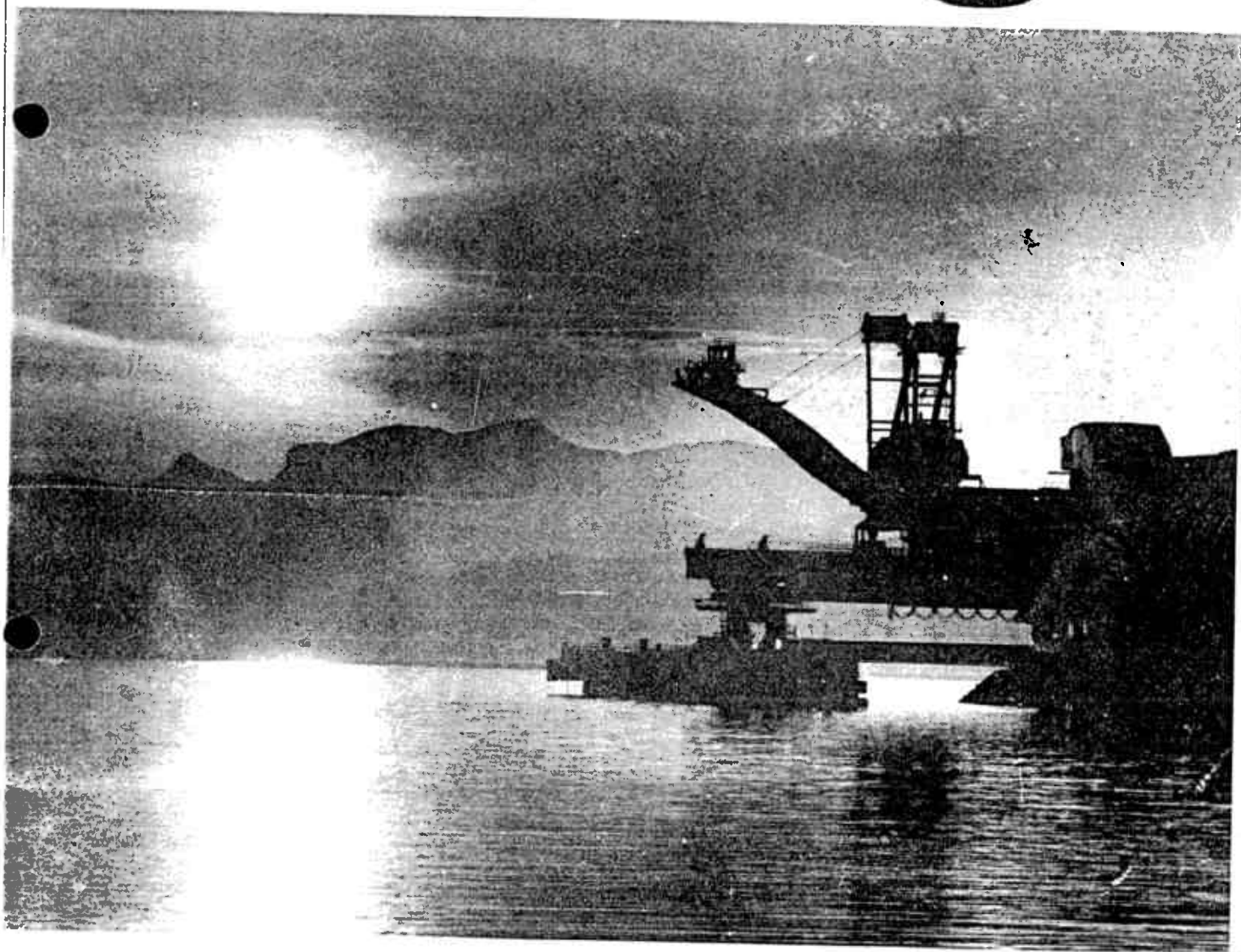


Dato:	Konstr./Tegnet	Godkjent	Maalestokk		
SCANDINAVIAN MAGNETITE PRODUCERS				Erstatning for:	Erstattet av:
Henvisning:		Beregning:		FIG. I	

FIG. 2 COST COMPARISON OF IRON ORE PRODUCERS



«LKAB kan bli nedlagt»



Synkende dollarkurs og lave priser for jernmalm på verdensmarkedet gjør at fremtidsutsiktene for det svenske gruveselskapet LKAB er mørke. — Jeg ser ikke bort fra at LKAB blir nedlagt i løpet av en fem til tiårsperiode, sier ad-

ministrerende direktør Ingemar Gustafsson. Han føler seg overbevisst at halvparten av dagens vel 4.000 ansatte må sies opp. Så alvorlig oppfatter han situasjonen.

FIG. 3

ORE RESERVES

MAGNETITE RESERVES

The world contains tremendous reserves of magnetite. There are however no known deposits that have the combined advantages of large size, low production costs, advantageous location with low transportation costs and byproduct income that the Selvåg deposit enjoys.

The newer, low-cost producers of iron ore (Brazil and Australia) produce primarily hematite not magnetite. These low-cost producers have forced the closure of some older "magnetite" producers, reduced production in others and thereby reduced the total amount of available magnetite.

It is not anticipated that any other new mining operation will be started based primarily on the production of magnetite. Some new "by-product" magnetite might be possible.

SCANDINAVIAN RESERVES

Scandinavia has many known deposit of magnetite. Here again, it is not expected that any new, primary production of magnetite will be started. The prospects are rather that the total amount of magnetite production in Scandinavia will decrease dramatically. Norways reserves of magnetite are estimated at a total of 725 million mtn. (NOU, 1984:8)

EUROPEAN RESERVES

There are some known deposits but no production. The last producer, in France, closed recently.

NORTH AMERICAN RESERVES

North America has also extensive reserves of magnetite as well as sizeable production. The Selvåg deposit can readily compete with these deposits on the basis of production and transportation costs. Here again there is no expected new production.

SOUTH AMERICA RESERVES

There are extensive known reserves of magnetite in Argentina, Chile and Peru, that could compete with Selvåg. They would have a production cost advantage but not a transportation advantage. It is also not anticipated that they would have any extensive byproduct income.

NORWEGIAN MAGNETITE DEPOSITS

There are many known magnetite deposits in Norway that are available. Some of them have previously been given a lot of attention as possible iron ore producers. Some have been extensively drilled and it is now possible to obtain proven ore reserves of over 100 million tons at little or no costs for exploration. Some of the deposits carry biproduct minerals such as titanium, phosphorus, rare earths, copper, nickel, cobalt and possibly gold and platinum.

Many of the deposits are located at or near the seashore thus giving them a transportation advantage such that they can readily compete on the US market.

The deposits are of four main types:

1. Titaniferous magnetite, stratabound deposits of volcanic or igneous origin.
2. Magnetite, stratabound of volcanic origin.
3. Magnetite of sedimentary origin.
4. Magnetite sands.

All are found in or associated with precambrian gneisses and/or igneous rocks of the Norwegian Caledonides. The location of some of the available deposits are shown in Fig. 5.

RØDSAND AREA DEPOSITS

The Rødsand area deposits are all precambrian age titaniferous magnetites which are always enclosed in amphibolites of the Raudsand group of orthogneisses. The deposits lie on the southern limb of the Molde - Tingvoll syncline. (See Fig. 6)

The main deposits in the area are those associated with the Rødsand mine, those in the Heindalen area and those at Meisingset. (See Fig. 7, 8 and 9).

The total reserves of the Rødsand area are approximately 182 million mtn. as shown in Table 4.

RØDSAND MINE RESERVES

The largest proven reserves are those in the mine. Approximately 16 million tons are developed between the 220 and - 340 levels. The could be produced at fairly reasonable costs; however, the production of additional undeveloped reserves would be prohibitively expensive. (See Fig. 10 and 11) The ore averages approximately 27% magnetite.

The Rødsand ore, as well as that of the other deposits in the area contains about 5% ilmenite and about 0,5% copper. The mine has previously produced concentrates of both minerals.

Total reserves of the mine are estimated to be 136 million mtn. (Sanetra, 1985).

HEINDALEN DEPOSITS

The most interesting deposit in this area economically speaking, is the Heindalen deposit which is located about 14 km. south-west of the Rødsand mine. There are actually two deposits here, one on either side of Heindalen Creek. The one on the west side contains approximately 2 million mtn. of strippable magnetite ore whereas the deposit on the east side contains approximately 24 million mtn. of ore that could be mined by combined room and pillar - sublevel caving mining techniques.

TABLE 4 RØDSAND AREA ORE RESERVES

	Mtn. x 1000
Rødsand Mine	
Proven ore levels -220 to -340	16,000
Probable ore levels -340 to -600	120,000
Heindalen Deposit	
Proven strippable	2,000
Proven underground	4,000
Probable underground	20,000
Meisingset Deposit	
Proven strippable	1,500
Proven underground	9,000
Probable underground	<u>10,000</u>
Total	
Proven strippable	3,500
Proven room and pillar	13,000
Proven sublevel stope	16,000
Probable underground	<u>150,000</u>
Grand Total	182,500
Average Grade	30% Magnetite

Taken from Rødsand Gruber estimates and NGU Bulletin 402.

The Heindalen deposit has essentially the same kind of ore and the same geological environment as that in the Rødsand mine. One can produce ore here and deliver it to the mill for essentially the same price as from the Rødsand mine. The reason it is more interesting is that Heindalen has more economically producable ore and that an investment here could be fairly easily recovered whereas an investment in the old mine probably could not be recovered. The plant at Heindalen would be very similar to a typical crushed aggregate plant and therefor readily moved or sold. The Heindalen deposit is held as an alternative to Selvåg.

MEISINGSET DEPOSIT

The Meisingset deposit is located across the Sunndals Fjord approximately 10 km. northeast of Rødsand. It contains approximately 20 million mtn. of ore of approximately the same type and grade as at Rødsand.

The ore here could also be produced very cheaply by the same methods as at Heindalen but transportating it over the fjord would make it somewhat more expensive.

DEPOSITS IN NORTH NORWAY

The Lofoten - Ofoten region contains many magnetite deposits. The deposits which were investigated in this study were:

1. Selvåg
2. Erikstadsfjord
3. Bogen
4. Gratangen
5. Salangen
6. Rolla
7. Andorja
8. Magnetite sands
 - a. Sortland
 - b. Bogen
 - c. Hanøyvika
 - d. Skaland
 - e. Stjernøy

The Bogen, Gratangen and Salangen deposits have ore containing only about 20% iron and were therefor quickly eliminated.

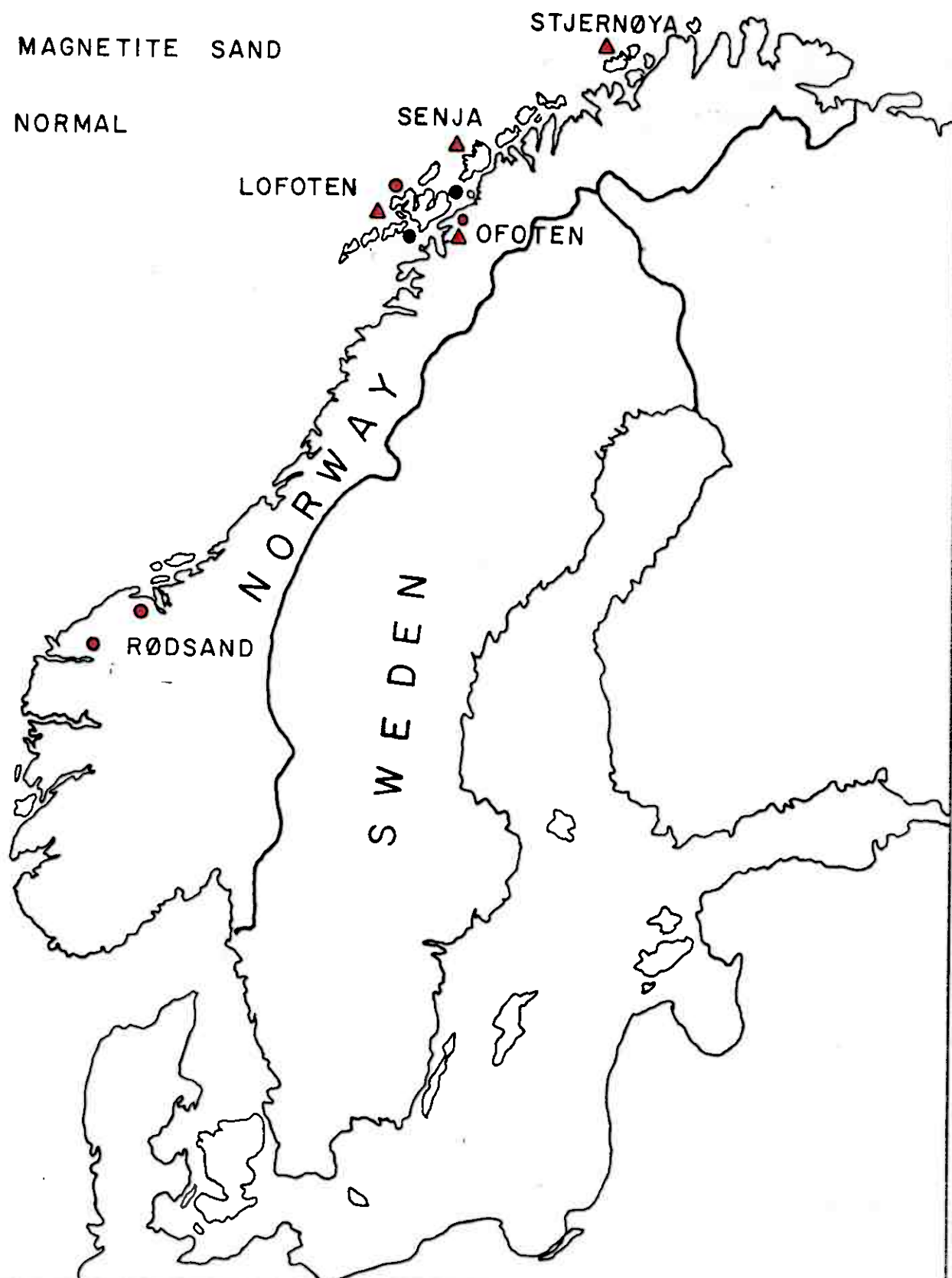
The Erikstadsfjord, Rolla and Andorja deposits have ore containing approximately 30% magnetite but are all relatively small deposits. They could be additional reserves for a transportable mill. (See Fig. 12).

MAGNETITE SAND DEPOSITS

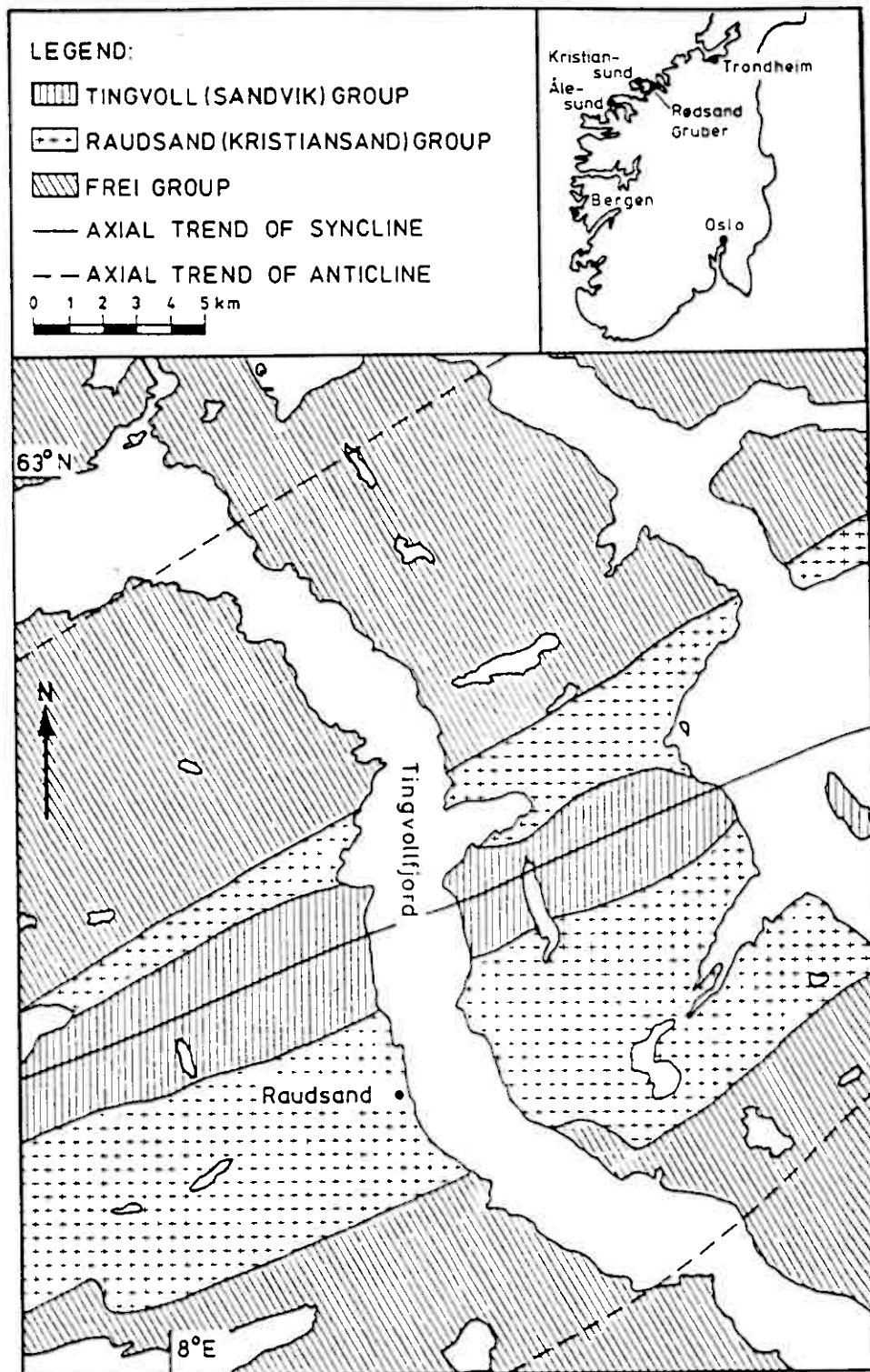
The magnetite sand deposits are all fairly small (a few million mtn.) and hold approximately 20% magnetite. Total identified reserves are about 10 million mtn. One could not justify an investment based on just one of these deposits but they could all be very inexpensive feed for a transportable mill. (See Fig. 12).

▲ MAGNETITE SAND

● NORMAL

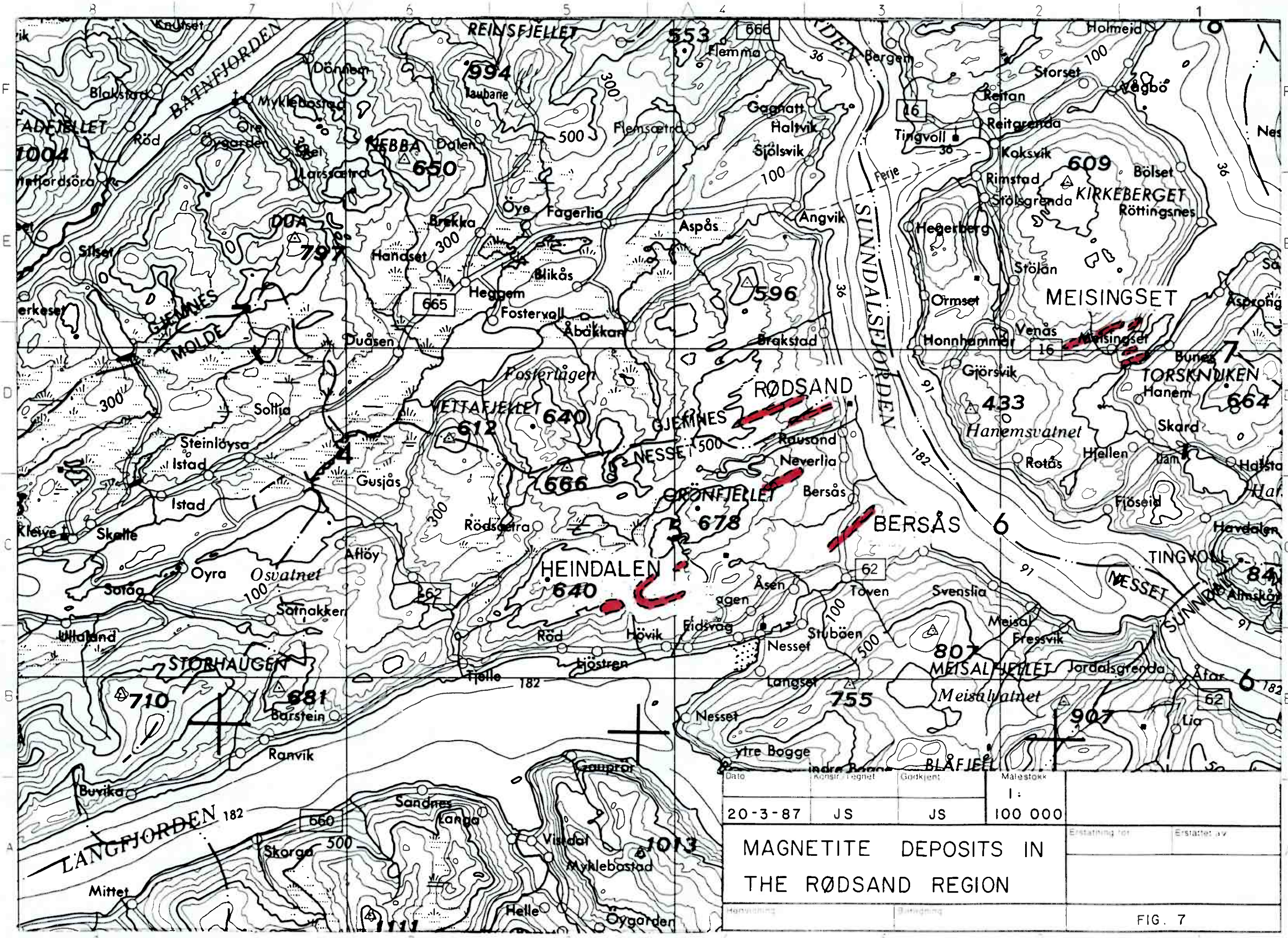


Dato	Konstr / Tegner	Godkjent	Målestokk		
AVAILABLE MAGNETITE DEPOSITS				Erstatning for:	Erstattet av:
Henvi sning		Beregning		FIG. 5	

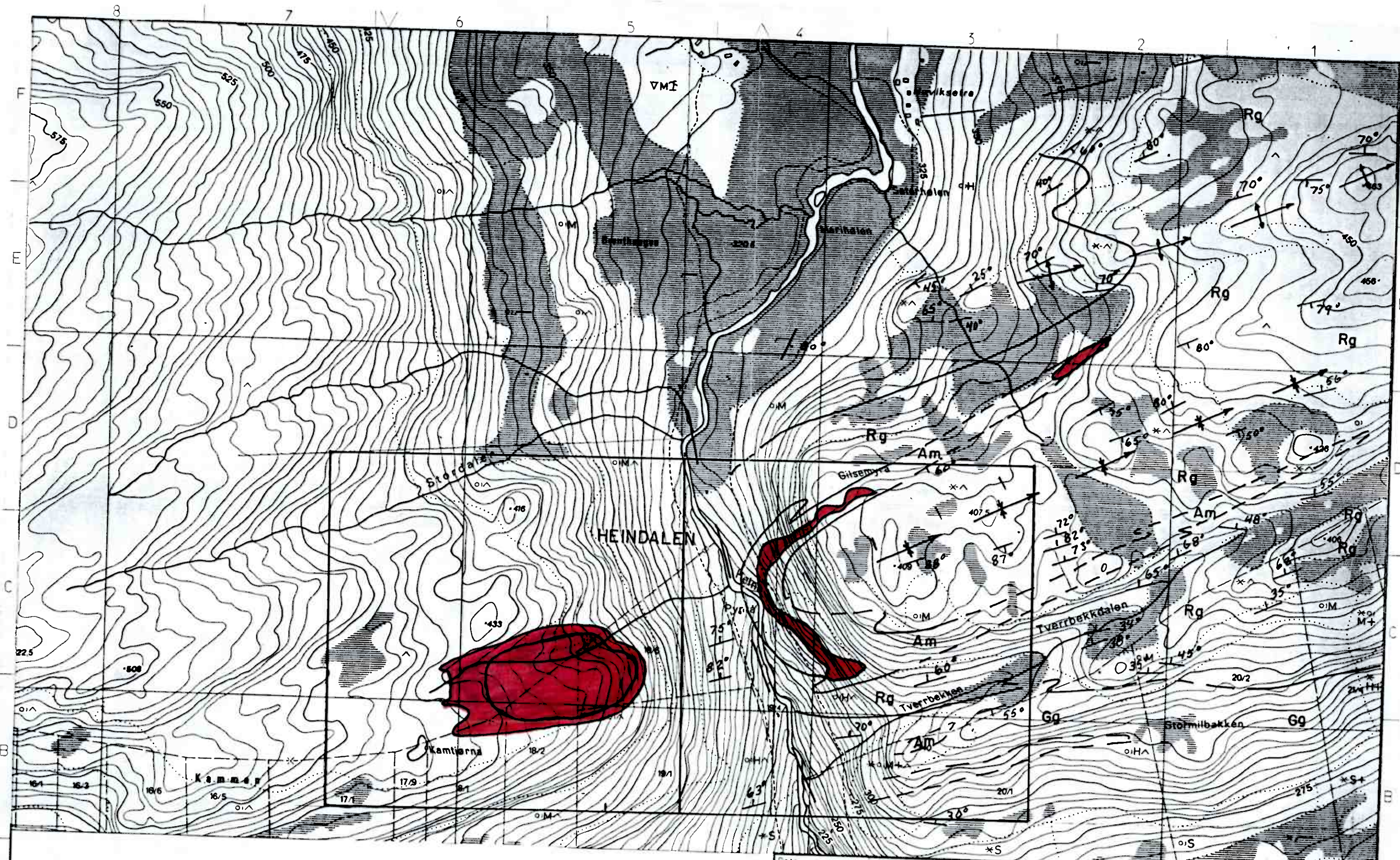


Dato	Konstr./Tegnet	Godkjent	Maletokk	V B I	
6 - 10 - 87	JS	JS			
MOLDE - TINGVOLL SYNCLINE RØDSAND REGION				Erstatning for	Erstatter av
				FROM SANETRA, 1985	
Henvisning			Beregning	FIG. 6	

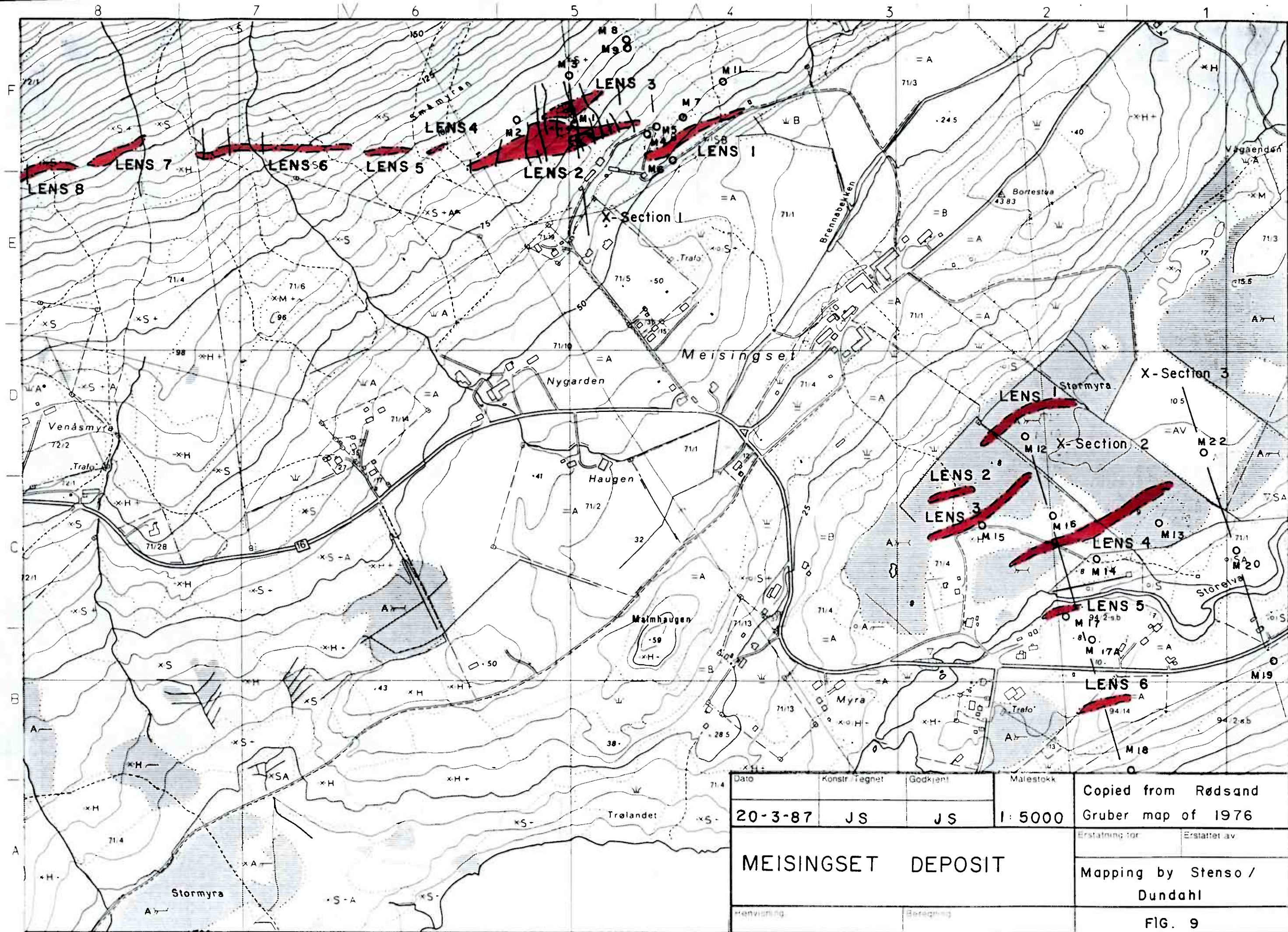
AS TØRKKØPI HD 2/NS 1402, NS 1417, NS 1415



Dato	Konstr. tegnet	Godkjent	Målestokk		
			1:		
20-3-87	JS	JS	100 000		
MAGNETITE DEPOSITS IN THE RØDSAND REGION				Erstatning for	Erstattet av
Hensiktsang		Beregning		FIG. 7	



Dato	Konstr. Tegner	Godkjent	Målestokk	Geological mapping by	
20-3-87	JS	JS	1:5000	A.M. Gautier 1977	
HEINDALEN DEPOSIT				Erstattet for	Erstattet av
FIG. 8					



Dato	Konstr. Tegnet	Godkjent	Målestokk	Copied from Rødsand Gruber map of 1976	
20-3-87	JS	JS	1:5000		
MEISINGSET DEPOSIT				Erstatning for	Erstattet av
				Mapping by Stenso / Dundahl	
				FIG. 9	

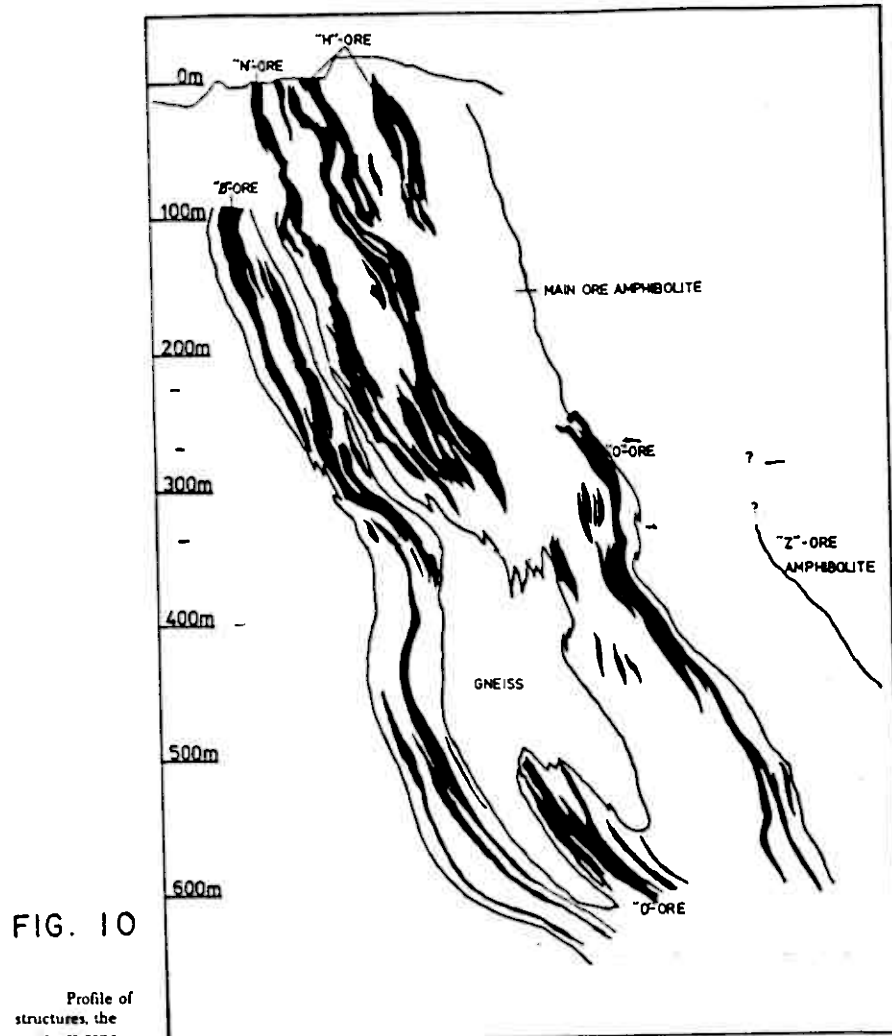


FIG. 10

Profile of
structures, the
main ore zone.

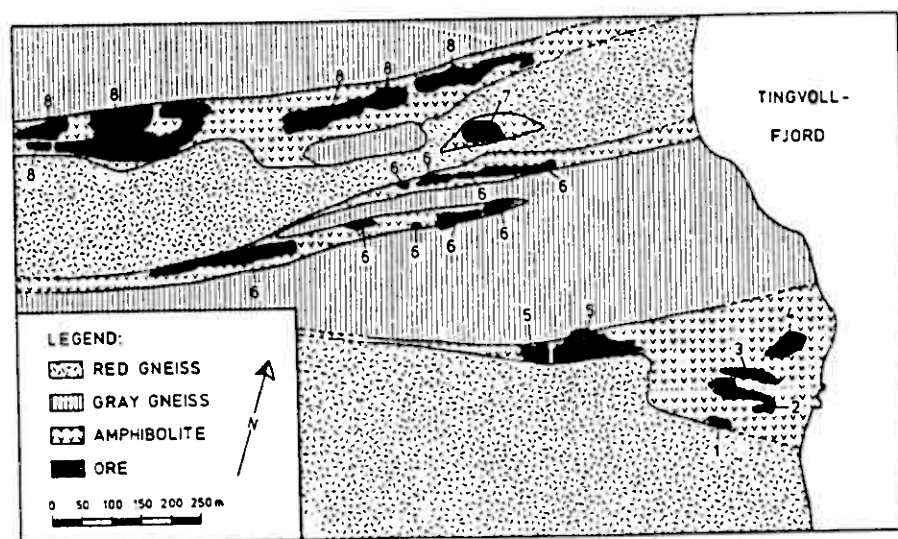
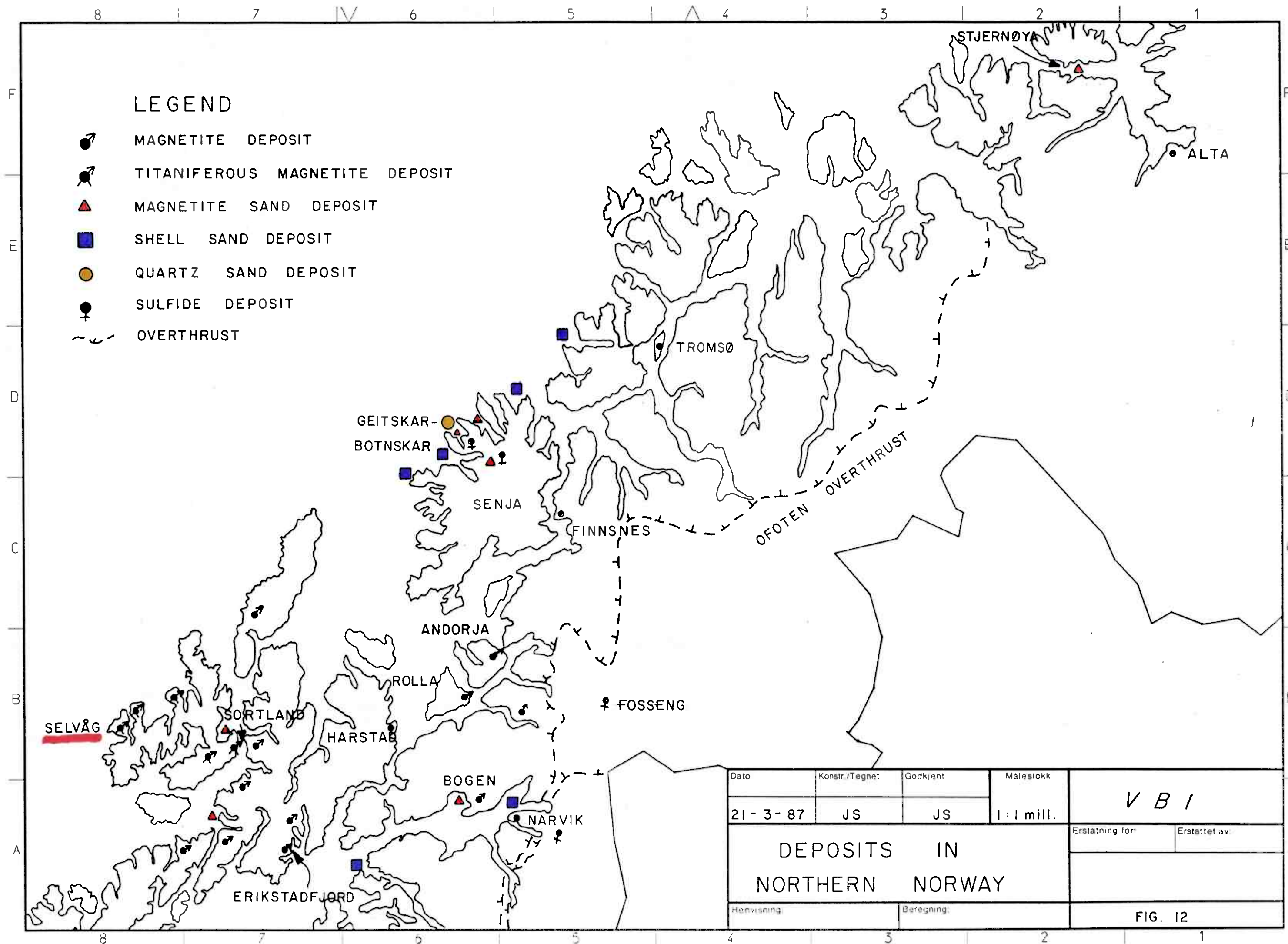


FIG. 11

Map showing the location of the ore bodies 1 = 'L'-ore, 2 = 'O'-ore, 3 = 'N'-ore, 4 = 'H'-ore, 5 = 'D'-ore, 6 = 'Z'-ore, 7 = 'R'-ore, 8 = 'Bergmester'-ore (geis 1965).

Dato	Konstr./Tegnet	Godkjent	Maletokk	V B I	
6-10-87	JS	JS			
ORE LENSES OF THE RØDSAND MINE				Erstatning for	Erstattet av
				FROM SANETRA, 1985	
Henvisning		Beregning		FIG. 10 - 11	



SELVAG DEPOSIT

SELVÅG DEPOSIT

The most interesting deposit in northern Norway is the Selvåg deposit. It probably contains well over 200 million mtn. of ore. There are approximately 44 million mtn. of probable ore containing 30% magnetite in what is called the "North Ore Body" (Øverlie, 1959) The location of the Selvåg deposit is shown in Fig. 13.

The deposit also contains approximately 150 million mtn. of probable ore in the "South Ore Body" and the rest of the deposit.

The deposit could very easily be developed utilizing a portable mill and is also interesting for the following reasons:

1. It has tremendous reserves that could be developed by cheap mining methods.
2. The mill could be located within 500 m. of the deposit thereby greatly reducing transportation costs.
3. The deposit has a large amount of high grade ore (50 - 60% magnetite) and can therefor readily produce RBC. *36% Magnetite
1/4 x Sulphide* *max max 31*
4. The magnetite is enclosed in a gabbro with sells readily in the area for about 50 kroner per mtn. *↑ (summer idle (mass 31 vol% int))*

The deposit was given a lot of attention in the 1950's and 60's by Christiania Spigerverk A/S (Elkem) as a possible iron ore producer. They drilled 7 diamond drill holes for a total of 1028 meters as well as performing extensive metallurgical studies. This is probably Norway's largest deposit of magnetite. It was rejected because it was not possible to separate the very finely laminated ilmenite from the magnetite and therefor could not be used as an iron ore. The presence of ilmenite would not have any affect on its use as heavy media or the other industrial magnetite products.

HISTORY

The Selvåg deposit was discovered in 1889. Som trenching was performed at the time. J. Vogt visited the deposit in 1895. At about the same time Christian Anker claimed the area for the first time. Detailed geological mapping, petrological investigations and some geochemical determinations were undertaken (Kolderup 1898, J. Vogt 1900/1901, Lund 1907, T. Vogt 1909, J. Vogt 1910). Reserve estimations were made of (Lund 1907, J. Vogt 1910 and 1918).

The mineral rights were later obtained by Ingolf Bjørnstad some time prior to 1930. Bjørnstad was also the owner of Skaland Grafitverk on the island of Senja some 100 miles further north.

Christiania Spigerverk A/S (now Elkem A/S) acquired the mineral rights from Bjørnstad in 1933. An investigation of the deposit was conducted by mining engineer Lt. Col. S. Smith. Additional trenching and some metallurgical testing was accomplished. In 1956 additional metallurgical testing utilizing core from the drilling was also done and a revised estimate of the ore reserves was presented (Øverlie 1959).

A further investigation was initiated by Dr. H.P. Geis in 1978 to obtain information for a conclusive decision about the deposit. These studies included geological mapping, petrological studies and a geophysical survey. (Priesemann 1981/1982, Giesecke 1981, Smoler 1981 and Friese 1982). The mineral rights were abandoned by Elkem in 1981.

A geochemical survey consisting of soil and stream sediment sampling conducted by the Norwegian Geological Survey (NGU) in 1985 also covered the Selvåg deposit. The deposit was last claimed in 1987 by Ernst Jensen and Tove Brandtzaeg and the mineral rights have now been acquired by the recently formed Vesterålen Bergindustri A/S.

GEOLOGY

The Selvåg deposit is a Proterozoic deposit of magmatic origin. The deposit occurs within the Eidet - Hovden intrusion. It is located in Nordland Fylke of northern Norway at latitude $68^{\circ} 47'N$ and longitude $14^{\circ} 14' E$. It lies on the Eidet - Hovden peninsula in the southwestern part of Langøya which is part of the Lofoten - Vesterålen island chain. (See Fig. 13).

The geology of the Eidet - Hovden peninsula is presented in Fig. 14 and a detailed map of the geology of the Selvåg deposit is presented in Fig. 15. Krause (1985) presents an extensive description of the geology, petrology and mineralogy of the deposit.

The deposit is enclosed in an olivine - gabbro.

GEOMETRY

Selvåg is a layered intrusive deposit. The ~~deposit~~^{mineralization} is a bowl or trough shaped synclinal lens about 6 km. long and 2 km. wide. (See Fig. 14). But just a small portion of the deposit has the necessary size and quality to be called "ore". The "ore" lies in two lenses located in the southeast corner of the deposit. These lenses are called the "North" and "South Ore Bodies". These two lenses were first discovered by Spigerverket but later mapped in detail by Priesemann (1980) (See fig. 15).

The "North Ore Body" is tabular about ²⁰⁰~~295~~ m. wide and 500 m. long. It has a dip of about ⁷⁵~~70~~° into the mountain. The northern and southern limits of the lens are in fact gradual changes to low grade ore.

A structural analysis of the associated faulting and the form of the lenses (^{Priesemann}Krause 1985) shows that the "South Ore Body" is a faulted off section of the deposit and extends down dip ^{uncertain}~~only~~ about ~~400~~ m. The "North" ^{mineralization}~~or main ore body~~ continues down dip

through the syncline and surfaces again on the west side of the Eidet-Hovden peninsula. The deepest extent of the ^{mineral} deposit is in fact unknown but it is estimated to be about 2000 m. below sea level.

*Hovden
finnes
nær på
det* If one were to place the "South Ore Body" back where it came from, one would have an ore lens which is about 295 m. wide and 1000 m. long. A general rule used in estimating the size of bedded deposits states that one can expect the deposit to extend down dip a distance equal to half the length of the outcrop. If we were to apply this rule to the Selvåg deposit we would get an "ore" deposit that is about 295 m. wide, 1000 m. long and about 500 m. deep. The total volume of ore would then be about 147 million cubic meters or 545 million metric tons. The stated possible reserve of 200 million mtn. of ore containing 25% Fe is therefor quite conservative. There is certainly many times the total reserves required for this project. The dip of 70° into the mountain does, however, limit the amount of ore that can be mined by open pit.

*han
vå sasse
leg på
Nord lense
hinn den
er
drivvedige*

STRUCTURE

The deposit is both layered and split by extensive faulting. (See Fig. 15). This combination may require rather conservative mining practices and thereby further limit the amount of ore mineable by open pit. !!

GEOGRAPHY

The Selvåg deposit lies on the Eidet Hovden peninsula in Bø kommune on the island of Langøya in the Vesterålen region of Nordland fylke. It is located at 68° 47' N. Latitude and 14° 14' E. longitude and about 300 km. north of the Arctic Circle. (See Fig. 13).

The nearest village is Eidet about 5 km. south. The kommune center (seat) is at Straumsjøen about 10 km. south. The nearest

town is Sortland about 50 km. to the east with a population of about 2000.

Supplies will be purchased from either Harstad which is about 100 km. to the northeast or from Tromsø which is about 300 km. to the northeast. Repair parts must be ordered from either Trondheim or Oslo. Delivery time can be fairly long.

The topography is fairly steep with the mountain rising to a height of 570 meters within 1 km. of the shore.

Despite the arctic location, the climate is fairly mild. The average winter temperature is about -5°C and about $+20^{\circ}\text{C}$ in the summer. The yearly precipitation is about ____ in. most of which comes in the summer and winter. The major winter problem is ice caused by alternating snow and rain.

The major vegetation is grass and scrub birch.

RESERVES

Based on the diamond drilling performed in 1956, the reserves of the "North Ore Body" were calculated by Øverlie (1957) to be 44 million mtn. of probable ore. The "South Ore Body" and the remainder of the deposit are estimated to contain an additional 150 million mtn. of probable ore.

Get this figure with a good estimate and correct.

SURFACE MINEABLE RESERVES

Utilizing conservative mining practices (45° pit slope) one could expect to mine approximately 6,5 million mtn. of ore containing an average of 30% magnetite. With more aggressive mining practices (60° pit slope), the total amount of ore mineable by surface mining would increase to approximately 16 million mtn.

It is expected that a fair amount of the ore can be mined utilizing the steeper (60°) pit slope. Testing the confirm this should be conducted during the first years of operation.

At a production rate of 600,000 mtn. per year of ore, these reserves would be sufficient for approximately 26 years of open-pit operation.

If a higher rate of production is desired, an operation based on combined open-pit and underground mining would be required.

ORE GRADE

25 Vol.-% The average grade of the deposit is reported to be approximately 30% magnetite (Krause, 1985) It must be pointed out; however, that the deposit is banded, with layers of high grade ore separated by layers of pure waste or low grade ore. The deposit contains significant amounts of ore containing +50 % magnetite. The assay results of sampling accomplished by Krause et. al. 1985 are shown in Tables 5, 6 and 7.

This was confirmed by the surface sampling performed this last summer. The results of this surface sampling are shown in Fig. 16 and Tables 8 through 11. The availability of ore containing over 50% magnetite is essential to the production of RBC.

The layered ore also simplifies the concentration process somewhat. A good deal of the waste rock can be removed, during the crushing stage. It is expected that a good deal of this waste rock (an olivine gabbro) can be sold as crushed aggregate. This would have the effect of lowering the concentration factor from about 3,4 to possibly 2 or lower.

mainly RP+

TABLE 5

Chemical analyses of titanomagnetite, Selvåg north ore body

	N 23	N 28	N 32	N 36	N 41	N 45	N 48	N 51	N 56
% FeO	28.9	30.0	33.6	28.6	28.5	28.8	28.8	27.7	29.7
% Fe ₂ O ₃	59.6	58.9	54.6	58.5	59.5	57.5	58.7	60.4	57.5
% SiO ₂	1.11	0.66	0.45	0.99	1.70	1.70	0.86	1.50	0.99
% Al ₂ O ₃	3.87	3.76	4.06	4.48	3.74	4.50	4.54	3.95	4.73
% MnO	0.18	0.21	0.23	0.21	0.22	0.19	0.19	0.21	0.19
% CaO	0.20	0.16	0.11	0.18	0.20	0.36	0.18	0.16	0.21
% MgO	0.96	1.00	0.88	0.93	1.10	1.10	0.86	0.88	0.95
% V ₂ O ₅	0.61	0.65	0.61	0.61	0.66	0.46	0.68	0.63	0.60
% TiO ₂	3.45	3.51	5.00	5.34	3.61	4.54	4.64	3.67	4.31
% Cr ₂ O ₃	0.021	0.020	0.016	0.004	0.008	0.110	0.007	0.004	0.004
% ZnO	0.028	0.025	0.027	0.027	0.026	0.026	0.025	0.029	0.026
% S	0.084	0.154	0.130	0.050	0.044	0.172	0.040	0.042	0.125
TOTAL	99.01	99.05	100.25	99.92	99.31	99.46	99.52	99.18	99.34

← total
Fe₂O₃
Fe findet
sich auch
in Px
und Gr

	N 59	N 64	N 68	N 72	N 76/1	N 82	N 88	N 92
% FeO	30.9	29.8	29.7	27.3	27.5	29.7	30.0	30.4
% Fe ₂ O ₃	56.7	57.3	57.1	59.9	62.5	59.7	58.6	58.3
% SiO ₂	1.07	0.87	0.68	0.98	0.62	0.53	0.93	0.80
% Al ₂ O ₃	4.25	4.44	4.40	4.78	4.12	4.04	4.12	4.16
% MnO	0.19	0.21	0.21	0.20	0.15	0.17	0.18	0.16
% CaO	0.19	0.20	0.18	0.18	0.15	0.20	0.16	0.14
% MgO	0.92	0.85	1.02	0.61	0.48	0.78	0.92	0.62
% V ₂ O ₅	0.60	0.54	0.60	0.59	0.70	0.58	0.48	0.48
% TiO ₂	4.31	4.84	5.13	5.31	3.09	4.01	4.26	4.34
% Cr ₂ O ₃	0.005	0.006	0.015	0.015	0.070	0.011	0.008	0.002
% ZnO	0.023	0.027	0.029	0.026	0.029	0.028	0.026	0.027
% S	0.020	0.045	0.120	0.009	0.008	0.014	0.113	0.011
TOTAL	99.18	99.13	99.18	99.9	99.42	100.34	99.80	99.44

TABLE 6

Chemical analyses of ilmenite

	Selvåg north ore body							Selvåg south ore body	
	N 23	N 28	N 32	N 36	N 41	N 88	N 92	S 18	S 66
% FeO	36.8	32.0	32.0	34.2	38.7	37.2	34.5	31.5	37.9
% Fe ₂ O ₃	18.3	24.6	21.8	20.5	12.0	12.2	14.2	20.2	12.4
% SiO ₂	< 0.05	< 0.05	< 0.05	< 0.05	0.10	< 0.05	0.10	0.28	0.31
% Al ₂ O ₃	1.17	0.33	0.29	0.21	0.26	0.76	0.76	0.61	0.47
% MnO	0.80	0.52	0.59	0.65	0.75	0.70	0.70	0.72	0.71
% CaO	0.07	0.04	0.03	0.04	0.09	0.12	0.05	0.08	0.05
% MgO	2.46	1.91	2.16	2.08	2.12	2.29	1.73	2.82	2.85
% V ₂ O ₅	< 0.5	0.04	0.04	0.06	< 0.05	< 0.05	< 0.05	< 0.05	< 0.05
% TiO ₂	40.1	40.5	40.8	42.0	39.3	45.5	47.7	42.6	44.3
% Cr ₂ O ₃	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.004	< 0.005	< 0.005
% ZnO	0.019	0.009	0.010	0.006	0.012	0.021	0.019	0.013	0.014
% S	0.115	n.d.	2.20	0.10	6.150	0.890	0.020	0.752	0.252
TOTAL	99.94	100.00	99.74	99.9	99.54	99.79	99.83	99.63	99.31

TABLE 7

Chemical analyses of titanomagnetite, Selvåg south ore body

	S 3/2	S 11/2	S 18	S 26	S 36	S 47	S 55/2	S 56	S 66	S 76/2
% FeO	31.0	30.3	30.5	31.5	31.1	30.6	31.3	30.8	30.9	29.9
% Fe ₂ O ₃	55.9	54.8	55.7	53.5	54.3	56.0	54.5	56.2	55.9	56.8
% SiO ₂	1.3	2.2	0.90	1.80	1.40	1.50	2.1	1.00	0.70	2.3
% Al ₂ O ₃	3.9	5.1	3.80	4.60	4.25	3.30	4.8	3.35	4.10	4.9
% MnO	0.23	0.17	0.21	0.19	0.22	0.21	0.20	0.19	0.21	0.17
% CaO	0.27	0.41	0.19	0.26	0.27	0.35	0.38	0.20	0.12	0.43
% MgO	1.16	0.76	1.21	1.30	1.30	1.60	0.93	1.35	1.10	0.86
% V ₂ O ₅	0.65	0.66	0.59	0.59	0.71	0.65	0.62	0.59	0.65	0.62
% TiO ₂	5.4	5.4	5.95	5.10	5.80	5.25	5.0	5.80	5.80	3.5
% Cr ₂ O ₃	0.009	0.025	0.029	0.039	0.042	0.020	0.058	0.039	0.019	0.077
% ZnO	0.021	0.019	0.023	0.019	0.028	0.023	0.016	0.020	0.024	0.020
% S	0.130	0.080	0.160	0.411	0.130	0.030	0.087	0.095	0.040	0.144
TOTAL	99.97	99.92	99.26	99.31	99.55	99.51	99.79	99.63	99.56	99.72

TABLE 8

Sample#	Lab#	Sc, ppm	La, ppm	Ce, ppm	Nd, ppm	Sm, ppm	Eu, ppm	Yb, ppm	Lu, ppm	U, ppm	Th, ppm
613	7H02-1	69	1.3	<3	<5	1.3	0.4	0.6	0.11	<1	<1
614	2	79	1.4	<3	<5	1.5	0.4	0.9	0.13	<1	<1
615	3	76	1.4	<3	<5	1.4	0.5	0.9	0.14	<1	<1
616	4	79	1.5	3	<5	1.5	0.6	1.1	0.11	<1	<1
617	5	84	1.6	<3	<5	1.6	0.5	0.8	0.14	<1	<1
618	6	73	1.3	4	<5	1.4	0.4	0.9	0.11	<1	<1
619	7	74	1.4	6	<5	1.4	0.4	0.9	0.14	<1	<1
620	8	76	1.6	8	<5	1.5	0.4	0.8	0.11	<1	<1
621	9	65	1.2	6	<5	1.2	0.3	0.7	0.14	<1	<1
622	10	74	1.4	3	<5	1.5	0.4	0.9	0.13	<1	<1
623	11	66	1.1	4	<5	1.2	0.3	0.6	0.10	<1	<1
624	12	79	1.6	4	<5	1.6	0.5	0.9	0.12	<1	<1
625	13	58	1.2	4	<5	1.2	0.3	0.6	0.07	<1	<1
626	14	83	2.0	4	<5	1.8	0.6	0.9	0.15	<1	<1
627	15	61	1.2	<3	<5	1.2	0.4	0.6	0.10	<1	<1
628	16	59	1.2	6	<5	1.1	0.4	0.6	0.06	<1	<1
629	17	65	2.4	7	<5	1.4	0.3	0.8	0.12	<1	<1
630	18	70	1.3	4	<5	1.3	0.5	0.8	0.12	<1	<1
631	19	64	1.2	<3	<5	1.1	0.4	0.9	0.12	<1	<1
632	20	63	1.2	6	<5	1.3	0.4	0.9	0.10	<1	<1
633	21	18	29.	40	20	3.7	0.7	2.2	0.32	5	6
634	22	29	16.	<3	<5	4.2	0.6	1.8	0.25	2	<1
635	23	15	28.	43	23	4.4	1.2	1.5	0.27	3	7
1858	24	1	3.6	4	<5	0.1	0.3	0.3	0.10	<1	<1
1859	25	<1	11.	8	<5	0.1	0.4	<0.2	<0.05	<1	<1
1860	26	46	39.	56	<5	5.1	0.4	1.6	0.27	<1	2
1861	27	<1	3.2	3	<5	<0.1	0.2	<0.2	<0.05	<1	<1
1862	28	14	92.	170	8	17.	1.2	3.6	0.43	2	7
1863	29	<1	34.	26	<5	0.3	0.3	<0.2	<0.05	<1	11

Sample#	Lab#	As, ppm	Sb, ppm	Mo, ppm	N, ppm	Ta, ppm	Cr, ppm
613	7H02-1	<2	<0.2	<5	<3	<1	70
614	2	<2	<0.2	<5	<3	<1	45
615	3	<2	<0.2	<5	<3	<1	46
616	4	<2	<0.2	<5	<3	<1	36
617	5	<2	<0.2	<5	<3	<1	40
618	6	<2	<0.2	<5	<3	<1	56
619	7	<2	<0.2	<5	<3	<1	30
620	8	<2	<0.2	<5	<3	<1	27
621	9	<2	<0.2	<5	<3	<1	22
622	10	<2	<0.2	<5	<3	<1	23
623	11	<2	<0.2	<5	<3	<1	20
624	12	<2	<0.2	<5	<3	<1	31
625	13	<2	<0.2	<5	<3	<1	21
626	14	<2	<0.2	<5	<3	<1	20
627	15	<2	<0.2	<5	<3	<1	17
628	16	<2	<0.2	<5	<3	<1	54
629	17	<2	<0.2	<5	<3	<1	86
630	18	<2	<0.2	<5	<3	<1	35
631	19	<2	<0.2	<5	<3	<1	30
632	20	<2	<0.2	<5	<3	<1	56
633	21	18	1.5	<5	<3	<1	100
634	22	16	<0.2	<5	<3	<1	95
635	23	<2	<0.2	<5	<3	1	64
1858	24	<2	<0.2	190	<3	<1	8
1859	25	<2	<0.2	<5	<3	<1	2
1860	26	<2	<0.2	<5	<3	<1	120
1861	27	<2	<0.2	<5	<3	<1	2
1862	28	<2	<0.2	<5	<3	1	32
1863	29	<2	<0.2	<5	<3	<1	<2

TABLE 9

Sample#	Lab#	Au, ppm	Ag, ppm	Cu, ppm	Co, ppm	Ni, ppm	Zn, ppm	Ba, %	Fe, %	Ti, %	Li, ppm	Sr, ppm	Se, ppm
613	7H02-1	<0.010	<0.5	240	78	58	190	<0.02	27.	3.10	4	64	1
614	2	<0.010	<0.5	120	110	50	170	<0.02	24.	2.60	3	80	1
615	3	<0.010	<0.5	160	120	64	160	<0.02	24.	2.70	3	35	1
616	4	<0.010	<0.5	130	84	34	180	<0.02	24.	2.70	3	59	1
617	5	<0.010	<0.5	100	60	15	160	<0.02	24.	2.90	3	47	1
618	6	<0.010	<0.5	93	86	25	190	<0.02	28.	3.10	3	39	<1
619	7	<0.010	<0.5	55	88	12	180	<0.02	27.	3.00	2	32	1
620	8	<0.010	<0.5	86	84	21	180	<0.02	26.	2.90	3	58	1
621	9	<0.010	<0.5	55	110	24	180	<0.02	27.	3.40	6	44	1
622	10	<0.010	<0.5	52	100	15	180	<0.02	28.	3.20	3	33	<1
623	11	<0.010	<0.5	72	83	15	200	<0.02	27.	3.10	4	37	<1
624	12	<0.010	<0.5	56	93	17	180	<0.02	26.	2.90	4	30	1
625	13	<0.010	<0.5	44	82	10	150	<0.02	25.	3.00	3	47	<1
626	14	<0.010	<0.5	45	73	9	160	<0.02	24.	3.10	3	53	1
627	15	<0.010	<0.5	43	87	11	190	<0.02	28.	2.70	3	26	<1
628	16	<0.010	<0.5	360	100	110	170	<0.02	25.	3.10	3	48	1
629	17	<0.010	<0.5	380	88	100	170	<0.02	26.	2.80	4	67	1
630	18	<0.010	<0.5	110	100	51	160	<0.02	24.	2.60	3	57	1
631	19	<0.010	<0.5	79	68	14	170	<0.02	23.	2.70	4	67	1
632	20	<0.010	<0.5	390	95	110	170	<0.02	24.	2.70	3	50	1
633	21	0.010	0.5	32	5	20	18	0.05	6.0	0.44	22	55	4
634	22	<0.010	<0.5	240	100	190	80	0.03	15.	1.30	23	100	<1
635	23	<0.010	<0.5	72	12	42	91	0.06	4.0	0.71	52	230	<1
1858	24	<0.010	<0.5	71	4	3	13	<0.02	1.3	0.09	6	49	2
1859	25	<0.010	<0.5	13	<1	<1	3	<0.02	0.25	0.03	12	240	<1
1860	26	<0.010	<0.5	130	17	39	77	<0.02	4.8	0.10	21	100	2
1861	27	<0.010	<0.5	65	3	<1	3	<0.02	1.1	0.02	7	91	1
1862	28	<0.010	<0.5	110	9	9	38	0.08	3.7	0.57	9	340	5
1863	29	<0.010	<0.5	12	1	<1	15	0.03	0.95	0.06	7	120	<1

Johannes Soyland
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 6501 Narvik, Norway

TELEPHONE 47-82-46590
 TELEX -64371
 TELEFAX -45961

303 238 5718 TABLE 10

01/13/1988 15:36 SHIPPING CONNECTION #5

303 238 5718 P.01

FORM NO. 85-208
PRINTED IN USA

7K12

page 1 of 3

VBI: Soyland

FAX 011-47-02-45901

Sample (rock)	Lab #	Fe %	Cu ppm	Ni	Co	Sc		
636	1	25.	110	50	59	70		
637	2	24.	45	45	59	70		
638	3	26.	46	50	76	71		
639	4	29.	98	77	96	59		
640	5	25.	160	110	86	72		
641	6	24.	210	91	77	73		
642	7	27.	260	120	100	67		
643	8	65.	560	240	200	30		
644	9	22.	330	110	67	68		
645	10	19.	230	100	59	68		
646	11	23.	160	99	59	80		
647	12	21.	300	110	65	72		
648	13	13.	250	110	64	75		
649	14	23.	150	120	74	76		
650	15	27.	250	91	84	65		
651	16	27.	170	130	99	62		
652	17	26.	220	110	99	68		
653	18	27.	230	91	74	68		
654	19	22.	140	76	79	76		
655	20	27.	160	100	87	47		
656	21	18.	170	96	65	46		
657	22	26.	220	91	73	44		
658	23	22.	190	83	64	66		
659	24	26.	250	110	80	58		
660	25	29	300	100	70	66		
661	26	32.	300	160	130	53		
662	27	23.	220	120	75	66		
663	28	26.	350	140	92	44		
664	29	26.	300	180	120	38		
665	30	18.	110	84	45	43		
667	31	6.5	110	45	7	8		
668	32	23.	90	39	<2	9		
669	33	11.	58	250	39	27		
670	34	15.	7	120	38	28		
671	35	7.2	120	110	29	5		
672	36	11	54	37	<2	9		
673	37	13	510	510	410	10		

IR12
VBI: Soyland

[illegible]

DRILLING

As previously stated, 7 diamond drill holes were drilled by Spigerverket in 1956 for a total of 1028 meters. The locations of these holes are presented on Fig. 15 and the cross sections and assay results are presented in Figures 17 through 21.

MAGNETOMETER SURVEY

As previously stated, a magnetometer survey was conducted in 1981 by B. Giesecke. The results of this survey are presented as 5 sections shown in Figures 22 through 26. (Giesecke 1981)

ASSOCIATED MINERALIZATION

Associated mineralization consisting of ilmenite (FeTiO_3), ~~vanadium~~ and sulphide minerals containing copper, nickel and cobalt were identified by Elkem in the work conducted in the 1950's. The mineralization was also identified by the geochemical survey performed by NGU in 1985. Some of these anomilous occurences are presented in Figures 27 through 32. (Sandvik 1985)

A surface sampling program conducted by VBI in the summer of 1987 also confirmed this associated mineralization and also identified the presence of scandium. The results of this sampling program are presented in Figure 16 and Tables 8 through 11.

SURFACE AND MINERAL RIGHTS

SURFACE

The surface rights to the Selvåg deposit are held by Rolf Nicolaissen who lives in Oslo. A lease agreement with the owner must be obtained. Since iron is a claimable mineral, the surface owner has no right to any of the mineral values other than scandium but it might be expected that the suraface owner may

"speculate" with the lease agreement in order to cash in on the mineral values. The surface owner cannot stop a mineral venture in that it is possible to expropriate the surface rights. The terms of the surface lease would then be determined by the courts. Leasing costs for surface rights, have generally been negligible.

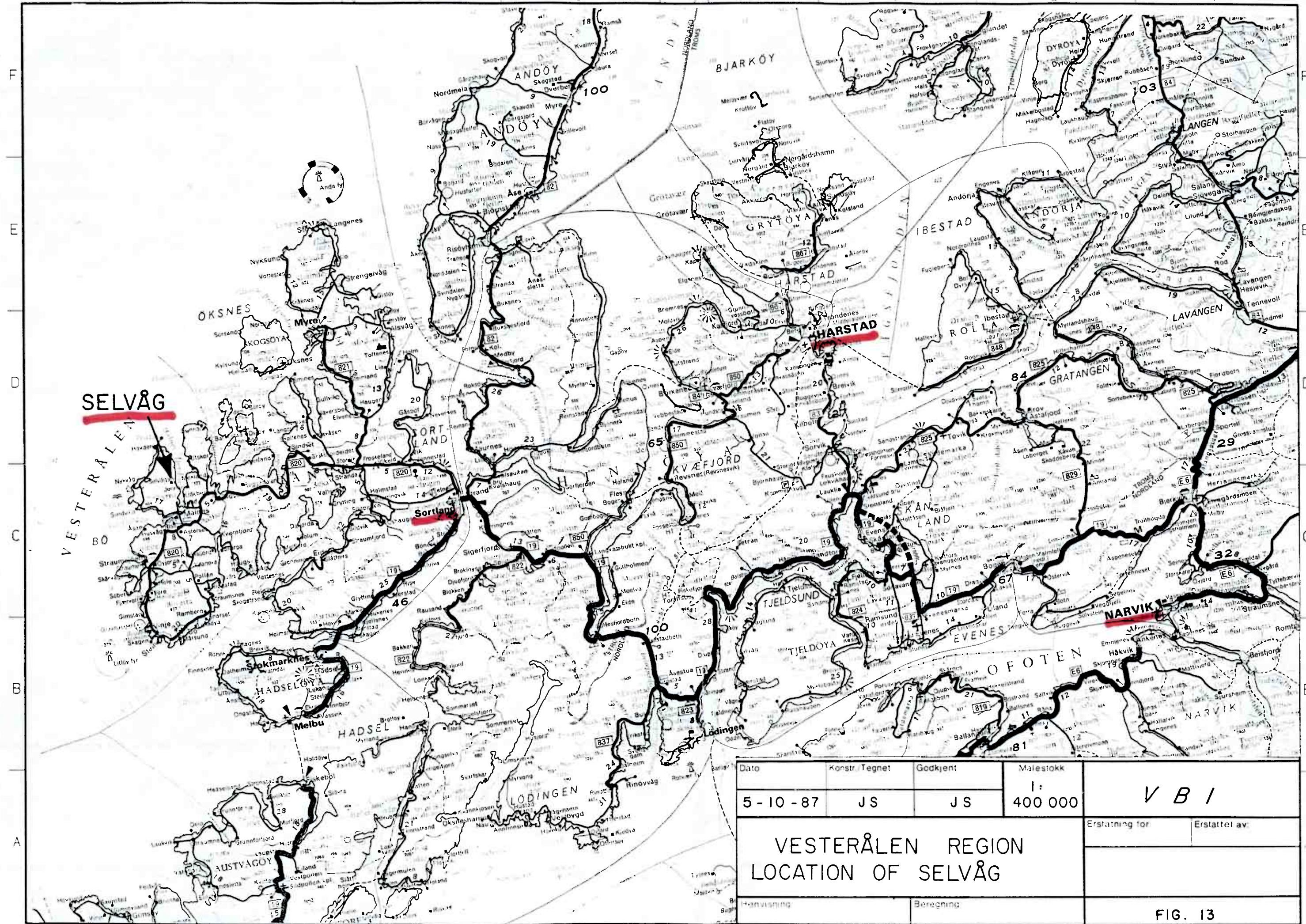
MINERAL RIGHTS

There are all together 17 claims staked on the Selvåg deposit which are held by Vesterålen Bergindustri A/S. The initial 5 claims staked by Ernst Jensen in April of 1987 cover the most interesting part of the deposit. A surrounding 12 claims were staked by Tove Brantzaeg in May of 1987. The original 5 claims were transferred to VBI in the process of incorporation. The remaining 12 claims are held in a lease/purchase agreement. The location of the claims in relation to the deposit are shown in Fig. 50.

SURFACE REQUIREMENTS

"Selvågen" or Seal Bay contains about 240,000 square meters of relatively flat land. This is more than sufficient room for the proposed plant. A proposed layout of the plant is shown in Fig. 34 and 35.

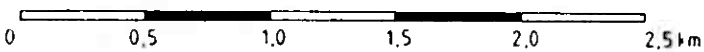
A S TORRKOPPI HD 2/NS 1402, NS 1417, NS 1415



Dato	Konstr. Tegnet	Godkjent	Maalestokk	V B I	
5-10-87	JS	JS	1:400 000		
VESTERÅLEN REGION LOCATION OF SELVÅG				Erstatning for	Erstattet av
Havising				FIG. 13	
Beregning					

EIDET-HOV DEN INTRUSION

GEOLOGICAL MAP



LEGEND

MANGERITIC ASSOCIATION

INTERNAL MANGERITES

- MANGERITE s.s.
- mineralized MANGERITE
- DIORITE, MONZODIORITE
- mineralized DIORITE, MONZODIORITE

EXTERNAL MANGERITES

- M MANGERITE VEIN
Grubbkollen, Spikerheia

GNEISS (undifferentiated)

GABBROIC SERIES

UPPER ZONE

- MESOGABBRO (UZa)
- LEUCO-, MESOGABBRO (UZb)
- MELAGABBRO, PERIDOTITE, MELATROCTOLITE (UZb)
- UPPER ORE HORIZON (UZc)

LOWER ZONE

- LEUCO-, MESOGABBRO
- MELAGABBRO, PERIDOTITE, MELATROCTOLITE, DUNITE
- LOWER ORE HORIZON (LZc)

GABBROPEGMATITE

NYKVÅG

Ravt

Husvt

Toftvt

Lundvt

Dalvt

Trihyrnavt

GUSTAD

EIDET

HOVDEN

MALNESFJORD

TRIHYRNA-SELVÅG
FAULT

Grubben

GEOLOGICAL MAP OF THE

SELVÅG DEPOSIT

Dato

Konstr. Tegnet

Gjekkent

Malstokk

V B I

Erstatning for

Erstattet av

FROM PRIESEMAN, 1985

FIG. 14

SELVÅG TITANOMAGNETITE OCCURRENCE GEOLOGICAL MAP.

0 50 100 150 200 250 m

LEGEND

LITHOLOGY

- High-grade ore
- Medium-grade ore
- Low-grade ore
- Peridotite, dunite
- Gabbroic and dioritic rocks
- Mangerite
- Gabbro-pegmatite
- Gabbro-pegmatite vein
- Quartz-feldspar/Mangerite vein, plug with inclination

TECTONIC

- Fault (defined approx.)
- Reverse fault (defined approx.)
- TSF Trihyrna - Selvåg Fault

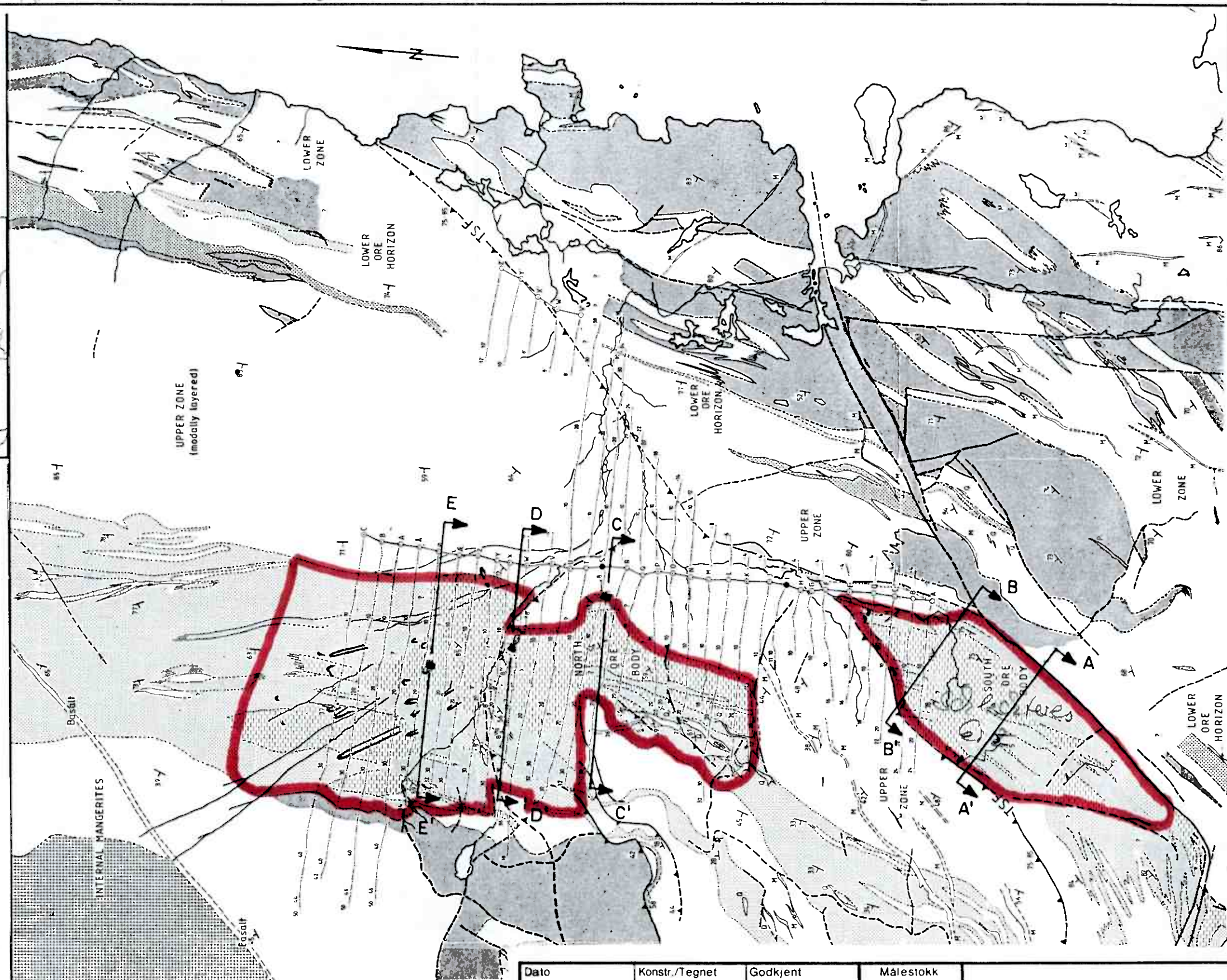
TOPOGRAPHY

- Strike and dip
- Baseline reading station
- Profile reading station
- Baseline post

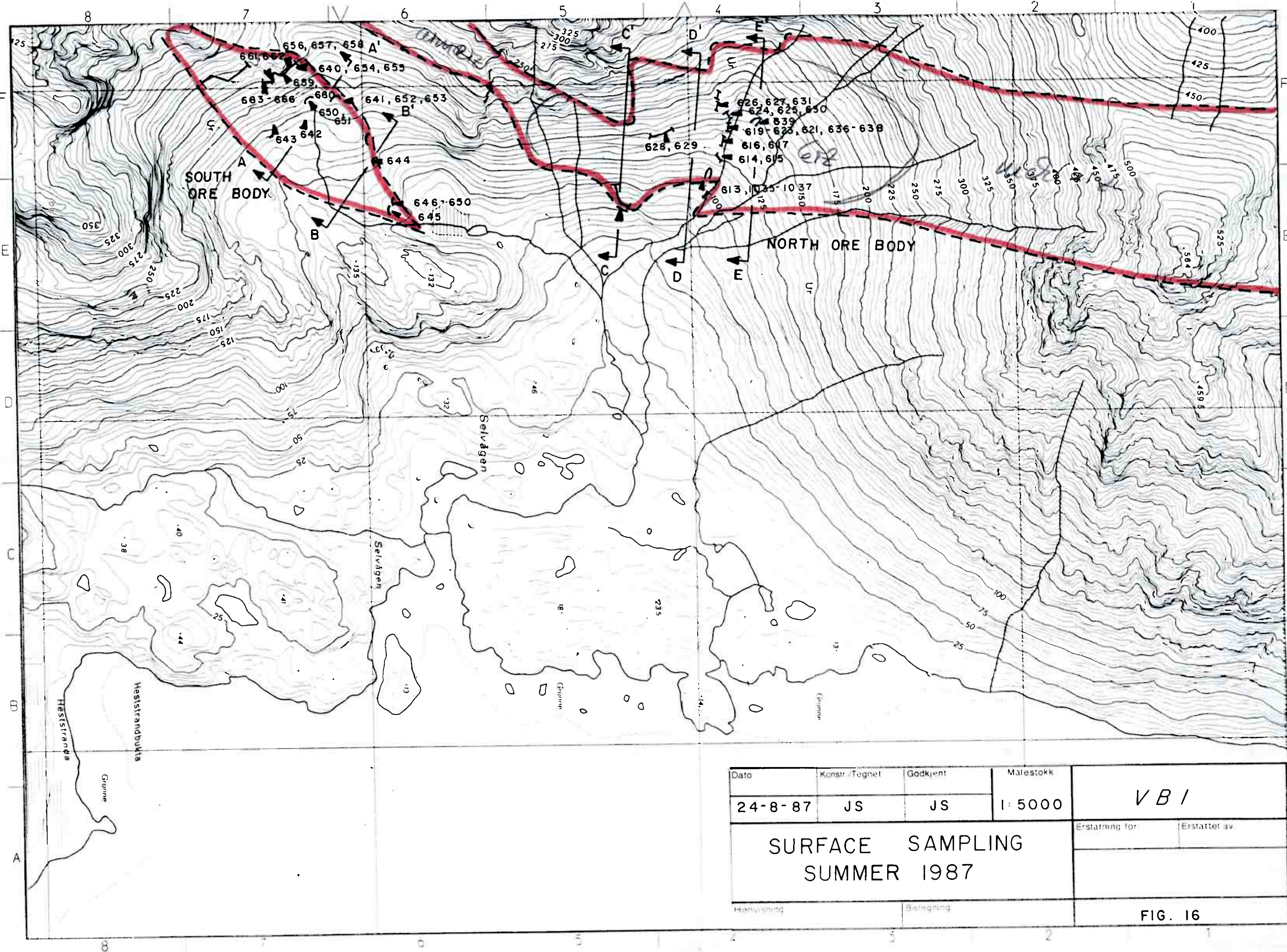
MAGNETOMETER SURVEY

- Brook
- Lake
- Digging
- Diamond drillhole
- Sampling profile

GEOLOGY: G. Pedali, 1978/79; F.-D. Prieseemann, 1980
GEOMAGNETIC: B. Giesecke, 1979

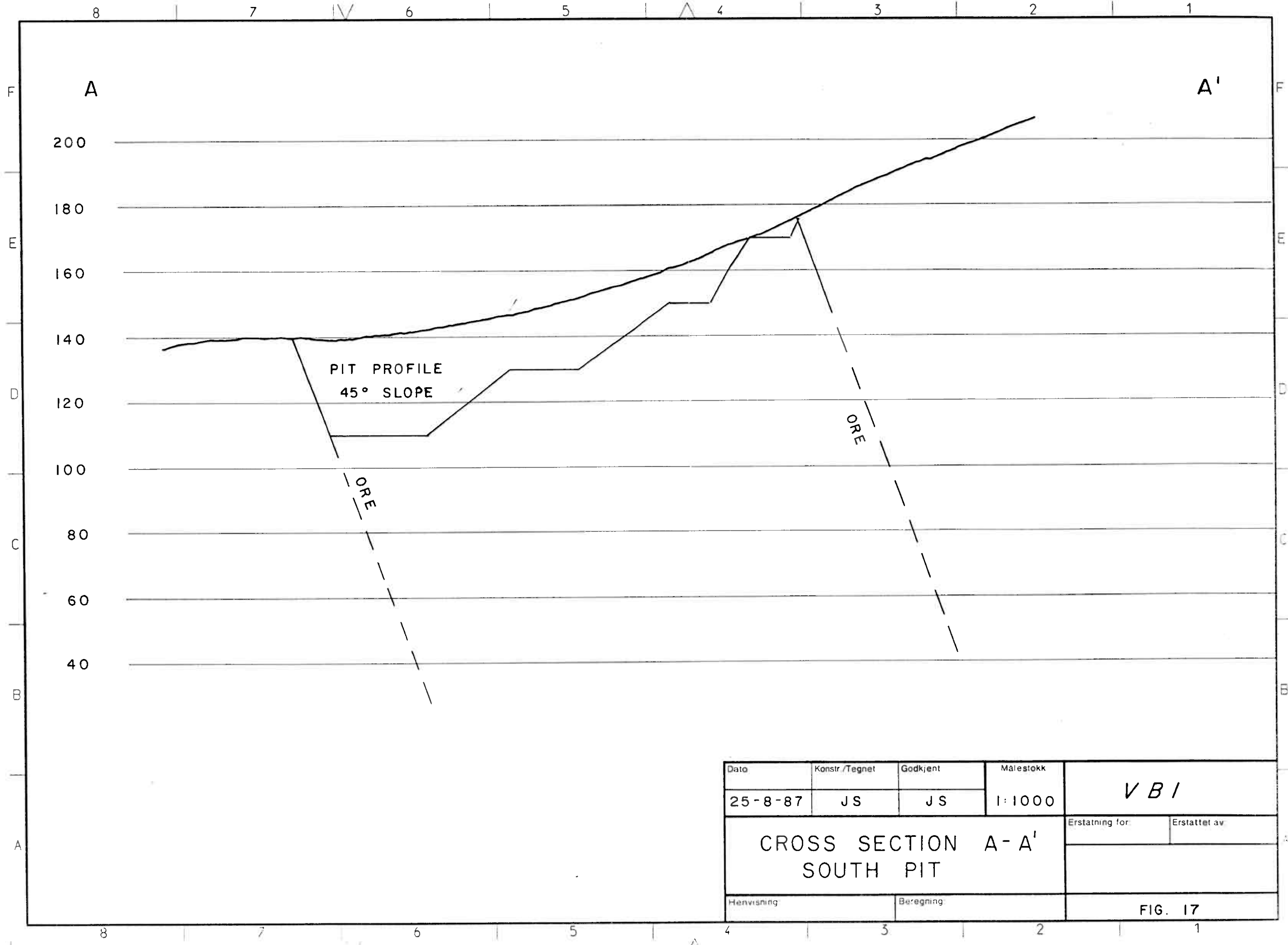


Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
GEOLOGICAL MAP OF THE SELVÅG DEPOSIT				Erstatning for:	Erstattet av:
				FROM PRIESEMANN, 1985	
Henvisning:		Beregning:		FIG. 15	

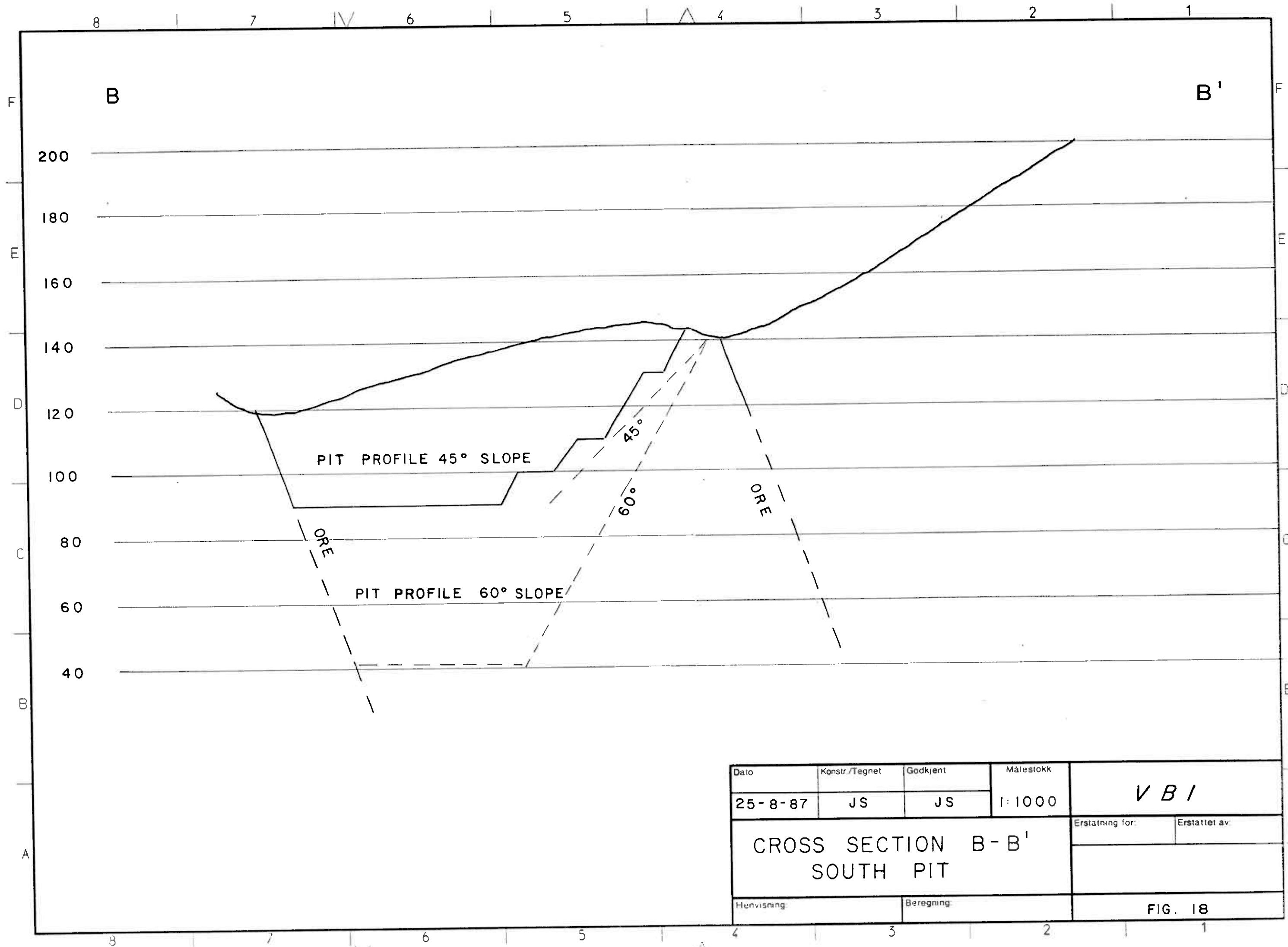


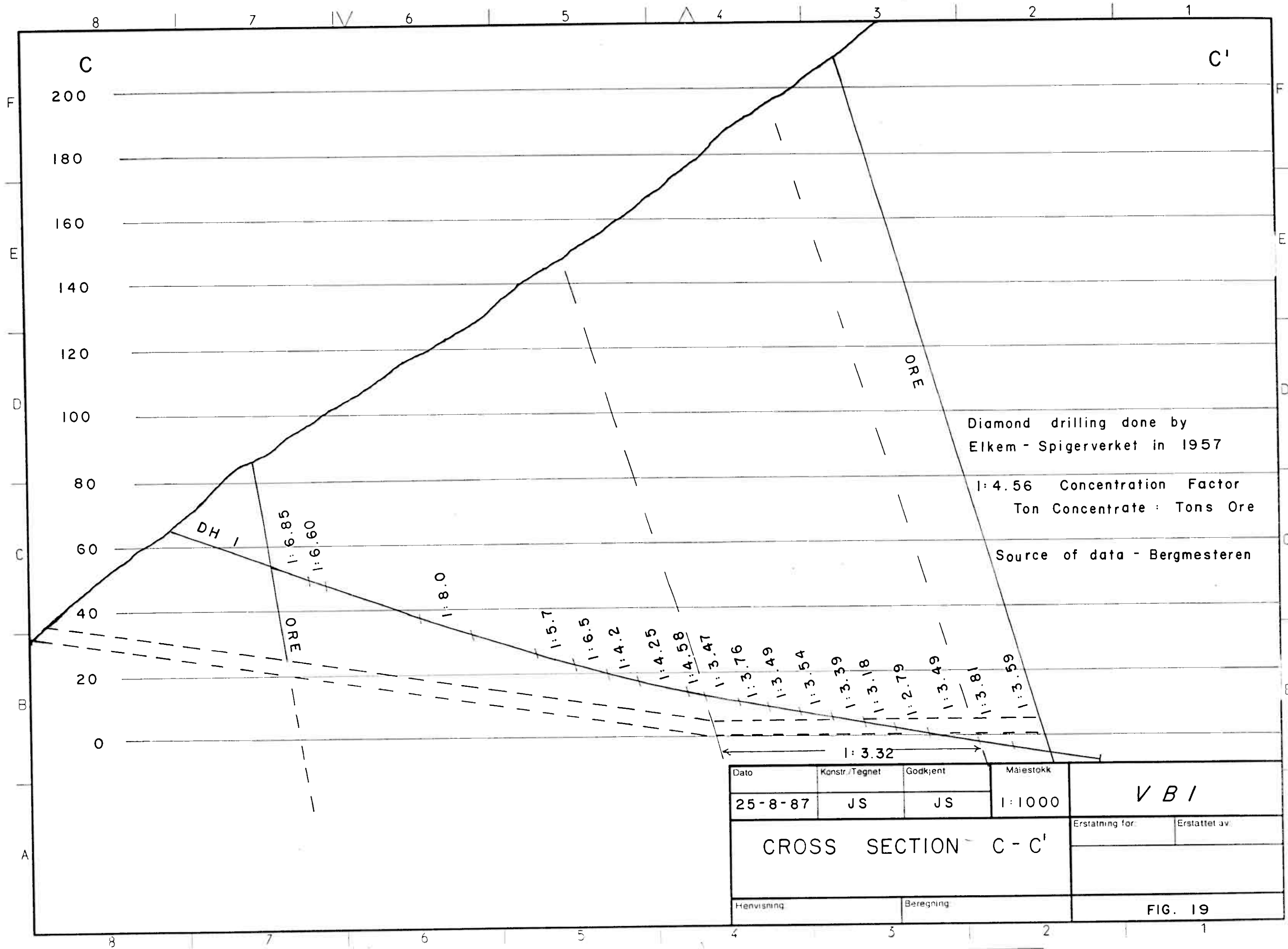
Dato	Konstr./Tegnet	Godkjent	Maalestokk	V B I	
24-8-87	JS	JS	1:5000		
SURFACE SAMPLING SUMMER 1987				Erstattet for	Erstattet av
Hensiktsang				Beregning	
				FIG. 16	

A S TØRHKØPI HD 2/NS 1402, NS 1417, NS 1415

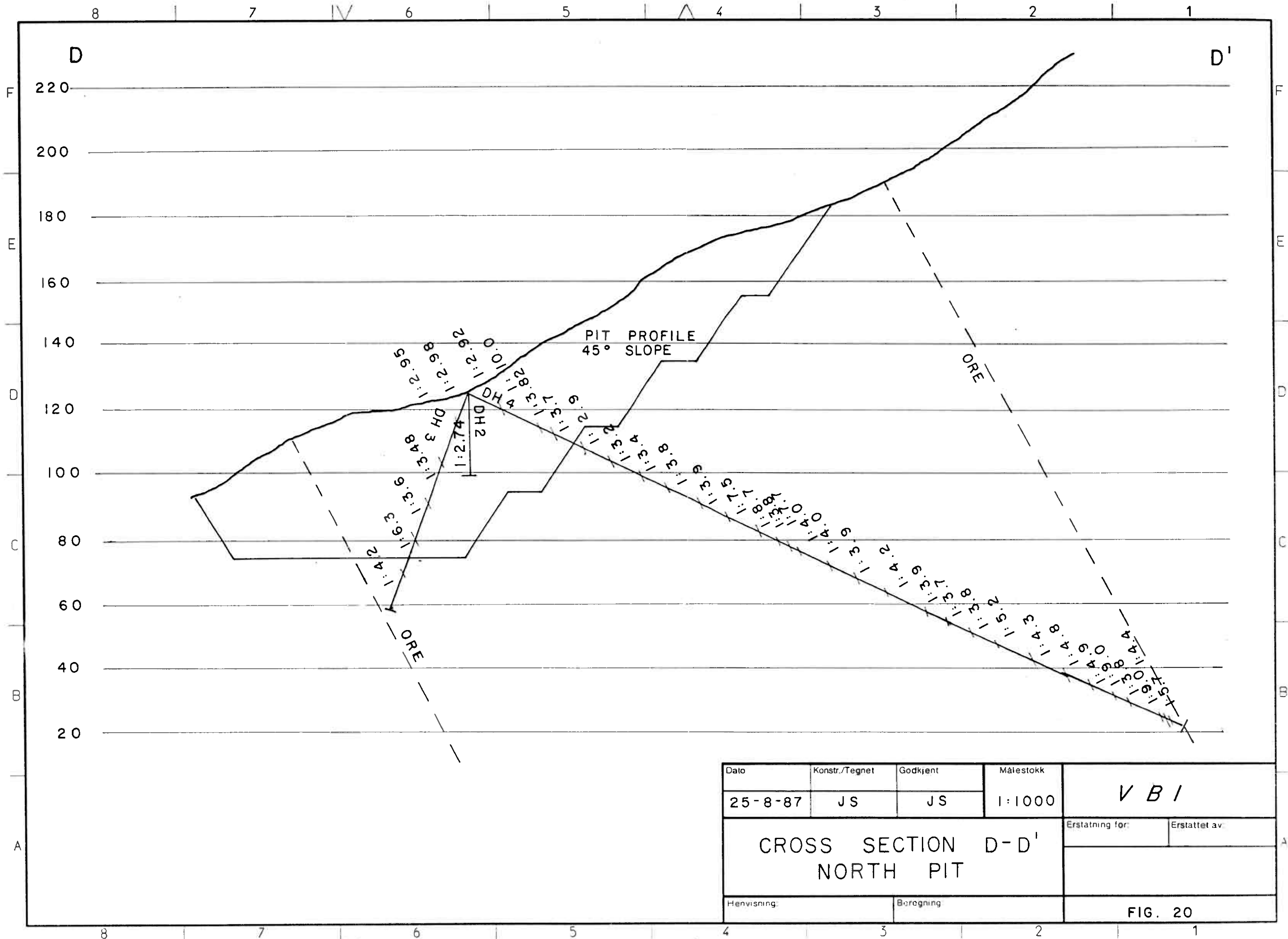


AS TORKOP1 HD 2/NS 1402, NS 1417, NS 1415

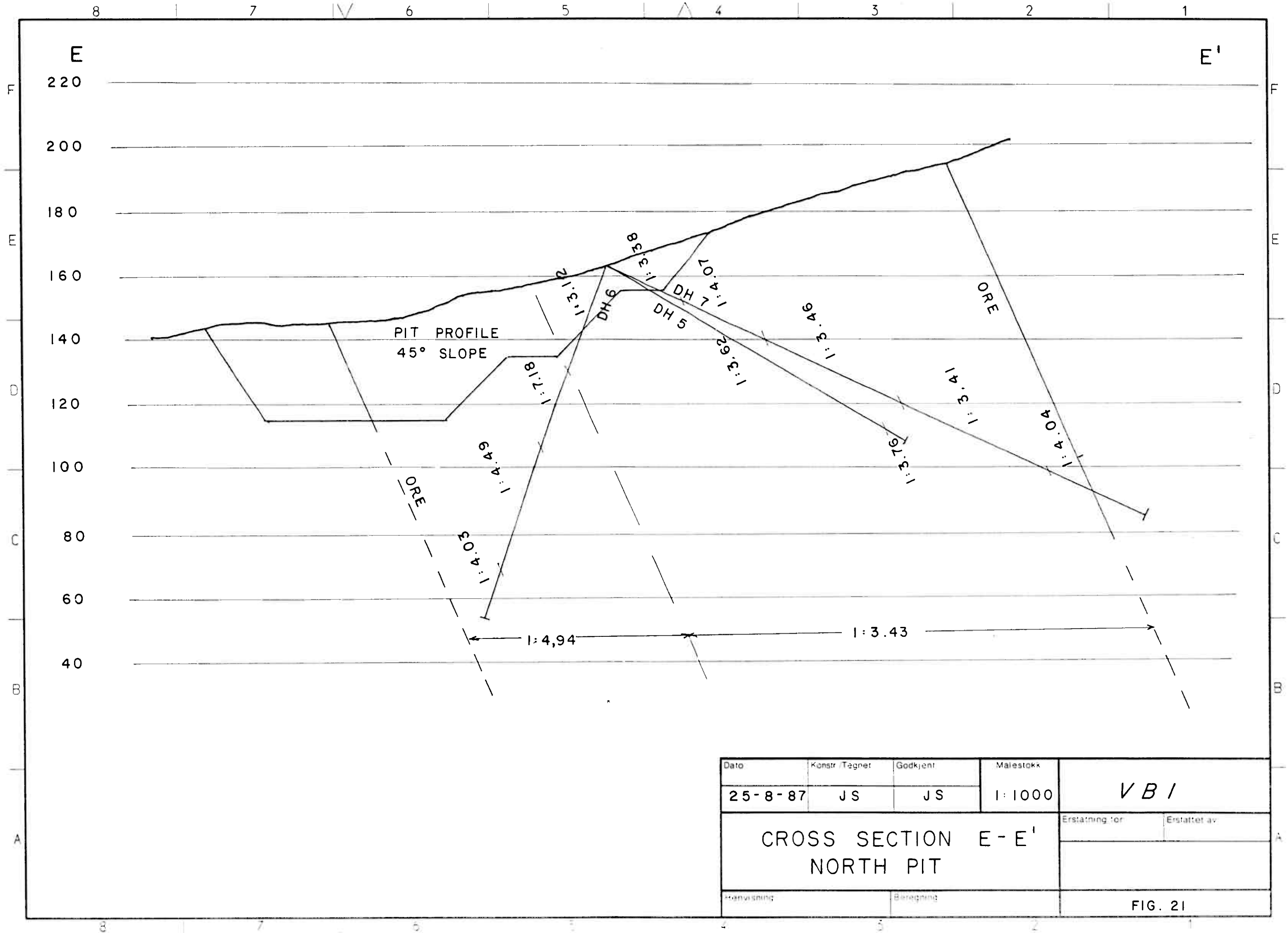




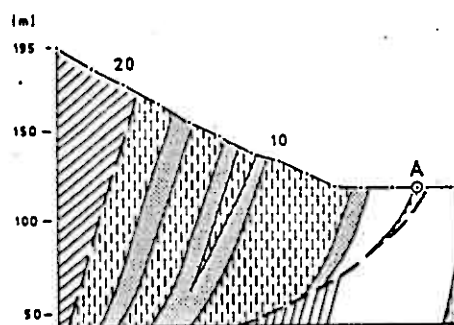
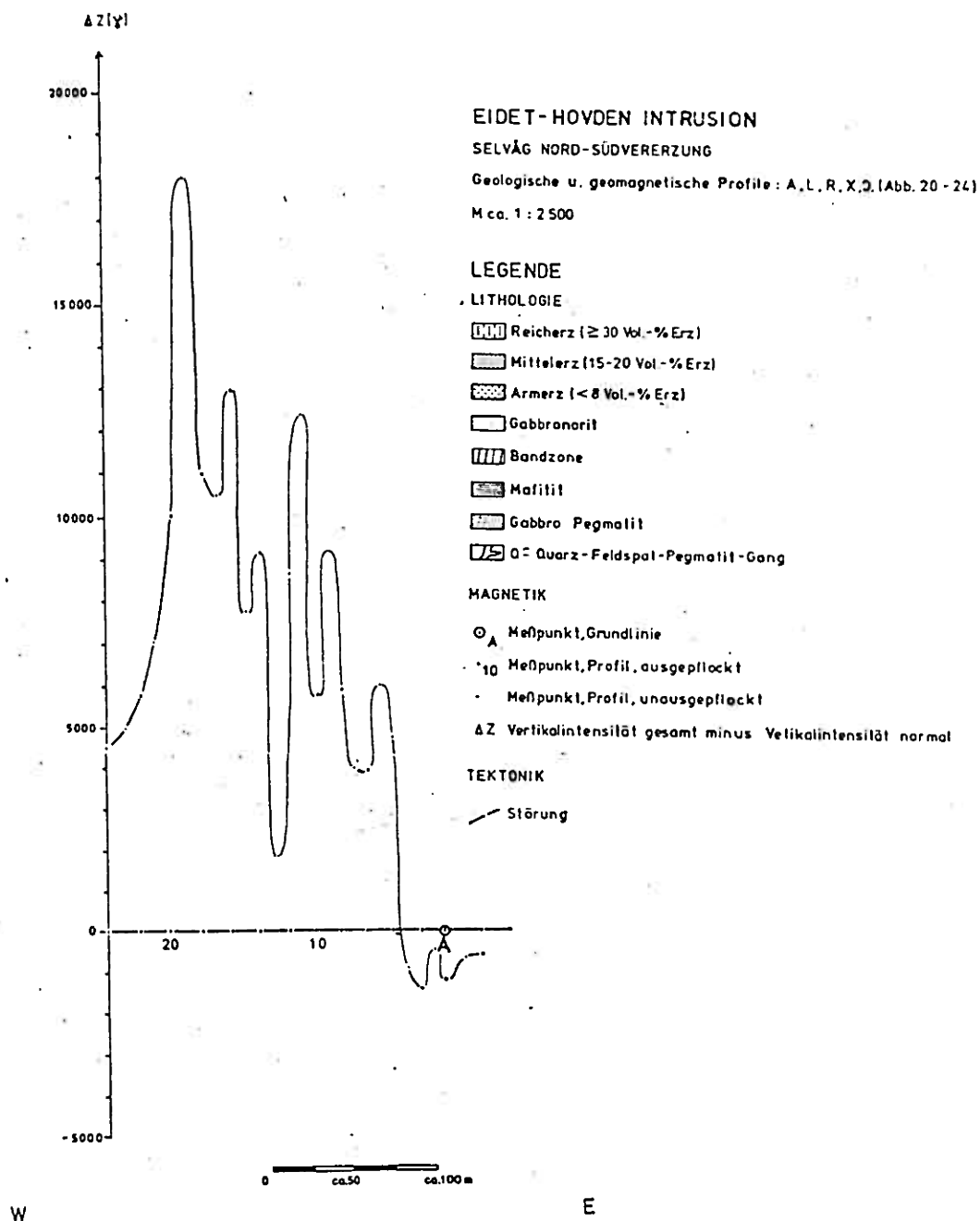
A S TORRKOPPI HD 2 / NS 1402, NS 1417, NS 1415



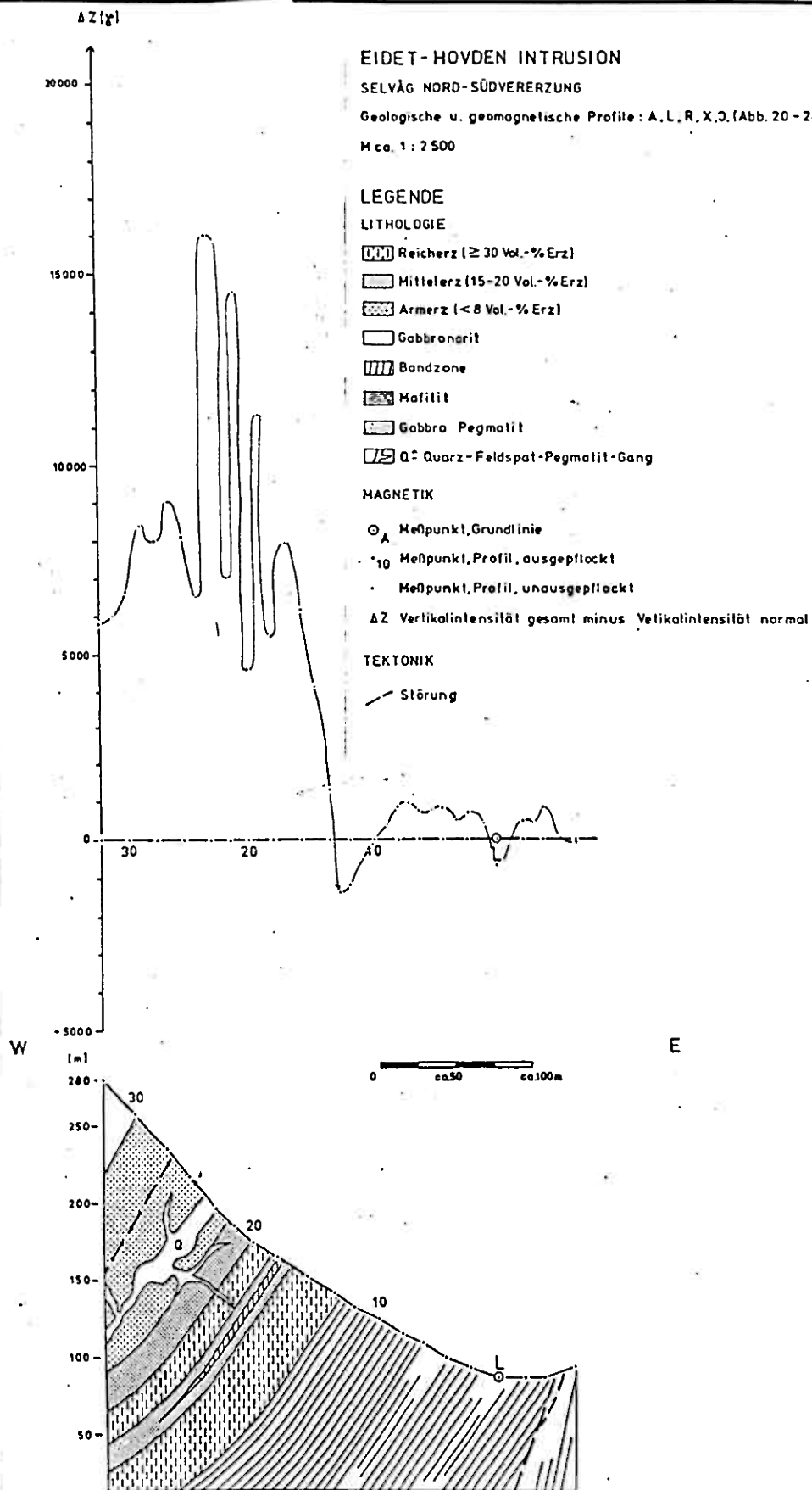
A S TORRKOPI HD 2 / NS 1402 NS 1417 NS 1415



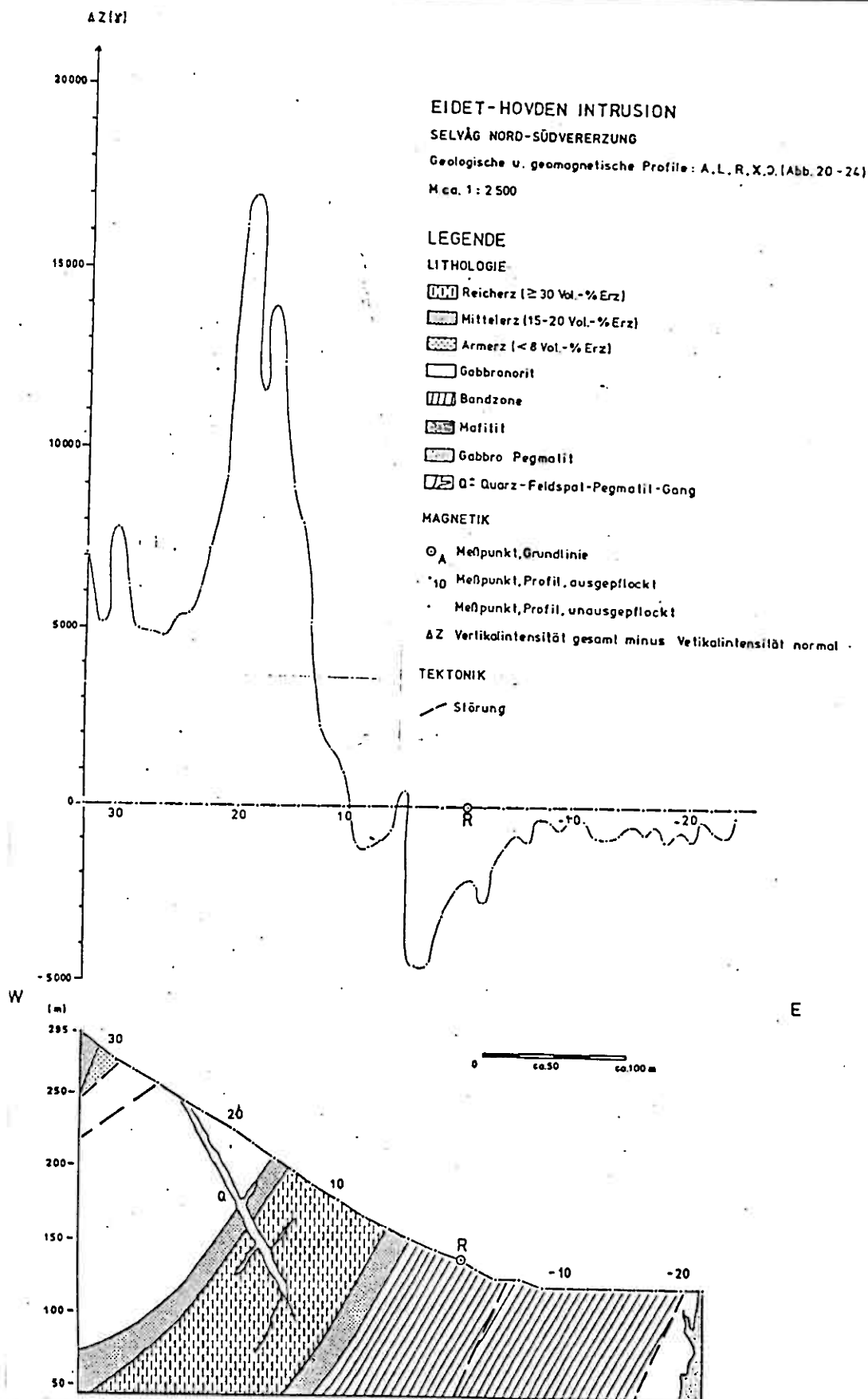
Dato	Konstr / Tegner	Godkjent	Målestokk	V B I	
25-8-87	JS	JS	1:1000		
CROSS SECTION E-E' NORTH PIT				Erstattning for	Erstattet av
Førvisning				Beregning	
				FIG. 21	



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
1 - 9 - 87	J S	J S			
MAGNETOMETER SURVEY SECTION A				Erstatning for	Erstattet av
				FROM PRIESEMANN, 1985	
Henvisning:		Beregning:		FIG. 22	



Dato	Konstr./Tegnet	Godkjent	Målestokk	<i>V B I</i>	
1 - 9 - 87	JS	JS			
MAGNETOMETER SURVEY SECTION L				Erstatning for:	Erstattet av:
				FROM PRIESEMANN, 1985	
Henvisning:		Beregning:		FIG. 23	



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
1-9-87	JS	JS			
MAGNETOMETER SURVEY SECTION R				Erstatning for:	Erstattet av:
				FROM PRIESEMANN, 1985	
Henvising:		Beregning:		FIG. 24	

EIDET-HOYDEN INTRUSION

SELVÅG NORD-SÜDVERERZUNG

Geologische u. geomagnetische Profile: A, L, R, X, J, (Abb. 20-24)

M ca. 1 : 2 500

LEGENDE

LITHOLOGIE

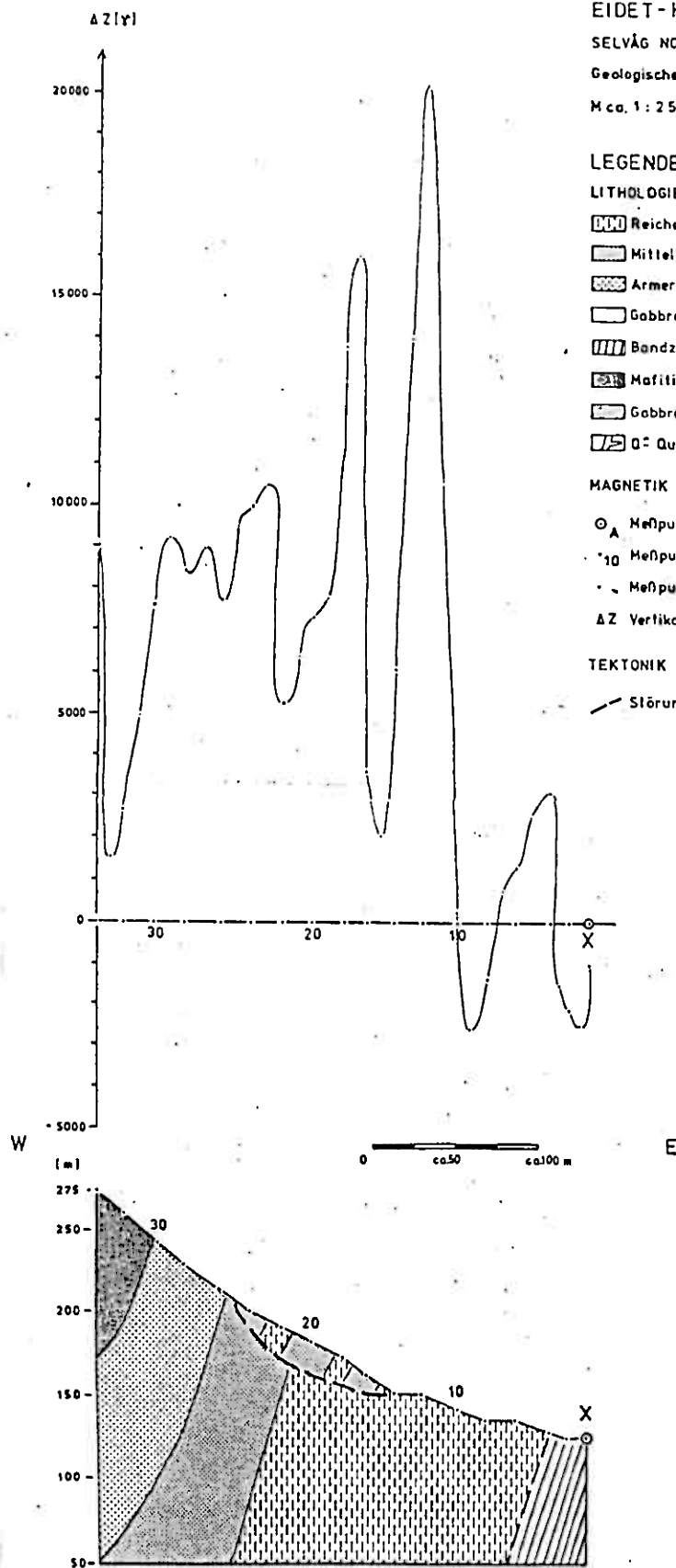
- Reicherz (≥ 30 Vol.-% Erz)
- Mittelerz (15-20 Vol.-% Erz)
- Armerz (< 8 Vol.-% Erz)
- Gabbroanorit
- Bandzone
- Mafilit
- Gabbro Pegmatit
- Quarz-Feldspat-Pegmatit-Gang

MAGNETIK

- Meßpunkt, Grundlinie
- Meßpunkt, Profil, ausgepflockt
- Meßpunkt, Profil, unausgepflockt
- ΔZ Vertikalintensität gesamt minus Vertikalintensität normal

TEKTONIK

- Störung



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
1-9-87	JS	JS			
MAGNETOMETER SURVEY SECTION X				Erstatning for	Erstattet av
				FROM PRIESEMANN, 1985	
Henvisning:		Beregning:		FIG. 25	

EIDET-HOVDEN INTRUSION

SELVÅG NORD-SÜDVERERZUNG

Geologische u. geomagnetische Profile: A, L, R, X, J. (Abb. 20-24)

M ca. 1 : 2 500

LEGENDE

LITHOLOGIE

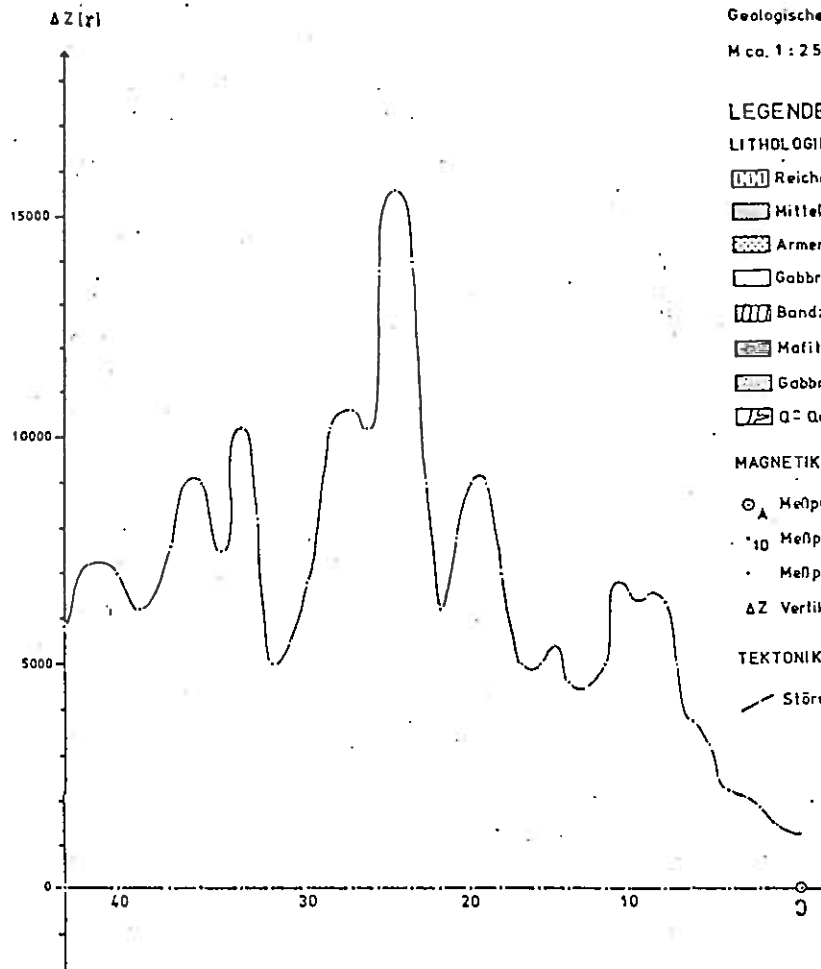
- Reicherz (≥ 30 Vol.-% Erz)
- Mittelerz (15-20 Vol.-% Erz)
- Armerz (< 8 Vol.-% Erz)
- Gabbroanorit
- Bandzone
- Mafilit
- Gabbro Pegmatit
- Q = Quarz-Feldspat-Pegmatit-Gang

MAGNETIK

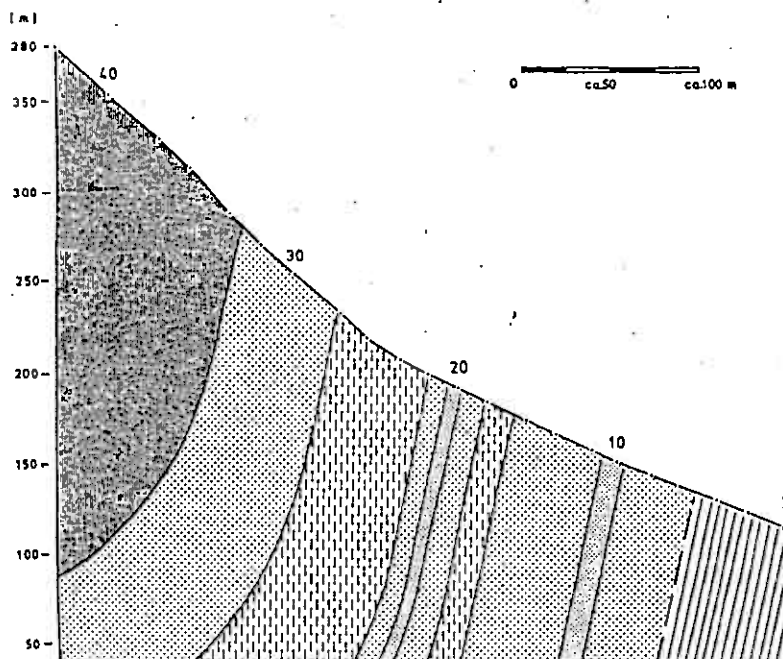
- Meßpunkt, Grundlinie
- Meßpunkt, Profil, ausgepflockt
- Meßpunkt, Profil, unausgepflockt
- ΔZ Vertikalintensität gesamt minus Vertikalintensität normal

TEKTONIK

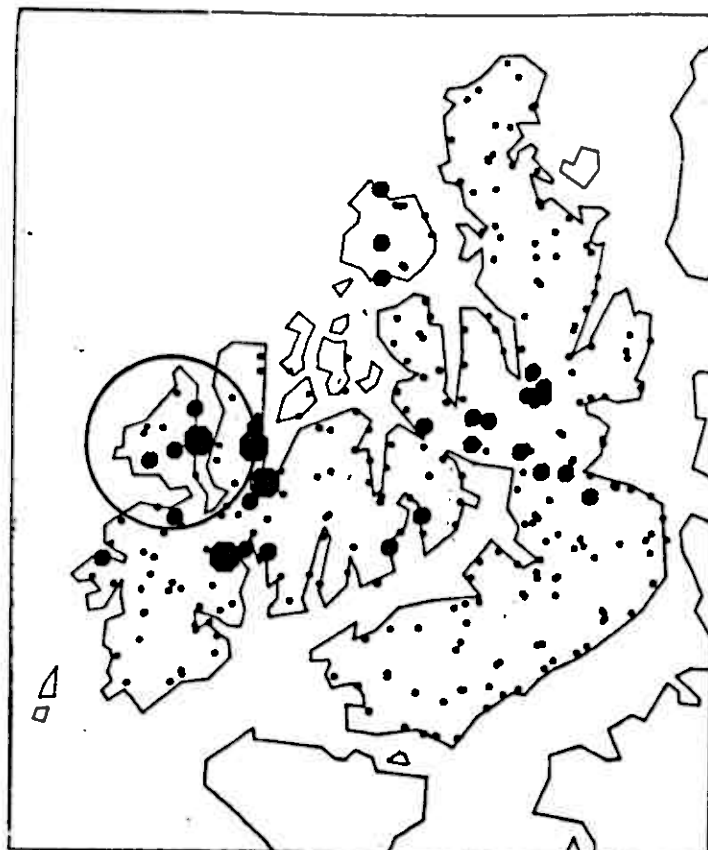
- Störung



E



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
1 - 9 - 87	JS	JS			
MAGNETOMETER SURVEY SECTION J				Erstatning for:	Erstattet av:
				FROM PRIESEMANN, 1985	
Henvising:		Beregning:		FIG. 26	



MORENE
VESTERAALEN 1985

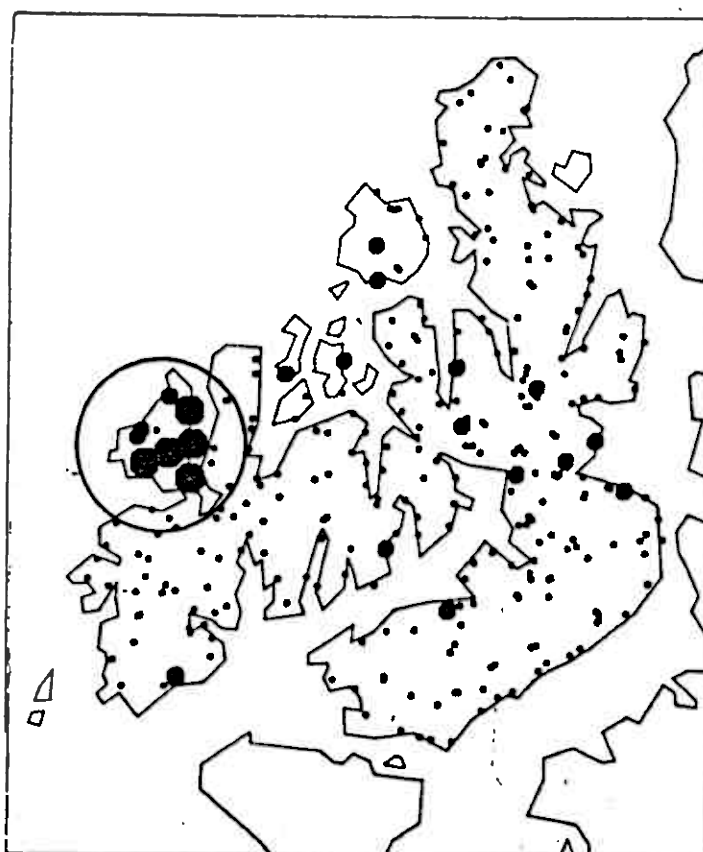
z MG

ØVRE GRENSE:

• 2.80

• 5.50

• > 5.80



MORENE
VESTERAALEN 1985

z NA

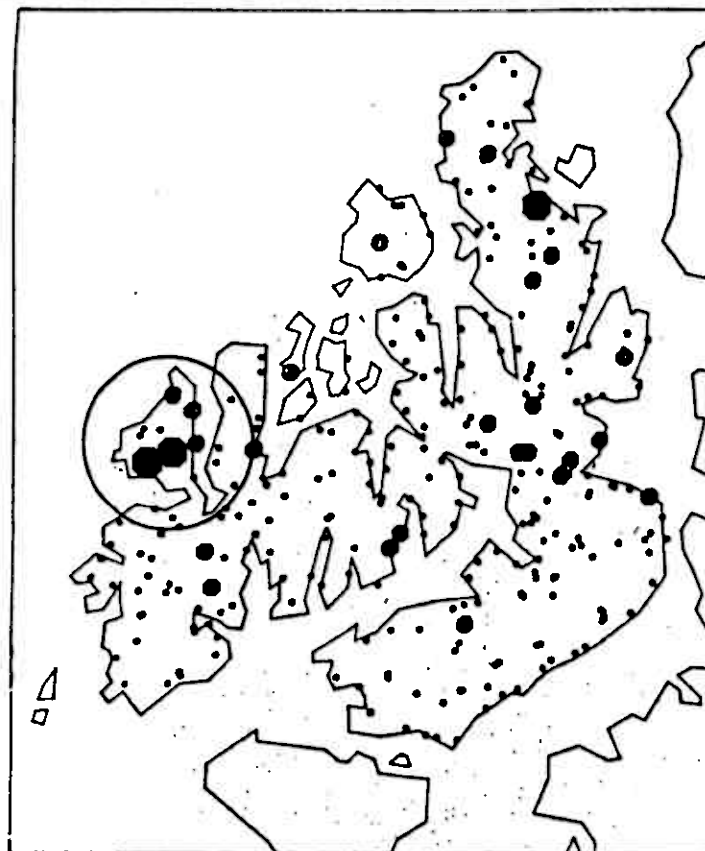
ØVRE GRENSE:

• .07

• .20

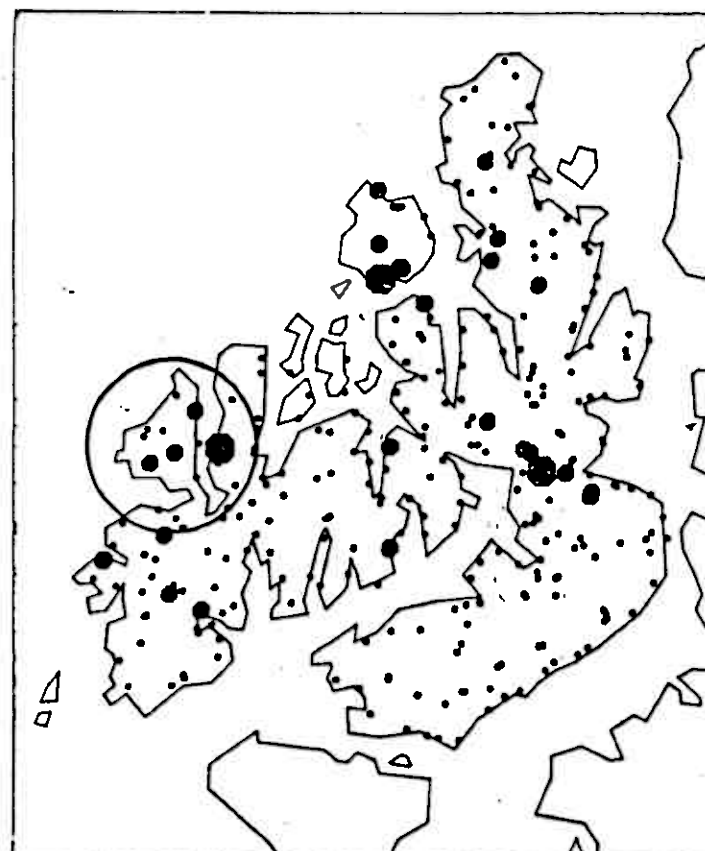
• > .20

Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
2 - 9 - 87	JS	JS			
GEOCHEMICAL SURVEY SOIL SAMPLES, Mg & Na				Erstatning for:	Erstattet av:
				FROM SANDVIK, 1985	
Henvisning:		Beregning:		FIG. 27	



MORENE
VESTERAALEN 1985

AL
ØVRE GRENSE:
• 3.5
• 5.0
• > 6.0



MORENE
VESTERAALEN 1985

PPM CU
ØVRE GRENSE:
• 66
• 110
• > 140

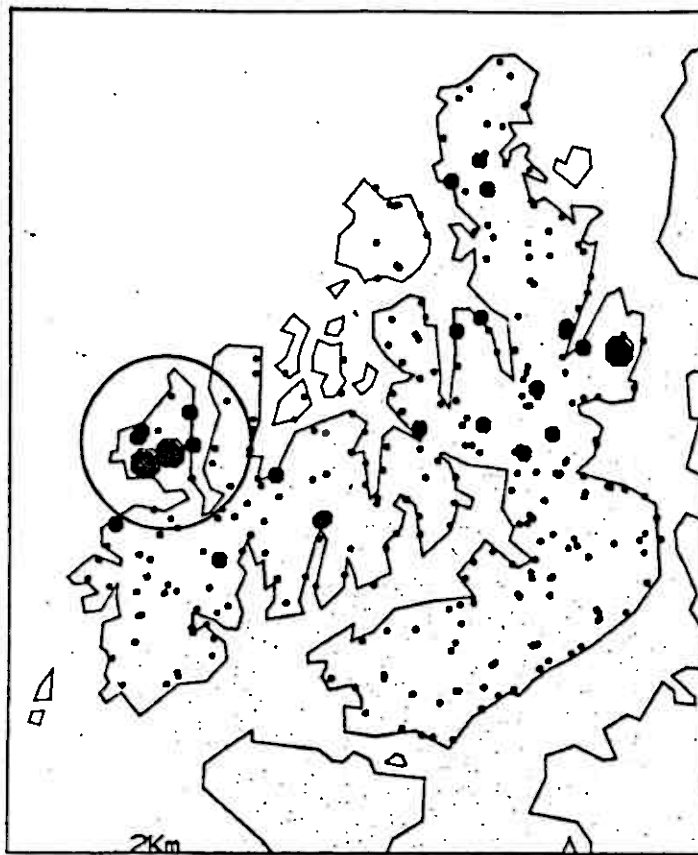
Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
2 - 9 - 87	JS	JS			
GEOCHEMICAL SURVEY SOIL SAMPLES, Al & Cu				Erstatning for:	Erstattet av:
				FROM SANDVIK, 1985	
Henvisning:		Beregning:		FIG. 28	

BEKKESEDIMENTER
VESTERAALEN 1985

PPM NI

ØVRE GRENSE:

- 25.0
- 50.0
- > 60.0

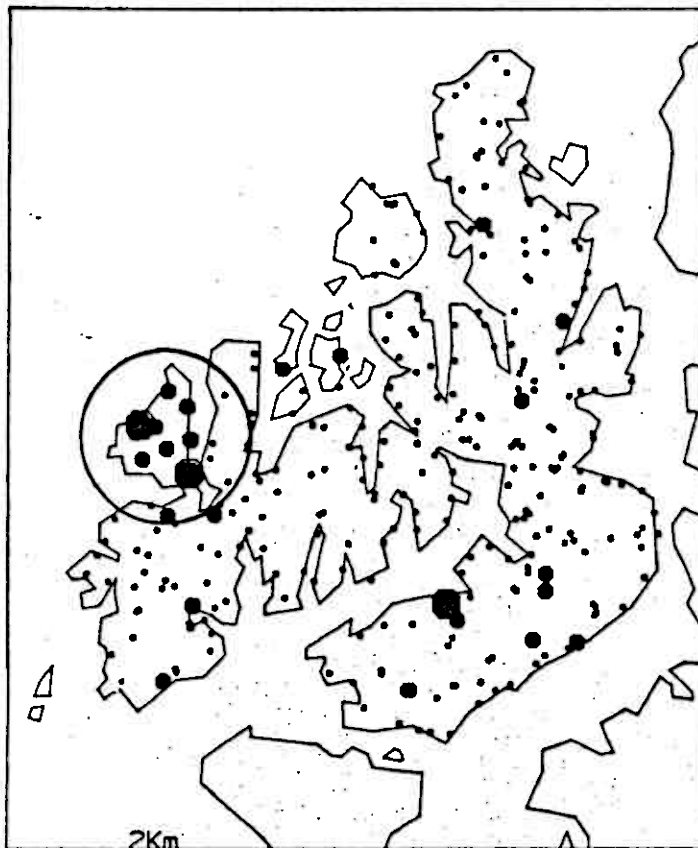


BEKKESEDIMENTER
VESTERAALEN 1985

PPM SR

ØVRE GRENSE:

- 20
- 40
- > 60



Dato	Konstr / Tegnet	Godkjent	Malstokk	V B I	
2 - 9 - 87	JS	JS			
GEOCHEMICAL SURVEY STREAM SEDIMENT, Sr & Ni				Erstatning for	Erstattet av
				FROM SANDVIK, 1985	
Henvisning		Beregning		FIG. 29	

BEKKESEDIMENTER
VESTERAALEN 1985

z MG

ØYRE GRENSE:

• 1.00

• 3.00

• > 3.00



BEKKESEDIMENTER
VESTERAALEN 1985

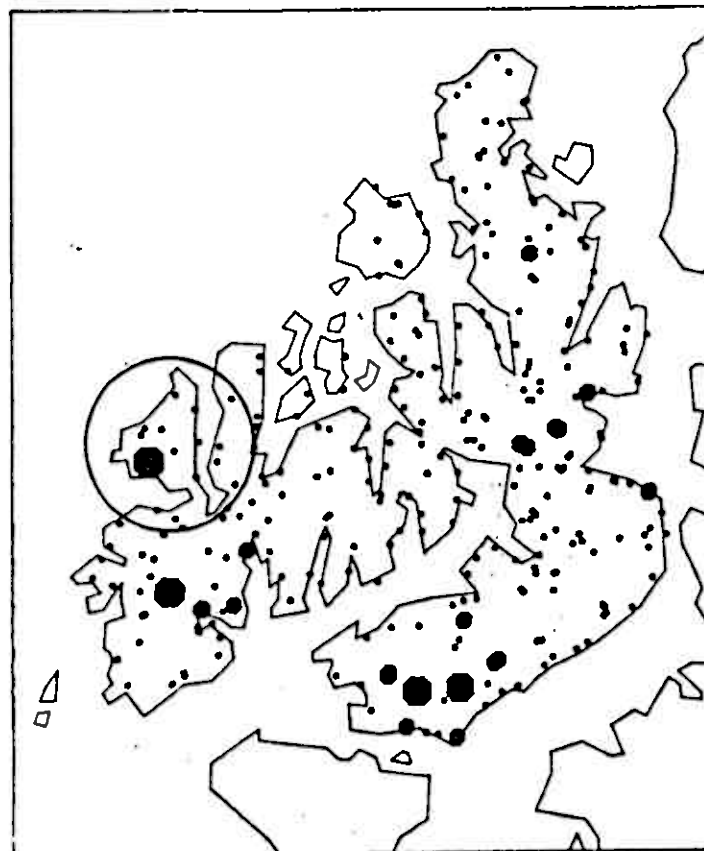
z MN

ØYRE GRENSE:

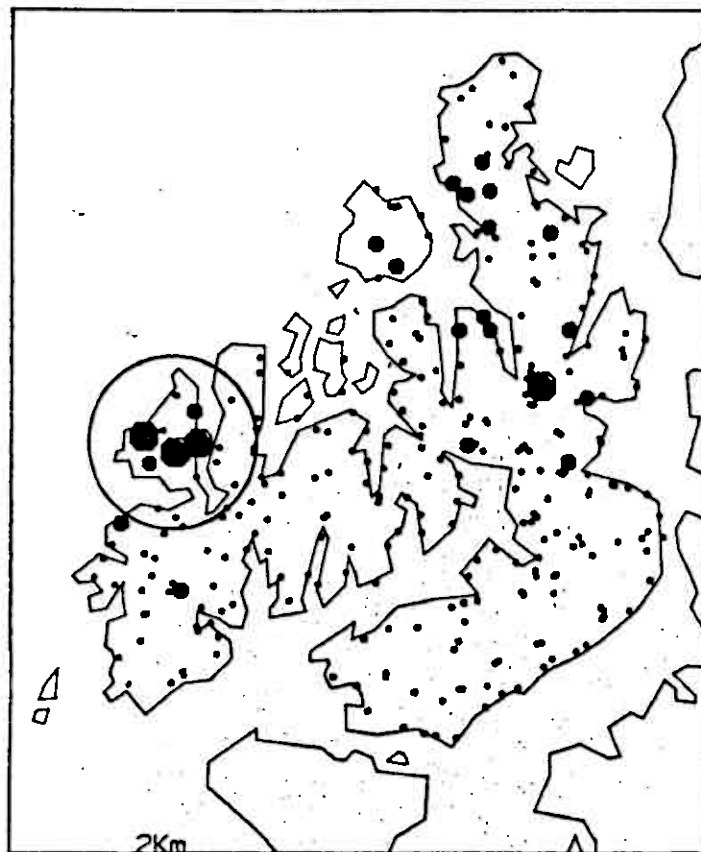
• .060

• .050

• > .050



Dato	Konstr./Tegnet	Godkjent	Malestøkk	V B I	
2 - 9 - 87	JS	JS			
GEOCHEMICAL SURVEY STREAM SEDIMENT, Mg & Mn				Erstatning for:	Erstattet av:
				FROM	SANDVIK, 1985
Henvisning:		Beregning:		FIG. 30	

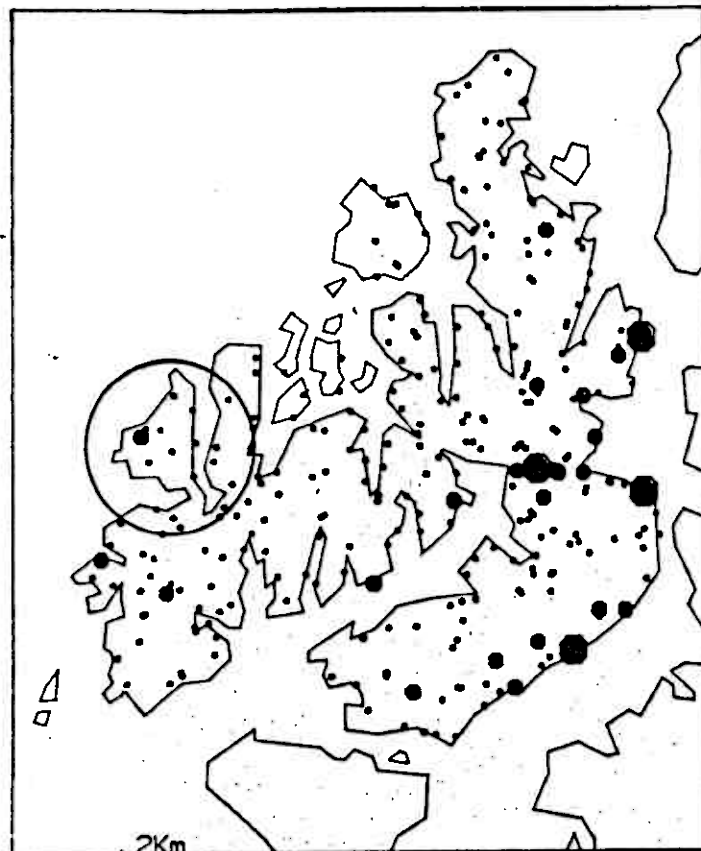


BEKKESEDIMENTER
VESTERAALEN 1985

PPM CU

ØVRE GRENSE:

- 25
- 15
- > 15



BEKKESEDIMENTER
VESTERAALEN 1985

PPM LI

ØVRE GRENSE:

- 8
- 15
- > 15

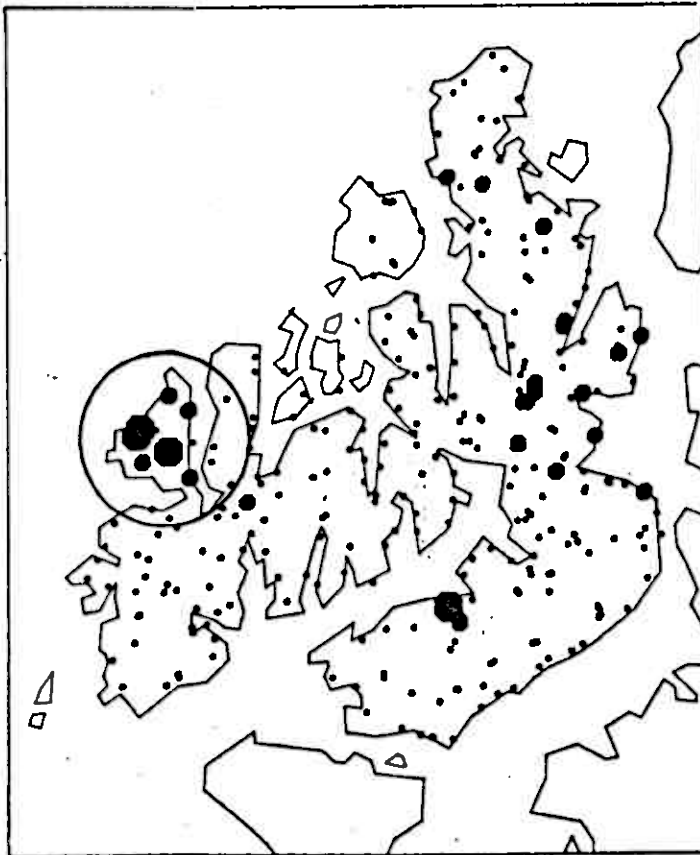
Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
2 - 9 - 87	JS	JS			
GEOCHEMICAL SURVEY STREAM SEDIMENT, Cu & Li				Erstatning for:	Erstattet av
				FROM SANDVIK, 1985	
Henvisning:		Beregning		FIG. 31	

BEKKESEDIMENTER
VESTERAALEN 1985

z AL

BYRE GRENSE:

- 1.80
- 2.00
- > 2.00

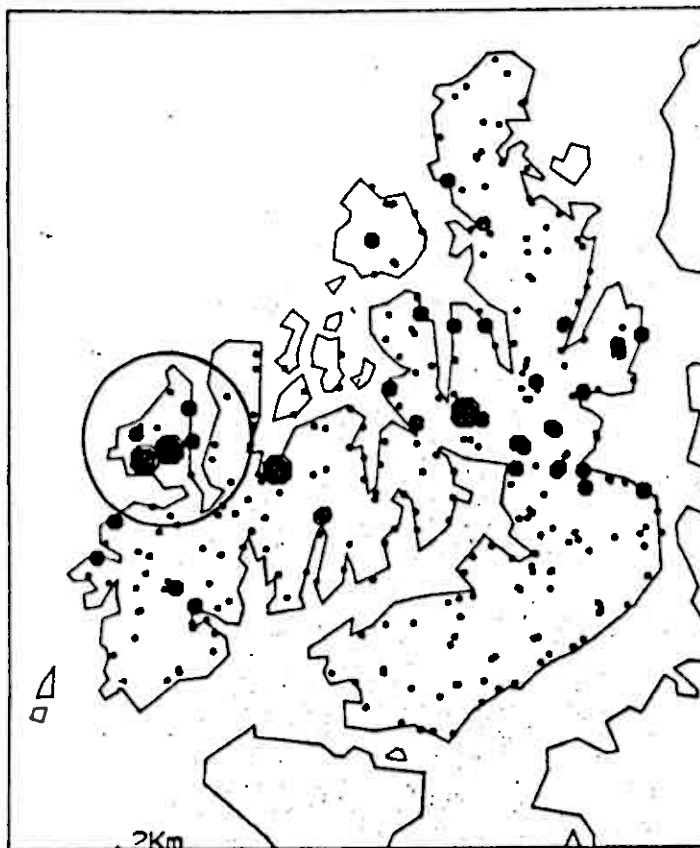


BEKKESEDIMENTER
VESTERAALEN 1985

PPM CO

BYRE GRENSE:

- 15
- 25
- > 25



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
2-9-87	JS	JS			
GEOCHEMICAL SURVEY STREAM SEDIMENT, Al & Co				Erstatning for:	Erstattet av:
				FROM SANDVIK, 1985	
Henvisning		Beregning		FIG. 32	

MINING SYSTEM

ROCK CONDITIONS

Both the ore and the surrounding country rock are very hard. The ore is layered, with little or no cohesion between the layers. The country rock is fairly fractured. These two conditions may require fairly conservative mining practices (45° pit slope).

Thorvaldsen (1975) has conducted a slope stability analysis of the Selvåg deposit in which rock strengths and fracture zones were studied. He recommended a maximum overall slope of 60° for the hanging wall and 70° for the footwall.

The mining plan presented here will use a 45° slope for the hanging wall and the back wall of the pit. 70° will be used for the footwall.

The slope stability conditions will have to be studied during the first years of operation. If it is found that a 60° pit slope for the hanging wall is stable, this slope would then be used for the last segment of the pit operation.

CONCESSION - OPERATING PERMITS

A "Driftskonsesjon" or operating permit has to be obtained from the Department of Industry. As long as an acceptable plan of operations is presented there are generally no large problems involved with obtaining the permit. The Dept. of Ind. may however set some conditions on the operation.

An "utslippstillatelse" or discharge permit has to be obtained from the Environmental Department if any gaseous, fluid or solid discharges are planned or expected.

An "Utmål" which is about the same as the American patented claim must be obtained from the Bergmester before more than 10,000 tons of ore are removed.

All of these permits will be applied for and obtained during the full feasibility study stage.

ORE CONTINUITY - SELECTIVE MINING

As previously stated the ore deposit is layered with layers of fairly rich ore separated by unmineralized or poorly mineralized waste rock. This intimate mixing of ore and waste will not cause any great difficulties with general operation in that the waste rock can be readily separated in the crushing plant and sold as aggregate. Some selective mining will be required for the production of RBC.

PROPOSED MINING PLAN

This evaluation will consider three production alternatives:

1. The mining of 600,000 mtn. per year of ore based on the sale of 180,000 mtn. per year of industrial mineral magnetite.
2. The mining of 900,000 mtn. per year of ore based on increased sale of industrial mineral magnetite or increased production of byproducts.
3. The mining of 1,2 million mtn. per year.

The first and most likely alternative, the mining of 600,000 mtn. per year of ore, will utilize only open pit mining. As previously stated in the ore reserve evaluation, estimates indicate enough ore for approximately 10,5 years with a 45° pit slope and 26 years of a 60° pit slope can be utilized. The plan calls for the mining of just ore. No stripping of overburden is necessary.

Pit design, pit profiles and haul roads are presented in Figures 36 through 45.

The pit design utilizes an overall pit slope of 45° , a bench width of 8,5 meters, a bench wall slope of 60° , a haul road width of 10 meters and a haul road incline of 10%.

Haulage will be limited to transportation of ore of to a centrally located shaft which leads to an underground jaw crusher located at the 0 level (Sea level). This will greatly reduce the amount of haulage required and also facilitate the initiation of underground mining if that should become necessary. The proposed shaft and crusher locations are shown in Figure 46.

The open pit mining of 900,000 to 1,2 million mtn. per year of ore, will require a combination of open pit and underground mining. The open pit mining will be exactly the same as in the first alternative. The extra production will come from an underground, vertical crater retreat or sub level stoping mining system. The proposed underground system is presented in Figure 46.

The placement of the primary crusher underground is purposely done to:

1. Limit truck transportation
2. Facilitate the establishment of underground mining when and if that becomes necessary.

The mine plans presented in report are only proposed plans, many details of location, size, etc. may be changed during the later planning or construction phases.

PRE-PRODUCTION DEVELOPMENT

The required pre-production development for the mine will include:

1. The driving of a 400 m. long 5 x 5 m. tunnel from about + 35 m. elevation down to 0 with a 10% incline (See Fig.46) The costs for this were estimated graphically from Technical Report 6 - 83 (Inst. for Anl., 1983) to be approx. Nkr. 5000/meter.
2. The driving of a 140 m. long 2,5 m. in diameter circular shaft from the 0 level up to about the + 140 m level. The costs for this were estimated graphically from Technical Report 1-81 (Inst. for Anl., 1981) to the approx. Nkr. 5000/meter.
3. The building of approx. 1 km. of mine haul road estimated from experience at Nkr. 1.000.000,-.
4. The driving of approx. 1000 m. of 5 x 5 m. production drifts at approx. Nkr. 5000/meter.
5. The stripping of approx. 60,000 m³ of topsoil and vegetation estimated from experience to be. approx. Nkr. 10/cubic meter.

CONCENTRATOR DESIGN

As previously stated, plans call for the production of 4 concentrates - 2 magnetite concentrates, an ilmenite concentrate and a sulphide concentrate. This will then require a magnetic separation circuit for the magnetite and two separate flotation circuits for the ilmenite and sulphides.

The production of RBC will require the jigging of - 6,5 mm + 2 mm ore in the crushing plant. The purpose of this is to provide the heaviest possible magnetite gravel. The jigged product will later be mixed with a coarse magnetite concentrate during ship loading.

LABORATORY BATCH TEST

A laboratorie batch test was conducted by the Mineral Dressing Laboratory at NTH (Norwegian Institute of Technology). The results of this study and the proposed flow sheet for the concentrator are presented as Encl. 1 and 2 and Fig. 47.

The required investment costs were evaluated by two means. The first being a graphical method presented by O'Hara (1960) and second an estimate provided by Tord Hansen, which is presented as Encl. 3. The investment costs for the consentrator have been estimated for both new and used equipment and for both a transportable (ship mounted) and a stationary mill.

SUPPORT FACILITIES

ROADS

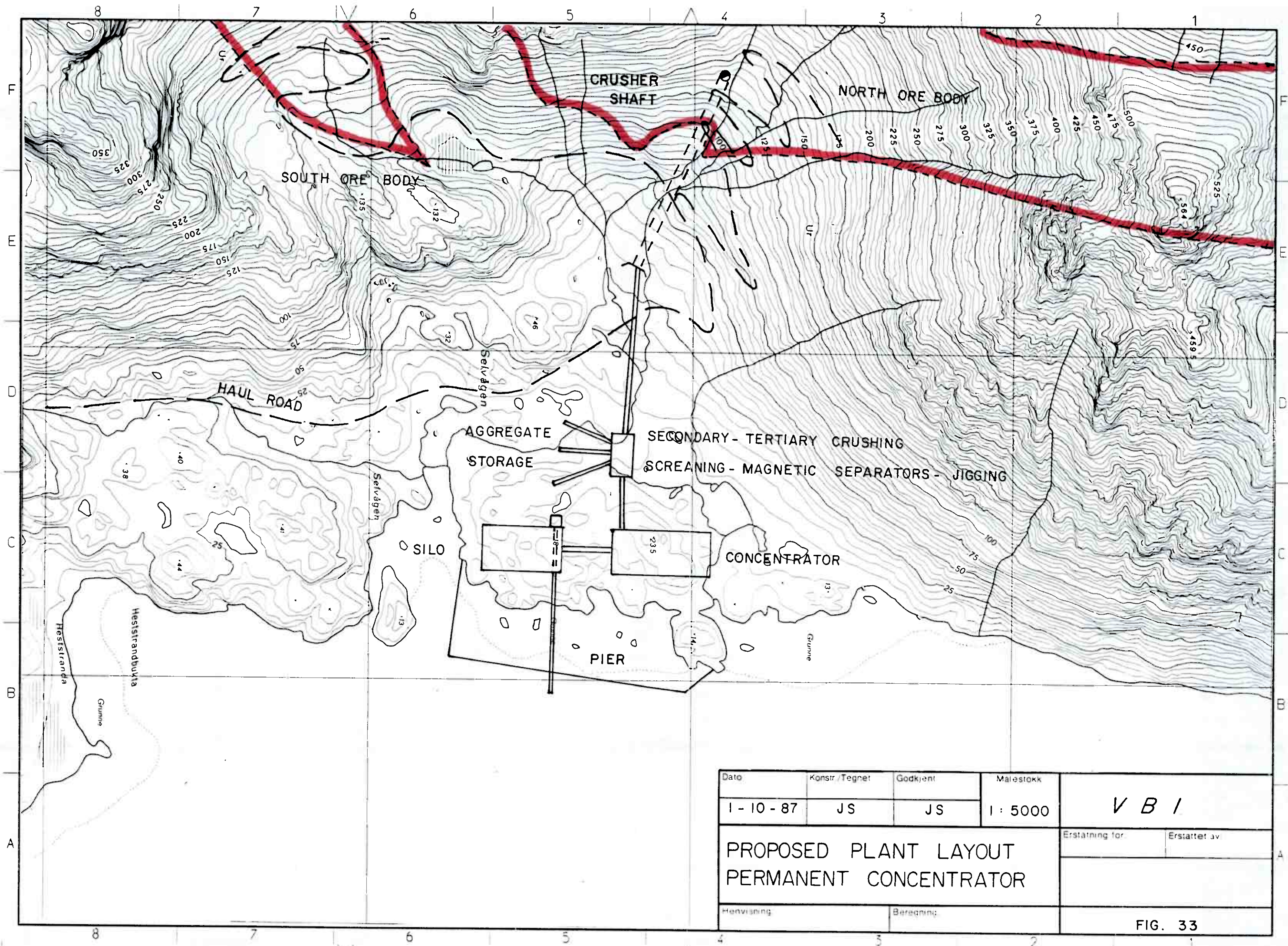
A 3 km. access road is currently being planted by Bø kommune which will connect the mine to the main road at Eide. The road will be constructed in the summer of 1988. Its location is shown on Fig. 48.

WATER

Process water can be obtained as fresh water from a lake over the mountain to the west or from a lake across the fjord to the east. In either case water would be pumped through a 16" plastic pipe to the concentrator. This pipeline with pumping station is estimated to cost 1 million Nkr. and the location is shown on Fig. 48.

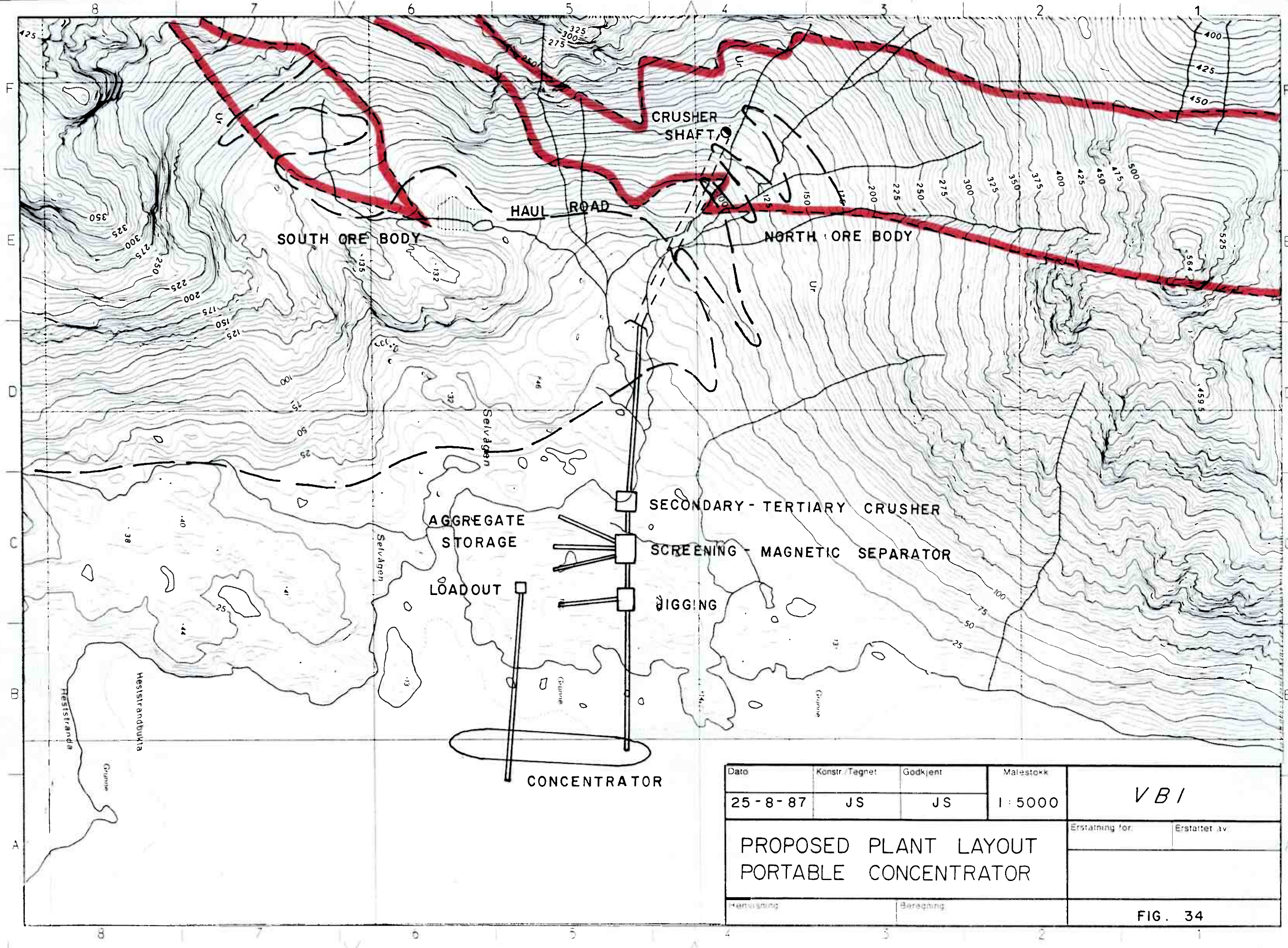
POWER

The local power company Vesterålen Kraftlag A/S is currently planning a new power line to supply a new asphalt plant to be located over the mountain to the west of the mine. The power company plans to redesign this power line to accomidate the approximately 10 mwa power requirements of the mine and mill.

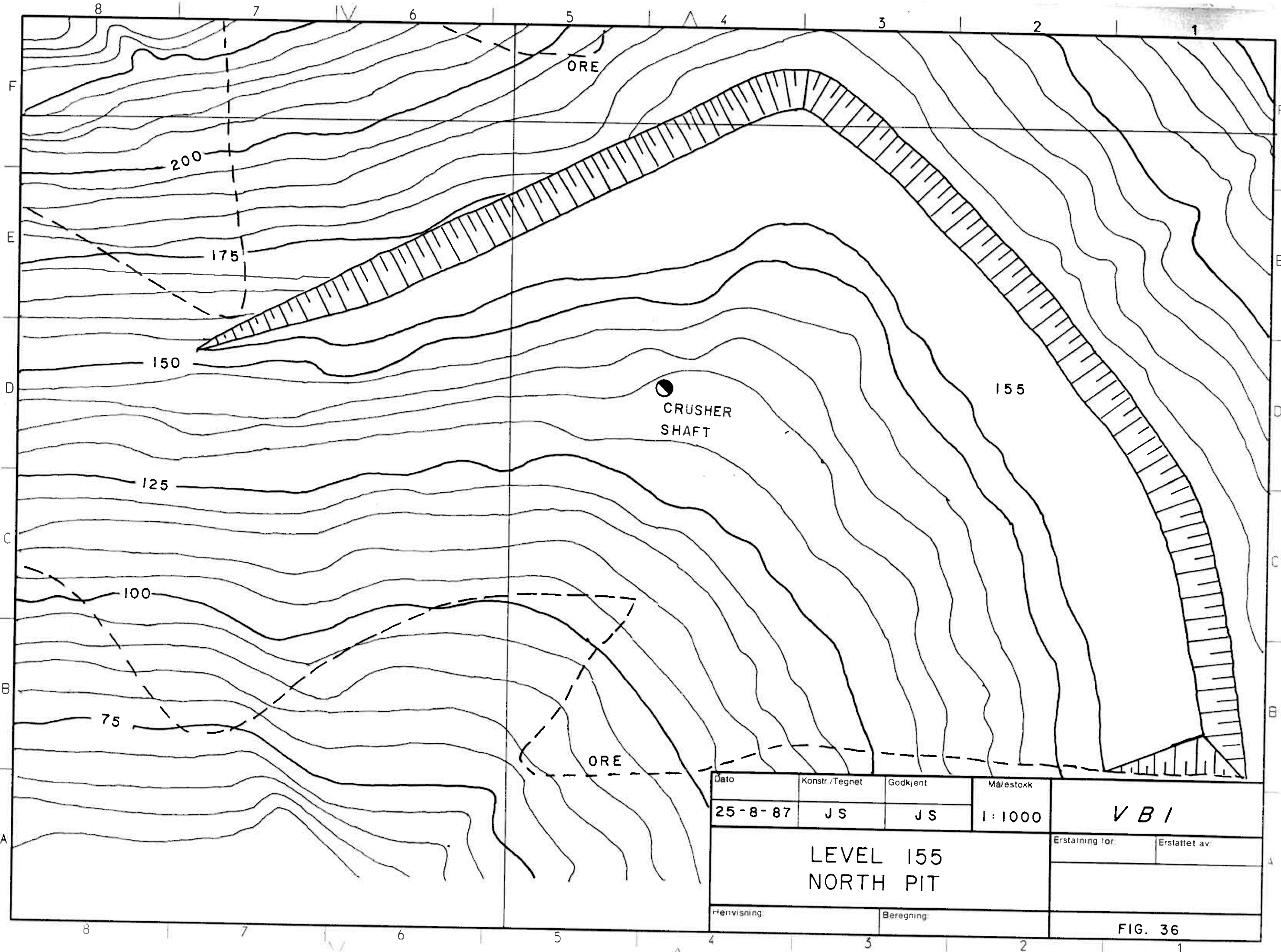


Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
1 - 10 - 87	JS	JS	1 : 5000		
PROPOSED PLANT LAYOUT PERMANENT CONCENTRATOR				Erstattning for	Erstattet av
Henvisning				Beregning	
				FIG. 33	

A STORRKOPI HD 2/NS 1402.NS 1417.NS 1415

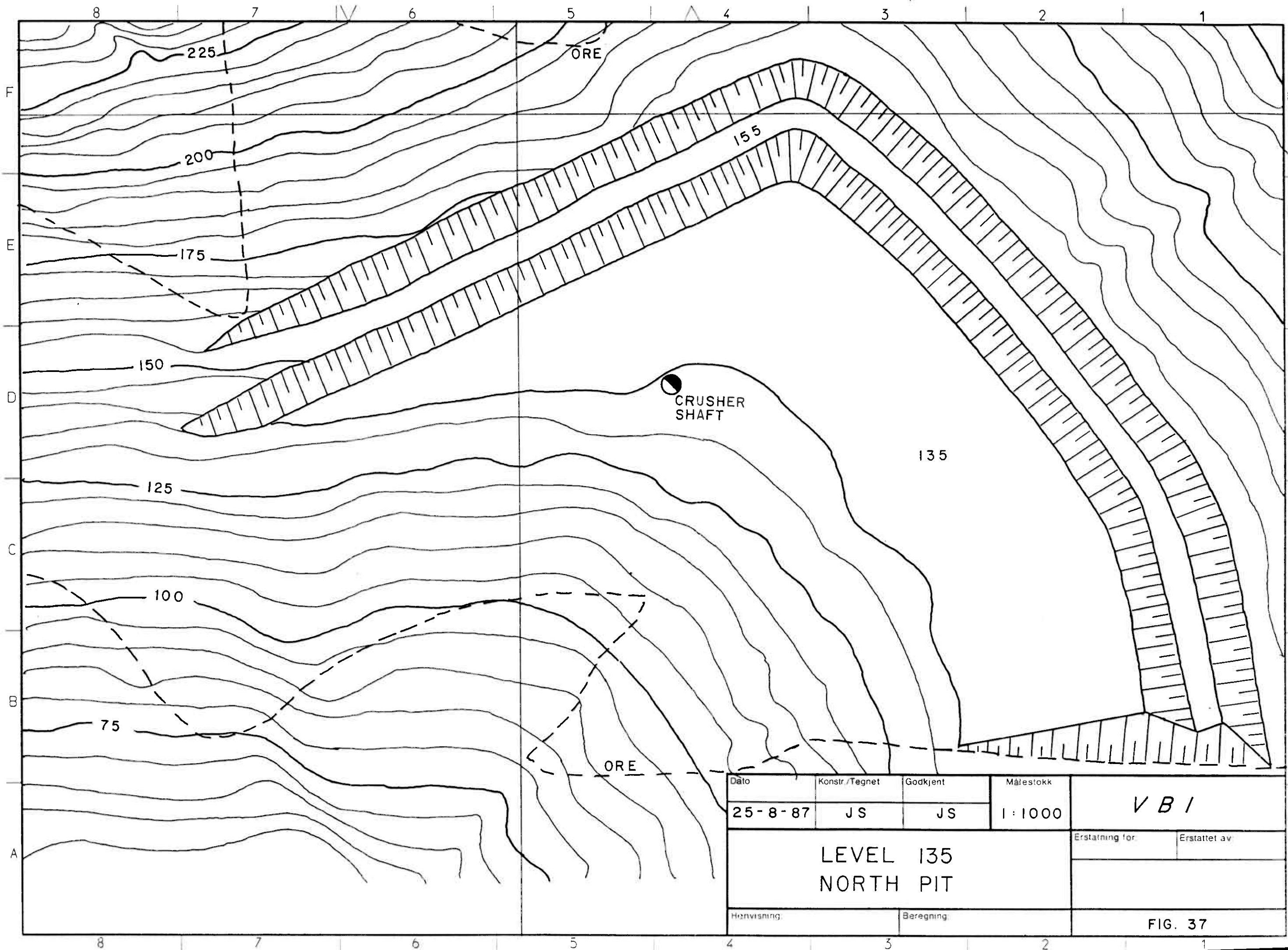


Dato	Konstr. / Tegn.	Godkjent	Maalestokk	VBI	
25-8-87	JS	JS	1:5000		
PROPOSED PLANT LAYOUT PORTABLE CONCENTRATOR				Erstatning for:	Erstattet av:
Rev. / Beregning				FIG. 34	



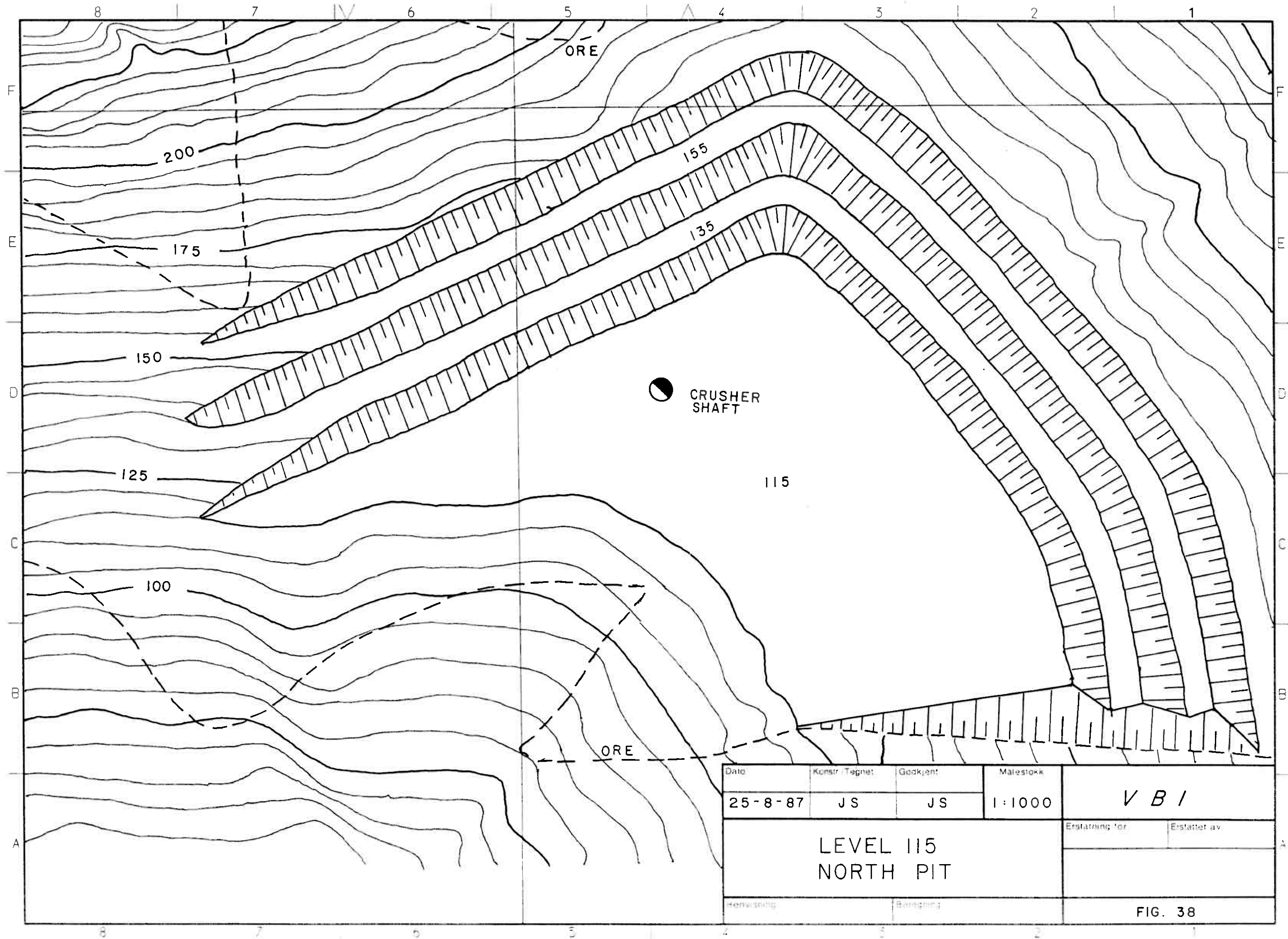
Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
25-8-87	JS	JS	1:1000		
LEVEL 155 NORTH PIT				Erstatning for:	Erstattet av:
Henvisning:		Beregning:		FIG. 36	

A. STORRKOPI HD 2/NS 1402, NS 1417, NS 1415

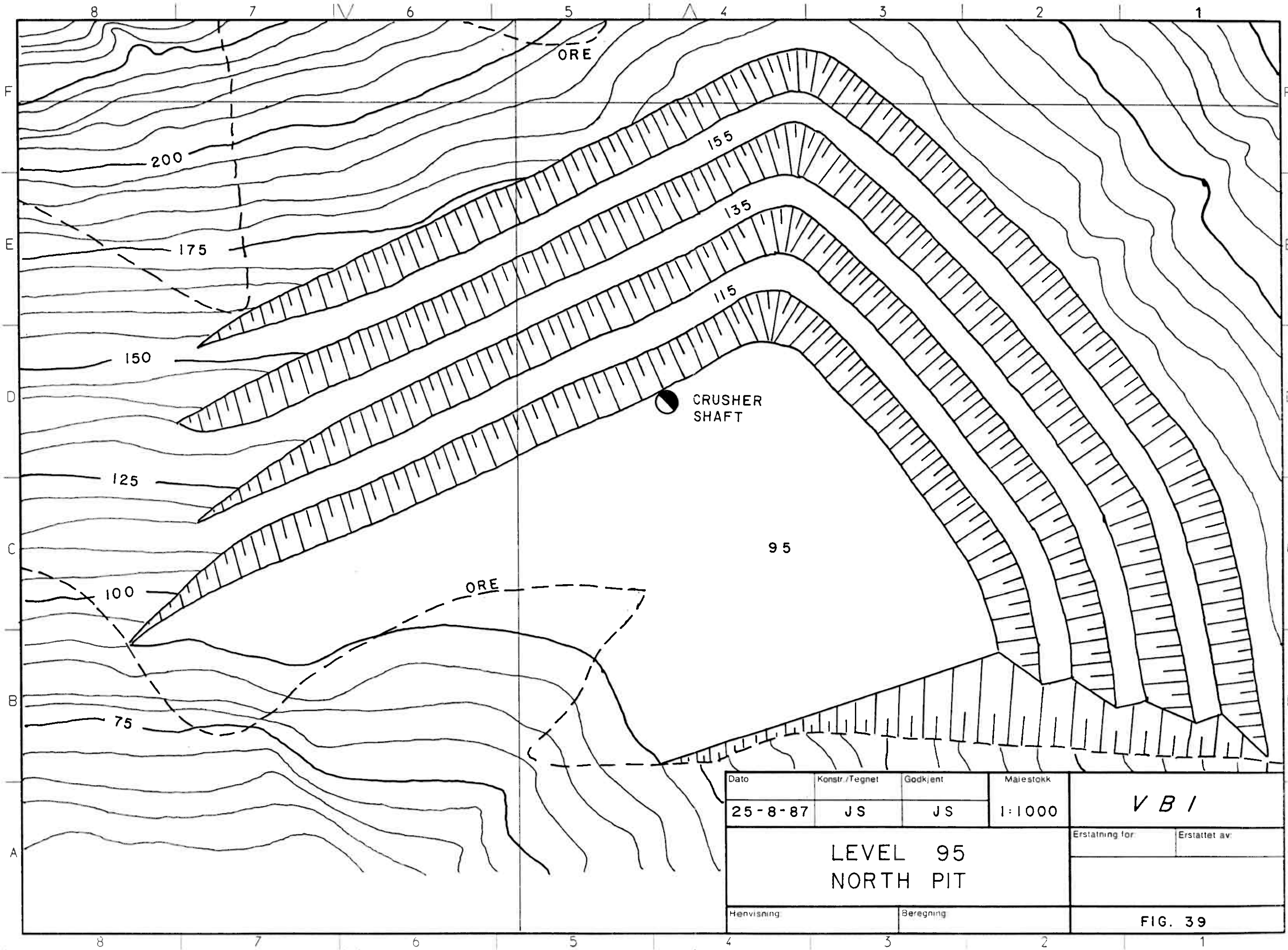


A S TORRKOPPI HD 2 / NS 1402, NS 1417, NS 1415

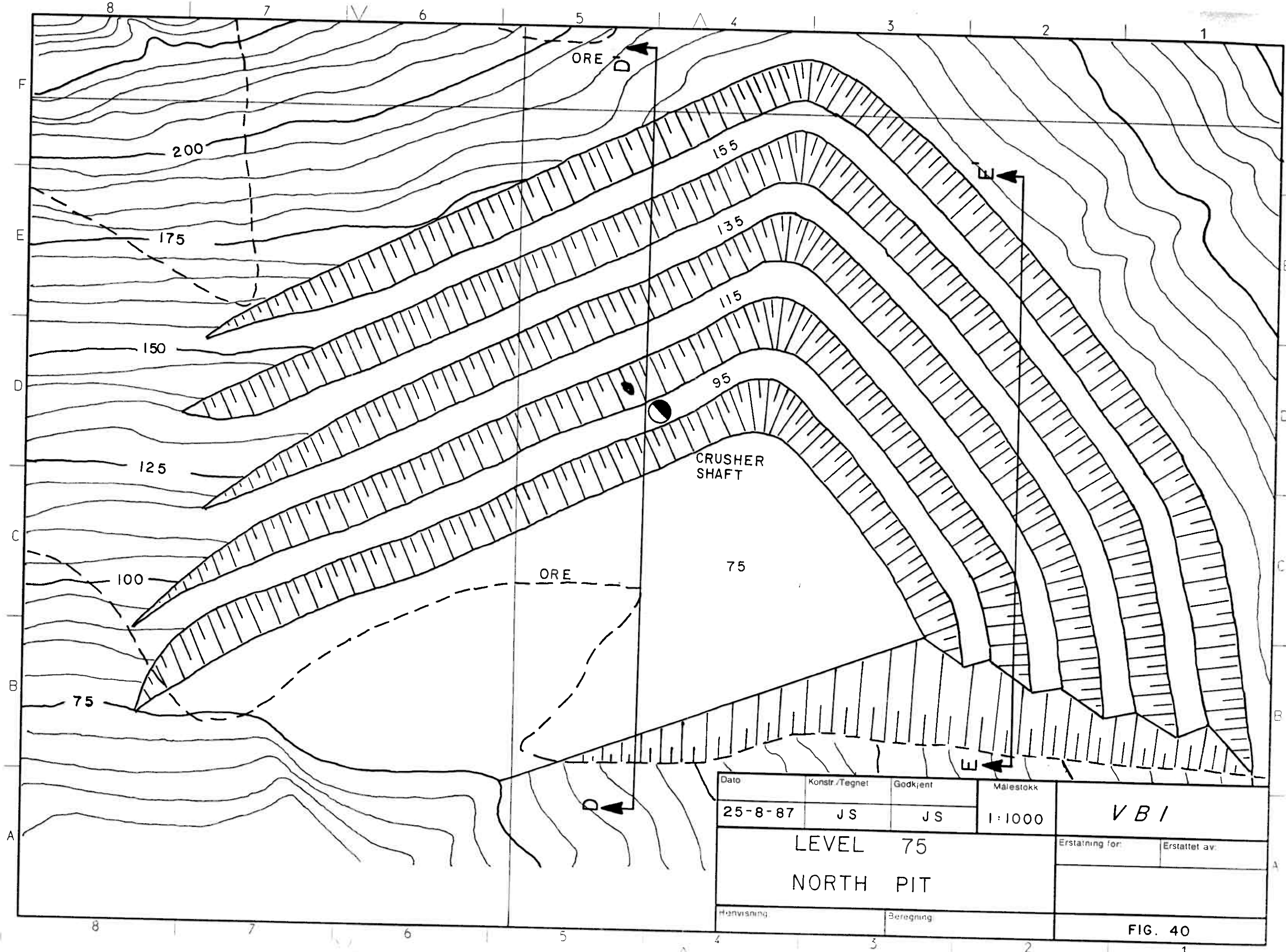
AS 10160001 HD 2/NS 1402 NS 1417 NS 1415



AS TORRKOPI HD 2 / NS 1402, NS 1417, NS 1415

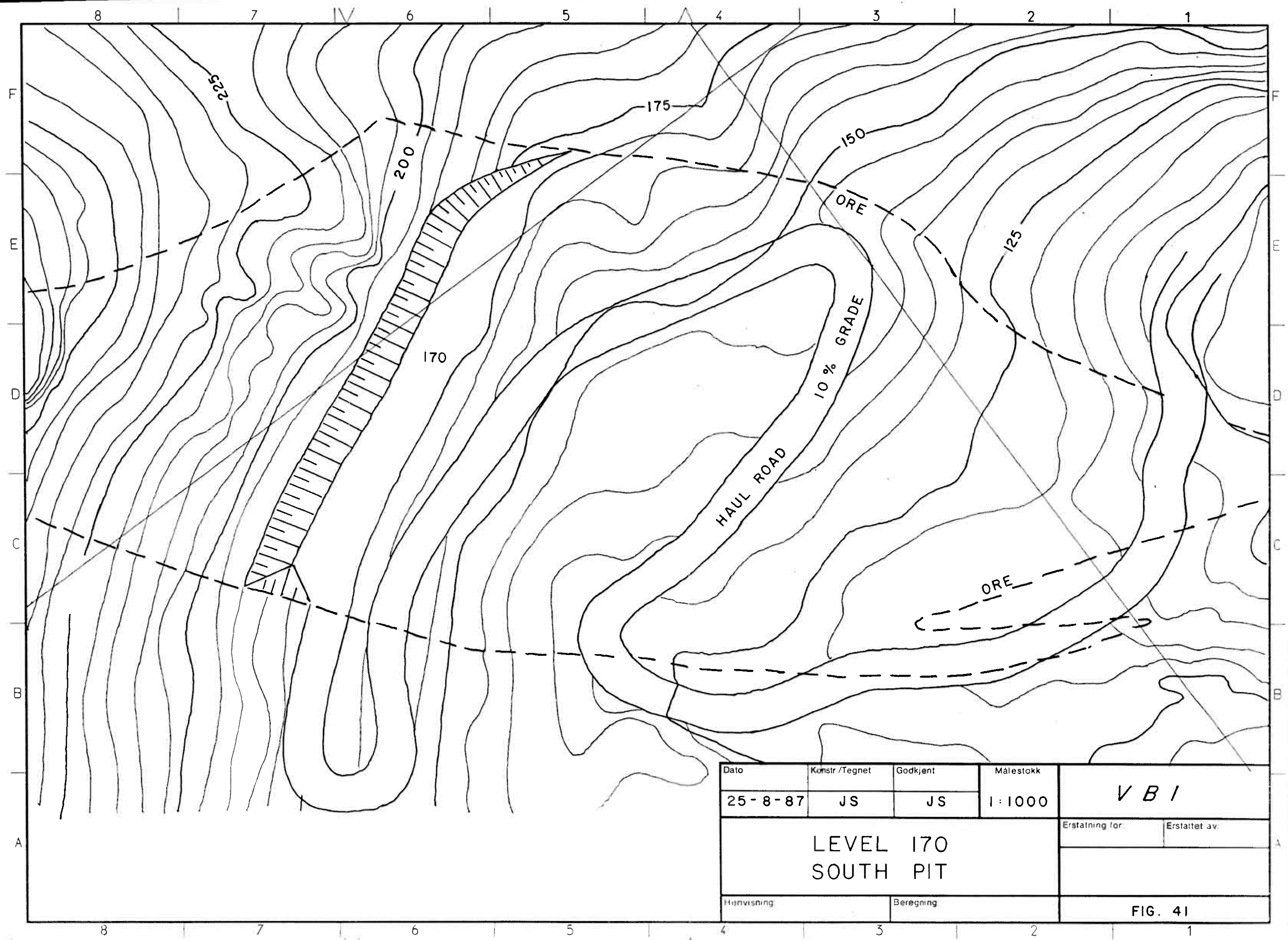


Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
25-8-87	JS	JS	1:1000		
LEVEL 95 NORTH PIT				Erstatning for:	Erstattet av:
Henvising		Beregning		FIG. 39	



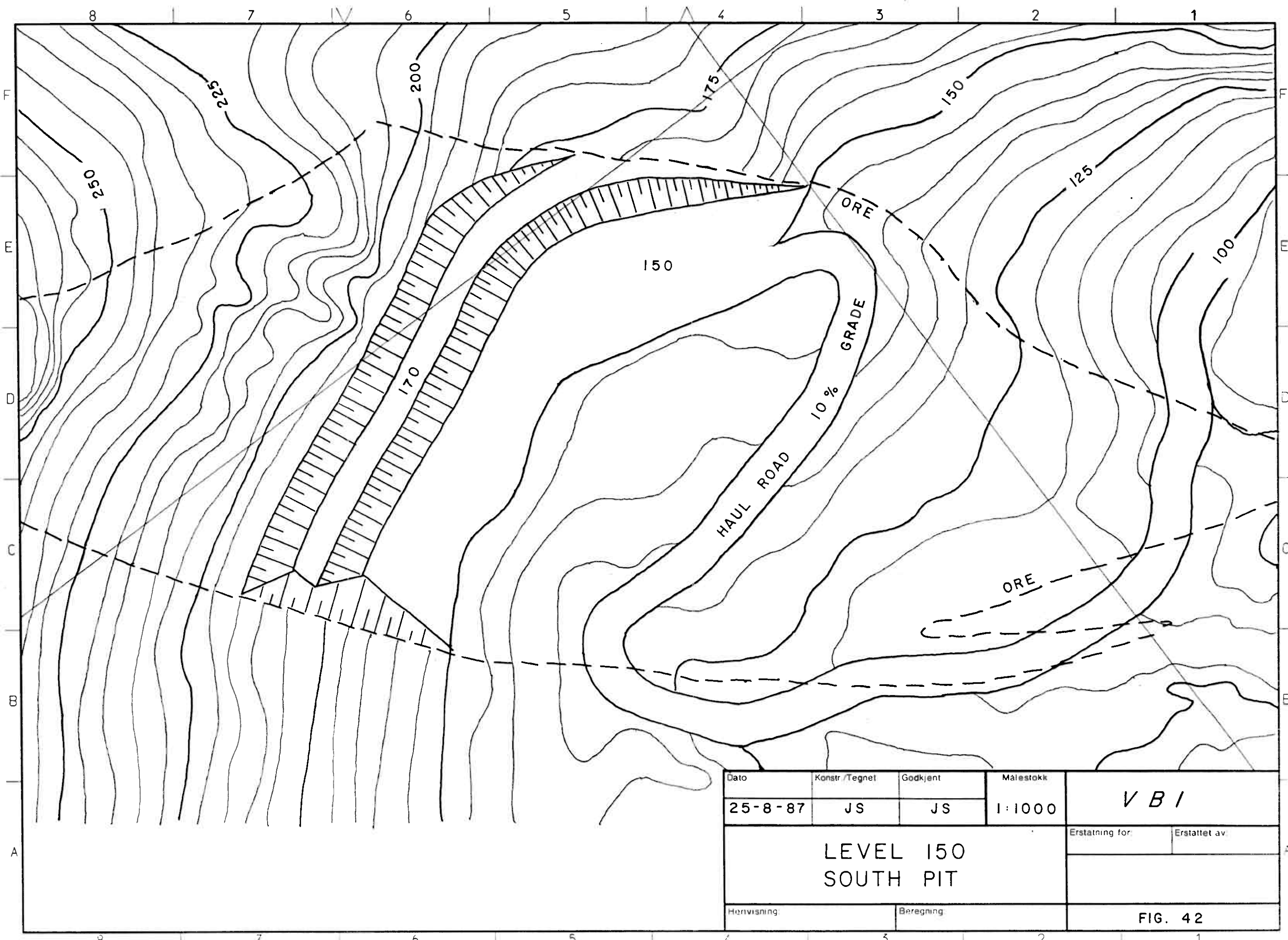
Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
25-8-87	JS	JS	1:1000	Erstattet for:	Erstattet av:
LEVEL 75 NORTH PIT					
Henviisning		Beregning		FIG. 40	

AS TØRHKOP1 HD 2/ NS 1402. NS 1417. NS 1415

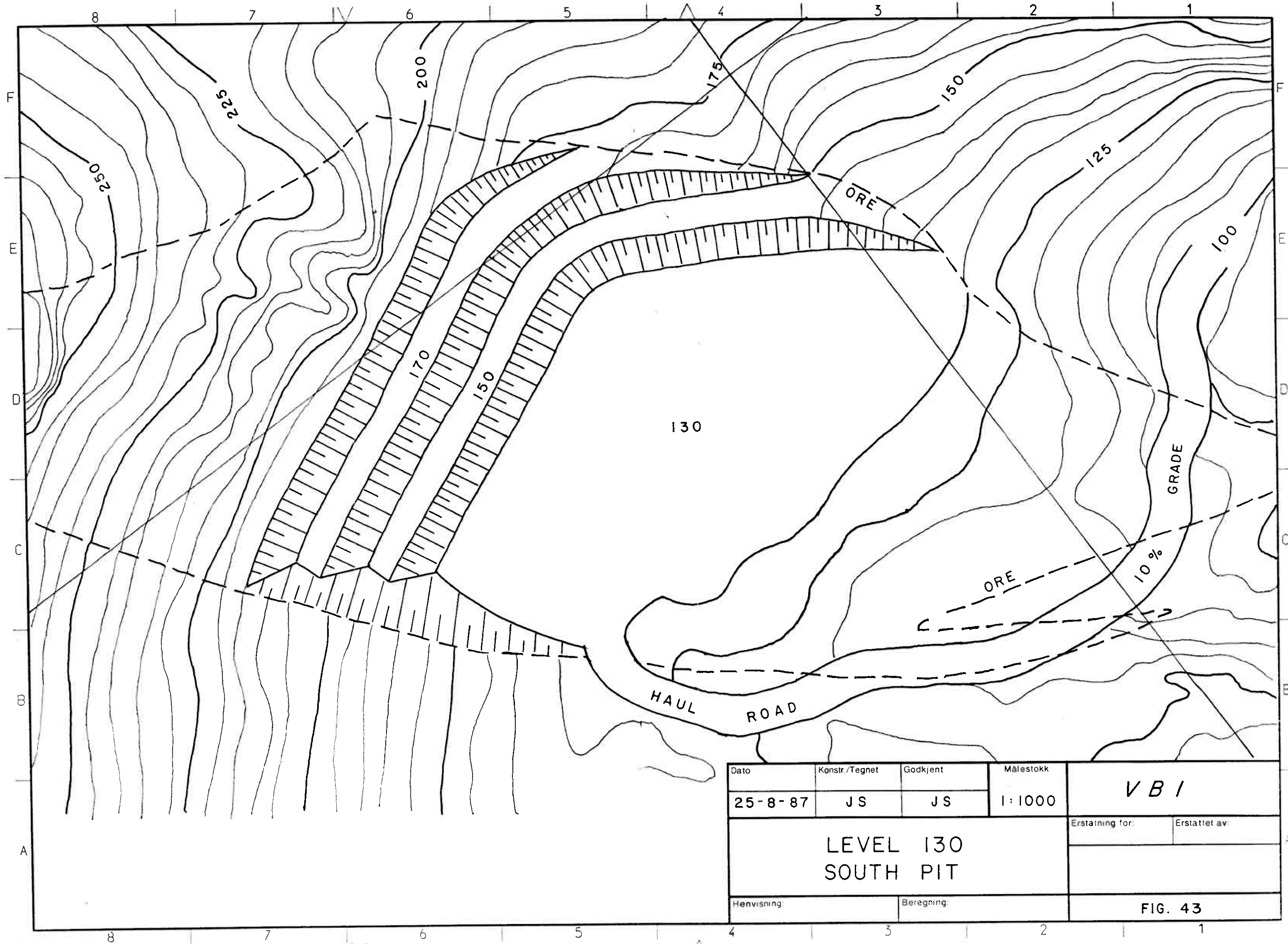


Dato	Konstr /Tegnet	Godkjent	Målestokk	V B I	
25 - 8 - 87	JS	JS	1 : 1000		
LEVEL 170 SOUTH PIT				Erstatning for:	Erstattet av:
Henvisning		Beregning		FIG. 41	

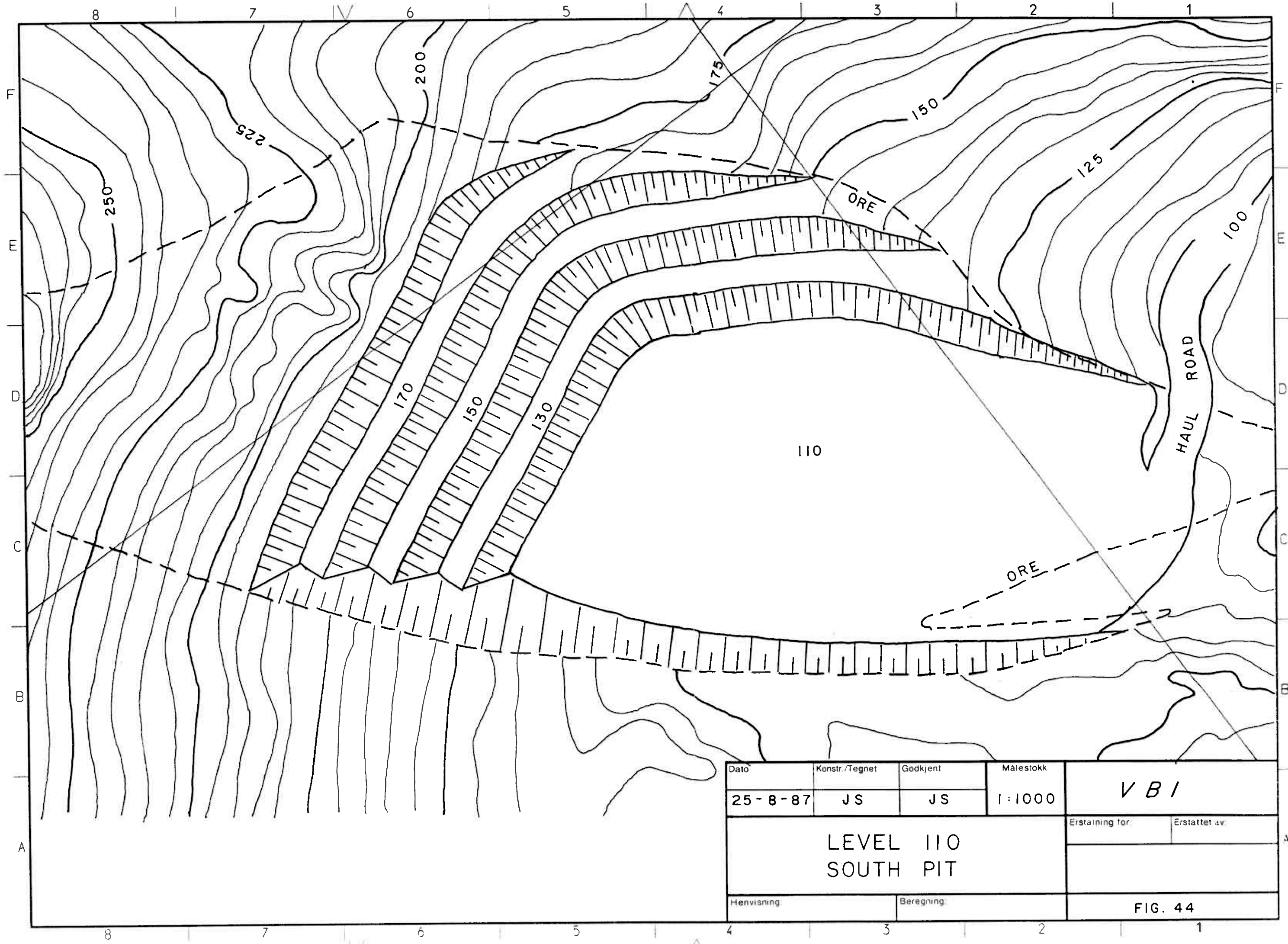
A S TORRKOPI HD 2 / NS 1402, NS 1417, NS 1415



Dato	Konstr / Tegnet	Godkjent	Målestokk	V B I	
25-8-87	JS	JS	1:1000	Erstatning for:	Erstattet av:
LEVEL 150 SOUTH PIT					
Henvisning:		Beregning:		FIG. 42	

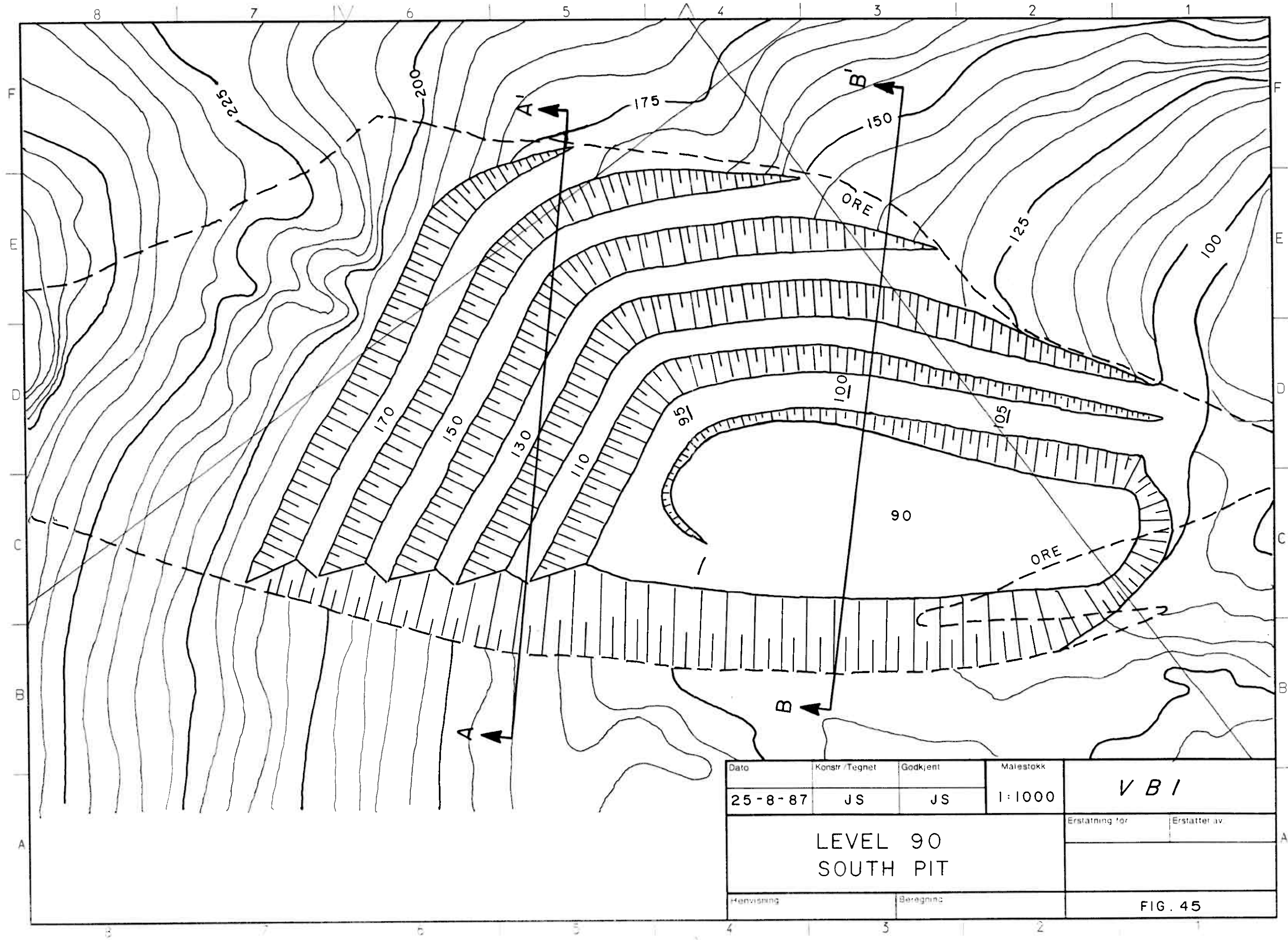


A S TORRKOPPI HD 2/NS 1402, NS 1417, NS 1415



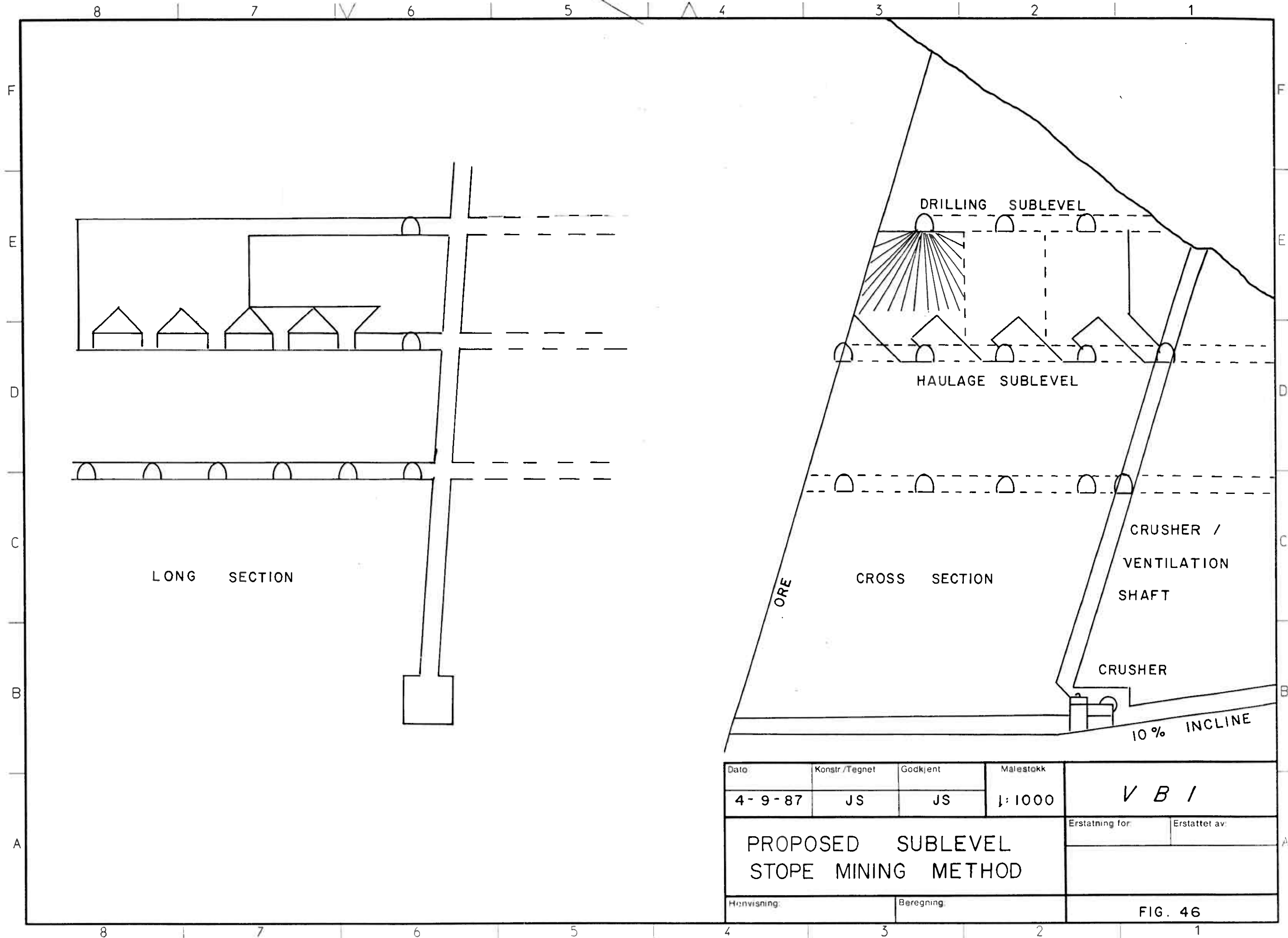
Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
25 - 8 - 87	JS	JS	1:1000		
LEVEL 110 SOUTH PIT				Erstatning for	Erstattet av
Henvisning:		Beregning:		FIG. 44	

AS 1000000 1002 1002 NS 1417 NS 1415

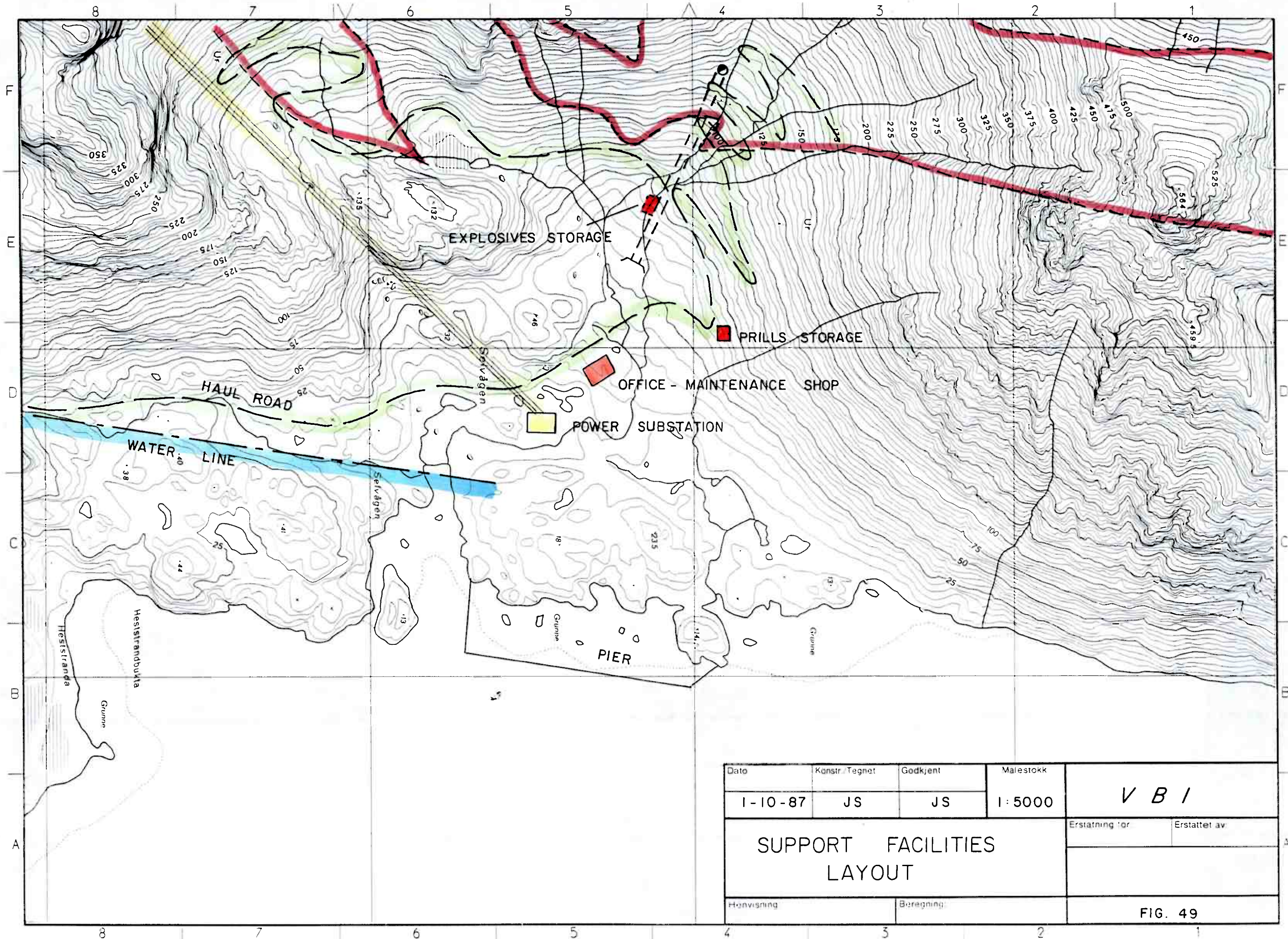


Dato	Konstr / Tegner	Godkjent	Målestokk	V B I	
25-8-87	JS	JS	1:1000	Erstatning for	Erstatter av
LEVEL 90 SOUTH PIT					
Henvisning		Beregning		FIG. 45	

A S TORRKOP HD 2 / NS 1402, NS 1417, NS 1415



Dato	Konstr./Tegnet	Godkjent	Malestokk	V B I	
1-10-87	JS	JS	1:20 000		
WATER - POWER - ROAD LOCATIONS				Erstatning for:	Erstattet av:
Henvisning:		Beregning:		FIG. 48	



Dato	Konstr. / Tegnet	Godkjent	Målestokk	V B I	
1-10-87	JS	JS	1:5000		
SUPPORT FACILITIES LAYOUT				Erstatning for	Erstattet av
Henvisning		Beregning		FIG. 49	

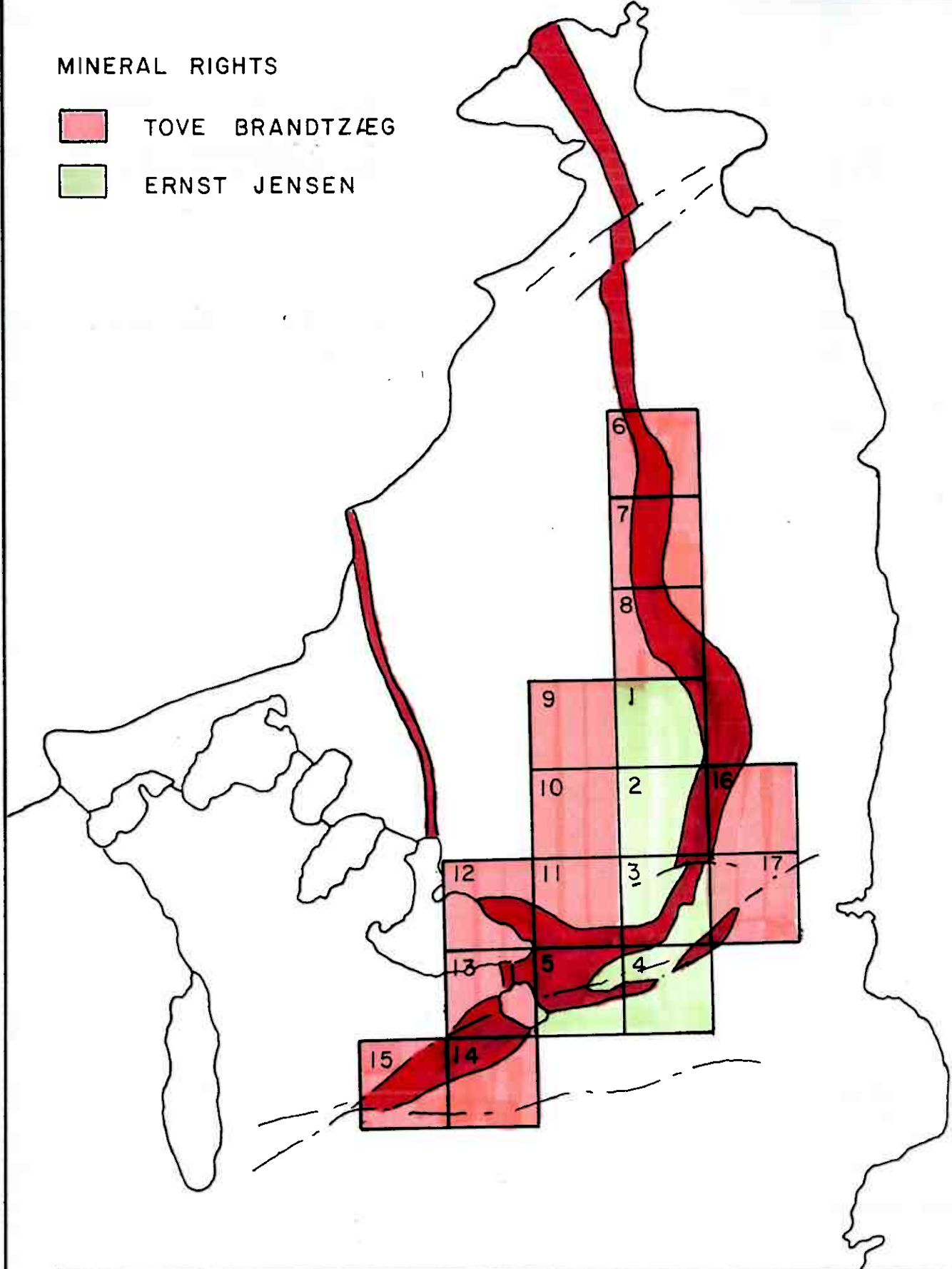
MINERAL RIGHTS



TOVE BRANDTZÆG



ERNST JENSEN



Dato	Konstr / Tegnet	Godkjent	Maalestokk	V B I	
28 - 10 - 87	JS	JS			
CLAIM LOCATIONS SELVAG DEPOSIT				Erstatning for:	Erstattet av
Henvisning:		Beregning:		FIG. 50	

This is estimated to cost 5 million Nkr. The cost estimated from the power company is presented as Enc. 7 and the location of the power line is shown on Fig. 48.

TAILING DISPOSIAL

In the initial stages the unrecoverable (non-sand) tailings will be dumped as deep as possible in the bottom of the fjord. The fjord is so deep (____) that no problems affecting local salmon farming are expected. As the underground mining advances, the tailings can be deposited in the abandoned rooms. However, this must be approved by the Dept. of Environment.

MAINTENANCE FACILITY

A maintenance shop for mine vehicles will cost approximately 2,5 million Nkr. and will be located as shown in Fig. 49.

REPAIR PARTS SUPPLY

A repair parts supply room will be included as part of the concentrator.

EXPOSIVE STORAGE

An ammonium nitrate (prills) mixing plant will be placed as shown in Fig. 49 and will cost 200,000 Nkr. A storage room for caps and dynamite will be located in the mine tunnel as shown in Fig. 49.

EQUIPMENT

SURFACE MINING

Surface Drilling will be accomplished utilizing 1 or 2 Atlas Copco Roc 712 drilling rigs. (See Fig. 51 to 53). Haulage will be accomplished utilizing 2 or 3 Cat 988 front end loaders

hauling to the central crusher shaft. (See Fig. 54 through 56). A explosives mixing and haulage truck will be utilized for the loading of the explosives. (See Fig. 57 through 59). Prices for this equipment are presented as Encl. 4 and 5.

UNDERGROUND MINING

The same equipment that is utilized for the open pit mining will also be utilized in the underground mining except that an Atlas Copco tunneling rig. will be utilized for the tunnel drilling. (See Fig. 60 through 62).

CRUSHING PLANT

The crushing plant will be a 3 stage crushing, screening, magnet separation and jigging plant. A layout is shown in Fig. 34 and 35 and a flow diagram is shown in Fig. 63. The purpose for this 3 stage crushing plant is to produce crushed aggregate and RBC (magnetite gravel) as well as to provide crushed ore for the mill.

The primary crusher will be a 5' jaw crusher placed underground at the bottom of the crusher shaft. The secondary crusher will be an KSL-D6 cone crusher. The tertiary crusher will be an Short Cone 360 crusher. The cost of the crushing plant is estimated at 18 million Nkr. (See Enc. 6). The major items of crusher plant equipment are shown in Fig. 65 through 71.

FIG. 51

Helhydrauliska pallborningsaggregat

ROC 712HC-01, ROC 712HC-01R

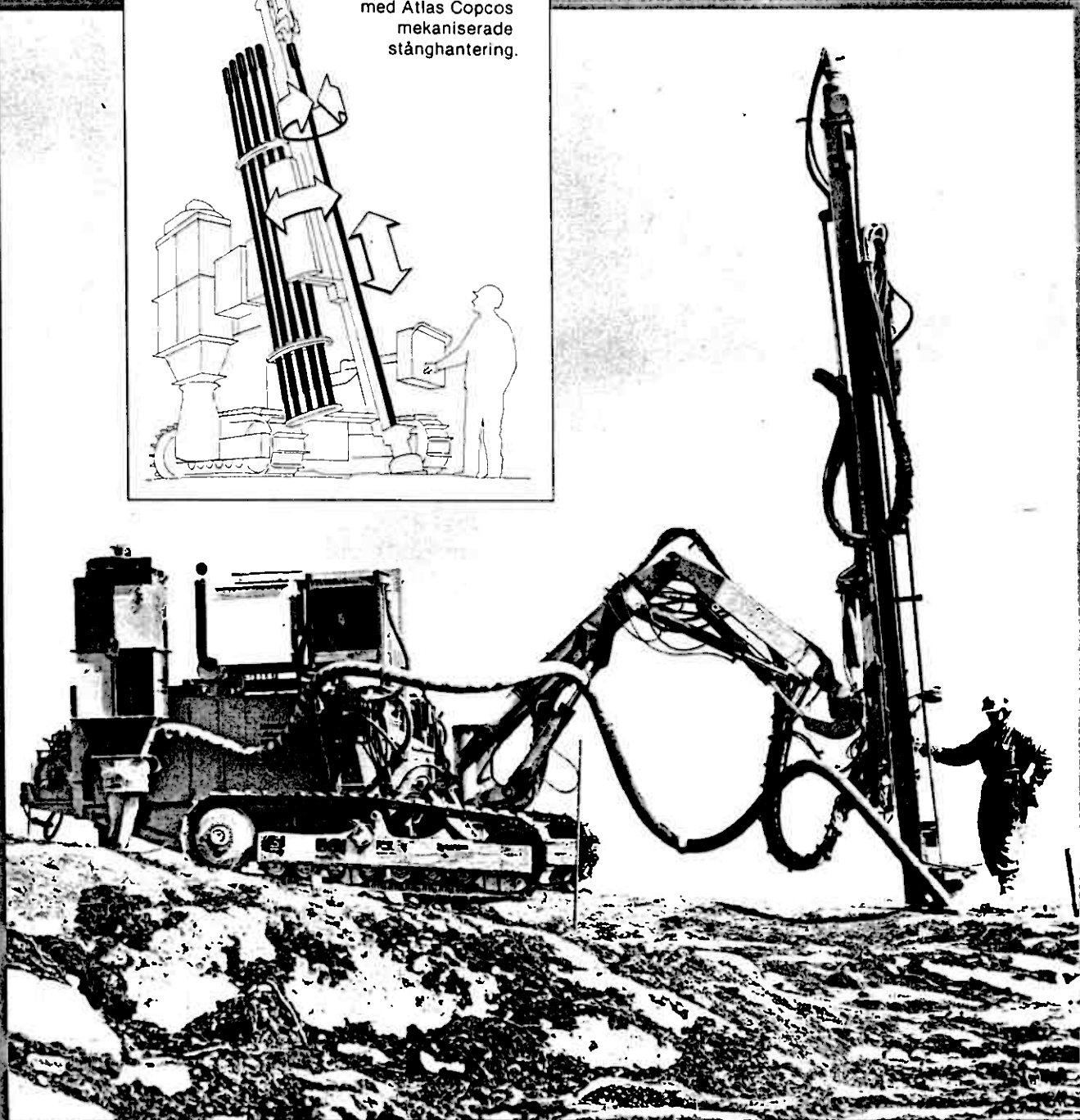
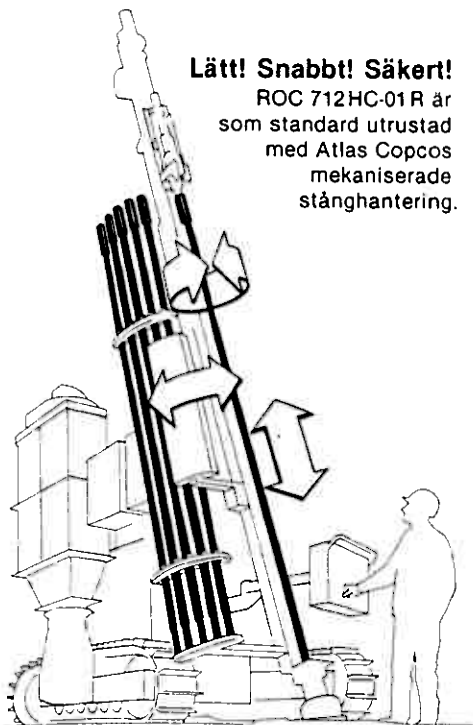
med vikbom och inbyggd kompressor

Atlas Copco

**HELGESEN
MASKIN A/S
9300 FINNSNES
TEL. 089/41046,**

Lätt! Snabbt! Säkert!

ROC 712HC-01R är
som standard utrustad
med Atlas Copcos
mekaniserade
stånghantering.



Mångsidiga borraraggregat för entreprenadarbeten och produktionsborrning

Exempel på viktiga komponenter i standard-utrustning och extra utrustning:

Hydraulisk kedjematare med styv balkprofil och 32 mm (1 1/4") matarkedja. För borrarstålslängd 3660 mm.

Slanggalje för styrning av slangarna vid liggarborrning.

Hydraulisk bergbormaskin COP 1238 LP för R32 och T38 skarvstängsutrustning.

Hydraulisk hylshållare för säkrare och enklare skarvning.

Vikbom ger stor räckvidd både vertikalt och horisontellt. Utsvängbar 90° för sidoborrning.

Hydrauliskt borrarstöd som är förskjutbart för bättre borrarstälstyrning och för friläggning av borrhålet. Ett hydrauliskt borrarstödstopp låser borrarstödet i övre läget, t.ex. vid byte av borrarbrona.

Främre manöverpanel med pådrag för borrning och bompositionering. Direktmonterad på mataren som standard.

Svängarm för manöverpanel vid borrning av liggare.

Svängarm för åkpådrag ökar operatörens säkerhet vid körning i svår terräng.

Kraftfull drivanordning med effektiva åkmotorer och automatiska bromsar. Bandpendling $\pm 10^\circ$ för varje bandram bidrar till goda åkegenskaper.

ROC712HC-01 och -01R är avsedda för pallborrning med 64—89 mm håldiameter. Båda är försedda med inbyggd kompressor och vikbom med stor räckvidd. De har utmärkta terränegenskaper och underlättar service och underhåll genom god åtkomlighet.

Utmärkande för ROC 712HC-01R är det mekaniserade stånghanteringssystemet, en viktig, arbetsbesparande utrustning som är standard på denna rigg.

RHS, mekaniserad stånghantering (Endast ROC 712HC-01R)
Alla sekvenser i stånghanteringen sköts med pådrag från manöverpanelen. Stångmagasinet rymmer sex R32- eller T38-stänger med en längd av 3660 mm.

Inbyggd Atlas Copco-kompressor gör borraraggregatet självförsörjande på tryckluft för spolning av borrhålet och smörjning av bormaskinen.

Hydrauldriven dammavskiljare ger bättre arbetsmiljö, lägre underhållskostnader genom mindre slitage på utrustningen, och förbättrad spolning.

Overvakningssystem för indikering av funktionsfel. Varningslampor på instrumentpanelen markerar vid olika fel på aggregatet. Vid vissa fel stannas dieselmotorn automatiskt.

Manöverplattform med pådragspaneler för dieselmotor, kompressor, åkning, bandpendling och vissa bomrörelser. Pådragspanelen är utsvängbar för god åtkomlighet vid service.

Hydrauliskt stödben för stadigare uppställning i svår terräng.

Hydraulisk winch ger ökad säkerhet vid körning och uppställning i svår terräng.

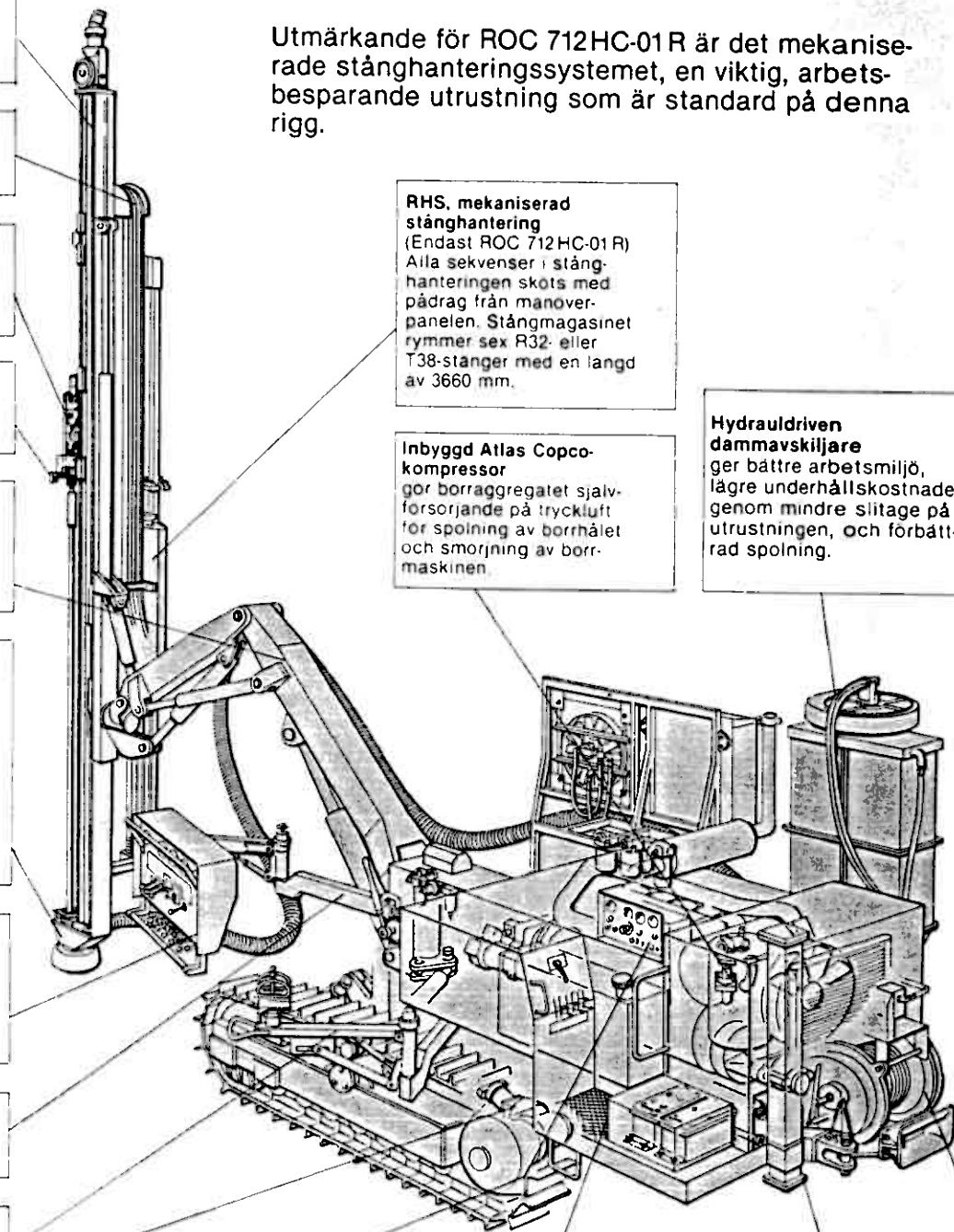


FIG. 53
Tekniska data

	ROC 712 HC-01	ROC 712 HC-01 R med mekani- serad stång- hantering
Vikt, i standardutförande	9900 kg	10350 kg
Prestanda		
Deutz diesel BF6L 913, effekt vid 2300 rpm	104 kW	104 kW
Åkshastighet, standard	1,5 km/h	1,5 km/h
Åkshastighet, extra utrustning	3,7 km/h	3,7 km/h
Dragkraft	75 kN	75 kN
Markfrigång	370 mm	370 mm
Backlagtningsförmåga	30°	30°
Bandpendling	±10°	±10°
Marktryck	0,067 N/mm ²	0,070 N/mm ²
Kedjematare		
Typ	CFH 712-03	CFH 712-02
Vikt, utan bormaskin	500 kg	650 kg
Längd, totalt	7050 mm	7500 mm
Matningslängd	4400 mm	4400 mm
Matningshastighet, max.	0,56 m/s	0,56 m/s
Matningskraft, max.	13 kN	13 kN
Hydraulisk bergbormaskin COP 1238 LP		
Vikt	150 kg	150 kg
Längd	1000 mm	1000 mm
Bredd, exkl. anslutningar	240 mm	240 mm
Höjd	225 mm	225 mm
Arbetstryck, slagverk	120—240 bar	120—240 bar
Rotationsvarvtal, steglöst reglerbart	0—300 rpm	0-300 rpm
Vridmoment, max.	500 Nm	500 Nm
Sandvik Coromant borrarstålsutrustning		
Skarvstänger		
R32	32 x 3660 mm*)	32 x 3660 mm
T38	38 x 3660 mm*)	38 x 3660 mm
Borrkronor, diameter		
För R32	48—64 mm	48—64 mm
För T38	64—89 mm	64—89 mm

*) Max. 3050 mm med både slanggalje och hydrauliskt borrarstodsstopp.

Mekaniserad stånghantering

Stångmagasin, kapacitet — 6 x R32/T38

Kompressor XA 85

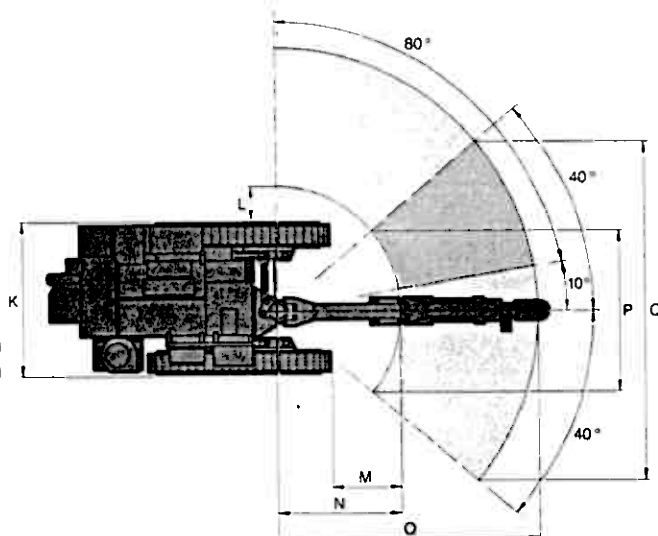
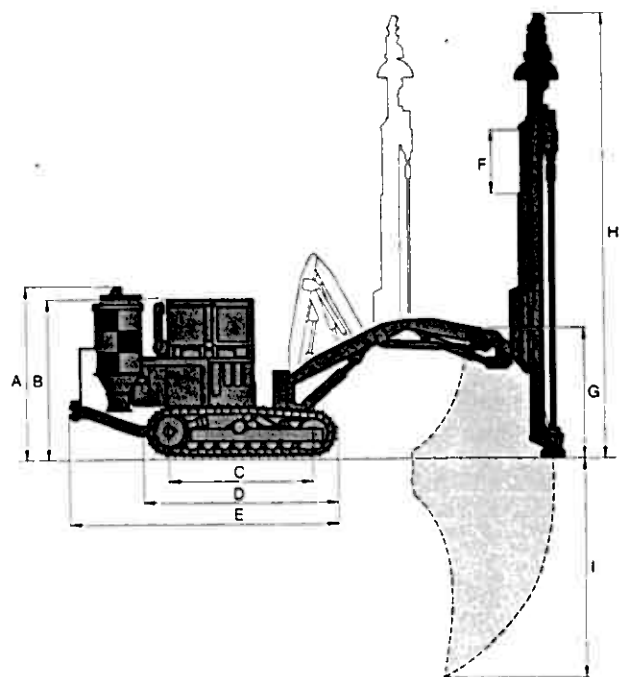
Max. arbetstryck 8 bar 8 bar
Normalt arbetstryck, upp till 1000 m över havet 7 bar 7 bar
Kapacitet vid 7 bar 82,5 l/s 82,5 l/s

Elsystem

Spänning 24 V 24 V
Batterier 2 x 12 V, 135 Ah 2 x 12 V, 135 Ah

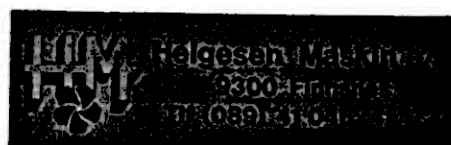
Oljevolym

Hydraulsystem, totalt 260 l 260 l
Hydrauloljetank 215 l 215 l
Bränsletank, diesel 210 l 210 l



Dimensioner, mm

A	B	C	D	E	F
2900	2630	2400	3140	4450	1200
G	H	I	K	L	M
2200	7050 (ROC 712 HC-01) 7500 (ROC 712 HC-01 R)	3700	2440	640	1230
N	O	P	Q		
2100	4430	2700	5700		





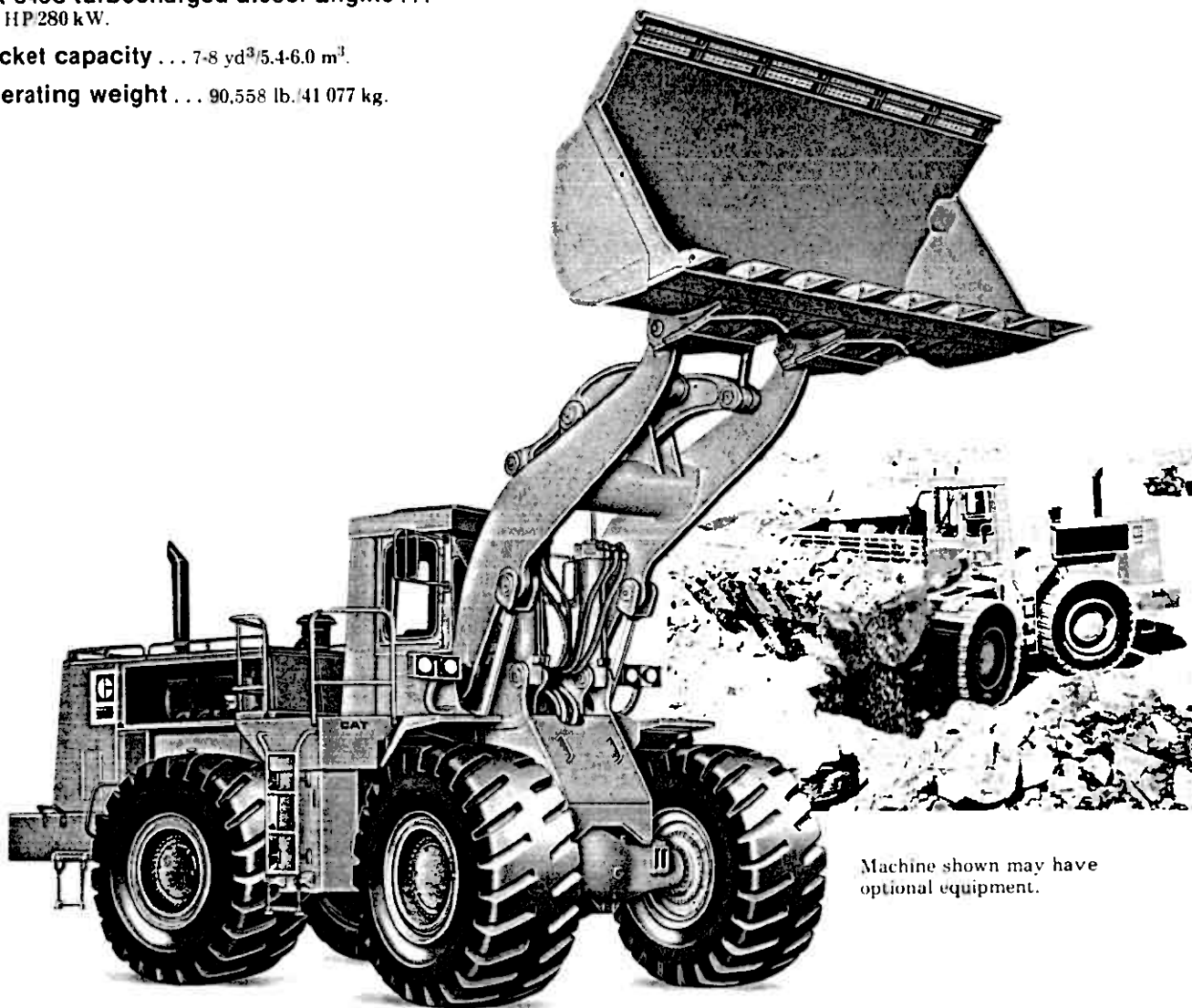
CATERPILLAR

988B

Wheel Loader

Summary of features

- **Rated load** . . . 21,200 lb./9600 kg.
- **Cat 3408 turbocharged diesel Engine** . . . 375 HP/280 kW.
- **Bucket capacity** . . . 7-8 yd³/5.4-6.0 m³.
- **Operating weight** . . . 90,558 lb./41 077 kg.



Machine shown may have optional equipment.



Caterpillar Engine

Flywheel power at 2200 rpm . . . 375 HP/280 kW.
(Kilowatts (kW) is the International System of Units equivalent of horsepower.)

The net power at the flywheel of the vehicle engine operating under SAE standard ambient temperature and barometric conditions, 77° F/25° C and 29.61" Hg/100 kPa, using 35 API gravity fuel oil at 60° F/15.6° C, and after deductions for fan, air cleaner, water pump, lubricating oil pump, fuel pump, alternator and muffler. No derating is required up to 7,500 ft./2300 m altitude.

Caterpillar four-stroke-cycle, 3408 turbocharged diesel Engine, 65" V-8 with 5.4"/137 mm bore, 6.0"/152 mm stroke and 1,099 cu. in./18.0 liters displacement.

Caterpillar direct injection fuel system. Integral inlet manifold porting with two intake and two exhaust valves per cylinder. Valves

are actuated by a pushrod mechanism. Single camshaft is mounted into "V" of engine. Variable timing fuel system. Adjustment-free fuel pumps, non-clogging injection valves.

24-volt direct electric starting system with ether starting aid standard. (Ether canister not included.)



transmission

Cat planetary type. Full power shift in four forward and four reverse speeds.

Single lever on left side of steering column controls both speed and direction. Rotate the handle for four speed ranges in forward and reverse. Move the lever forward or backward for directional change. Transmission lever is locked in neutral by moving steering column to forward-most position.

Variable capacity torque converter lets operator match rimpull to specific application.

Bucket Type Rated load(\$)		V-Edge		ROPS		Straight Edge		Stationary		General Purpose	
		Without Teeth	With Teeth	Without Teeth	With Teeth	Without Teeth	With Teeth	Without Teeth	With Teeth	Without Teeth	With Teeth
		21,200	21,200	21,200	21,200	21,200	21,200	21,200	21,200	21,200	21,200
		5600	5600	5600	5600	5600	5600	5600	5600	5600	5600
Capacity, heaped	yd ³	7.00	7.00	7.00	7.00	7.00	7.00	7.00	7.00	8.00	8.00
	m ³	5.4	5.4	5.4	5.4	5.4	5.4	5.4	5.4	6.0	6.0
Capacity, struck(\$)	yd ³	5.95	5.95	5.95	5.95	5.95	5.95	5.95	5.95	6.80	6.80
	m ³	4.55	4.55	4.55	4.55	4.55	4.55	4.55	4.55	5.2	5.2
Width(\$)	ft	11'11"	11'11"	11'11"	11'11"	11'11"	11'11"	11'11"	11'11"	11'11"	11'11"
	mm	3645	3645	3645	3645	3645	3645	3645	3645	3645	3645
Dump clearance @ full lift and 45° discharge(\$)	ft	11'4"	10'5"	10'8"	12'2"	11'5"	11'8"	11'5"	11'8"	11'8"	11'8"
	m	3.457	3.184	3.260	3.722	3.492	3.548	3.492	3.548	3.548	3.548
Reach @ full lift and 45° discharge(\$)	ft	6'5"	6'11"	6'10"	5'6"	6'3"	6'0"	6'3"	6'0"	6'0"	6'0"
	m	1.953	2.116	2.082	1.687	1.908	1.820	1.908	1.820	1.820	1.820
Reach @ 45° discharge angle, 7'0"/2130 mm clearance(\$)	ft	8'9"	9'1"	9'0"	8'1"	8'8"	8'5"	8'8"	8'5"	8'5"	8'5"
	m	2.668	2.773	2.723	2.471	2.634	2.562	2.634	2.562	2.562	2.562
Reach with lift arm horizontal and bucket level	ft	11'6"	12'7"	12'3"	10'3"	11'4"	11'0"	11'4"	11'0"	11'0"	11'0"
	m	3.511	3.843	3.742	3.135	3.454	3.352	3.454	3.352	3.352	3.352
Digging depth(\$)	in	2.8"	2.8"	2.8"	2.8"	2.8"	2.8"	2.8"	2.8"	2.8"	2.8"
	mm	72	72	72	72	72	72	72	72	72	72
Overall length(\$)	ft	33'10"	35'2"	35'3"	32'11"	33'11"	33'7"	33'11"	33'7"	33'7"	33'7"
	m	10.340	10.729	10.748	10.021	10.340	10.233	10.340	10.233	10.233	10.233
Overall height(\$)	ft	22'10"	22'10"	22'10"	21'5"	21'5"	22'2"	21'5"	22'2"	22'2"	22'2"
	m	6.952	6.952	6.952	6.520	6.520	6.753	6.520	6.753	6.753	6.753
Loader clearance circle (bucket in carry position)(\$)	ft	55'11"	56'6"	56'6"	55'11"	56'5"	56'5"	56'5"	56'5"	56'5"	56'5"
	m	17.046	17.224	17.224	17.056	17.208	17.184	17.208	17.184	17.184	17.184
Static tipping load,**											
Straight(\$)	lb	50,276	49,407	47,125	51,784	51,091	50,869	51,091	50,869	50,869	50,869
	kg	22,805	22,411	21,376	23,489	23,175	23,074	23,175	23,074	23,074	23,074
Full 35° turn(\$)	lb	45,478	44,608	43,142	47,099	46,226	46,034	46,226	46,034	46,034	46,034
	kg	20,269	20,234	19,569	21,364	20,968	20,881	20,968	20,881	20,881	20,881
Breakout force*(\$)	lb	80,932	80,257	84,978	104,087	103,637	88,575	103,637	88,575	88,575	88,575
	kN	360	357	378	463	461	394	461	394	394	394
Operating weight**	lb	89,971	90,558	91,534	89,365	89,870	89,429	89,870	89,429	89,429	89,429
	kg	40,811	41,077	41,520	40,536	40,765	40,565	40,765	40,565	40,565	40,565
With Beadless Tires											
Static tipping load											
Straight(\$)	lb	55,985	55,117	53,604	57,582	56,839	56,631	56,839	56,631	56,631	56,631
	kg	25,395	25,001	24,315	26,119	25,805	25,688	25,805	25,688	25,688	25,688
Full 35° turn(\$)	lb	50,639	49,769	48,280	52,158	51,466	51,243	51,466	51,243	51,243	51,243
	kg	22,970	22,575	21,900	23,659	23,345	23,244	23,345	23,244	23,244	23,244
Breakout force*(\$)	lb	81,381	80,707	85,428	104,761	104,312	89,250	104,312	89,250	89,250	89,250
	kN	362	359	380	466	464	397	464	397	397	397
Operating weight	lb	98,168	98,754	99,731	97,662	98,067	97,626	98,067	97,626	97,626	97,626
	kg	44,529	44,795	45,238	44,254	44,483	44,283	44,483	44,283	44,283	44,283

*Measured 4.0"/102 mm behind tip of cutting edge with bucket hinge pin as pivot point.

**Static tipping load and operating weight shown include sound-suppressed cab and ROPS, 35/65-33, 24 PR (L-4) tires, or 35/65 R33 (L-4) equivalent, (or Beadless Tires), full fuel tank and operator. Machine stability and operating weight are affected by tire ballast and attachments. For additional static tipping load capacity, use tire ballast or counterweight, not both. Add the following to machine operating weight and static tipping load:

	Change in Operating Weight		Change in Articulated Static Tipping Load	
	Lb	Kg	Lb	Kg
Remove cab only	- 659	- 299	- 454	- 206
Remove ROPS canopy only	-1,973	- 895	-1,609	- 730
Add counterweight	+3,386	+1536	+6,537	+2965
*35/65-33, 24 PR (L-4) tires	+5,906	+2679	+7,284	+3304
35/65-33, 24 PR (L-5) tires	+2,156	+978	+1,329	+603
35/65 R33 (L-5) equivalent tires	+1,268	+ 575	+ 783	+ 355
*35/65-33, 24 PR (L-5) tires	+7,253	+3290	+7,617	+3455
*35/65 R33 (L-4) equivalent tires	+6,334	+2873	+7,795	+3536
*35/65 R33 (L-5) equivalent tires	+6,753	+3063	+7,546	+3423

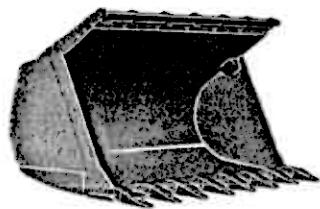
*75% fill CaCl₂ ballast included for rear tires only.

Specifications and ratings conform to all applicable standards recommended by the Society of Automotive Engineers, SAE Standard J732c (1979) and SAE Standard J742b (1980) govern loader ratings, denoted in the text by (\$).

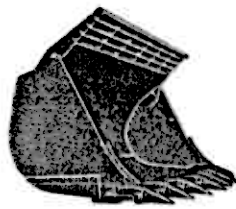
FIG. 56



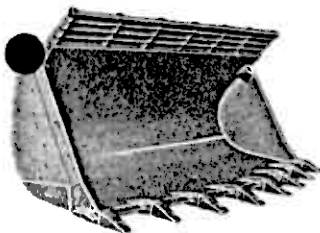
988B buckets provide exceptional flexibility in matching the machine to job conditions. All are welded construction, low-carbon, abrasion-resistant steel, with high-strength material used in side plates, side cutting bars and bucket shells. They feature a tapered floor design of approximately 7°, with box-sectioned reinforcing material placed under the floor for increased structural strength.



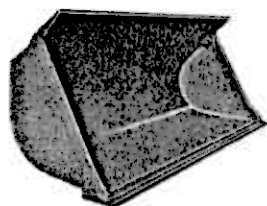
• **Straight-edge rock bucket** with flush-mounted teeth provides good penetration and a level floor. Used in high-impact rock loading applications.



• **Spade-nose rock bucket with Modulok system** features quick change wear surfaces and has abrasion-type teeth. Recommended for high-abrasion rock applications.



• **V-Edge Rock bucket** is designed for use in high impact, tough rock loading applications. V-edge provides high penetration forces and high wear resistance. Available with eight weld-on double strap teeth, including integral corner teeth, for maximum aggressiveness.



• **General Purpose Loose Material bucket** is designed for handling stockpiled aggregates or other easy to load material weighing 2700 lb/yd³/1600 kg/m³ or less. Bolt-on cutting edge system is standard, consisting of two reversible center sections and two reversible corner segments. Cannot be equipped with bucket teeth.



standard equipment

24-volt direct electric starting. 50-amp alternator. Muffler. Power shift transmission. Variable capacity torque converter. Sealed loader linkage. Automatic bucket positioner. Automatic lift kickout. Backup alarm. Crankcase guard. Fenders. Drawbar. Horn. Four front and two rear working lights. Instrument panel lights. Adjustable steering column. Sound-suppressed cab plus ROPS. Outside rear view mirrors. Suspension seat. Seat belt. Service, parking and emergency braking system. 35/65-33, 24 PR (L-4) tires. Electronic Monitoring System (EMS). Diagnostic connector.

Functions monitored by EMS — Refer to page 5 for details.

LEVEL I — Alternator. Fuel level. Transmission oil filter.

LEVEL II — Coolant temperature. Hydraulic oil temperature. Transmission oil temperature.

LEVEL III — Coolant flow. Engine oil pressure. Brake oil pressure. Parking brake applied.

Critical functions have both audible and visible warning systems.

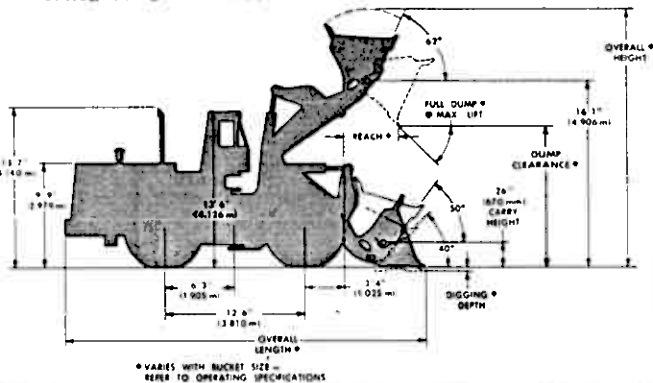
Indicators: Air cleaner service. Clock hour meter. Variable capacity torque converter setting.

Materials and specifications are subject to change without notice.



dimensions (approximate)

Tread width	8'6"/2591 mm	Beadless Tires
Width over tires	11'8"/3553 mm	8'8"/2640 mm
Ground clearance	18.7"/474 mm	11'7"/3520 mm
Decrease in vertical dimensions	1.6"/41 mm	17"/431 mm



optional equipment

(with approximate change in operating weight)

	Lb	Kg
Air conditioner/heater/defroster	293	133
Air conditioner and defroster	281	128
Beadless Tire arrangement	see Operating Specifications	
Buckets:		
Rock, V-type	7,630	3460
Rock with 8 double-strap teeth, V-type	8,210	3720
Rock, straight	7,000	3180
Rock with 8 flush-mounted teeth, straight	7,360	3340
General Purpose Loose material	7,600	3450
Rock Modulok, V-type	9,340	4240
Cab, sound-suppressed (removed)	-659	-299
Canopy, ROPS (removed)	-1973	-895
Counterweight	3,386	1536
Differential NoSPIN	20	9
Electrical converter (for 12-volt accessories)	5	2.3
Fast fuel system	13	6
Fast oil change system	9	4
Fire extinguisher	40	18
Fire suppression system (includes supplemental steering system)	739	335
Heater and defroster	137	62
Heater, engine coolant	7	3
Heater, fuel	26	12
Hydraulic system (additional valve)	320	145
Lighting system, two ROPS mounted front floodlights	20	9
Power train guard	245	111
Seat covers	2	1
Starting receptacle	7	3
Supplemental steering system	350	159
Tires	see Operating Specifications	
Tool kit	18	8
Vandalism protection, instrument panel guard	3	1.4
Cap locks for:		
Radiator	3	1.4
Hydraulic tank	2	0.9
Fuel tank	1	0.5
Transmission oil filler	4	2
Washer and wiper, rear	9	4



The SDA charging truck is designed to mix and deliver ANFO in quarries and open pit mines. Standard bulk bodies are available for a transport capacity of 5, 7 or 10 tons of Ammonium Nitrate. The body is separated in compartments for a safe-on-road transport and for separating different qualities of Ammonium Nitrate.

The fuel oil dosage pump is carefully adjusted for a specific capacity which gives a very high degree of accuracy. The charging capacity is 50 - 400 kg ANFO per minute.

The mixing is carried out in a vertical auger at the rear end of the truck. A slewable discharge auger transports the explosive to a weightless suspended downspout which allows a large working area. All holes with diameters over 100 mm can be charged.

The bulk body is also available for charging only. Such units are delivered without equipment for oil dosage.

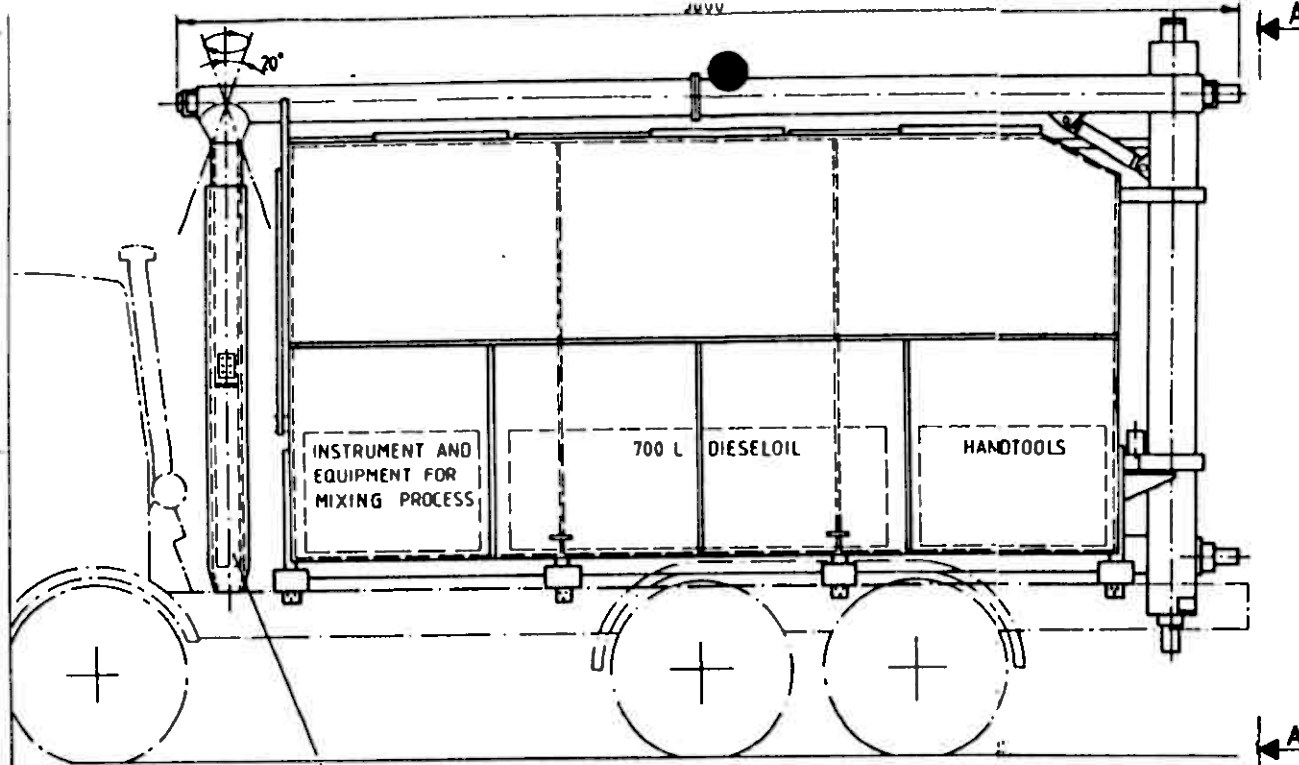
Nitro Nobel Mec

Mechanised Explosives Charging

Box 1205 S-126 11 Stockholm, Sweden Phone +46 8 744 25 20 Telex 11267 nobel s

A member of the Nitro Nobel Group

02 - 8777 - 0



THE OUTER TELESCOPIC TUBE
IS SPRING LOADED TO APPEAR
WEIGHTLESS

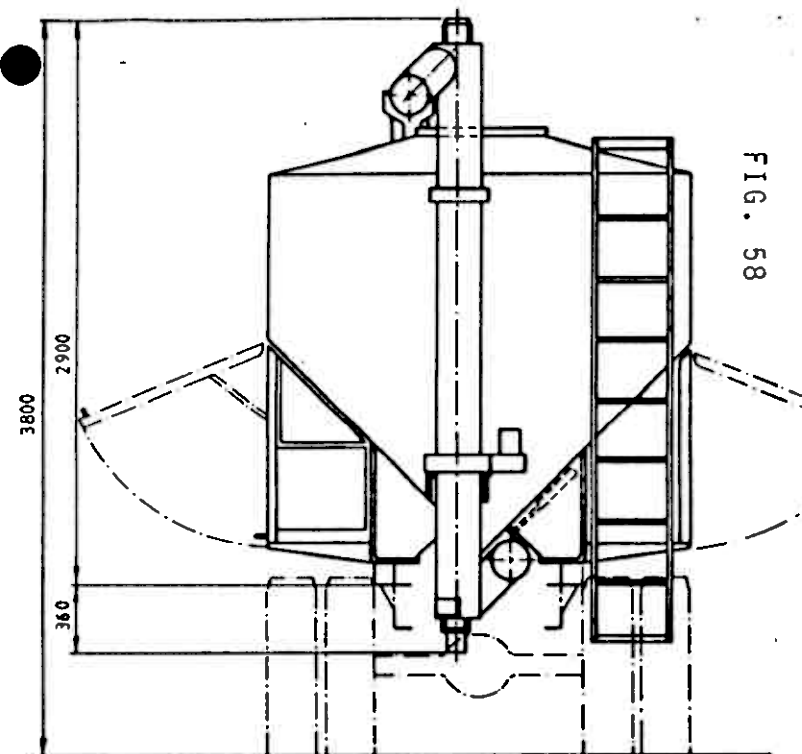
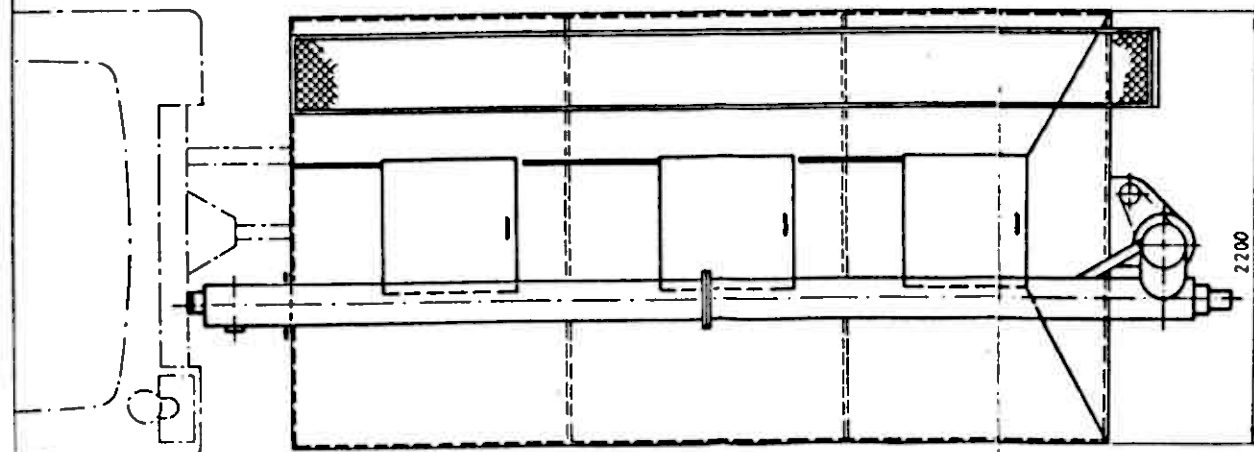
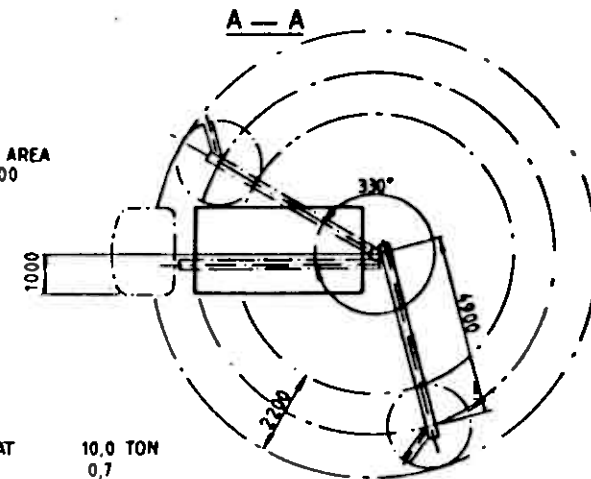


FIG. 58

COVERAGE AREA
SCALE 1:100



AMONIUMNITRAT 10,0 TON
DIESELOIL 0,7
ANFO BULK SDA 5610 3,5
TOTAL WEIGHT 14,2 TON

Det	Art	Benaming	Material	Det. Rev. nr	Rev.
AIB/SN	Qub	85 03 28	Scale 1:20		
ANFO BULK MIXING AND CHARGING UNIT SDA 5610			Nitro Nobel		

TECHNICAL DESCRIPTION

Type	SDA 4305	SDA 4307	SDA 5610
AN	5,000 kg	7,000 kg	10,000 kg
Fuel Oil	300 kg	500 kg	700 kg
No. of compartments	2	2	3
Length	4,3 m	4,3 m	5,6 m
Width	2,2 m	2,2 m	2,2 m
Height over truck frame	2,6 m	2,9 m	2,9 m
Cover radius	3,6 m	3,6 m	4,9 m
Weight gross	8,000 kg	10,500 kg	14,500 kg
" net	2,500 kg	3,000 kg	3,500 kg

BODY

Material: 5 mm carbon steel SIS 1312 bottom section
4 mm -"- -"- -"- -"- all over

Painting: Epoxy painting white zinc primer

Gates: Each compartment provided with a hydraulically operated gate valve for auger.

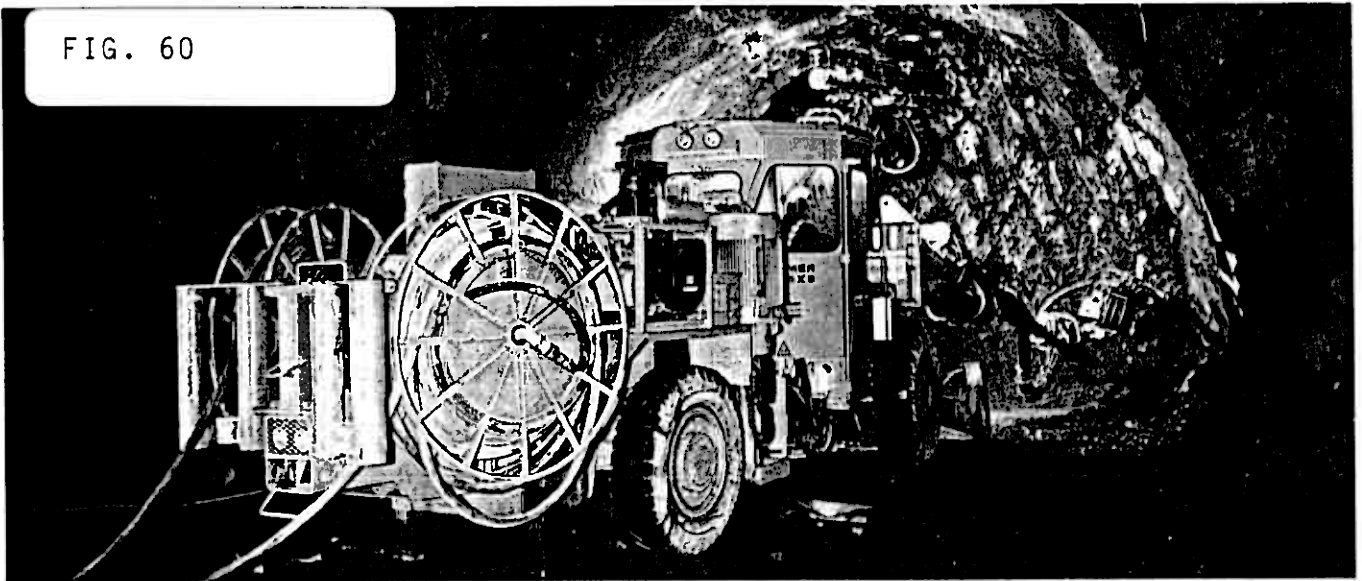
Sliding doors: Each compartment has a sliding door on top for AN filling.

General standard equipment: Both sides of the body are provided with cabinets for tools and other equipment. Ladder and catwalk for the access to body top.

ROCKET BOOMER H135

Featuring the Hydraulic Rock Drill COP 1440.

FIG. 60



Electro-hydraulic drill rig with two BUT 35 booms for cross-sections up to 90 m².

Carrier

Type
Engine, Deutz F6L 413FW

Electric system
Max. travel speed
Transmission
Hill climbing ability

Braking system

Tyres, boom axle
engine axle
Steering system
Turning radius, outer
inner

Boom BUT 35

Weight boom only
Feed extension
Boom extension
Feed roll-over
Parallel holding

Power Pack BHU 40-2

Electric pump motors
Voltage
Frequency
Hydraulic pumps
Pressure, impact mechanism
Hydraulic oil tank, volume
Hyd. oil type

DC 26D, articulated
102 kW (139 hp) at
2300 rpm
24 V
13 km/hr
Hydraulic, type Clark 24000
1:4 at max. load on drive
wheels
Air brakes, with parking
brakes and emergency
brake
14.00 x 24
14.00 x 24
Power steering
7,100 mm
4,500 mm

2,700 kg
1,600 mm
1,600 mm
360°
Complete

2 x 75 kW
380-660 V
50 or 60 Hz
Axial piston pumps
150-250 bar
240 litres
mineral

Rock Drill COP 1440

Impact power
Impact rate
Lub. air consumption (at 2 bar)
Water req. (at 12 bar)
Rotation system
Rotation speed
Weight
Noise level

22 kW
60-70 Hz
2.5 l/s
2 x 1.1 l/s
Separate rotation
0-350 rpm
151 kg
106 dB(A)

Optional equipment

- Protective roof
- Silenced operator's cabin
- Hose and cable reel
- Water booster pump (for flushing)
- Service platform HL-75
- Exhaust scrubber
- Exhaust catalyzer
- Extra working lights 2 x 1500 W



Atlas Copco

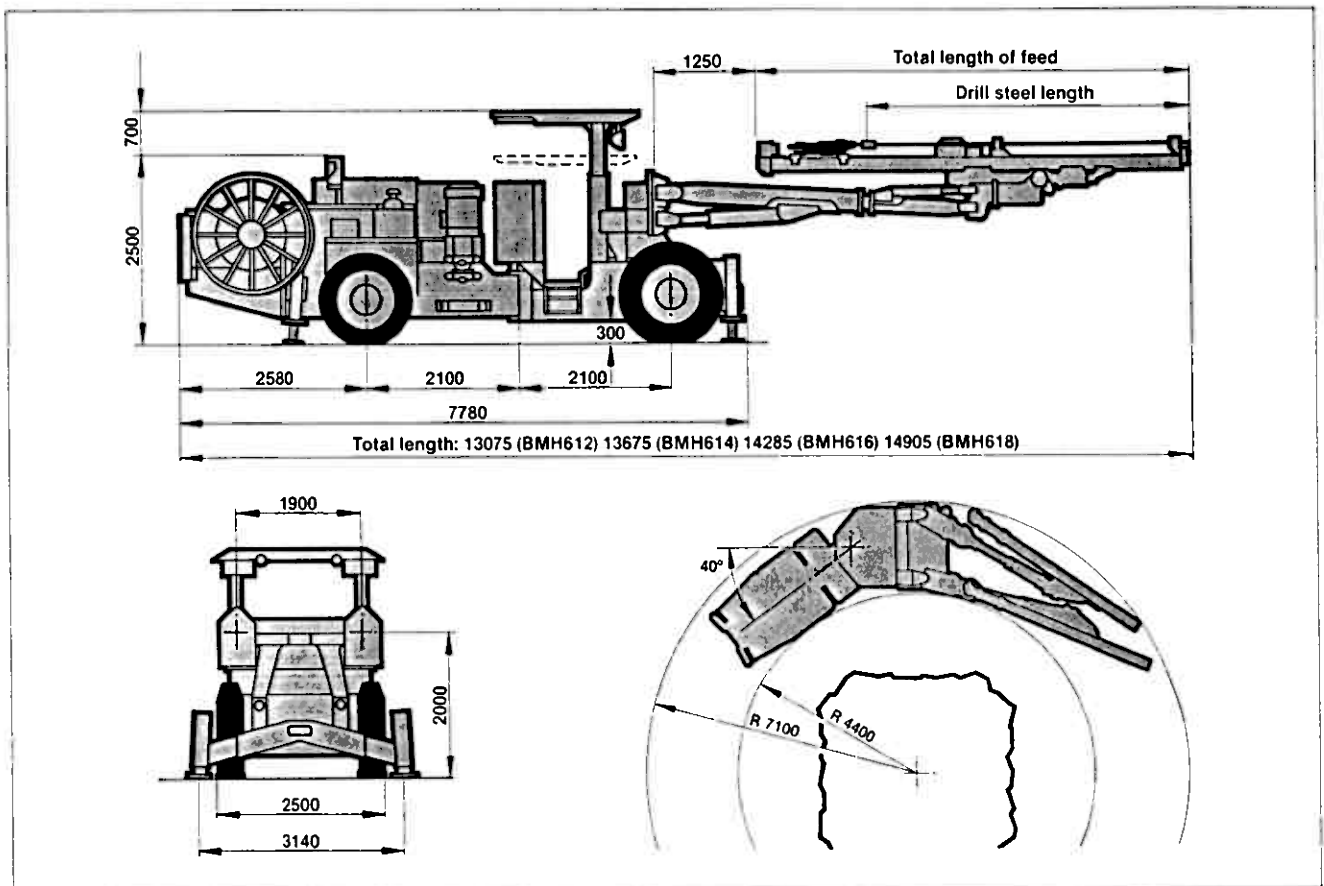
9851 1532 01

Technical Specification

Boomer H135

Hydraulic drill rig with two BUT 35 booms
for cross sections from 12 to 90 m²

Atlas Copco



Features

- Electro-hydraulic drilling with COP 1238
- Four wheel traction
- Articulated steering
- Accurate, rapid and simple positioning with BUT 35
- Precise parallel holding
- No blind spots in the coverage

Main components

Carrier	DC 25D
Boom	2 x BUT 35
Power pack	BHU 38-2 DCS
Feed	2 x BMH 600
Rock drill	2 x COP 1238

Carrier

Type	DC 25D
Engine Deutz F6L 413FW	102 kW (139 hp) at 2300 rpm
— alt. Volvo BM TD 45U	84 kW (114 hp) at 2200 rpm
Electrical system	24 V
Max. travel speed	12 km/hr
Transmission	Hydraulic, type Volvo BM HT 100
Hill climbing ability	1:4 at max. load on drive wheels
Braking system	Air brakes, with parking brake and emergency brake
Tyres, boom axle	14.00 x 24
engine axle	12.00 x 24
Steering system	Power steering

Boom BUT 35

Weight boom only	3000 kg
Feed extension	1600 mm
Boom extension	1600 mm
Feed roll-over	360 degree
Parallel holding	Complete
Printed Matter No.	ACC 11188

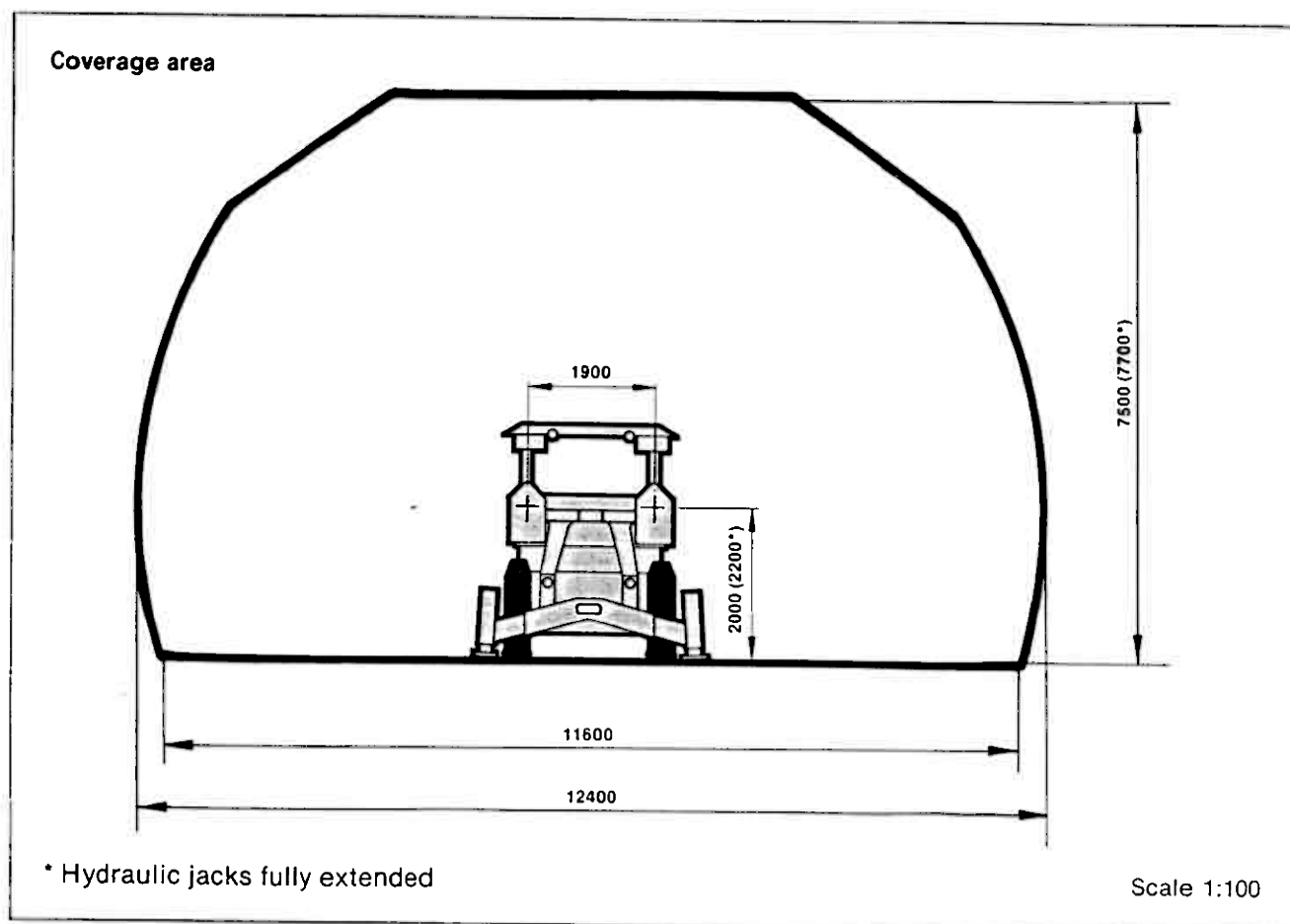
Power pack BHU 38-2 DCS

Electrical pump motors	2 x 45 kW
Voltage	380—660 V
Frequency	50 or 60 Hz
Hydraulic pumps	2 x double axial piston pumps
System pressure, impact mechanism	150—250 bar
Hydraulic oil tank, volume	240 litres
Hyd. oil types	mineral, HFC, HFB

Feeds

	BMH 612	BMH 614	BMH 616	BMH 618
Total length, mm	5295	5895	6505	7125
Max hole depth, mm	3405	4005	4615	5235
Drift steel length, mm	3700	4305	4915	5525
Weight, incl. rock drill, kg	540	570	595	670
Feed force, kN	12.5	12.5	12.5	12.5

Boomer H135



Rock drill COP 1238ME

Drill steel	R38
Impact power, max	15 kW
Impact rate	40—60 Hz
Lub. air consump. (at 2 bar)	2.5 l/s
Water requirement (at 6 bar)	0.6 l/s
Rotation system	separate rotation
Weight	151 kg
Sound level	106 dB(A)

Electrical system

Total el. power cons.	100 kW
Pump motors	2 x 45 kW
Voltage	380—660 V
Frequency	50 or 60 Hz
Rec. size of el. cable, (RDOT) 380—440 V	4 x 70 mm ²
500—660 V	4 x 50 mm ²

Dimensions and weights

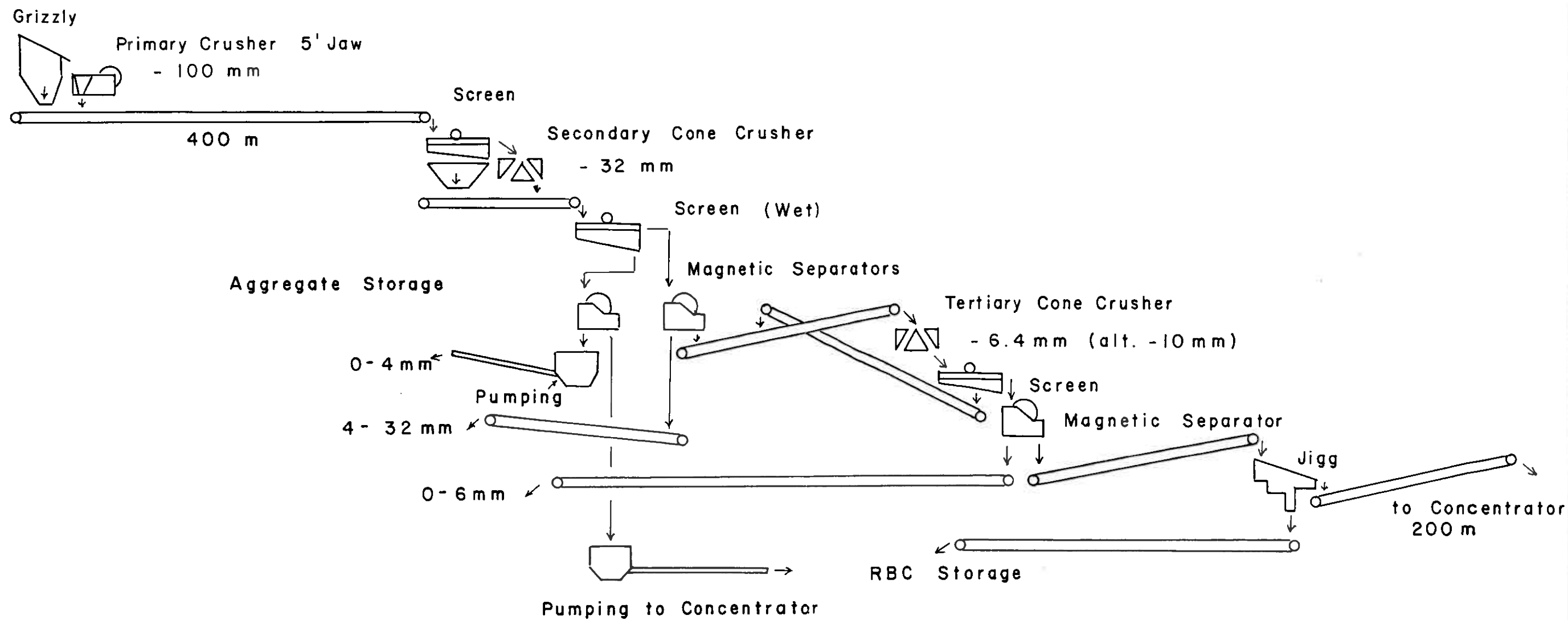
Height with protective roof, transp.	2500 mm
Height with protective roof, drilling	3200 mm
Width	2500 mm
Length (with 18 fts feeds)	14905 mm
Turning radii	
Outer (with booms & feeds)	7100 mm
Inner	4400 mm
Gross weight	
— excl. service platform	25.5 tons
— incl. service platform	28.5 tons

Optional equipment

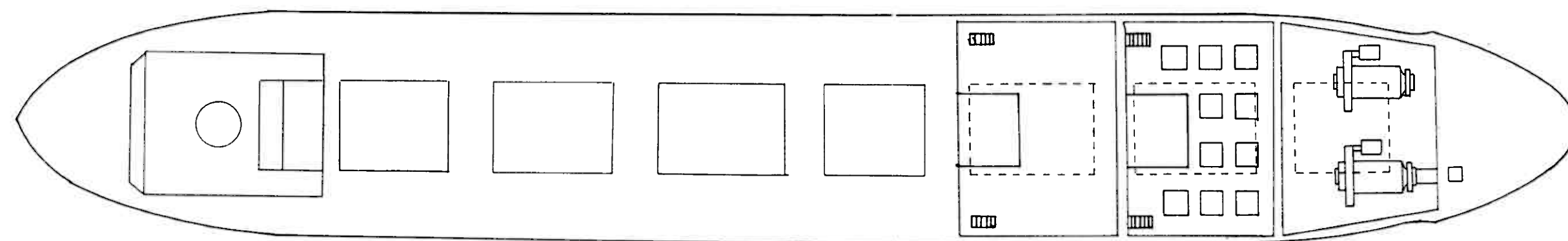
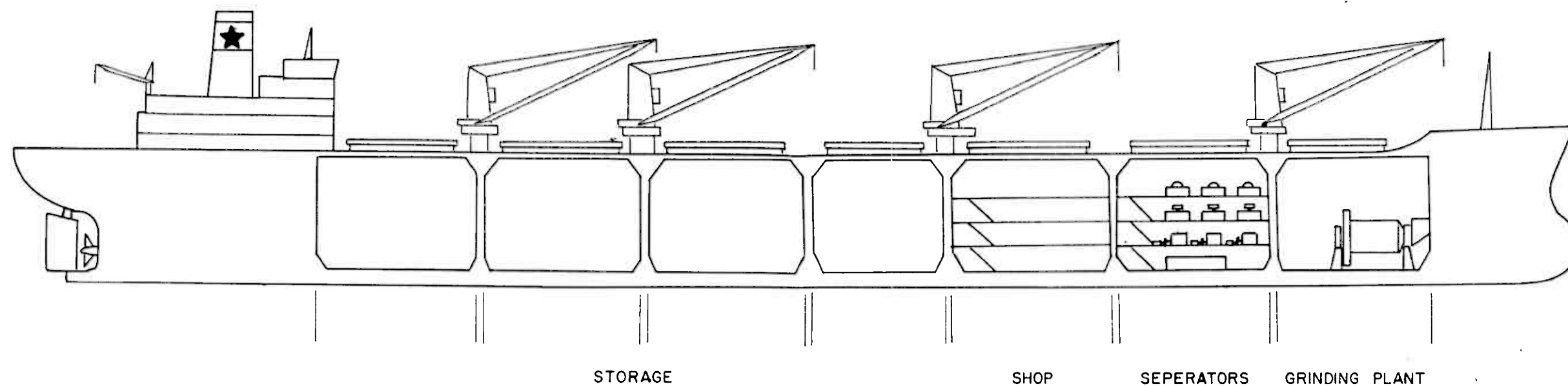
- Protective roof, hydraulic raiseable
- Silenced operators cabine
- Hose and cable reel
- Water booster pump (for flushing)
- Service platform
- Exhaust scrubber
- Exhaust catalyzer
- Extra working lights 2 x 1500 W
- Telescopic feed BMHT 600

Atlas Copco

E 11298b



Dato	Konstr./Tegnet	Godkjent	Målestokk	V B I	
31-8-87	JS	JS			
PROPOSED CRUSHING PLANT FLOWSHEET				Erstatning for:	Erstattet av:
Henvisning		Beregning		FIG. 63	



Date	Author/Designer	Location	Material		
				Erstellung für	Erstellung zu
PROPOSED PLANT LAYOUT				FIG. 64	
Verzeichnis		Bezeichnung			

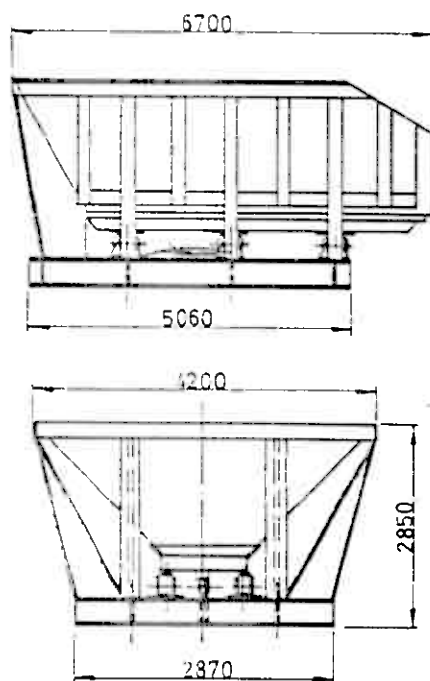


FIG. 65

MA 04
05 80**AKER TRØNDELAG AS**
AKERGRUPPEN

BMH 1200 x 5000

TEKNISKE SPESIFIKASJONER

Dimensjoner:

- A Aker Bordmater BMH 1200 x 5000
Bordets drift er hydraulisk.
Kapasiteten er regulerbar ved å
endre slaglengden som styres av
kontaktløse magnetbrytere, samt
ved å stille mengderegulerings-
ventilen.
- B Hydraulisk aggregat.
Motor: ASEA M180L, 22 kW
v/1500 o/min.
Oljevolum : 250 liter
Max trykk : 98 bar
Sylinder : CD 10-SS- 125/63/200 HT

Bruksområde:

Materen er godt anvend-
bar både for fjell og
grus. Materen er ikke
selvrensende.

DATA

Bordets bredde : 1200 mm
Bordets lengde : 5000 mm
Fyllkasse volum : 20 m³
Slag : 0 - 200 mm

Vekt: 18800 kg



FIG. 66

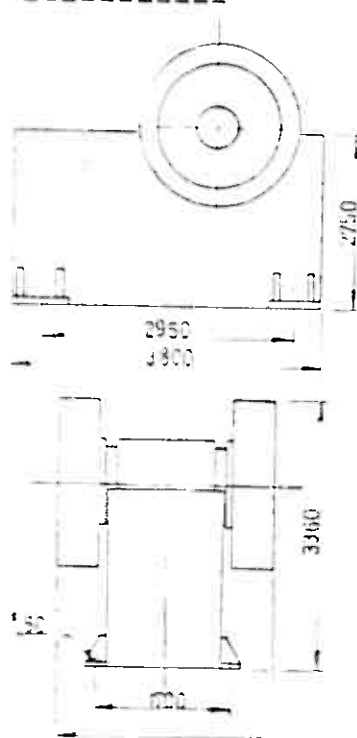
RK 13
05 80

AKER TRØNDELAG AS **AKERGRUPPEN**

RK 1200 x 1000

TEKNISKE SPESIFIKASJONER

Dimensioner:



- A Aker Rotasjonsknuser RK 1200 x 1000
- B Elektrisk sleperingsmotor, ASEA type MAM 355 S
110 KW v/975 o/min, 220/380 volt, 50 Hz, 3 fas.
- C Kontaktorpådrag type PEG 160
- D Kontaktor " DEKG 630
- E Strammeskinner " SP 6
- F Kileremmer, 10 stk type D-360
- G Renskive, ϕ 375 mm
- H Kapsler av strekkmetall for beskyttelse av svinghjul, kileremmer og motorrenskive
- I Fundamentramme for påmontering av knuser og el.motor.

Beskrivelse:

Forknuser.

DATA

Inntak : 1200 x 1000 mm
Spalt : 135 x 300 mm
Høyde fast pl. : 2100 mm
Exenter : 15 mm
Turtall : 215 o/min
Gapvinkel : 13° - 20°

Vekter

Ramme : 23500 kg
Kjeve : 8268 "
Svinghjul : 4000 "
Fast pl. : 1690 " (2 stk)
Bev. pl. : 1600 " (2 stk)
Øvre renskive : 437 "
Nedre renskive : 287 "
Vekt knuser : 31 tonn
Vekt motor :

HORIZONTAL VIBRATING SCREEN

ML Vibrating Screen

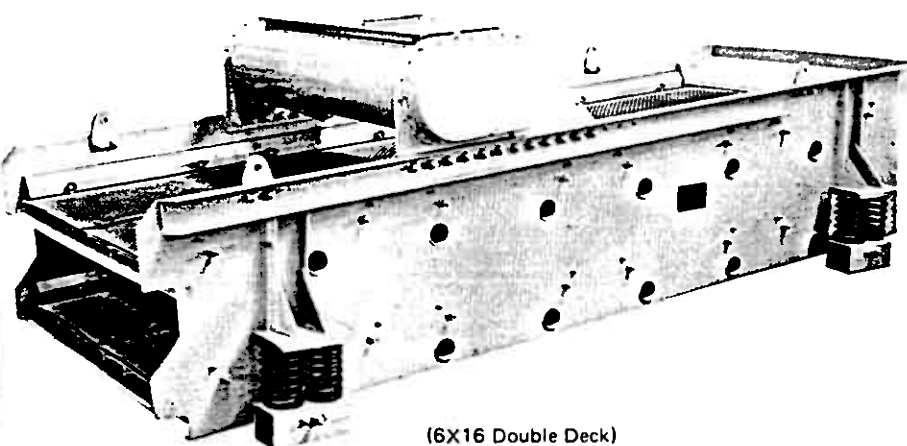
Horizontal type screen suited to such uses as screening, washing, and dewatering of medium and small lumps. Highly rigid, lightweight screen of fully welded one-piece structure.

FEATURES

- Selection of screen surface most suited to operating conditions permits large capacity processing.
- The compact, fully welded design makes the screen lightweight.
- The vibrating mechanism mounted on the upper section permits easy maintenance.
- High building is not required for installation.

Standard Dimension

Size mm (feet)	Motor Output kW(HP)		
	Single Deck	Double Deck	Triple Deck
920 × 2440 (3 × 8)	7.5 (10)	7.5 (10)	7.5 (10)
1220 × 2440 (4 × 8)	7.5 (10)	7.5 (10)	11 (15)
1220 × 3050 (4 × 10)	7.5 (10)	7.5 (10)	11 (15)
1220 × 4270 (4 × 14)	11 (15)	11 (15)	11 (15)
1530 × 3050 (5 × 10)	11 (15)	11 (15)	11 (15)
1530 × 3660 (5 × 12)	11 (15)	11 (15)	11 (15)
1530 × 4270 (5 × 14)	11 (15)	11 (15)	15 (20)
1830 × 4270 (6 × 14)	11 (15)	11 (15)	15 (20)
1830 × 4880 (6 × 16)	11 (15)	15 (20)	—



(6X16 Double Deck)

HLW Vibrating Screen

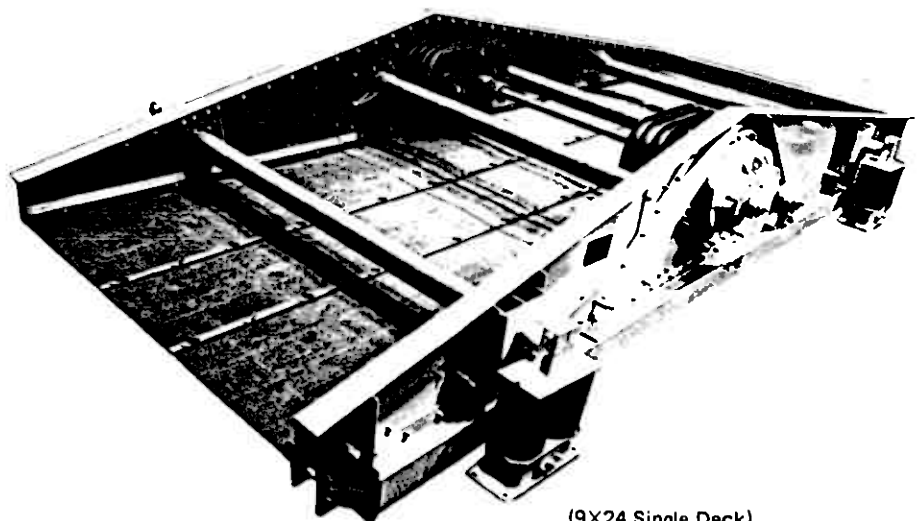
High strength, simple structure through computerized body design. Also can be used as an inclined screen.

FEATURES

- The selection of the screen surface most suited to the operating conditions permits large capacity processing.
- Rational design permits lightweight and easy maintenance.
- Mounting or removal of vibrating mechanism is simplified.
- High building is not required for installation.
- This screen can be also used as an inclined screen.

Standard Dimension

Size mm (feet)	Motor Output kW(HP)	
	Single Deck	Double Deck
2140 × 4880 (7 × 16)	15 (20)	18.5 (25)
2140 × 6100 (7 × 20)	15 (20)	22 (30)
2440 × 4880 (8 × 16)	18.5 (25)	22 (30)
2440 × 6100 (8 × 20)	18.5 (25)	30 (40)
2750 × 6100 (9 × 20)	22 (30)	37 (50)
3050 × 6100 (10 × 20)	30 (40)	37 (50)
3050 × 7320 (10 × 24)	37 (50)	45 (60)

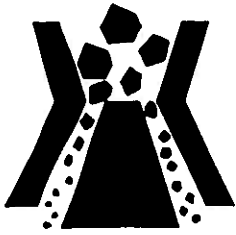


(9X24 Single Deck)

Japanese patent No. 1037941

South African patent No. 77/6524

Patent pending: Brazil



GYRATORY CRUSHER

Type 36" and type 45" gyratory crushers are designed to crush large quantities of medium-sized lumps based on the design and manufacturing technology of our extra large gyratory crushers, which enjoy a great reputation, worldwide, among large-scale mining operations. This compact crusher provides large crushing strength.

High crushing capacity

The maximum capacity crushing chamber handles large quantities of products, thanks to the computerized design.

Compact size

This crusher, designed to handle a large capacity for its size, can be installed in a small space.

Hydraulic mechanism

The hydraulic mechanism enjoys a great reputation both at home and abroad. The discharge opening, depending on the wear in the crushing chamber, can be adjusted in one minute.

Rationalization of crushing plant at low cost

High crushing capacity and compact form permits low cost rationalization and simplification of plants.

Crushing capacity table

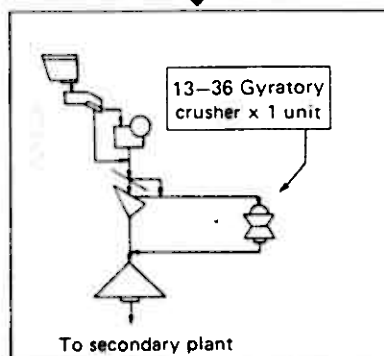
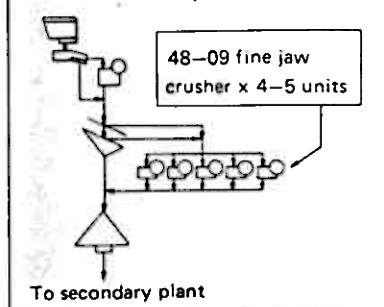
1mt=1.1st

Nominal Size	Allowable Max. Feed Size mm (inch)	Motor Output kW (HP)	Capacities mt/h							
			Open Side Setting of Discharge Opening mm (inch)							
			38 (1 1/2)	44 (1 3/4)	51 (2)	57 (2 1/4)	63 (2 1/2)	70 (2 3/4)	89 (3 1/2)	
9-36	140×200×280 (5 1/2 × 8 × 11)	45 (60)	90	100	110	120				
		75 (100)		135	150	165				
		95 (125)			180	200	220			
		95 (125)				220	240			
11-36	170×240×340 (6 3/4 × 9 1/2 × 13 1/2)	45 (60)		100	110	120				
		75 (100)			150	165				
		95 (125)				200	220			
		95 (125)					240			
13-36	200×280×400 (8 × 11 × 16)	45 (60)			110	120	135	150		
		75 (100)				165	180	200		
		95 (125)					220	240		
		95 (125)						260		
12-45	180×250×360 (7 1/4 × 10 × 14 1/4)	95 (125)	135	155	175	190	215	250	280	
		110 (150)			215	245	260	300	340	
		150 (200)				290	340	370		
14-45	220×300×440 (8 3/4 × 11 3/4 × 17 1/4)	95 (125)			175	190	215	250	280	
		110 (150)				260	300	340		
		150 (200)						370		
16-45	240×340×480 (9 1/2 × 13 1/2 × 19)	95 (125)			175	190	215	250	280	
		110 (150)				260	300	340		
		150 (200)							370	

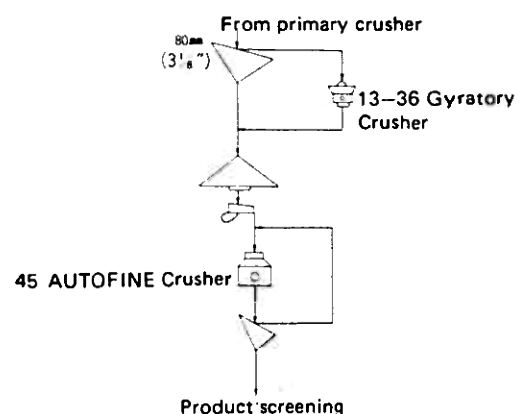
Note: The crushing capacities above are applicable when ore with a bulk density of 1.6mt/m³ (100 pounds per cubic foot) is fed continuously. The values above may vary more or less depending on the properties of the ore.

Examples of rationalization and simplification of crushing plants

(e.g. 1) One unit instead of 4-5 fine jaw crushers



(e.g. 2) For preconditioning of tertiary crushers in addition to AUTOFINE crushers



There has been a tendency for S-T Jaw crushers, used as primary crushers to become larger year by year in rationalizing crushing plants. As a result, larger secondary crushers are in demand. The Gyratory crusher, which meets this demand, is the most suited to preconditioning for tertiary crushers. In particular, this crusher, combined with our most sophisticated AUTOFINE Crusher, makes possible a compact plant with large capacity.

Crusher products

typical screen analysis

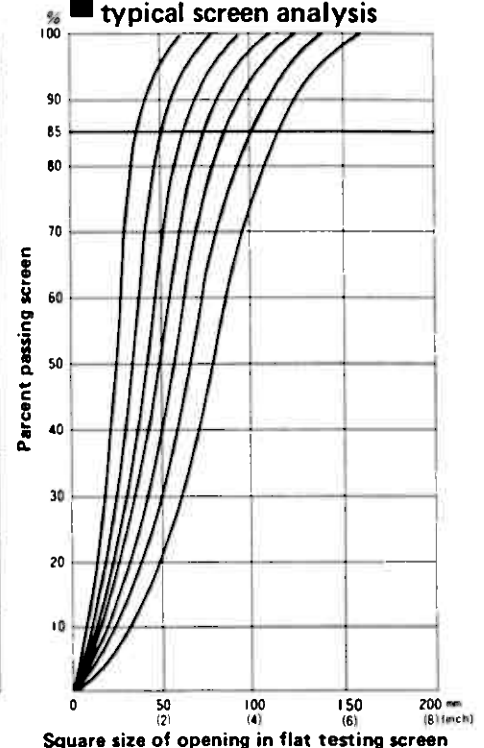
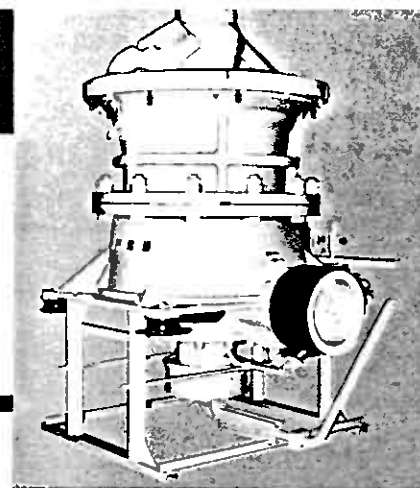
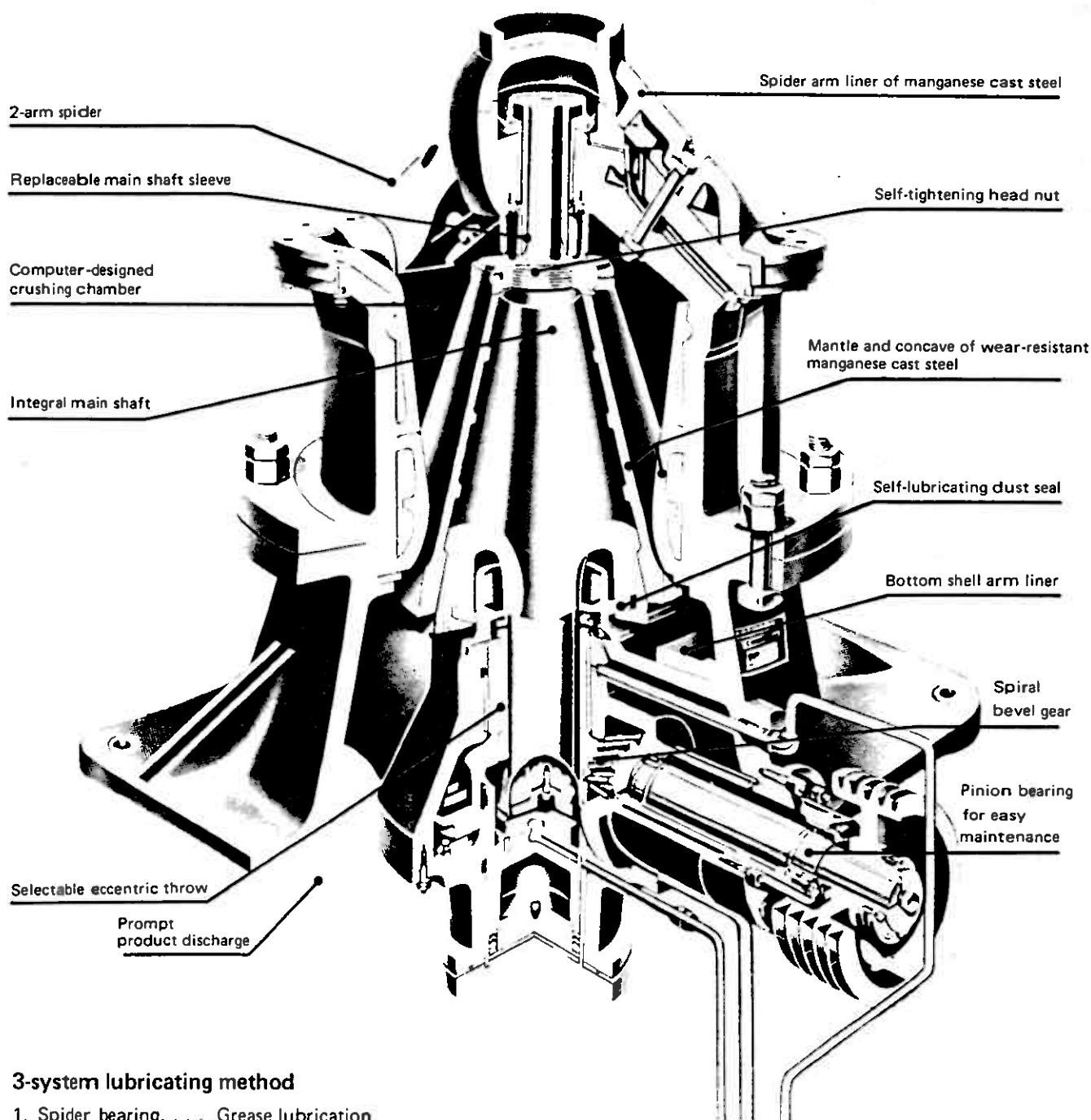


FIG. 69

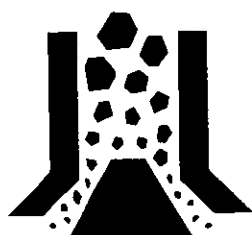


(13-36)



3-system lubricating method

1. Spider bearing. . . .Grease lubrication
2. Pinion bearing. . . .Oil bath lubrication
3. Step bearing, Eccentric bearing, Bevel gear
Automatic external lubricating system



SHORT CONE CRUSHER

This crusher, a modified EX-CONE crusher, is an extrafine type developed to mass-produce fine final products.

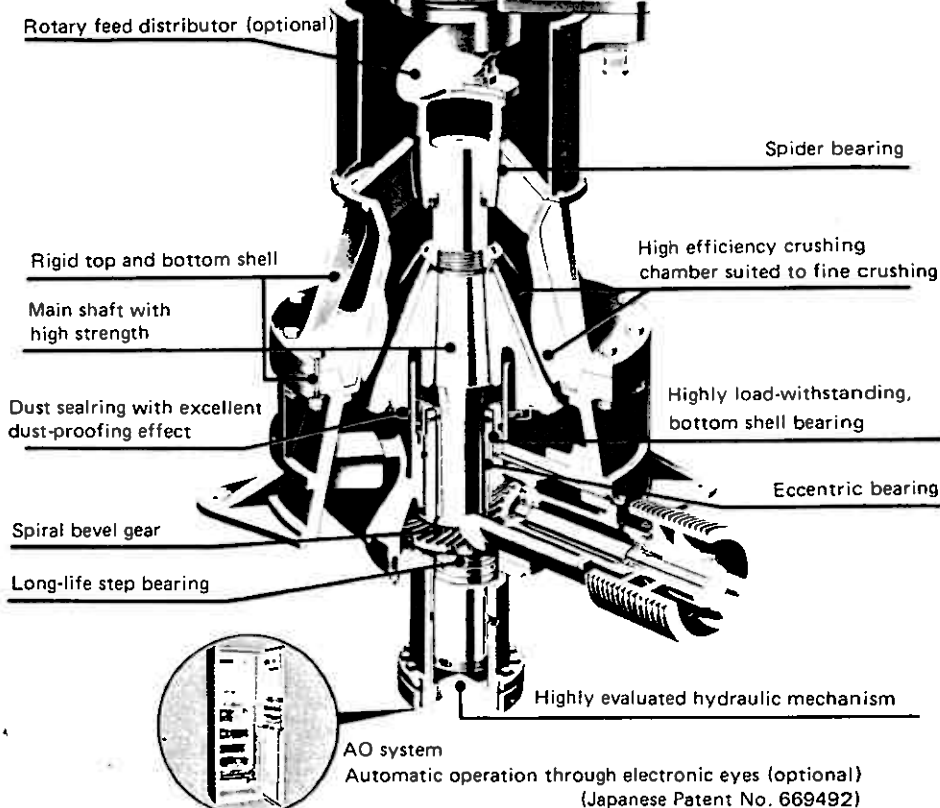
The Short Cone Crusher, incorporating a crushing chamber computer designed for fine crushing, enjoys a great reputation as an advanced crusher.

● **Performance most suited to fine particle size product**

This crusher is most suited to the production of 13mm ($\frac{1}{2}$ "), 5mm ($\frac{3}{16}$ ") final product, and feeding materials for rod mill.

● **High fine-crushing capacity**
The fine-crushing capacity is improved approximately 50%, as compared with that of a conventional EXCONE crusher.

● **Parts common to standard EXCONE crusher**
Parts other than the concave ring are common to the standard EXCONE crusher.



Crushing capacity

1mt=1.1st

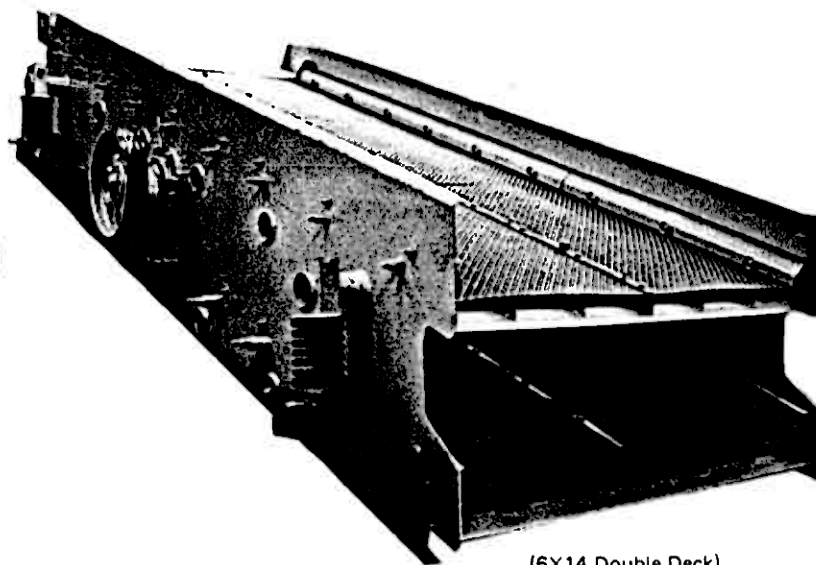
Nominal Size	Allowable Feed Size	Pinion Speed rpm	Motor Size kW (HP)	Capacities mt/h			
				Closed Side Setting mm (inch)			
				6.5 ($\frac{1}{4}$ ")	8 ($\frac{5}{16}$ ")	9.5 ($\frac{3}{8}$ ")	13 ($\frac{1}{2}$ ")
236	40mm(1 $\frac{1}{2}$ ") Passing Square Opening	1160	95 (125)	68	70	73	77
2 ½ 45	50mm(2") Passing Square Opening	985	130 (175)	94	97	100	113
351		985	150 (200)	113	122	132	145
360		860	220 (300)	120	132	145	172
372		800	300 (400)	200	220	230	250
384		690	370 (500)	256	291	327	354

Note:

1. The crushing capacities above may vary, depending on operating conditions.
2. The capacities above are applicable only when the bulk specific gravity is 1.6mt/m³ (100 pounds per cubic foot).
3. Consult us when the discharge opening on the closing side is 6.5mm ($\frac{1}{4}$ ").
4. Product will be smaller than the C.S.S. is 60–70%. In general, however, the particle size of end products varies depending on the properties of the crushed materials.

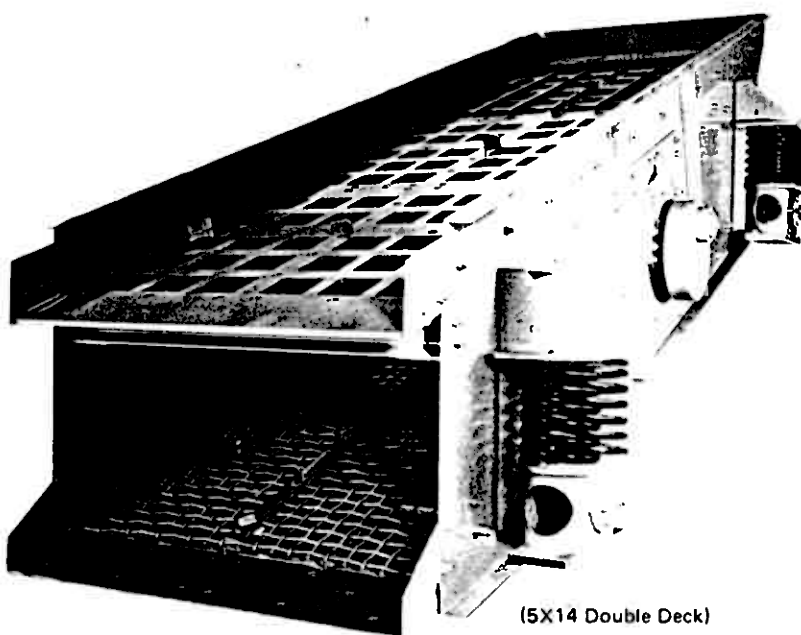
INCLINED SCREEN

ST EXFLO Vibrating Screen



(6X14 Double Deck)

XH EXFLO Vibrating Screen



(5X14 Double Deck)

Inclined vibrating screen most suited to screening of medium or small size lumps. High strength, fully welded one-piece structure.

FEATURES

- The selection of the screen surface most suited to the operating conditions permits large capacity processing.
- Compact design of full welding permits light weight.
- Simple structure permits easy maintenance.
- This Screen can be used in a number of ways.

Standard Dimension

Size mm (feet)	Motor Output kW(HP)		
	Single Deck	Double Deck	Triple Deck
920 × 2440 (3 × 8)	3.7(5)	3.7(5)	3.7(5)
1220 × 2440 (4 × 8)	3.7(5)	3.7(5)	3.7(5)
1220 × 3050 (4 × 10)	3.7(5)	3.7(5)	5.5(8)
1530 × 3050 (5 × 10)	5.5(8)	5.5(8)	7.5(10)
1530 × 3660 (5 × 12)	5.5(8)	5.5(8)	7.5(10)
1530 × 4270 (5 × 14)	7.5(10)	7.5(10)	—
1830 × 4270 (6 × 14)	7.5(10)	7.5(10)	—
1830 × 4880 (6 × 16)	7.5(10)	7.5(10)	—

This vibrating screen, provided with a powerful vibrating mechanism, is of ample strength to support the vibrating mechanism. It is most suited to scalping or screening large size lumps.

FEATURES

- Large output vibrating mechanism makes this screen the most suited to large capacity processing.
- Oil bath lubrication and shaft sealing mechanism are provided for easy maintenance.
- High quality vibration isolating springs are employed.
- A long life perforated plate is used as screen surface. Hard faced perforated plate or rubber screen can also be used.
- Screen surface is fixed with bolts.

Standard Dimension

Size mm (feet)	Motor Output kW(HP)	
	Single Deck	Double Deck
1220 × 2440 (4 × 8)	7.5(10)	7.5(10)
1220 × 3050 (4 × 10)	7.5(10)	11 (15)
1530 × 3050 (5 × 10)	11 (15)	11 (15)
1530 × 4270 (5 × 14)	11 (15)	11 (15)
1830 × 4270 (6 × 14)	15 (20)	15 (20)
1830 × 4880 (6 × 16)	15 (20)	15 (20)
2140 × 4880 (7 × 16)	22 (30)	30 (40)
2140 × 6100 (7 × 20)	30 (40)	30 (40)
2440 × 4880 (8 × 16)	30 (40)	30 (40)
2440 × 6100 (8 × 20)	30 (40)	30 (40)
2750 × 4880 (9 × 16)	37 (50)	37 (50)
2750 × 6100 (9 × 20)	2 × 30(40)	2 × 30(40)
3050 × 6100 (10 × 20)	2 × 30(40)	2 × 30(40)
3050 × 7320 (10 × 24)	2 × 37(50)	2 × 37(50)

HELGESEN MASKIN A/S

ENCLOSURE 4

Vesterålen Byggmaskin A/S
Boks 416

8501 NARVIK

Bank: Gisund Sparebank
Telefon: (089) 41048 - 41172
Bankgiro: 4776.05.00409
Postgiro: 3 96 61 08

9301 FINNSNES. 30.09.87
Postboks 270

HYDRAULISK DREVET BORVOGN, TYPE ROC 712HC-01R

Viser til tidligere samtale med HR. Søyland og sender som avtalt tilbud på ovennevnte borvogn.

Vi har fornøyelsen av å tilby:

1 stk. hydraulisk drevet borvogn, type ROC 712 HC-01R,
hullområde: 48-89 med følgende utstyr:

- Vinsj
- Støvsuger DCT 120
- Bergboremaskin type COP 1238 ME
- Anordning for å kunne kjøre redusert slagverkstrykk ved påhugg
- Nødvendig utstyr for gassfylling av akkumulator (ekskl.gassflaske)
- Støtteben bak
- Elektrisk dieselpåfyllingspumpe
- Arbeidslys - 3 lamper 24V - 70W
- Borstålsholder
- Kompressor ombord 5 m³/min
- Hydraulisk borstød
- Automatikk for å hindre fastboring
- Drivstoffbesparer
- 2 hastighets kjøremotorer
- Hydraullåser innebygget på sylindere
- Timeteller motor
- Timeteller slagverk
- Brannslukningsapparat
- Verktøykasse bestående av: Momentnøkkel 0-40 kpm
Umbrakonøkkel 3/16"
Piper 17, 19, 24, 27 og 32
- Instruktørhjelp ved oppstart

Tilbud
side 2

Videre vil vi nevne at

- mer enn 250 hydrauliske borvogner fra Atlas Copco er i drift i Norge
- komponentene er gjennomprøvet
- kombinasjonen leddet bom, kraftige kjøremotorer, lavt tyngdepunkt og god bakkeklaring, gir borvognen utmerkede terrengegenskaper.

TILBUD

ROC 712HC-01R som beskrevet ovenfor..... Kr. 1.940.000,--

Ekstraustyr for ROC 712HC-01R

Pristillegg

Vinkelmåler type Director	kr	35.000,--
Vinkel- og dybdemåler type Director	kr	56.000,--
Glødeflammeanlegg for motor	"	4.500,--
Sentralsmøeanlegg ROC 712HC-01R.....	"	19.000,--
Spriddosering for spyleluft.....	"	3.900,--

Alle de oppgitte priser er ekskl. mva.

Leveringstid : Lager, men taes forbehold om mellomsalg

Leveringsted : Fritt lev. Langhus

etalingsbetingelser: Netto kontant pr. 30 dager.

Det taes forbehold om prisendring.

Vi håper tilbudet er av interesse og ser frem til å høre fra Dem om dette.
Skulle De trenge flere opplysninger, står vi med glede til tjeneste.

Med vennlig hilsen
Helgesen Maskin A/S

Erling Helgesen



Pay & Brinck a/s

ENCLOSURE 5

DATTERSELSKAP AV DYNO INDUSTRIER A/S

BROBEKKVEIEN 62 B, OSLO - POSTBOKS 65 RISLØKKA, 0516 OSLO 5 - TLF. (02) 64 54 00
BANK: CHRISTIANIA BANK OG KREDITKASSE - BANKGIRO 6001.06.72530
POSTGIRO 510.4237 - TELEGRAM: PABRIMAS - TELEX: 71631

Johannes Søyland
Vesterålen Bergindustri A/S
Postboks 416
8501 NARVIK

Deres ref.:

Vår ref.:
ANLEGG
RH/ts
ANL-76.5

Dato:
Oslo, 4. september 1987

CATERPILLAR HJULLASTERE OG TRUCKER

Vi viser til telefonsamtale med undertegnede 28. august 1987, og har gleden av å oversende brosjyrer og tekniske spesifikasjoner for Caterpillar 988B - 980C hjullastere og Caterpillar 773B - 769C trucker.

Caterpillar 988B hjullaster kr. 2.500.000,- ekskl. mva
Caterpillar 980C hjullaster kr. 1.700.000,- ekskl. mva
Caterpillar 773B truck kr. 2.500.000,- ekskl. mva
Caterpillar 769C truck kr. 1.800.000,- ekskl. mva

Prisene forstås å være forventede transaksjonspriser i 2 kvartal 1988, levert Oslo.

Prisene er relevante, og bør kunne legges til grunn for Deres budsjett for 1988.

I henhold til avtale, vil vi ta kontakt i løpet av mars/april 1988.

Håper vårt materiale er av interesse. Vennligst ta kontakt om De ønsker flere opplysninger om våre produkter.

Med hilsen
pr. Pay & Brinck a/s

Rolf Hagemoen
Rolf Hagemoen
Ass. salgssjef



cc: Reg.sjef B. Hansen
Tromsø

Vedlegg

Caterpillar, Cat og er varemerker for Caterpillar Tractor Co.

BRUMUNDAL:
Strandsagveien, Tlf. (085) 40 511
Postboks 288, 2380 Brumunddal
KRISTIANSAND:
Ægirs vei 3, Tlf. (042) 92 555
Postboks 1041, 4601 Kristiansand S
STAVANGER:
Duså 1, Tlf. (04) 59 81 44
Postadresse 4070 Randsberg

BERGEN:
Liavegen 8, Tlf. (05) 18 47 50
Postboks 87, 5090 Nyborg i Åsane
TRONDHEIM:
Bromstadveien 70, Tlf. (07) 91 57 40
Postboks 3723 Granåsilla, 7001 Trondheim
MO I RANA:
Industriområdet Grubhei, Tlf. (087) 31 399
Postboks 8, 8610 Grubhei

NARVIK:
Fagernesveien 22/24, Tlf. (082) 46 496
Postboks 278, 8501 Narvik
HARSTAD:
Båtbygger Danielsens vei nr. 1, Tlf. (082) 64 381
Postboks 314, 9401 Harstad

TROMSØ:
Kvaløyvegen, Tlf. (083) 83 044
Postboks 623, 9001 Tromsø
ALTA:
Midtbakken, Tlf. (084) 35 033
Postboks 220, 9501 Alta

Vesterålen Bergindustri A/S
Fagernesvn. 1

8500 NARVIK

DERES REF.

VÅR REF.

DATO

JS/OET/RRS

22. oktober 1987.

Att.: Adm.dir. J. Søyland.

TILBUD PÅ KNUSEVERK.

Vi viser til Deres brev av 22.09.1987 hvor De ber om tilbud på knuseverk for et kombinert pukk- og magnetitt-oppredningsanlegg.

Vi takker for Deres hevendelse og kan etter vår foreløpige vurdering tilby som følger:

1. Basis:

1.1.	<u>Kapasitet</u>	:	900.000 - 1.000.000 Tpy		
1.2.	<u>Fe₃O₄-innhold</u>	:	30 % (25 % Fe)		
1.3.	<u>Produkter</u>	:	(Estimert)	T/hr	Tpy
1.3.1.	Pukk		0 - 4 mm	: 33	108.900
			4 - 32 mm	: 150	495.000
			0 - 6 mm	: 50	165.000

NB! Vanlig pukk til vegbruk er p.t. 0 - 18 mm og 18 - 32 mm samt delvis 32 - 90 mm. Ved å sette inn en enkelt-dekket sekundær-sikt over lagersiloer kan fraksjonen 4 - 32 deles til en 4 - 18 og 18 - 32 fraksjon, om markedet tilsier dette. Produkt 32 - 90 kan produseres ved å sette inn ekstra duk på VS-1 for utsikting av 32 - 90 mm etter behov, og arrangere pukk-siloene (3 stk.) for 0 - 18 mm, 18 - 32 mm og 32 - 90 mm.

.. / 2

NORMAS INDUSTRIER A/S

POSTADRESSE:
INNHERREDSVN. 18
7014 TRONDHEIM

BESØKSADRESSE:
INNHERREDSVN. 20
TRONDHEIM

TELEFON: 07 51 29 33
TELEFAX: 07 52 23 12
TELEX: 55 136

POSTGIRO: 422 45 80
BANKGIRO: 8601 08 43245

Dersom andre fraksjoner ønskes kan sikteduker byttes i sekundær-sikt. Siloene kan bygges slik at man enkelt kan dele disse opp etter behov. utmating må da skje f.eks. ved 2 matere/silo.

1.3.2. Magnetitt:

Magnetitt-produksjonen skjer på relativt grove materialer, og utvinning vil derfor være sterkt variabel. Med utgangspunkt i gehalt lik 30 % Fe_3O_4 som gjennomsnitt, vil en oppgradering til 50 - 60 % være mulig i grov-separasjonsverket.

Produktmengder (estimert) :	0 - 4 mm	17 t/hr
	0 - 6,4 mm)	
	(Alt. 0 - 10 mm))	50 t/hr
	Sum	67 t/hr

Kapasiteten i systemet er tilstrekkelig til å håndtere 100 t/hr.

1.3.3. Prøvetaking:

Prøvetaking kan legges inn i systemet etter behov. Kostnad ca. kr. 300.000,-.

2. Tilbud - knuseverk:

2.1. Vibrasjonsmater (M-1) m/grizzly. Kapasitet = 400 tph.

Det tilbys her en Kobelco mater.

Antall : 1 stk.
 Type : DHF-6 (920 x 3050 mm)
 Stativ : Ikke tatt med.
 Motor : 15 KW, ikke inkludert.

Pris : kr. 400.000,-.

Alternativt tilbys en brukt Aker Bordmater 1200 x 5000 mm:

Pris : kr. 200.000,-.

2.2. Primærknuser (K-1).

Det anbefales her en pendelknuser.

Antall : 1 stk.
 Type : KSL Exjaw 42 x 48 (1070 x 1220 mm inntak)
 Stativ : Ikke tatt med.
 Motor : 130 KW, ikke inkludert.

Pris : kr. 2.560.000,-.

Alternativt tilbys en brukt Aker Rotasjonsknuser
type RK 1200 x 1000 i overhalt stand.

Pris : kr. 700.000,-.

2.3. Beltetransportør (BT-1)

Antall : 1 stk.
Type : 1000 mm x 400 m.
Motor : KW

Pris : kr. 1.363.400,- uten understøttelse og
kapsling.

2.4. Vibrasjonssikt (VS-1)

Her anbefales et 1-dekkes Heavy Duty sikt med
areal = 14,6 m².

Antall : 1 stk.
Type : 8 x 20 SDXH
Stativ : Ikke inkludert.
Motor : 30 KW, ikke inkludert.

Pris : kr. 587.100,-.

2.5. Vibrasjonssikt (VS-2)

Det tilbys her et enkeldekket horisontalsikt,
areal = 13 m².

Antall : 1 stk.
Type : 7 x 20 SD"HLW"
Stativ : Ikke inkludert.
Motor : 18 KW, ikke inkludert.

Pris : kr. 389.300,-.

2.6. Sekundær-knuser (K-2)

Vi tilbyr her en spindelknuser.

Antall : 1 stk.
Type : 16 x 60" KSL DG Gyrotory.
Motor : KW, ikke inkludert.

Pris : kr. 2.657.400,-.

2.7. Magnetseparator (MS-1)

Det tilbys her en Scanmec Magnetseparator.

Antall : 1 stk.
Type : SM - 915Ø x 1800.
Motor : Inkludert.

Pris : kr. 350.000,-.

2.8. Magnetseparator (MS-2)

Her det behov for 2 stk. separatorer, også fra Scanmec A/S.

Antall : 2 stk.
 Type : SM 1200Ø x 3000.
 Motor : Inkludert.
 Pris : kr. 500.000,- pr. stk., tilsammen
kr. 1.000.000,-.

2.9. Magnetseparator (MS-3)

Det vil her klare seg med en stk., lik pos. 8.

Antall : 1 stk.
 Type : SM 1200Ø x 3000.
 Motor : Inkludert.
 Pris : kr. 500.000,-.

2.10. Vibrasjonssikt (VS-3)

Det tilbys her 2 stk. Kobelco-sikt, med areal ca. 4,5 m².

Antall : 2 stk.
 Type : KSL - RFH 45A
 Motor : 7,5 KW, ikke inkludert.
 Pris : kr. 80.340,- pr. stk., tilsammen
kr. 160.680,-.

2.11. Tertiærknuser (K-3)

Her anbefales 2 stk. Short Cone konknusere (tilsvarende S/Head).

Antall : 2 stk.
 Type : Short Cone 360 (CSS = 8 mm)
 Motor : 220 KW, ikke inkludert.
 Pris : kr. 1.884.900,- pr. stk., tilsammen
kr. 3.769.800,-.

2.12. Beltetransportør (BT-2)

Her har man anbefalt et 800 mm belte, lengde ca. 50 m.

Antall : 1 stk.
 Type : 800 mm x 50 m.
 Motor : Ikke inkludert.
 Pris : kr. 279.680,-.

2.13. Beltetransportør (BT-3 - BT-6)

Her er det tenkt 4 stk. belter.

Antall : 4 stk.
Type : 650 mm x 25 m.
Motor : Ikke inkludert.

Pris : kr. 131.100,- pr. stk., tilsammen
kr. 524.400,-.

2.14. Beltetransportør (BT-7)

Antall : 1 stk.
Type : 650 mm x 200 m.
Motor : Ikke inkludert.

Pris : kr. 471.960,-.

2.15. Beltetransportør (BT-8 - BT-9)

Her er det antatt 50 m lengder.

Antall : 2 stk.
Type : 500 mm x 50 m.
Motor : Ikke inkludert.

Pris : kr. 166.060,- pr. stk., tilsammen
kr. 332.120,-.

2.16. Vibrasjonssikt (VS-4)

Her er det foreslått et Kobelco sikt, 2 dekket, 8,9 m².

Antall : 1 stk.
Type : KSL 1830 x 4270.
Motor : 15 KW, inkludert.

Pris : kr. 318.000,-.

2.17. Elektromotorer og startutstyr m/kabel.

Her er det antatt en pris lik ca. 20 % av maskinpakken.

Pris : ca. kr. 3.000.000,-.

Samlet budsjettpris fritt levert Trondheim eksklusive merverdiavgift

kr. 18.663.840,-.

For videre behandling av prosjektet vil vi gjerne stille opp til et møte for å diskutere vårt tilbud nærmere. Alternativt kunne vi gjerne arrangere et møte her i Trondheim.

For oppredningsverket vil vi også kunne tilby engineering og utstyr. Vi kan der vise til vårt samarbeid med Kirkenes Engineering A/S, hvor den nødvendige ekseptise på magnetseparasjon forefinnes.

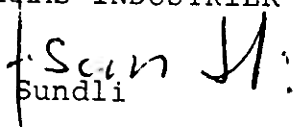
Det mottatte flytskjema er påført antatt materialstrøm i systemet samt referanser til valgt utstyr og følger vedlagt.

Vi ser frem til å høre nærmere fra Dem når De har studert vårt tilbud.

Med vennlig hilsen

NORMAS INDUSTRIER A/S

J. Sundli


O. E. Tårland

Vedlegg: Flytskjema
Brosjyrer - Kobelco utstyr
Data - RK 1200 x 1000
BM 1200 x 5000

CONCENTRATOR

CONCENTRATOR

Cost for a concentrator designed to produce 400,000 and 600,000 tons per year based on a 3 shift - 5 day work schedule have been evaluated. Should the production be increased to 800,000 tons, it will be done by going over to a 5 shift continuous working schedule.

The concentrator will produce 4 concentrates, a coarse magnetite concentrate, a fine magnetite concentrate, an ilmenite concentrate and a sulphide concentrate.

A laboratory scale batch test has been done by the "Oppredningslaboratoriet" at the Norwegian Institute of Technology. The result of this test are presented as Encl. 1 and 2.

when sulphide reduced to 10 mill.

The proposed flowsheet is shown as Fig. 47. The concentrator is estimated to cost 56,5 million N kr. for 400,000 TPy and 83,5 million Nkr. for a 600,000 Tpy. (In-place Concentrator).

Investment costs for the concentrator are evaluated for 5 different design alternatives and 3 different production levels. The design alternatives are:

1. New Equipment - Permanent Concentrator.
2. Used Equipment - Permanent Concentrator.
3. Used Equipment - Transportable Concentrator.
4. Used Equipment - Permanent Concentrator
- Pumping of ore to concentrator.
5. Used Equipment - Transportable Concentrator - Pumping.

The investment costs for the various design alternatives and production levels are presented in Table 12.

TABLE 12 ALTERNATIVES FOR CONCENTRATOR

ITEM	TYPE OF CONCENTRATOR - COSTS Nkr. x 1000 (400,000 mtn. / year *)				
	NEW PERMANENT	USED PERMANENT	USED TRANSPORTABLE	PUMPING USED-PERM	PUMPING USED-TRANSP
Crushing Plant	18,500	6,000	6,000	2,000	2,000
Site Exc. Foundations Building	12,000	12,000	3,000	12,000	1,000
Grinding Plant	40,000	2,000	2,000	2,000	2,000
Process Plant		8,000	8,000	8,000	8,000
Storage Bins	10,000	10,000		10,000	5,000
Dock Facility	10,000	10,000	5,000	10,000	5,000
Ship			20,000		20,000
Housing	2,000	2,000		2,000	
Office/Shop	2,500	2,500		2,500	
Pumping Plant				6,000	6,000
SUM	95,000	52,500	44,000	49,500	44,000

* To obtain costs for 600,000 mtn./ year multiply by 1.3, for 800,000 mtn./ year multiply by 1.5

TRANSPORTABLE CONCENTRATOR

The use of transportable concentrators is nothing new. They have been used in dredge mining for many years. Polaris, the world's most northerly mine, was recently developed utilizing a concentrator mounted on a barge. The barge cost \$ 4,455,000, but was specifically designed and built for this operation. A recent purchase of a normal 20 m x 60 m barge went for a price of \$ 410,000.

The total capital costs for the Polaris mine amounted to \$ 89,000,000 (Legget, 1982).

The proposal presented here is somewhat different in that it proposes the use of an old ship (50,000 to 150,000 Dwt.). In addition to providing a ready made enclosure for the concentrator, the ship can also provide the following:

1. Ore storage bins.
2. Dock facilities
3. Housing and office space.
4. Power generation
5. Maintenance facilities.

The use of this approach also has the following advantages:

1. Cheaper to build
2. The investment can be recovered if economics change.
3. It could make development of smaller remote deposits feasible.
4. Better construction techniques under the controlled conditions of a ship yard.
5. Can be constructed near the source of the mill equipment and then moved as a whole to the site.
6. Deposits in very rugged terrain can be developed without extremely high costs for mill site excavation.

A rough layout of the ship-mounted concentrator is shown in Fig. 64 and a layout of the crushing plant and concentrator is shown in Fig. 34.

As previously stated an evaluation of the investment costs for all of the concentrator design alternatives are presented in Table 12. This shows that the ship-mounted concentrator will be approximately 8 million Nkr. less costly than a permanent concentrator also utilizing used equipment.

CHOSEN CONCENTRATOR DESIGN

The design alternative that is chosen for the economic evaluation presented in this report is alternative 3 (used equipment-permanent concentrator-production of 600,000 mtn. per year of ore). The design alternative which will actually be implemented is a matter to be decided later during discussions conducted by the board of directors and with possible joint venture partners. The production and product sales figures for the nine different concentrator design and production rate alternatives are presented in Table 13.

MIKROSKOPERING AV KNUSEPRODUKT

AV SELVÅG-MALM

1987-10-19

AVD. FOR BERGTEKNIKK

RAPPORT
RAPPORT

N - 7034 Trondheim-NTH

ENCLOSURE 1

Telefon: (07) 59 30 00
Telex: 55 620 SINTEF N
Telefax: (07) 59 24 80

Rapportens tittel MIKROSKOPERING AV KNUSEPRODUKT AV SELVÅG-MALM	Dato 1987-10-19 Antall sider og bilag 5 s
Saksbehandler/forfatter Terje Malvik	Ansv. sign. (faglig) <i>Terje Malvik</i> Terje Malvik
Avdeling for bergteknikk	Prosjektnummer 363002.47
ISBN nr.	Prisgruppe

Oppdragsgiver Vesterålen Bergindustri A/S	Oppdr.givers ref. Knut Sandvik
---	--

Ekstrakt

Resultatet viser at ca. 40 % av magnetitten er frimalt ved 0,5 mm kornstørrelse, økende til ca. 60 % ved 0,25 mm og nærmere 80 % frimaling ved 0,1 mm.

I grovere kornklasser viser ilmenitten litt høyere frimaling enn magnetitt. Eksempelvis er nærmere 50 % av ilmenitten frimalt ved 0,5 mm. Under ca. 0,3 mm viser ilmenitt og magnetitt ganske like frimalingsverdier.

Stikkord på norsk

Indexing Terms: English

Gruppe 1
Gruppe 2
Egenvalgte
stikkord

Bergteknikk	Rock and Mineral Eng.
Mineralogi	Mineralogy
Magnetitt	Magnetite
Ilmenitt	Ilmenite
Selvåg	Selvåg

Ellin Kragh
AVDELINGSSJEF

MIKROSKOPERING AV KNUSEPRODUKT AV SELVAG-MALM.

Prøve av knust malm fra Selvåg ble overlevert oss for mikroskopundersøkelser av Prof. Knut Sandvik ved Oppredningslaboratoriet, NTH. Hensikten var å fremskaffe grunnlag for en vurdering av mulighetene til å fremstille magnetitt og ilmenitt-produkt.

Prøven ble siktet på 850, 417, 208 og 104 mikrometer sikt. Polerslip ble fremstilt av alle fraksjoner unntatt fraksjonen +850 mikrometer. Materialet i denne fraksjonen er for grovt til at man vil få brukbare kvantitative informasjoner ved en mikroskopering av slip.

Mikroskopering.

Mikroskoperingen er utført i form av en kornanalyse. Mellom 500 og 800 korn er systematisk registrert i hvert slip og klassifisert etter følgende nøkkel:

- Helkorn : 100 % av mineralet. Mineralet er tilsynelatende frimalt.
- Halvkorn : Blandingskorn med i størrelsesorden mellom 20 og 80 % relative mengder av mineralene.
- Smittede korn : Blandingskorn med en hovedfase og en smittefase. Smittefasen utgjør under ca. 20 % av kornarealet.

Resultatet av kornanalysen er gitt i tabell 1, med angivelse i volum-prosent av de enkelte registrerte korntyper. Man kan merke seg at for gruppen smittede korn er hovedmineralet oppført først i tabellen.

Kommentarer til mikroskoperingen.

Materialet inneholder en ganske sammensatt Fe-Ti-mineralogi. I denne orienterende undersøkelsen er det ikke gått i detalj inn på denne, men det er hovedsakelig konsentrert om de to hovedfasene magnetitt og ilmenitt.

Følgende er av betydning:

Magnetitten inneholder alltid spindler og dråpeformete inneslutninger av spinell. Vanlig er også at magnetitten inneholder lameller av forskjellig størrelse av ilmenitt. Tilsynelatende fører ikke all magnetitt ilmenitt, men den inneholder alltid spinell. Forholdet er imidlertid ikke undersøkt nærmere. Dersom ilmenitt alltid inngår i magnetitten vil betegnelsen ilmenitt-magnetitt være en korrekt betegnelse.

I tillegg til den ilmenitten som opptre i form av lameller i magnetitten, og som fysisk ikke kan skilles fra denne, opptre hva som er betegnet for fri ilmenitt i materialet. Dette er ilmenitt som opptre i egne korn og som tilsynelatende ikke nødvendigvis er knyttet til magnetitten. Denne ilmenitten kan konsentreres til et eget produkt. I tabellene er betegnelsen ilmenitt anvendt for denne kategori ilmenitt. Vanligst opptre denne ilmenitten fri for inneslutninger av andre mineraler,

Tabell 1

Resultat kornanalyse av knuseprodukt av Selvåg-malm.

	Fraksjon (mikrometer)			
	-850+417	-417+208	-208+104	-104
Volum-prosent korntype				
<u>Helkorn</u>				
mt	8,1	17,4	16,0	18,8
ilm	2,9	3,6	4,9	6,8
sulf	-	0,6	0,2	1,0
gang	37,9	47,6	64,9	66,0
Sum helkorn	48,9	69,2	86,0	92,6
<u>Halvkorn</u>				
mt/g	15,8	7,6	4,0	3,2
mt/ilm	0,7	1,4	1,5	0,6
ilm/g	3,7	1,4	0,2	0,8
Sum halvkorn	20,2	10,4	5,7	4,6
<u>Smittede korn</u>				
mt/g	15,1	6,0	3,8	0,2
mt/ilm	5,2	1,0	-	0,2
g/mt	7,3	10,8	3,4	2,2
ilm/mt	-	0,4	-	-
ilm/g	1,5	0,6	0,7	0,2
g/ilm	1,8	1,6	0,4	-
Sum smittede	30,9	20,4	8,3	2,8

Betegnelser i tabellen: mt = magnetitt (med ilmenitt og spinell)
 ilm = ilmenitt ("fri" ilmenitt)
 sulf = sulfider (ves. svovelkis)
 g = gangart (bergartsmineraler)

men ganske vanlig synes også å være intime sammenvoksninger med et mineral som er antatt å være en spinell.

Mineralfordeling.

Med grunnlag i kornanalysen (data i tabell 1) er fordelingen av magnetitten og den frie ilmenitten beregnet i forskjellige korntyper. Resultatet er gitt i tabell 2.

Figur 1 gir frimalingskurvene for magnetitt og ilmenitt, og figur 2. fordelingen av magnetitt og ilmenitt i forskjellige korntyper.

I de grovere kornklasser er frimalingen av magnetitt lavere enn for ilmenitten. For eksempel er i underkant 40 % av magnetitten frimalt ved 500 mikrometer kornstørrelse, økende til

Tabell 2.

Fordeling av magnetitt og ilmenitt i forskjellige korntyper.

	Fraksjon			
	+417	+208	+104	-104
	Fordeling i prosent			
<u>Magnetitt</u>				
Magnetitt i helkorn	23	59	71	88
Magnetitt i hovedfase	52	21	15	2
Magnetitt i halvkorn	23	15	12	9
Magnetitt i smittefase	2	5	2	1
 <u>Ilmenitt</u>				
Ilmenitt i helkorn	41	62	76	88
Ilmenitt i hovedfase	18	9	10	2
Ilmenitt i halvkorn	31	24	13	9
Ilmenitt i smittefase	10	5	1	1

ca. 60 % ved 250 mikrometer, og nærmere 80 % ved 100 mikrometer. For ilmenitt er frimalingen ved de samme kornstørrelser h.h.v. ca. 50, 70 og 80 %.

Man kan imidlertid merke seg at en relativt sett større andel av magnetitten opptrer som hovedfase i smittede korn enn hva som er tilfellet for ilmenitt. En større andel av magnetitten er derfor utvinnbar enn tilsvarende for ilmenitten ved samme kornstørrelse. Av figur 2 fremgår at betraktes magnetitt i helkorn plus magnetitt i hovedfase samfengt, vil nærmere 80 % av magnetitten være utvinnbar allerede ved ca. 500 mikrometer kornstørrelse.

Man vil ved magnetseparasjon også ta med seg halvkorn med magnetitt, og lett også gangart med smitte av magnetitt. Hvis man gjør et overslag over mengde magnetitt i et konsentrat ved 100 % utvinning, og antar samme fordeling i korntyper som denne undersøkelsen har vist, vil man teoretisk ende opp med et konsentrat som holder ca. 62 % magnetitt ved 400 mikrometer, ca. 77 % magnetitt ved 200 mikrometer og ca. 85 % ved 100 mikrometer kornstørrelse. Omregnet til Fe-innhold tilsvarer dette ca. 44, 55 og 60 % oksydbundet Fe i konsentratet.

Dette må antas å være minimumsanslag. Man vil sannsynligvis oppnå noe bedre verdier ved forsøk. Hovedsakelig fordi gangart med smitte av magnetitt i større grad enn halvkorn vil gå i avgangen, og fordi disse smittekorne bidrar mest til å nedsette konsentratet.

Når det gjelder mulighetene for å fremstille et ilmenitt-konsentrat, ser man at det først vil være under ca. 150 - 200 mikrometer at man vil ha høy nok frimaling til å oppnå et brukbart produkt, og samtidig oppnå akseptabel utvinning.

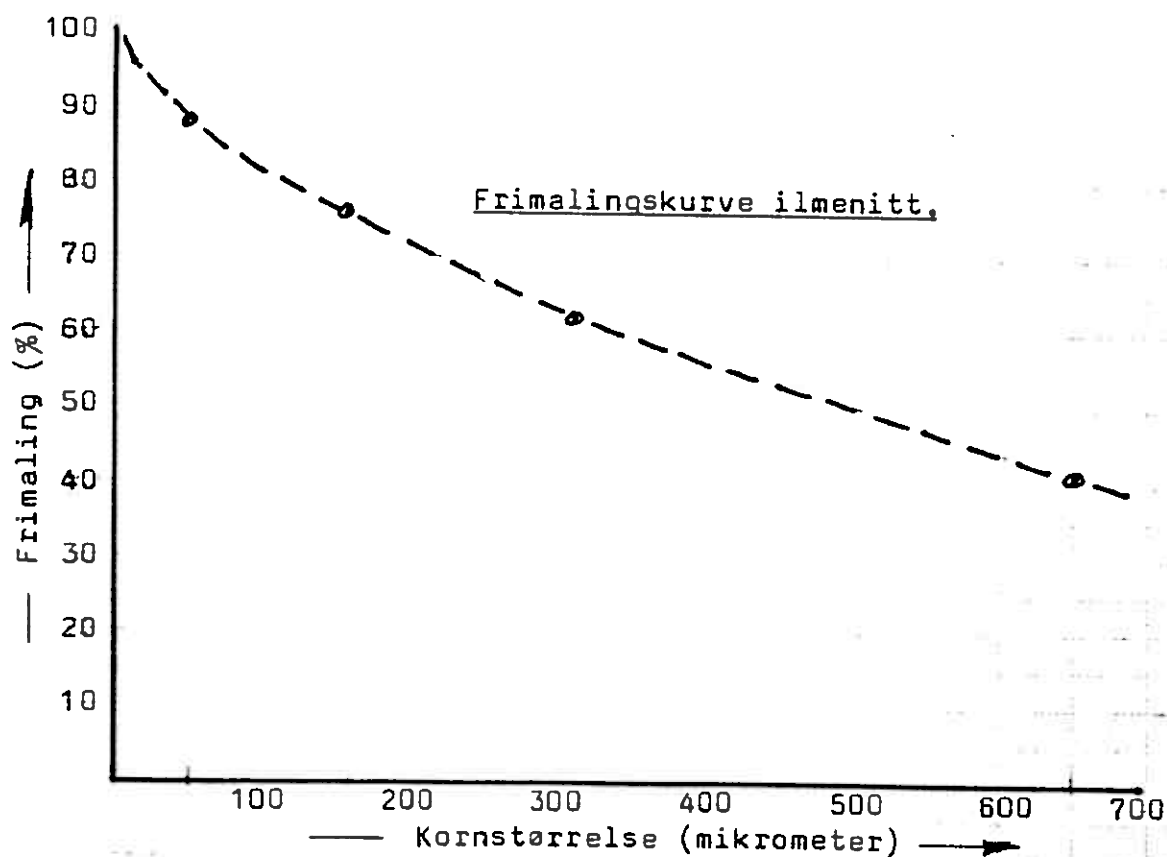
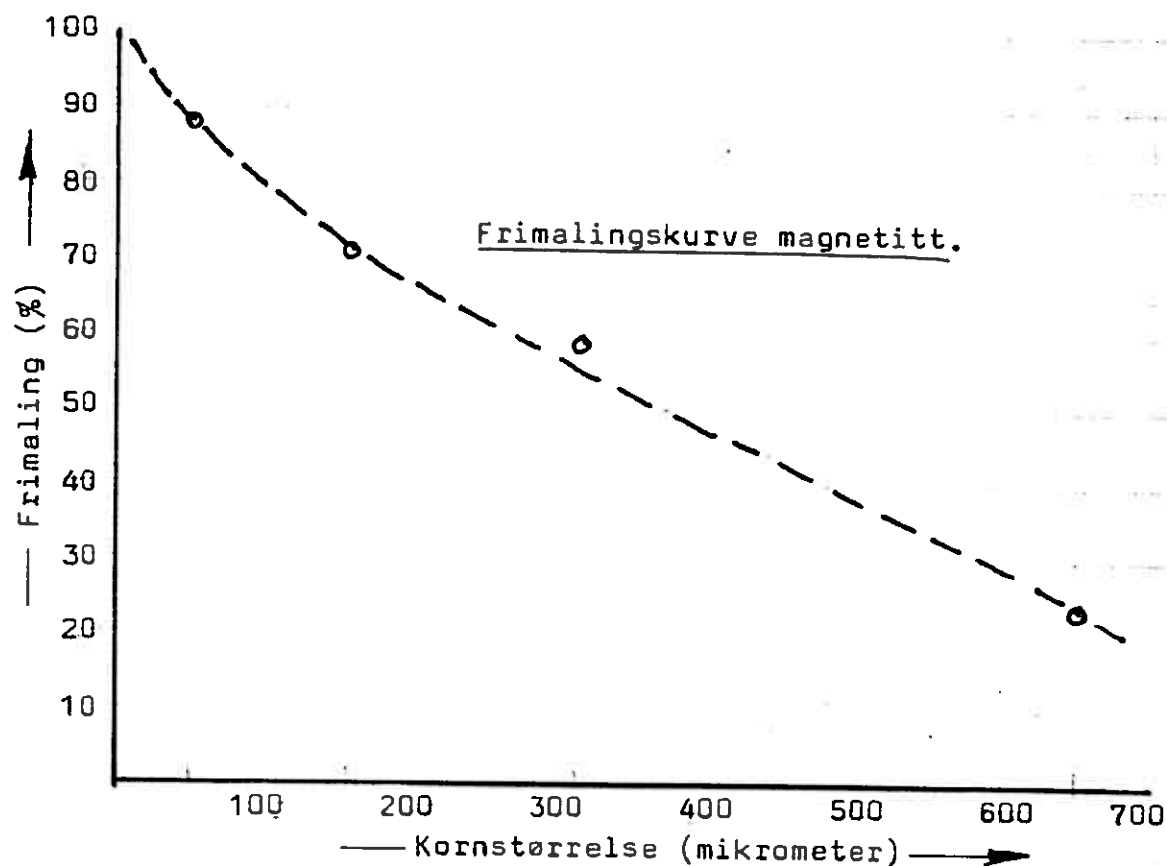


Fig.1. Frimalingskurver til magnetitt og ilmenitt i knuseprodukt av Selvåg-malm.

NB. Ilmenitten omfatter såkalt "fri" ilmenitt. Den lamell-bundne ilmenitten i magnetitt er ikke medregnet. Magnetitten er en ilmeno-magnetitt med spinell-inneslutninger.

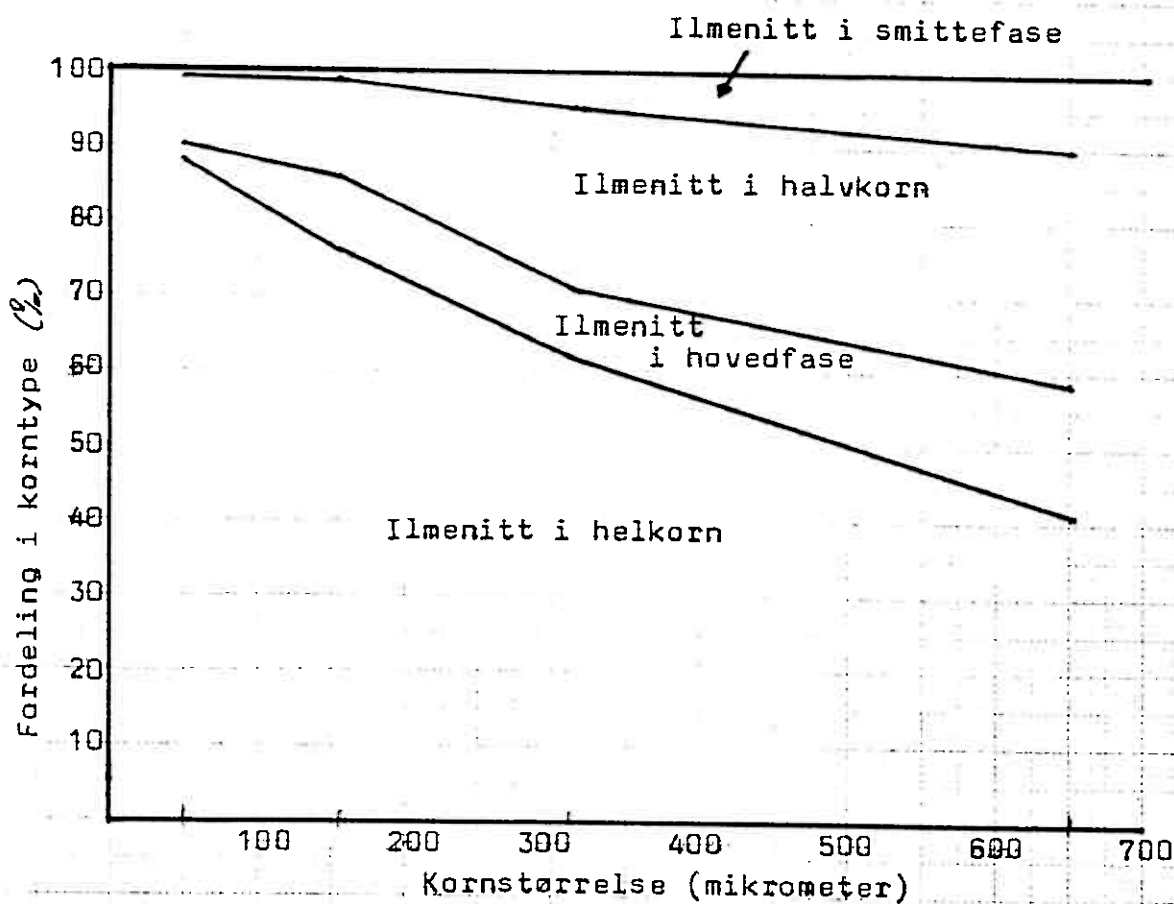
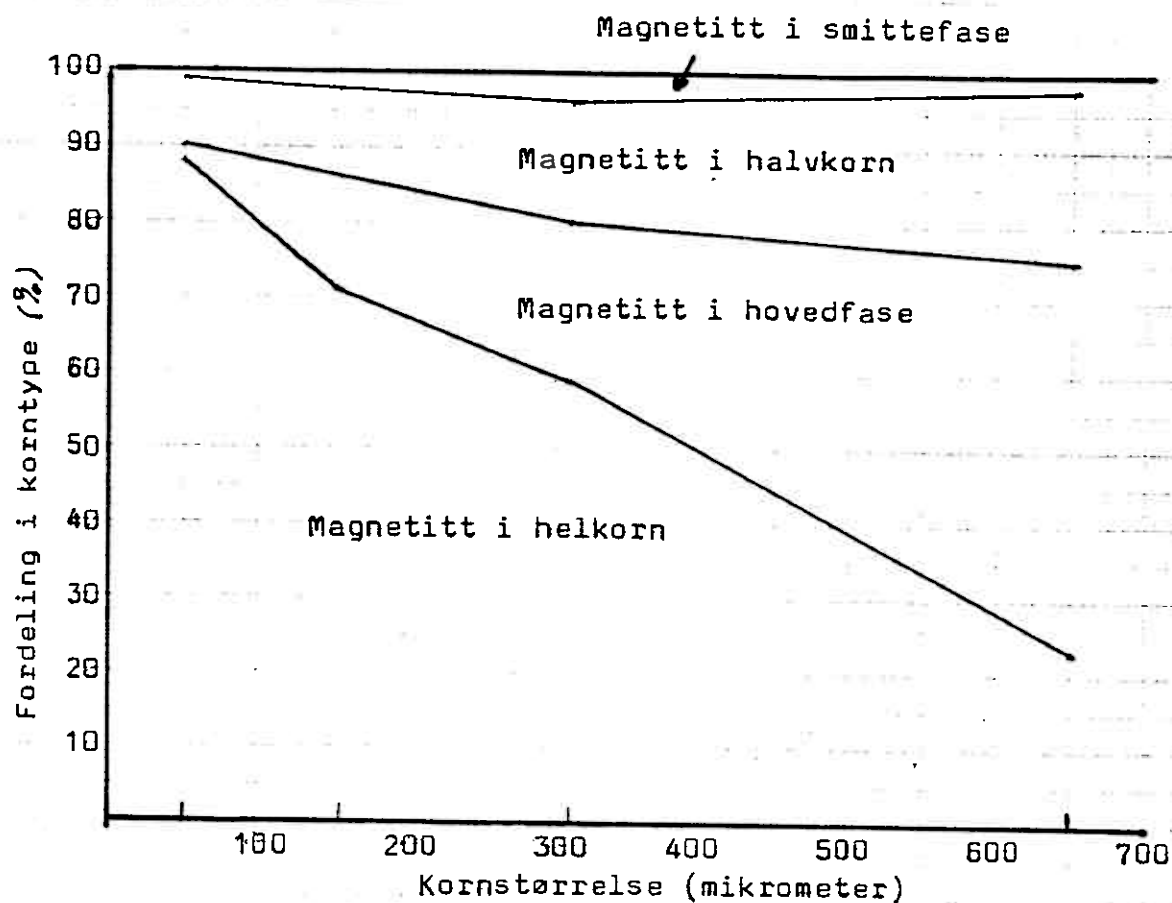


Fig.2. Fordeling av ilmenitt og magnetitt i helkorn og i forskjellige typer blandingskorn, som funksjon av kornstørrelse i knuseproduktet. Data fra tabell 2.

TABLE 13 PRODUCTION RATES

ALT.	PRODUCTION					SUM
	ORE	MAGNETITE	ILMENITE	SULPHIDE	AGGREGATE	MILLION Nkr.
1	600,000	180,000 36 mill.	24,000 8.4 mill.	2000 6.8 mill.	200,000 7 mill.	58.2
2	600,000	180,000 36 mill.	24,000 8.4 mill.	2000 6.8 mill.	200,000 7 mill.	58.2
3	600,000	180,000 36 mill.	24,000 8.4 mill.	2000 6.8 mill.	200,000 7 mill.	58.2
4	600,000	180,000 36 mill.	24,000 8.4 mill.	2000 6.8 mill.		42.2
5	600,000	180,000 36 mill.	24,000 8.4 mill.	2000 6.8 mill.		42.2
6	900,000	270,000 54 mill.	36,000 12.6 mill.	3000 10.2 mill.	200,000 7 mill.	83.8
7	1,2000.000	360,000 72 mill.	48,000 16.8 mill.	4000 13.6 mill.	200,000 7 mill.	109.4

CHOSEN PRODUCTION RATE

The production rate chosen and presented in this evaluation is 600,000 mtn per year of ore. The production rate actually implemented is matter to be decided later.

PRODUCTS AND PRODUCTION RATES

The operation is designed to produce 6 different products which are:

1. A course magnetite concentrate
2. A fine magnetite concentrate
3. A magnetite gravel (RBC-PCC)
4. A sulphide concentrate.
5. An ilmenite concentrate
6. Sand and Gravel

} *faller int*

The primary products is of course the magnetite concentrate which will primarily be sold as heavy media. The technical specifications of the heavy media are presented in Encl. 7. The result of a lab test conducted on our heavy media is presented in Encl. 8. A chemical analysis of the other concentrates produced in the lab. test are presented in Encl. 9.

SCANDIUM

faller int

The chemical analysis of the concentrates produced in the Lab. test shows that the scandium lies in the tailings and can be concentrated. The economic evaluation takes no consideration of the scandium values.

ECONOMIC EVALUATION

As previously stated, this economic evaluation of the Selvåg deposit considered 9 different design and production alternatives. The various factors such as investment costs, employment levels, income, discounted present worths, payback periods and internal rates of return for all of the alternatives are presented in Table 14.

CHOSEN ALTERNATIVE

As previously stated, the alternative chosen for detailed presentation in this analysis is alternative 3 (Used Equipment-Permanent Concentrator- 600,000 Tpy ore). As also previously stated, this may not be the alternative that is actually implemented.

The manning table for alternative 3 is presented in Table 15, investment costs are presented in Table 16 and income and production costs are presented in Table 17.

The results show that alternative 3 will have an annual net income prior to depreciation and taxes of 30.048 million Nkr. The discount present worth of 20 years of operation is 77.4 million Nkr. The playback period is 3 years and the internal rate of return is 31 %. These figures are presented in Table 18.

RISK ANALYSIS

MARKET

The planned closing of SSAB's two major mines and the very probable closing or production change over to pellets only of LKAB creates a very favorable market situation.

TABLE 14 ECONOMIC COMPARISON OF DEVELOPMENT ALTERNATIVES

ALT.	PRODUCTION ORE x 1000	EMP.	TOTAL INVEST	DUF GRANT	NET INVEST	OPERATING INCOME	PRESENT WORTH	PAY BACK	INTERNAL ROR
1	600,000	35	144,625	36,156	108,469	26,563	32,594	4.9	22%
2	600,000	35	91,500	17,875	73,625	30,048	77,427	3.1	31%
3	600,000	35	80,875	12,718	68,159	30,595	80,862	2.8	32%
4	600,000	33	85,000	19,375	65,625	26,048	63,546	3.2	30.25%
5	600,000	33	78,125	12,781	65,344	26,086	63,890	3.1	30.5%
6	900,000	40	123,312	27,578	95,734	47,862	128,777	2.5	35%
7	1,200,000	63	142,062	31,765	110,297	61,496	181,182	2.3	41%

TABLE 15 MANNING TABLE

	NUMBER	SALARY + BENEFITS Nkr. x 1000
Administration		
General Manager	1	420
Office Manager	1	250
Clerk	<u>1</u>	190
	3	
Mine		
Mine Superintendent	1	275
Geologist	1	250
Driller (2x2sh.)	4	225
Loader Oper. (2x2sh.)	<u>4</u>	225
	10	
Concentrator		
Mill Superintendent	1	275
Lab Technician	1	225
Maintenance Supv.	2	250
Shift Boss	3	250
Crusher Oper (2x3sh.)	6	190
Mill Oper. (2x3sh.)	6	190
Mechanics	2	225
Electrician	<u>1</u>	225
	22	
Total	35	

TABLE 16 INVESTMENT COSTS - ALTERNATIVE 2

		Nkr. x 1000
MINE		
Mobile Equipment		
Front End Loaders Cat 988 (2 x 2500)	5,000	
Drill Rigs Atlas Copco 712	4,400	
Utility Vehicles (4 x 200)	800	10,200
Permanent Installations		
Roads (1 Km. x 1,000)	1,000	
Stripping (60,000 m ³)	600	
Tunnel (400 m x 5)	2,000	
Shaft (140 m x 5)	700	
Ventilation	200	4,500
CONCENTRATOR (see Table)		52,500
POWER		5,000
WATER		1,000
UNFORSEEN 15%		10,980
ENGINEERING 10%		<u>7,320</u>
TOTAL INVESTMENT		91,500
DUF GRANT		<u>17,875</u>
NET INVESTMENT		73,625

FORDELER

Store Forekomst

Gode Beligenet

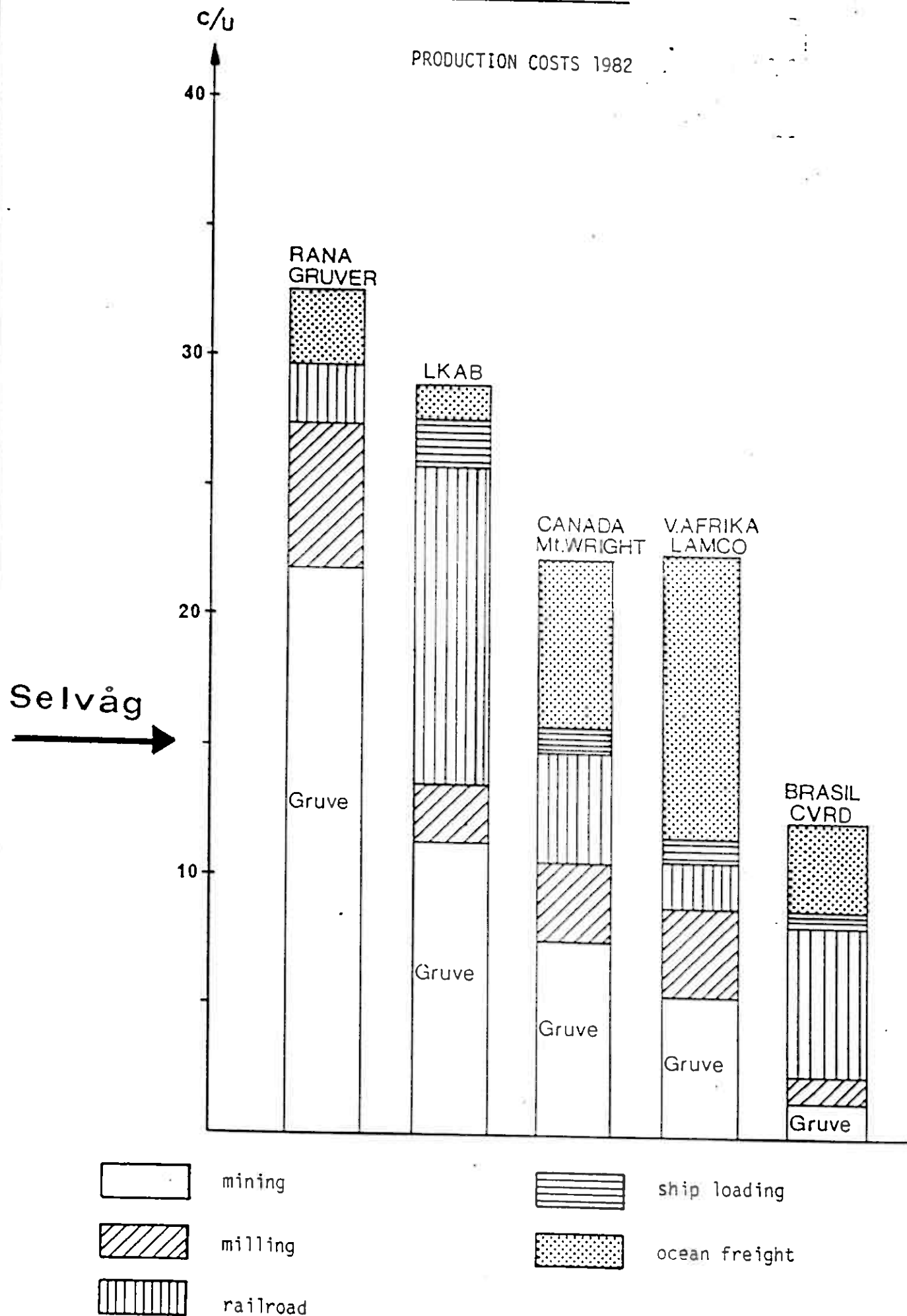
● Lave Driftskostnader

Lave Transportkostnader

Biprodukt Verdier

●

FIG. 2 COST COMPARISON OF IRON ORE PRODUCERS



SELVÅGPROSJEKTET

GROVE-TREKK

Produksjon 180.000 Tonn Slig

● Marked Heavy Medea
Europa - USA

Nåværende Produksjon - SSAB
nedl. 1992

Investerings 136 mill.

● Sysselsetting 35 - 50
Spinoff 100

Omsettnings 50 mill.
Spinoff 100 mill.

Malmreserver 200 mill. tonn
333 år

FINANSIERING

Totalt 136 mill.

Seal Bay 34 mill.

● DUF 34 mill.

Garanterte Lån 34 mill.

Bank 34 mill.

● Nåverdi 75 mill.

Internrente 25 %

Tilbakebetalingstid 3 1/2 år

TABLE 17 PRODUCTION INCOME / COSTS - ALTERNATIVE 2

PRODUCTION / SALES FOB MINE		Nkr. x 1000	
Magnetite (180,000 x 200)		36,000	
Ilmenite (24,000 x 350)	2	8,400	
Sulphides (2,000 x 3400)	2	6,800	+ 6,800
Aggregate (200,000 x 35)	2	<u>7,000</u>	13,000
TOTAL SALES		58,200	
		13,000	
		<u>45,200</u>	
PRODUCTION COSTS			
Materials			
Explosives	1,200		
Drill steel	300		
Balls, Reagent	3,600		
Fuel	1,800	6,900	
Wages		7,890	
Marketing		3,000	
Administration		3,000	
Interest		<u>7,362</u>	
TOTAL PROD. COSTS		28,152	
GROSS PROFITS		<u>30,048</u>	
DEPRECIATION		<u>7,362</u>	
NET PROFIT BEFORE TAXES		22,686	

Total costs per mtn. ore = Nkr. 46.92

TABLE 18 DISCOUNTED CASH FLOW - RATE OF RETURN ANALYSIS - ALTERNATIVE 2

	YEAR	INVESTMENT	OPERATING INCOME	DEPR. & DEPL.	TAXABLE INCOME	TAXES (50 %)	NET PROFIT AFTER TAX	CUM. NET CASH FLOW	ANNUAL NET CASH FLOW	TRIAL 15% INTEREST RATE		TRIAL 25% INTEREST RATE		30 % INTEREST RATE		TRIAL % INTEREST RATE	
										FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE
BEFORE ZERO AFTER ZERO																	
	-2																
	-1	73,625						-73,625			-73,625				-73,625		
	1		30,048	25,918	4,130	2,065	2,065	45,642	27,983	.9332	26,113	.8962		.7692	21,524	.7143	
	2		30,048	13,647	16,401	8,200	8,201	23,195	22,447	.8115	18,215	.7170		.5917	13,281	.5102	
	3		30,048	13,647	16,401	8,200	8,201	- 748	22,447	.7056	15,838	.5736		.4552	10,217	.3644	
	4		30,048	13,647	16,401	8,200	8,201	21,699	22,447	.6136	13,773	.4589		.3501	7,858	.2603	
	5		30,048	13,647	16,401	8,200	8,201	44,146	22,447	.5336	11,977	.3671		.2693	6,044	.1859	
	6		30,048	13,647	16,401	8,200	8,201	66,593	22,447	.4640	10,415	.2936		.2072	4,651	.1328	
	7		30,048	13,647	16,401	8,200	8,201	89,040	22,447	.4034	9,055	.2349		.1594	3,578	.0949	
	8		30,048	13,647	16,401	8,200	8,201	111,487	22,447	.3508	7,874	.1879		.1226	2,752	.0678	
	9		30,048	13,647	16,401	8,200	8,201	133,934	22,447	.3050	6,846	.1503		.0943	2,116	.0484	
	10		30,048	13,647	16,401	8,200	8,201	156,381	22,447	.2652	5,952	.1203		.0725	1,627	.0346	
	11		30,048	7,512	22,536	11,268	11,268	175,161	18,780	.2306	4,330	.0962		.0558	1,047	.0247	
	12		30,048	7,512	22,536	11,268	11,268	193,941	18,780	.2006	3,767	.0769		.0429	805	.0176	
	13		30,048	7,512	22,536	11,268	11,268	212,721	18,780	.1744	3,275	.0615		.0330	619	.0126	
	14		30,048	7,512	22,536	11,268	11,268	231,501	18,780	.1516	2,847	.0492		.0254	477	.0090	
	15		30,048	7,512	22,536	11,268	11,268	250,281	18,780	.1319	2,152	.0394		.0195	366	.0064	
	16		30,048	7,512	22,536	11,268	11,268	269,061	18,780	.1146	1,872	.0315		.0150	281	.0046	
	17		30,048	7,512	22,536	11,268	11,268	287,841	18,780	.0997	1,628	.0252		.0116	217	.0033	
	18		30,048	7,512	22,536	11,268	11,268	306,621	18,780	.0867	2,477	.0201		.0089	167	.0023	
	19		30,048	7,512	22,536	11,268	11,268	325,401	18,780	.0754	1,416	.0161		.0068	127	.0017	
	20		30,048	7,512	22,536	11,268	11,268	344,181	18,780	.0655	1,230	.0129		.0053	99	.0012	
	TOTALS							344181			77,427				4,292		

Rødsand Gruber, Sydvaranger and Rana Gruber are considering a push into the heavy media field. But, the absence of LKAB and SSAB will more than compensate for these. The market should have more than enough room for a new production of the size considered here. Market share should not be a problem for Selvåg.

SHIPPING COSTS

Shipping costs will have an affect on the economics of the Selvåg project. The limiting factor here is the capacities of the shipping and recieving port facilities.

These capacities are:

Shipping

Rødsand	13,000 Mtn.
Foldal	35,000 Mtn.
Rana	30,000 Mtn.
Selvåg	150,000 Mtn.

Recieving

New Orleans	50,000 Mtn.
England	5,000 Mtn.
Germany	20,000 Mtn.
(prefer)	3,000 Mtn.

Shipping costs per. mtn. - kilometer are shown in Fig. 4.

An analysis of this data shows that, for shipments to the USA, Selvåg can complete with anyone. For shipments to Europe the picture is different.

The lower capacities of the European recieving facilities will require smaller ships and thereby limit Selvågs competitiveness in Europe.

The RBC sold in Europe is shipped from Narvik in 3000 mtn. ships. Selvåg can therefor compete quite easily in this segment of the market.

EXCHANGE RATES

This economic evaluation is based on a sale price of \$ 20 FOB for heavy media to the US and an exchange rate of 7 US dollars per Norwegian Krone. An exchange rate under 7 will affect the projects economics as far as sales to the USA is concerned. Average exchange rates for the last 8 years are shown in Fig. 72. An analysis of this data shows that the average exchange rate has historically been about 7.00. The affect that various exchange rates will have on the profil from sales to the USA are shown in Fig. 73.

PRODUCTION COSTS

Because of the positive developments in the market, it is expected that production costs will increase at the same rate as sales prices.

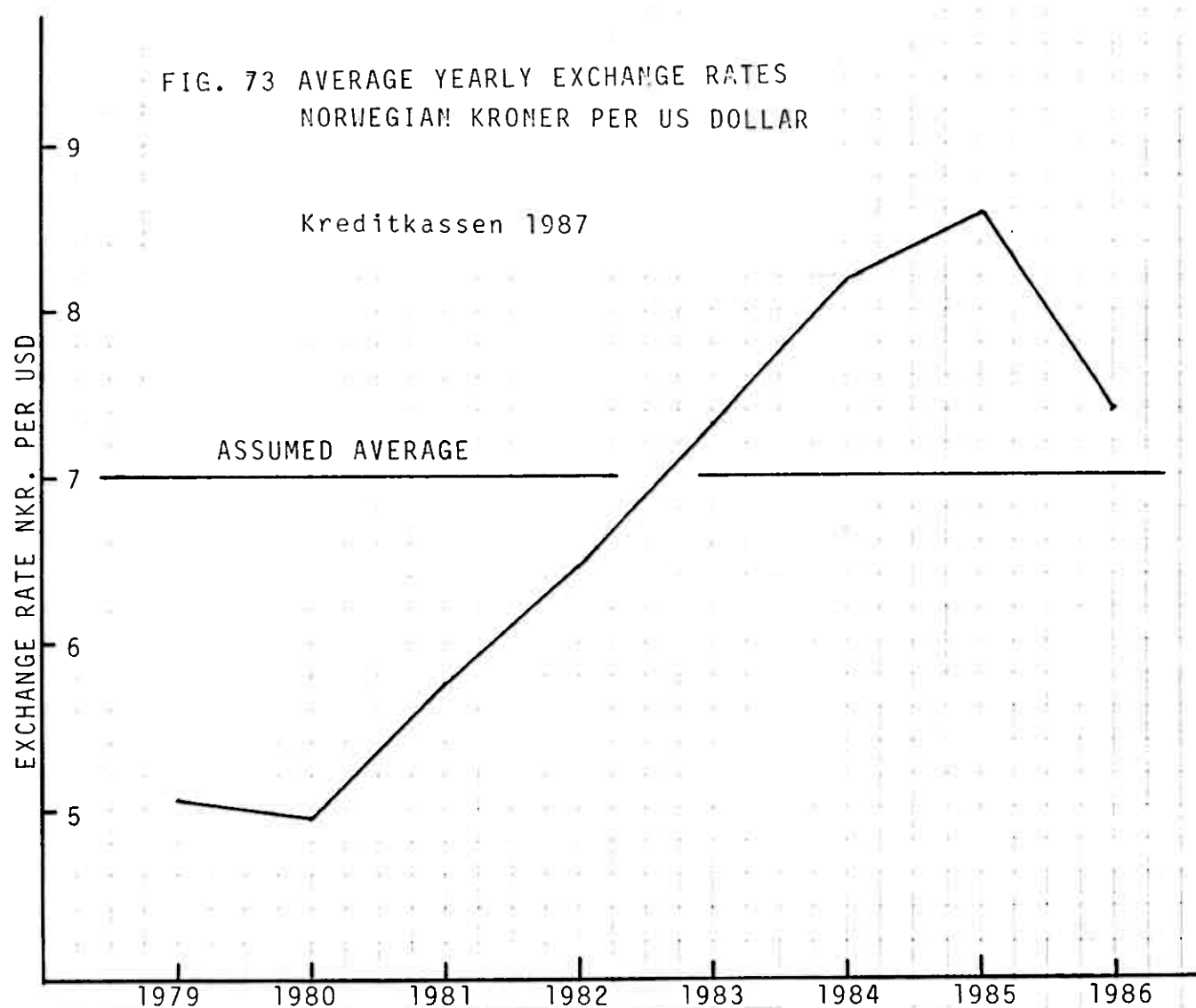
ORE GRADE

The ore grade, which averages about 25% Fe for the entire deposit, can be expected to vary considerably. The sale of aggregate will help to eliminate the affects of the ore grade variations.

ENVIRONMENTAL IMPACT

BLASTING NOISE AND VIBRATIONS

The site is very isolated. It is expected that the noise and vibration from blasting will be noticed from the nearest villages; but, due to the terrain, the affects will be very minor.



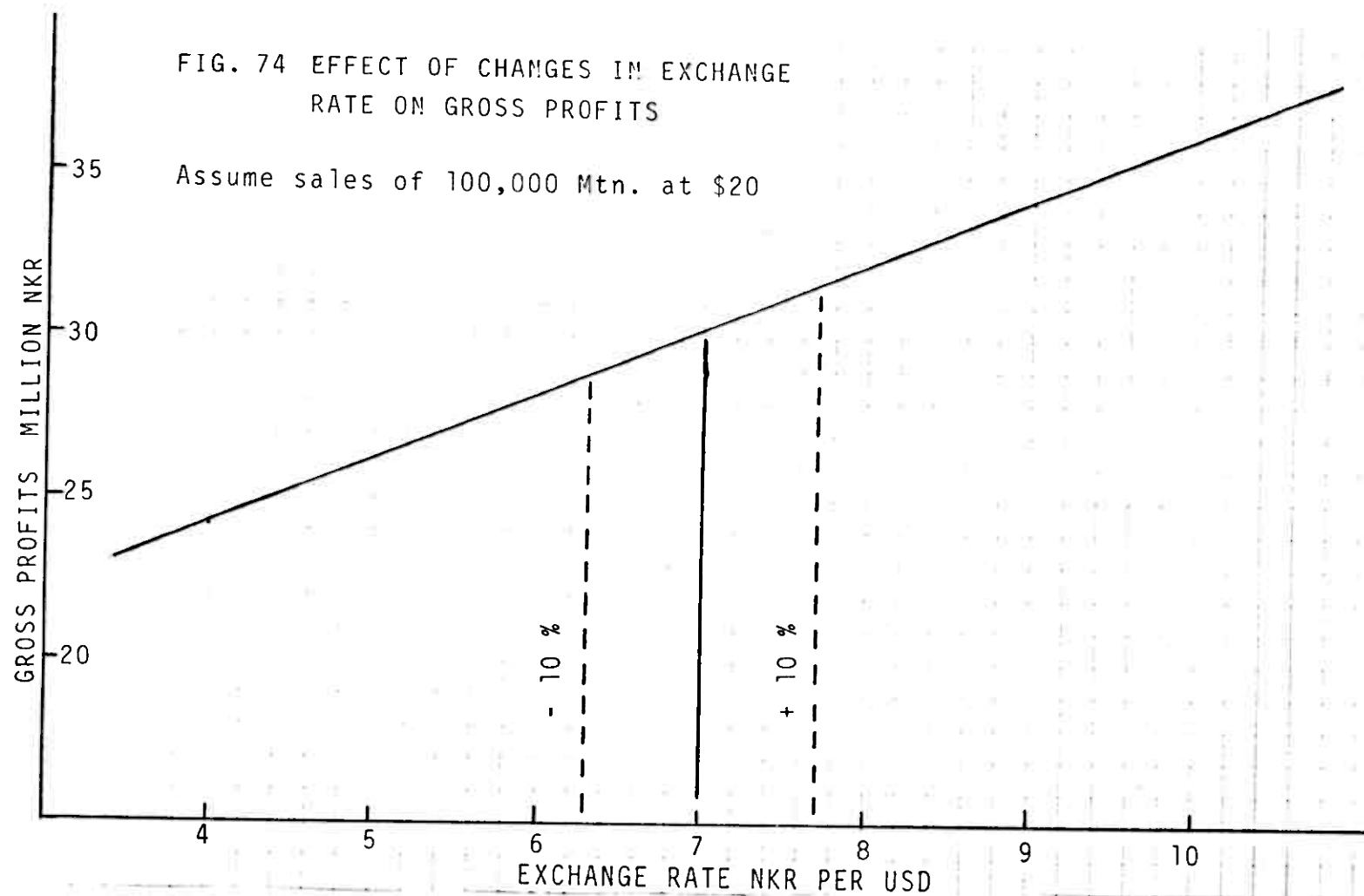


FIG. 75 EFFECT OF CHANGES IN AVERAGE MAGNETITE SALES PRICES ON GROSS PROFITS

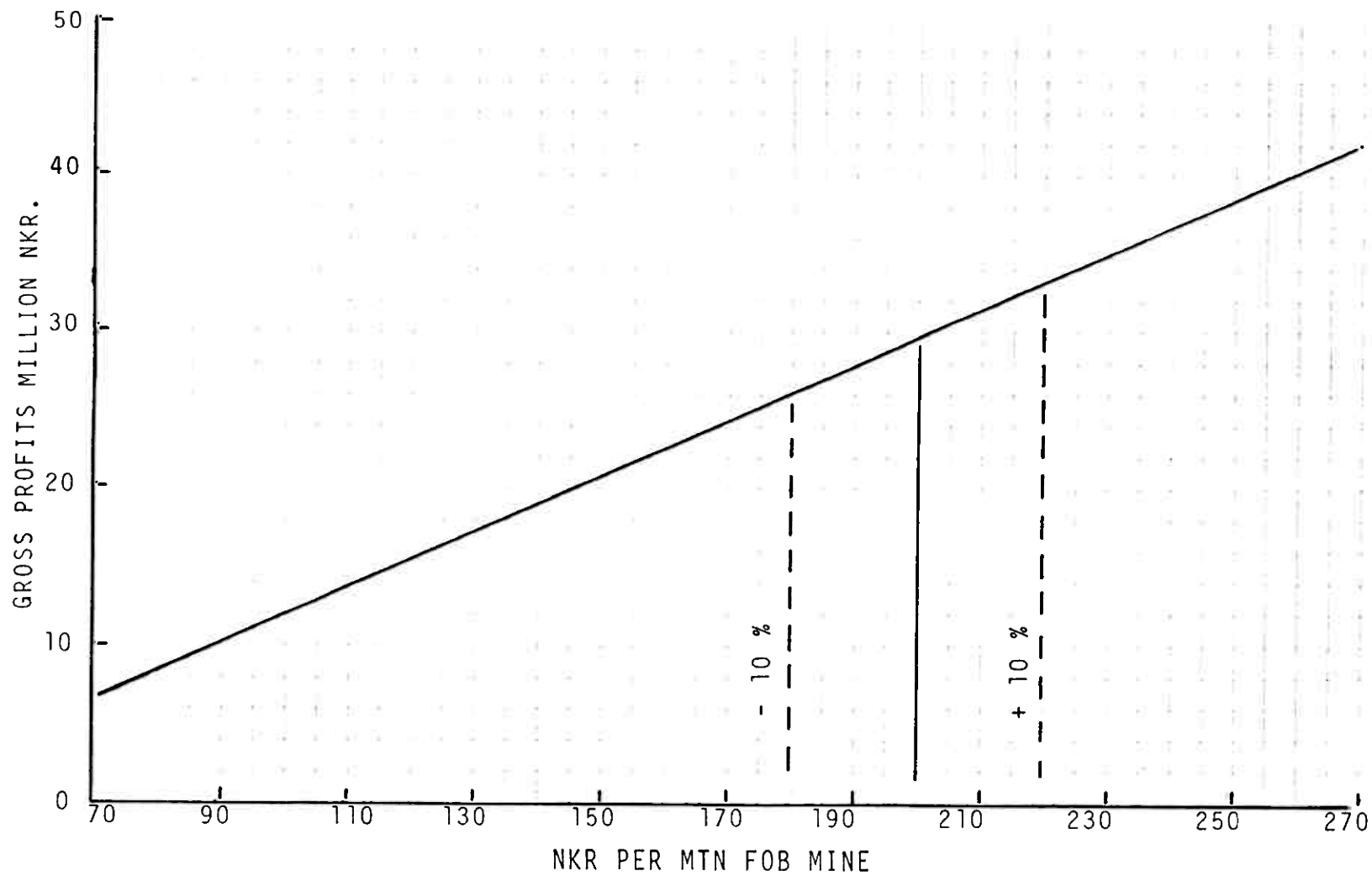


FIG. 76 EFFECT OF INCREASED NET INVESTMENT COSTS ON PRESENT WORTH

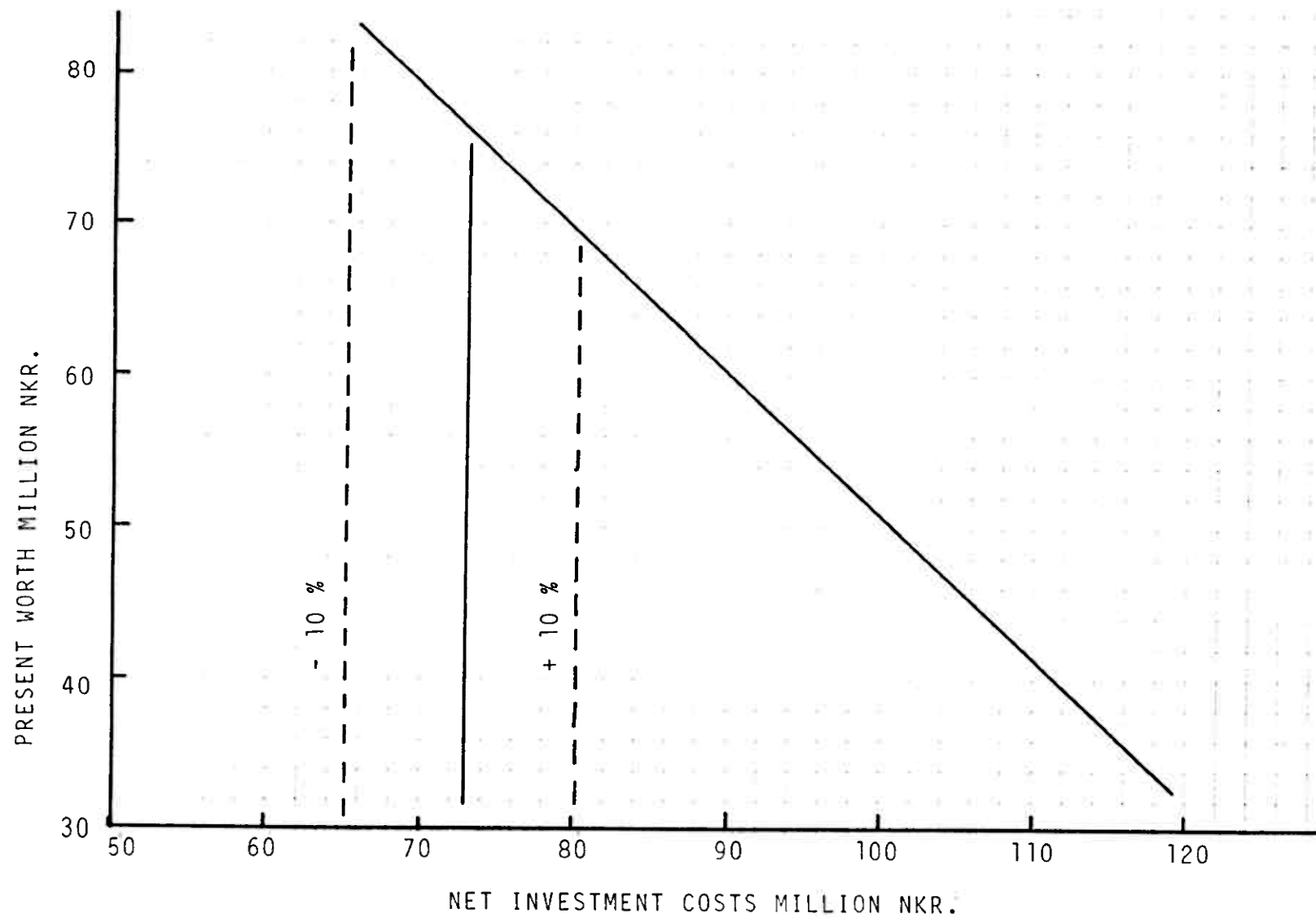
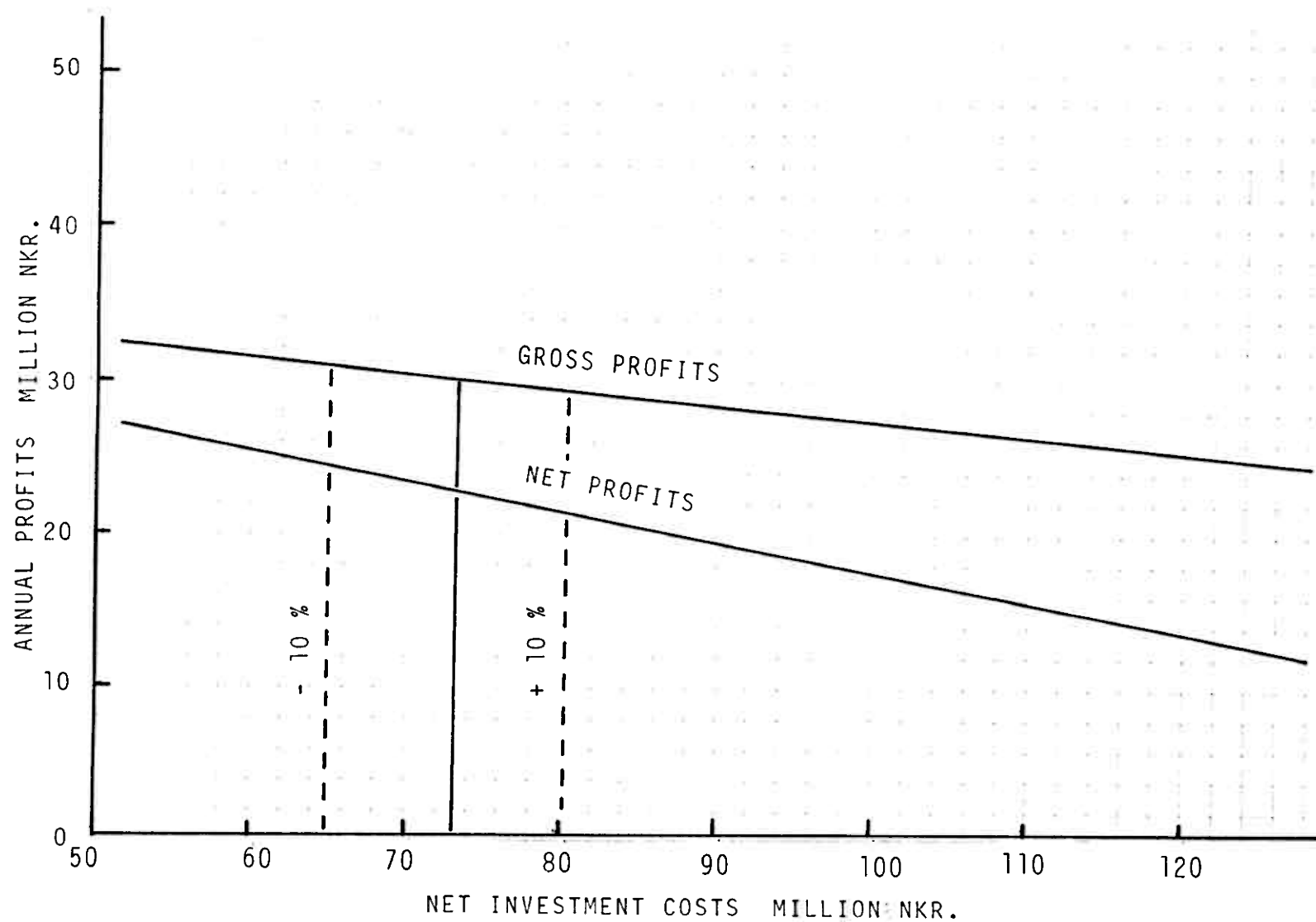


FIG. 77 EFFECT OF INCREASED NET INVESTMENT COSTS ON ANNUAL PROFIT



SOCIAL IMPACT

The operation will probably employ about 35 people. The greatest unemployment in the area is among women and an effort will be made to recruit and utilize these women. The remaining workers, Men, can probably be recruited from the local workforce, therefor, no great influx of workers and families is expected.

ENVIRONMENT IMPACT STUDY

An environmental impact evaluation is being conducted by Bø kommune. The results of this evaluation is presented as Encl. 10.

The only expected impacts are visual and tailings disposial.

VISUAL IMPACT

The visual impact will be very minor.

The Selvåg deposit is located in a side valley of a very sparsely populated fjord (Malnesfjord). It is only visable from the very tiny village of Hysfjorda across the fjord. The village has only about 20 residents.

Only the concentrator and a very small portion of the north pit will be visible from the village. The layout of the concentrator and mine is shown in Figures 34 and 35.

TAILINGS DISPOSIAL

In the inital years of the operation, it will be necessary to deposit about 50,000 tons of tailings per year in the fjord. The fjord is ___ meters deep and, if the tailings are deposited in the very bottom, they should have no affect on the local fishing. In the latter years of operation the tailings can be deposited in the underground excavations. The tailings will contain some flotation reagents (_____) but they are NOT toxic.

AIR AND WATER POLLUTION

There is no expected impact on air and water pollution. The operation will have no gaseous or liquid emissions.

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FRANK & SCHULTE

GESELLSCHAFT MIT BESCHRÄNKTER HAFTUNG

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N-7002 Trondheim

Ihr Zeichen

JGH/aj

Ihr Schreiben vom

25.1.88.

Durchwahl

438 248

Unser Zeichen

BK/Eu

Essen 1, Alfredstraße 154

08.02.88

Lieber Herr Heim,

ich danke Ihnen sehr herzlich für Ihren Brief vom 25.v.M. und würde es sehr begrüßen, wenn Sie mich auch weiterhin über die alte und neue Magnetit-Produktion unterrichtet halten, insbesondere über die von Johannes Soyland geplante Exploration.

Das in Ihrem Brief erwähnte Granat-Projekt wird von meinem Kollegen, Hans-Jürgen Reiprich, geprüft, und eine separate Nachricht geht Ihnen schnellstens zu.

Mit freundlichen Grüßen

- Bernhard Krüger -



Frank & Schulte GmbH Postfach 101255 D-4300 Essen 1

Mr. Johannes Soyland
President
VBI Vesteralen Bergindustri A/S
Postboks 416
N-8501 Narvik

Ihr Zeichen

Ihr Schreibenvom

Durchwahl
438 248

Unser Zeichen
BK/Eu

Essen 1, Alfredstraße 154
20.01.88

Dear Sir,

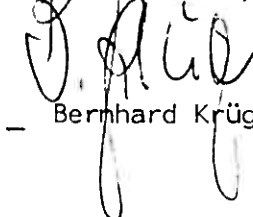
We refer to our recent meeting and your letter of Dec 22, 1987 and note with great interest that you work on the possibilities going in production with Magnetite ex Selvag Deposit at short date, and would like our company to do the marketing. Once again we confirm that we are highly interested in marketing your products in Europe, but also USA, on a long term basis. To our knowledge the tonnages will be the following:

GREAT BRITAIN	80,000mt	fine Magnetite
EUROPE	5,000mt	course Magnetite
EUROPE	20,000mt	medium fine Magnetite
EUROPE	30,000mt	fine Magnetite
USA	250,000mt	fine Magnetite

We understand that Fosdalen Bergverk will switch their Iron Ore production from metallurgical to non-metallurgical, and consequently this source is going to last until after the year 2000. We also know that Sydvaranger A/S will ship a trial lot of approx. 35,000mt fine Magnetite in the course of this month to USA via National Lead. The present price as an average is ranging between NKR 180.-- to 200.--pmt, dry weight, fob port of shipment. Due to strong competition of Sydvaranger A/S, Fosdalen, Titania A/S and SSAB, no doubt, price level will go down.

As we are keenly interested in a cooperation with you we look forward to receiving more detailed information from you.

Yours sincerely,


- Bernhard Krüger -

Dr. Johann G. Heim
Norsulfid
Brøsetveg 168
7000 Trondheim



KOCH CARBON INC

January 19, 1988

Johannes Soyland President
VBI Vesterialen Bergendustri A/S
Fagernesveien 1
Postbolss 416
8501 Narvik
Norway

Dear John,

Thank you for your recent visit and your explanation of the Selvag project which sounds very exciting. We have received the prepared sample of Selvag Magnetite ore which you sent to our Tazewell plant. Our test indicate that this ore should be suitable for our process. Koch Carbon could conditionally be in a position to purchase up to 200,000 nt/year of Magnetite concentrate subject to price and quality considerations. Please keep us informed as to the progress of the Selvag project.

Sincerely,

A handwritten signature in dark ink, appearing to read 'Mark Wolff'.

Mark Wolff
Koch Carbon, Inc.

MAW/clf

Dr. Johann G. Heim
Norsulfid
Brøsetvegen 168
7000 Trondheim



VBI *Vesterålen Bergindustri A/S*

Narvik
25 Jan. 1988

Dr. Johann G. Heim
Chief Geologist
Norsulfid
Brøsetveg 168
7000 Trondheim

OPPSUMERING AV AVTALE

Jeg viser til vår møte den 19 Jan. 1988 og oppsummerer herved det vi ble enig om.

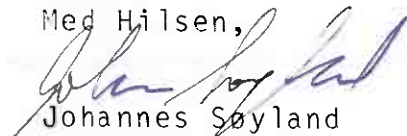
1. Rapporten om Selvåg gjøres ferdig innen Jan 1988 og en kopi sendes Outokumpu. En kopi av alle "letters of intention" sendes fortløpende.
2. Outokumpu (Dr. Heim) kontakter Messet Kommune og DUF Møre og Romsdal for å sjekke mulighetene til Kommunal/ DUF støtt til en magnetittprosjekt i Nesset Kommune.
3. Et "letter of intention" skrives av Outokumpu etter forslag fra Soyland angående Senja prosjektet.
4. Outokumpu ordner med en helikopter befaring av Senja og andre interessant områder i Mai/Juni tidsrommet.
5. Outokumpu holdes løpende orientert om utvikling i prosjektene.

FORSLAG TIL BREV

Outokumpu (Norsulfid) er interessert i å delta i malmletting-prosjektet "Geitskar-Botnskar Kopper-Nikkel-Kobolt" i Berg Kommune på Senja.

Dersom en avtale blir oppnådd er vi villig å bidra med opptil Nkr. _____ (200.000 ?).

Med Hilsen,


Johannes Søyland
Adm. Dir.



Narvik
26-11-87

Dr. Johann G. Heim
Chief Geologist
Folldal Verk A/S
1324 Lysaker

OTHER MINERAL PROSPECTS HELD BY VESTERÅLEN BERGINDUSTRI A/S

In addition to the Selvåg project, VBI has other mineral prospects that we feel are equally as interesting.

These are:

1. A copper-nickel-cobalt-rare earth deposit.
2. A process for producing micronized lime filler that should prove to be about 20% cheaper than other existing production.

We are currently conducting prefeasibility studies on both of these projects.

If Outokumpu might be interested in either of these projects and would be willing to sign a non-competition agreement, we would gladly present the projects to you.

Our expectations for the funding of these projects is as presented in the attached diagram.

Sincerely,



Johannes Søyland
President

MAGNETITE AS AN INDUSTRIAL MINERAL

AN ECONOMIC EVALUATION OF VARIOUS ALTERNATIVES FOR THE
PRODUCTION OF MAGNETITE AS AN INDUSTRIAL MINERAL FROM
VARIOUS MAGNETITE DEPOSITS IN NORWAY.

A study of the various possible production and transport
systems that might be applied to various Norwegian magnetite
deposits including the evaluation of the use transportable
concentraters.

A thesis for a PhD in Mineral Economics

by

Johannes Søyland

MAY 1987

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EXECUTIVE SUMMARY

The purpose of this report is to evaluate the economic potential of 5 different magnetite producing facilities in Norway.

The following production possibilities will be examined:

1. Rødsand Concentrator - Heindalen Deposit- Trucking
2. Rødsand Concentrator - Heindalen Deposit - Pumping
3. Rødsand Concentrator - Meisingset Deposit - Trucking - Barge
4. Portable Concentrator - Selvåg Deposit
5. Portable Concentrator - Magnetite Sands

Of all the possibilities examined, The Selvåg alternative appears by far the best. This is due to the fact that this deposit alone can produce magnetite gravel which sells for much higher prices. At Selvåg it is possible to establish an operation where the biproducts more than cover the cost of the operation. The Selvåg operation would use a concentrator mounted in an old ship. The operation would have a production cost of Nkr.37.96 per mtn. ore. The Selvåg deposit has also the largest reserves and thereby by largest quantities of higher grade reserves.

It is proposed that the Selvåg deposit be developed by a transportable concentrator. This in itself is nothing new, but in this case the concentrator would be mounted in an old ship. This ship could also then provide for concentrate storage, dock facilities, housing and office space and maintenance facilities.

The five alternatives have the following investment costs, production costs and net profits.

	Total invest	Prod Cost	Net Profit
1. Rødsand-Heindalen-Truck	39,612	40.97	4,613
2. Rødsand-Heindalen-Pumping	29,187	35.62	- 511
3. Rødsand-Meisingset	-	-	-
4. Portable Concentrator Selvåg	57,500	37.96	19,480
5. Portable Concetrator	64,250	35.65	13,050

The deposits have the following total ore reserves:

1. Heindalen	26 million mtn.
2. Rødsand	136 million mtn.
3. Meisingset	20.5 million mtn.
4. Selvåg	+200 million mtn.
5. Magnetite Sands	10 million mtn.

All signs tend to indicate that the Selvåg alternative would be the best investment.

off long term amounts for up to 3 years

GENERAL STATISTICS ABOUT NORWAY

GOVERNMENT

Norway has a constitutional monarchy. the King has a fair amount of influence but the main power lies with the "Storting" or parliament. The government is quite stable but the administration can change several times between elections.

Norway is a "sosialistic" country but the politics tend to be a mixture of socialism and capitalism.

The government has been involved with a great many state owned industries but the current trend is to divest itself of all money losing operations.

The country is divided into 19 "Fylker" or counties. These are then divided into Kommuner, or communities and independent "Byer" or cities. The Kommunes are perhaps like our township and can include several villages and towns.

FINANCE

GOVERNMENT SUPPORT

The government gives monetary support to investment in both older and new operations. The support is not guaranteed but one can expect a grant of as much as 40 - 50% of the investment for a new operation and up to 30% for investment in an existing operation.

AVAILABLE LOANS

The government is also willing to provide loans for up to the remaining investment. Interest rates are around 13% and you can put off initial payments for up to 3 years.

In general, any economically sound project involving products for export trade can obtain 100% financing in Norway. All one needs is a firm sales commitment.

The government also allows for the setting aside of funds tax free for later investments in new facilities or environmental protection. This is similar to the depletion allowance in the US.

TAXES

Individual income tax is very high in Norway. Corporate income tax is at the same level as in the US (50%). The value added tax is 20%. There is little or no property taxes.

ECONOMY

Norway's economy is essentially quite stable. It is, however, very dependent on the North Sea oil industry which is currently somewhat depressed.

Because of the oil industry, inflation is fairly high in relation to the rest of the world. It stands currently at about 8 %.

Interest rates are also fairly high, currently about 13%.

Unemployment is quite variable. In southern Norway it is quite low but in the northern districts it is fairly high, up to 20% in some outlying communities.

INFRASTRUCTURE

COMMUNITIES

Both the Rødsand mine and the Selvåg deposit are located in rural areas. The Rødsand mine lies in Nettet Kommune with a population of about 10,000 inhabitants. The nearest village, Raudsand, has about 400 inhabitants. The selvåg deposit lies in Bø Kommune on the island of Langøya. The kommune has a population of about 3000 people.

WORKFORCE

AVAILABILITY

The primary industries in the area are fishing and farming. Although the areas are fairly isolated, there are enough potential workers within commuting distances of both areas.

TECHNICAL COMPETENCE

At Rødsand, a completely trained workforce is available.

At Selvåg, the potential employees are fairly well educated. Fairly well qualified mechanics and equipment operators are available. Miners and mill operators will probably require some training.

WAGES

The wage rates are similar to those in the US. The current wage statistics for the mining industry are presented in Table 1. (BVLI, 1987)

UNIONS

The level of organization and the associated union powers vary throughout the country. The government operations are usually heavily organized; whereas, the situation in private industry is much more variable.

Norway has what's called the "Arbeidsmiljøloven" or Work Environment Law which gives all employees the same rights regardless of union involvement.

The "Arbeidsmiljøloven" requires that a company informs and consults its employees regarding all proposed operational changes. Management is, however, not required to accept the employee's recommendations.

PRODUCTIVITY

Productivity in Norway is also quite variable. The government owned operations have notoriously low productivity. The productivity levels in private companies is again more variable. Norway has also some of the world's most productive operations. It is reported to have the world's most productive underground mine, Norsk Nefelin on the island of Stjernøya.

TABLE 1 WAGE SCALES FOR NORWEGIAN MINES
(BVLI 3RD QUARTER 1986)

MINE	HOURLY WAGE NKR		TOTAL HOURLY EARNINGS NKR	
	HIGH	LOW	HIGH	LOW
Folldal	70.39	61.09	80.02	63.70
Titania	69.32	61.47	82.97	67.34
Fjordstein	62,38	62.37	71.00	66.15
Killingdal	61.20	61.20	62.16	62.16
Fosdalen	61.05	53.96	70.69	55.50
Orkla	65.01	53.89	70.13	55.60
Grong	70.29	61.03	81.77	67.72
Skaland	53.05	53.05	53.05	53.05
Nord-Norge	68.72	56.37	71.68	57.08
Sydvaranger	68.91	61.97	86.58	65.55
Bleikvasli	72.30	61.00	76.77	61.90
Nefelin	85.41	71.22	93.74	76.88
Bidjovagge	60.64	59.75	71.54	63.21
Sulitjelma	67.92	56.13	74.05	59.69
Finneid	50.48	50.48	87.56	87.56

SUPPORT ORGANIZATIONS

The availability of mechanical/welding shops, equipment dealers, contractors and supply organizations is somewhat better at Rødsand than at Selvåg, but it is acceptable at both locations. Rødsand has a complete mechanical/welding shop on site.

Repair parts must usually come from either Oslo, Stavanger or Trondheim. Delivery times for some items can be fairly long.

TRANSPORTATION

SURFACE

The surface highway net is fairly well developed. The roads are normally two lane and at times quite narrow. Truck transportation can at times be the most efficient means.

Rail transportation is available as far north as Narvik. At Rødsand the nearest railhead is at Åndalsnes about 50 km. away. At Selvåg the nearest railhead is at Narvik about 200 km. to the east.

SEA

Both Rødsand and Selvåg are located at the seashore and therefor have ocean shipping readily available. The shipping industry is very well developed in Norway.

AIR

Airfields and the airline industry are also very well developed; however, in northern Norway one can experience the fact that fresh vegetables are prioritized and therefor, air freight of repair parts may not be the best alternative.

At Rødsand, the nearest airport is located at Molde, approximately 60 km. away. For Selvåg, the nearest airport is a field for small planes at Sortland about 40 km. away.

GEOGRAPHY

The geography at most locations in Norway is fairly rugged. The mountains usually rising steeply from the fjords to an elevation of up to 1000 meters. Terrain will not seriously affect any of the proposed operations.

CLIMATE

Norway lies in an arctic or subarctic environment. Winter temperatures can reach - 40° C at some locations. Summer temperatures usually lie between + 20 and + 30° C. Since both Rødsand and Selvåg are located at the seashore, the winter temperatures are somewhat milder, usually not below - 10° C.

The main periods of heavy precipitation are the summers and winters. Because of alternating rain and snow during the winter months, the main winter is the development of ice on the roads.

Indoor storage of concentrates is almost a necessity if one is to maintain shipments during the winter months.

WATER SUPPLY

Fresh water is readily available at most locations. At Rødsand, the supply net is of course already established. At Selvåg, fresh water can be obtained from a lake $\frac{1}{2}$ km. away.

POWER SUPPLY

Rødsand has its own power station already established and power costs would be about 1 cent per Kwh. Power is also available from the local power company for about 2 cents per Kwh.

The established power net at Selvåg is small and the nearest power is about 2 km. away. The local power company is required to provide power to the site at no investment cost to the mine. The local power rate is about 4 cents per kwh.

PRODUCTION COSTS OF NORWEGIAN MINING

The production costs of Norwegian mining companies again, very variable. Some of the government owned operations are very costly while other operations are quite efficient. Table 2 shows a comparison of production costs from some of the Norwegian companies.

ENVIRONMENTAL RESTRICTIONS

Norway does have environmental protection laws that must be taken into account. They require essentially that all new operations and their associated potential pollution be reviewed and approved by the Dept. of Environment.

A simplified environmental impact statement must be presented. The regulations are, however, somewhat more lenient than those in the US. Most of the mines in Norway dump their tailings into the fjords.

TABLE 2 PRODUCTION COSTS FOR NORWEGIAN MINING COMPANIES 1983

MINE	MINING METHOD	MILLING METHOD	PRODUCTION COST NKR/mtn	CAPITAL COST NKR/mtn	TOTAL COST NKR/mtn	PRODUCTION mtn/MANSHIFT	TOTAL PRODUCTION
Breivik	openpit	crushing	163.09	40.60	203.69	3.6	10,000
Ringknuten	openpit	crushing	35.85	4.05	39.90	57.2	151,000
Grong	room & pillar	flotation	94.63	13.91	108.54	17.8	482,738
Olivin	openpit	crushing	60.92	4.65	65.57	29.5	1,200,000
Vinterbro	openpit	crushing	26.88	5.28	32.16	96.9	319,664
Fjordstein	openpit	crushing	40.26	6.78	47.04	76.1	770,000
Skaland	open stope	flotation	320.00	123.20	443.20	2.6	52.370
Mofjellet	open stope	flotation	137.05	22.64	159.69	10.3	152.363
Killingdal	magazine	flotation	462.05	46.89	508.94	2.5	36,517
Fosdalen	open stope	magnetic	89.82	3.54	93.46	9.5	525,000
Bleikvasli	sandfill	flotation	148.50	31.25	179.75	8.9	173.692
Orkla	open stope	flotation	37.59	5.84	43.43		336,921

MARKET STUDY

The total market for magnetite as an industrial mineral is very difficult to establish. Magnetite is of course mainly used as an iron ore. There are no separate statistics as to its use as an industrial mineral. A large amount of the magnetite that goes to use as an industrial mineral is taken directly from iron ore supplies. Some of the specialty products of magnetite are controlled by minerals agents and statistics as to quantity and price are closely guarded secrets.

However; after working in the field for some time, one can get a fairly accurate picture of the size of the total market and the quantities and prices of the major products.

PRODUCTS AND PRICES

The total industrial mineral market for magnetite appears to be about 1.5 to 2 million tons per year. The major users are the oil, coal and electric heating industries and the quantity used will of course vary according to the needs of these industries.

The major products are:

1. Heavy Media
2. Pipe Coating Concentrate
3. Refractory Block Concentrate
4. Ballast

1. HEAVY MEDIA \$ 20 to \$ 50 per mtn. FOB

Here magnetite is utilized for both its fairly high specific gravity and its magnetic properties. It is used to make a dense slurry (specific gravity about 2) which is used to clean coal or separate ore from gangue materials. The magnetic properties are then used to separate the magnetite and return it to the circuit.

Heavy media is divided into numerous grades of varying grain sizes. Generally speaking, the coarser products command the highest prices. The grain size distributions of the various grades are approximately as follows:

Coarse magnetite	85% - 0.2 mm + 0.06 mm
Semi coarse magnetite	75% - 0.2 mm + 0.06 mm
Fine magnetite	50% - 0.06 mm
very fine magnetite	85% - 0.06 mm

For all grades the specific gravity must be between 4.8 and 5.0 and the magnetic constituency must be 95% or better. Chemical analysis plays a very minor role.

This appears to be the largest market for industrial mineral magnetite. The US appears to have a need of from 300,000 to 500,000 stn. per year dependent on fluctuations in the cleaned coal market. Europe utilizes from 150,000 to 250,000 mtn. per year.

2. PIPE COATING CONCENTRATE \$ 30 to \$ 40 per mtn. FOB

Here one uses a very coarse (0-10 mm) magnetite gravel which is used to coat oil and gas pipelines that are to be laid on the ocean floor. The primary consideration here is that of the bulk density of the final product (magnetite cement) which should be about 4.

The product demands a fairly good price because not all magnetite deposits can produce a product that has this coarse of a grain distribution and still hold a bulk density of +4.

This product is of course dependent on activity in the offshore oil industry. Current demand is quite low; however, expected development of the gas fields in the Barents Sea (Northern Norway) would create a strong demand for this product in the future.

3. REFRACTORY BLOCK CONCENTRATE \$ 50 to \$ 100 per mtn. FOB

This material is used by the producers of electric furnaces to make a magnetite briquet which is used to store heat energy during periods of cheaper electrical power. The furnaces heat the briquets at night and they store enough heat to warm the houses during the daytime periods of higher electrical rates.

The primary properties of magnetite which are utilized here are its relatively high specific heat and specific gravity. The grain size distribution is 0 - 6.3 mm and the bulk density must again be +4.

The primary market is England and Europe and the total market appears to be about 200,000 mtn. per year.

Again, not all deposits can produce this product, therefore the higher prices.

4. BALLAST \$ 20 to \$ 40 per mtn. FOB

This again is a coarse magnetite gravel (0 - 10 mm), bulk density +4.

Some finer magnetite is used occasionally as ballast in ships; however, the main market is as ballast for the large concrete oil platforms.

Here the market is totally dependent on the construction of such platforms. Each concrete platform can use as much as 200,000 mtn. of magnetite.

The major market is the North Sea.

PRODUCTION OF RBC - PCC

To produce these products one must be able to produce a concentrate with a grain size up to 10 mm and still maintain a fairly pure concentrate. The ability to do this is dependent on the size and distribution of the magnetite grains in the ore. To be able to effectively produce these products, a deposit must contain substantial amounts of ore with a grade of 50 - 60% magnetite. Not all deposits have enough of this high grade ore.

Of the deposits investigated, the only one that appears to be able to produce a substantial amount of this product is the Selvåg deposit.

Another factor that affects RBC - PCC production is the fact that the receiving port facilities can only handle 3000 ton boats. The product must therefore be produced in Europe.

MAGNETITE PRODUCERS

As previously stated, magnetite is primarily produced as an iron ore and there appear to be no accurate statistics as to the total amount of magnetite produced in the world. A fairly accurate guess would be around 100 million tons per year.

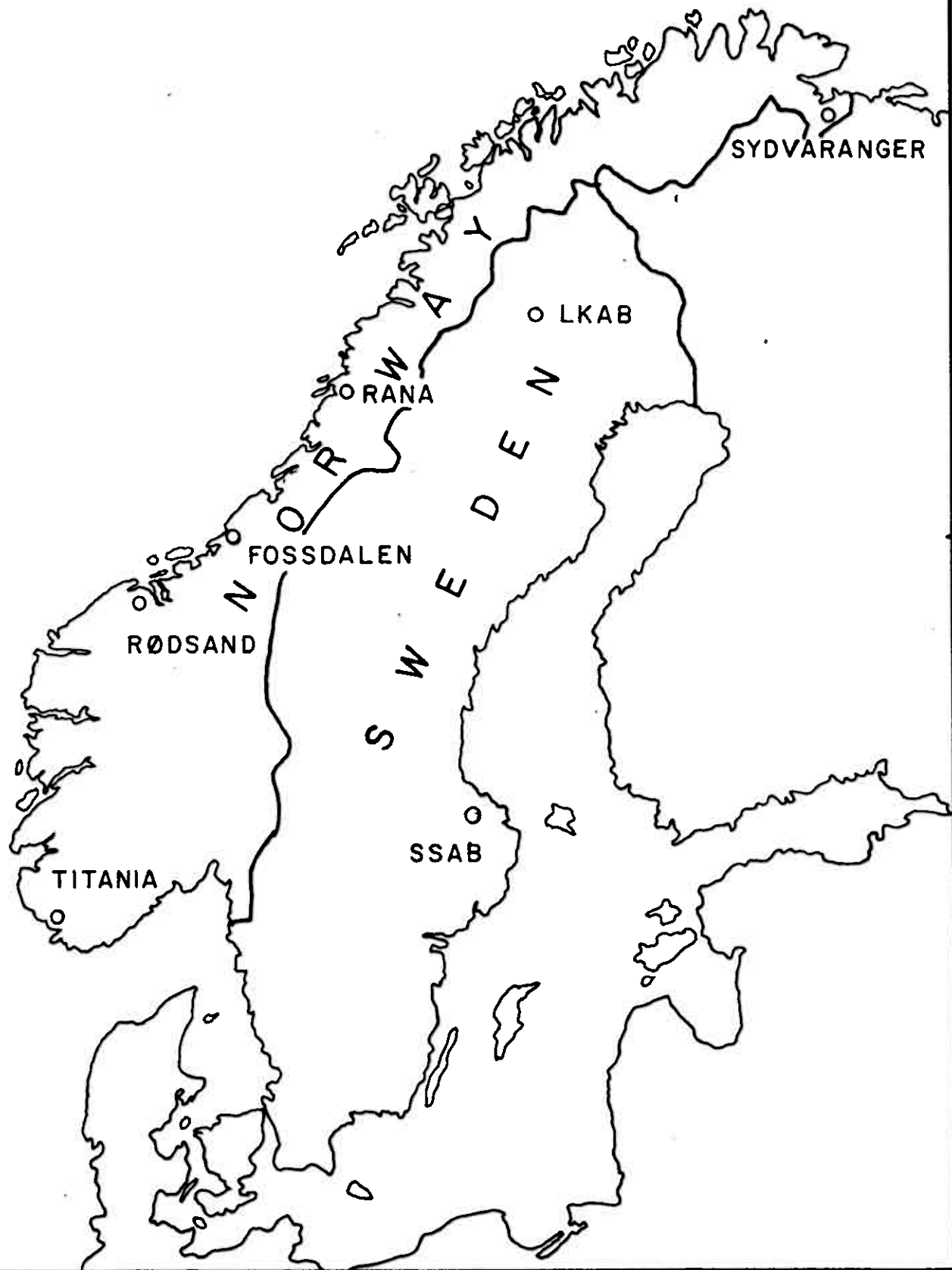
It appears; however, that the production of magnetite is decreasing in favor of hematite. Many older, non-competitive magnetite producers have been closing and the newer, competitive iron ore producers (Australia and Brazil) produce primarily hematite.

Norway and Sweden currently produce about 30 million stn. of magnetite per year. The current producers are shown in Fig. 1. Aside from Rødsand and Titania, which are minor producers, all are government owned operations. They are all very bureaucratic and inefficient, all losing money and all under strong pressure to rationalize or close down. Production costs of some of them compared to operations in Canada, Afrika and Brazil are shown in Fig. 2.

When private companies such as Kennecott and Anaconda could not manage to rationalize sufficiently and were forced to close, it can easily be understood that these government owned bureaucracies will have a very difficult time doing it.

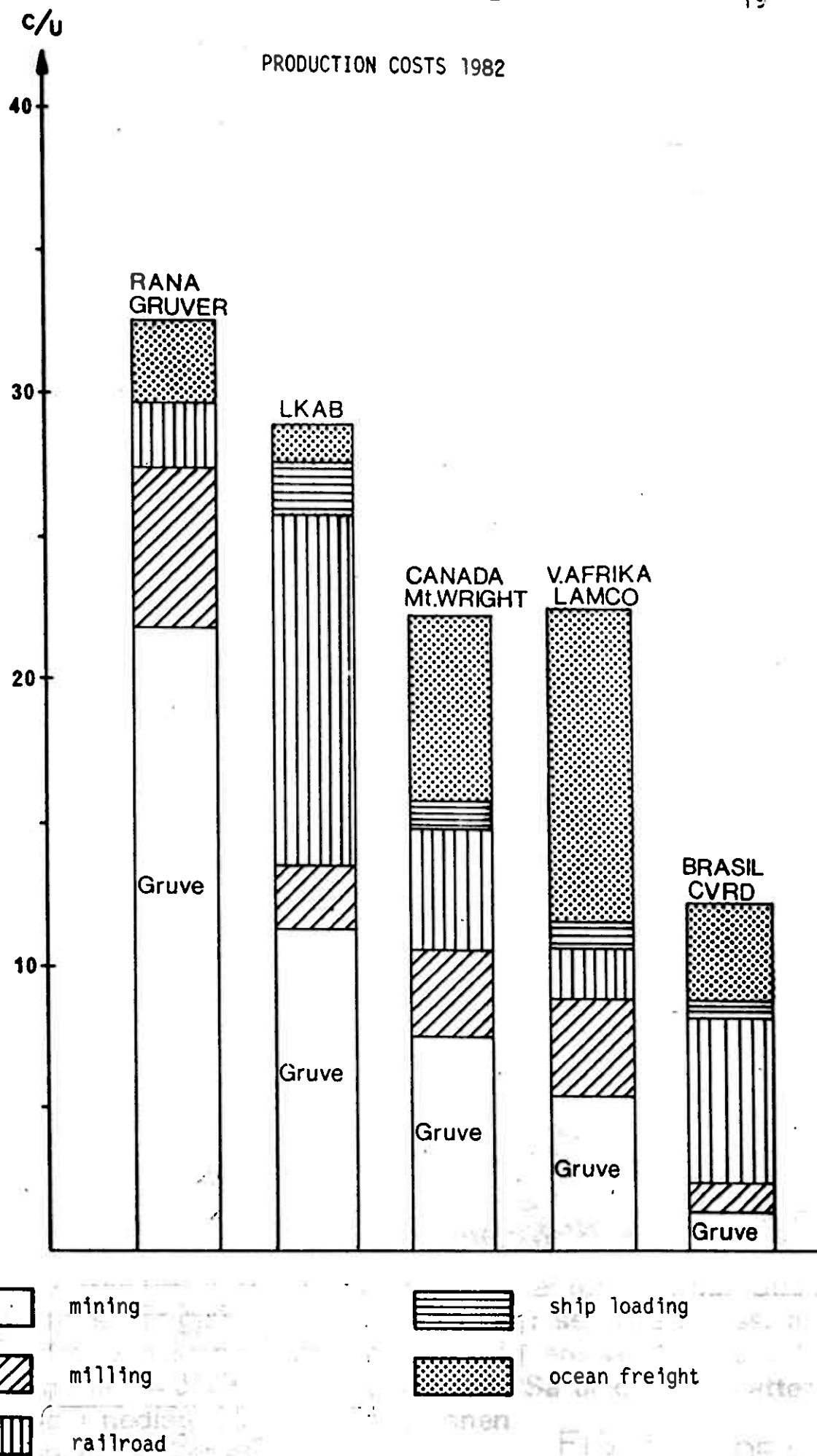
One example of the inefficiencies of these companies is Sydvaranger, which recently required a government subsidy of \$100.000 per employee per year. A statement by the president of LKAB that it to might have to close is shown in the newspaper article presented as Fig. 3.





Dato	Konstr./Tegnet	Godkjent	Målestokk		
SCANDINAVIAN MAGNETITE PRODUCERS				Erstatning for:	Erstattet av:
				FIG. I	
Henvising:		Beregning:			

FIG. 2 COST COMPARISON OF IRON ORE PRODUCERS



The government owned mines all have the following problems:

1. Heavily organized bureauracracies.
2. Low productivity.
3. Mines that have extended beyond the economic limits of their orebodies.

TRANSPORTATION

Transportation costs play a very important role for the entire iron ore industry. However, due to the extremely high cost of US rail transportation, it is an even more important factor for the US heavy media users. A marketing study conducted in 1984 shows that it can be cheaper to ship magnetite from Norway to Pittsburgh via the Mississippi River than from upstate New York by rail. These figures are presented in Fig. 4.

FIG. 4 COST COMPARISONS FOR US MAGNETITE SUPPLIERS

	Elkem A/S Rødsand	Beckley	Reise-Viking
Sales price FOB mine	\$18/stn		\$22/stn
Transport to US	\$6 to \$12		
Crushing & screening	\$3		\$3
Port unloading	\$2.50		
Barge transportation	\$6		
Rail Transportation			\$22
Price CIF W. Va.	\$38.50	\$48	\$47

MAGNETITE DEPOSITS

There are literally hundreds of known magnetite deposits in Norway that are available. Some of them have previously been given a lot of attention as possible iron ore producers. Some have been extensively drilled and it is now possible to obtain proven ore reserves of over 100 million tons at little or no cost for exploration. Some of the deposits carry biproduct minerals such as titanium, phosphorus, rare-earths, copper, nickel, cobalt and possibly gold.

Many of the deposits are located at or near the seashore thus giving them a transportation advantage such that they can readily compete on the US market.

The deposits are of four main types:

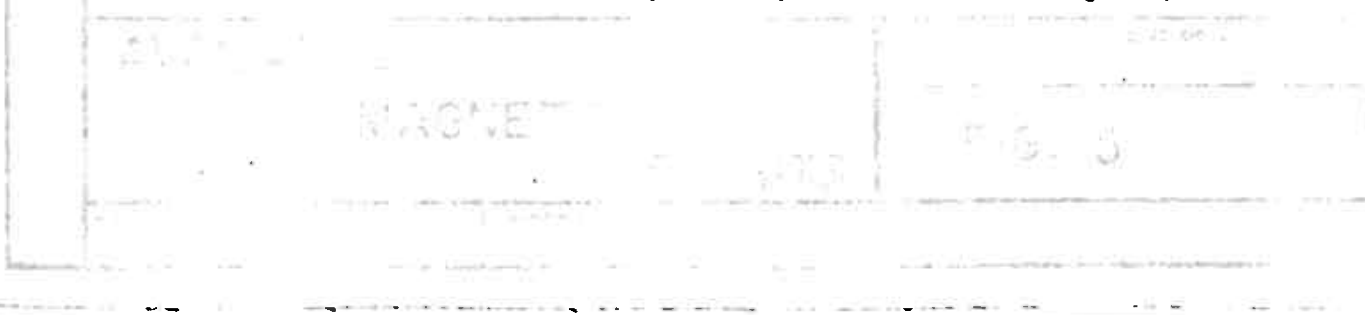
1. Titaniferous magnetite, stratabound massive deposits of volcanic origin.
2. Magnetite, stratabound of volcanic origin.
3. Magnetite of sedimentary origin.
4. Magnetite sands.

All are found in or associated with precambrian gneisses and/or igneous rocks of the Norwegian Caledonides.

The deposits considered as possible sources for this investigation are those associated with the Rødsand mine or those in the Lofoten - Ofoten region of northern Norway. These areas are shown in Fig. 5.

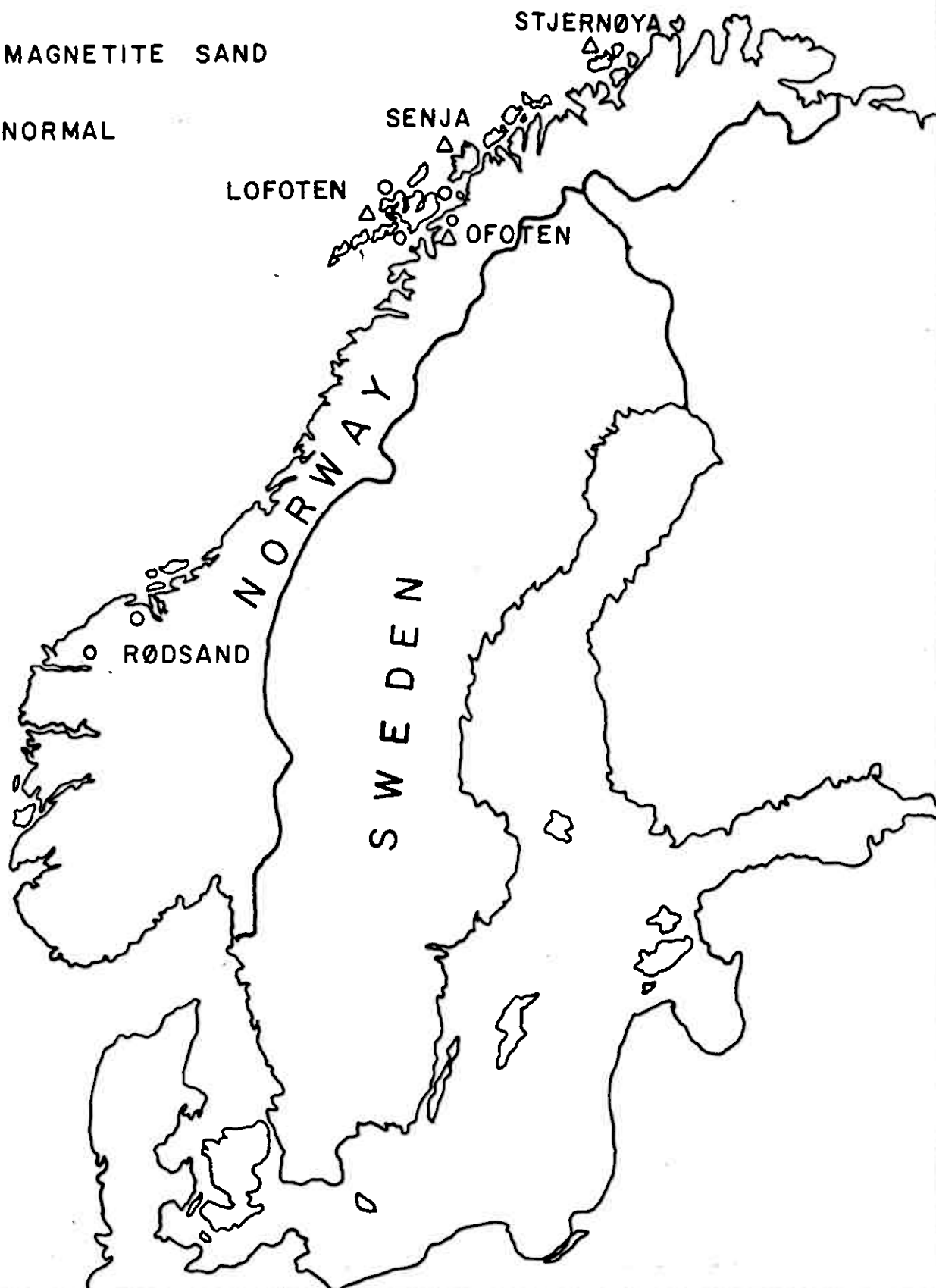
RØDSAND AREA DEPOSITS

The Rødsand area deposits are all precambrian age titaniferous magnetites which are always enclosed in amphibolites of the Rødsand group of orthogneisses. The deposits lie on the southern limb of the Molde - Tingvoll syncline. (See Fig. 6)



△ MAGNETITE SAND

○ NORMAL



Dato	Konstr./Tegnet	Godkjent	Målestokk		
AVAILABLE MAGNETITE DEPOSITS				Erstatning for:	Erstattet av:
				FIG. 5	
Henvisning:		Beregning:			

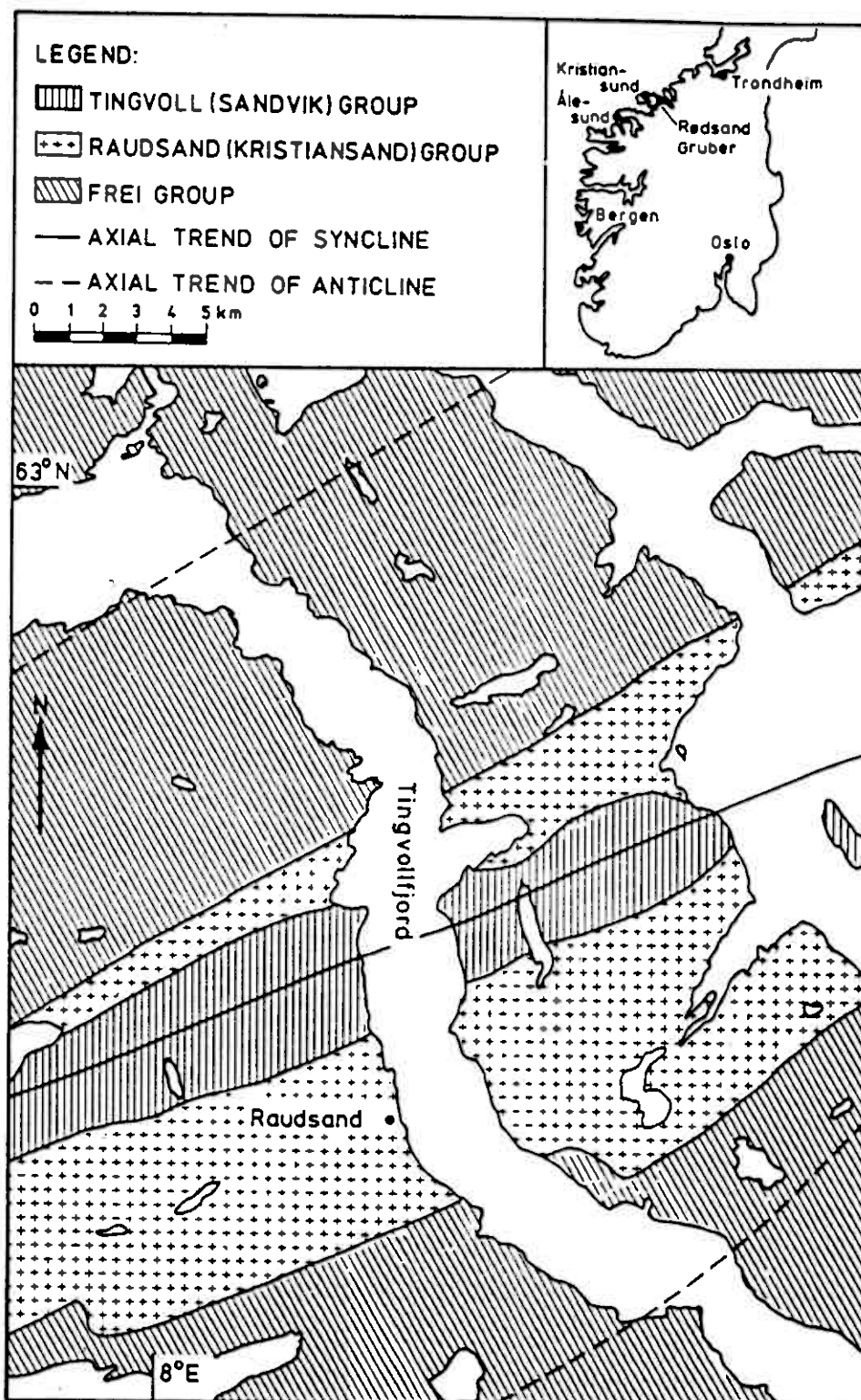


FIG. 6

The main deposits in the area are those associated with the Rødsand mine, those in the heindalen area and those at Meisingset. (See Fig. 7, 8 and 9)

The total reserves of the Rødsand area are approximately 182 million mtn. as shown in Table 3.

RODSAND MINE RESERVES

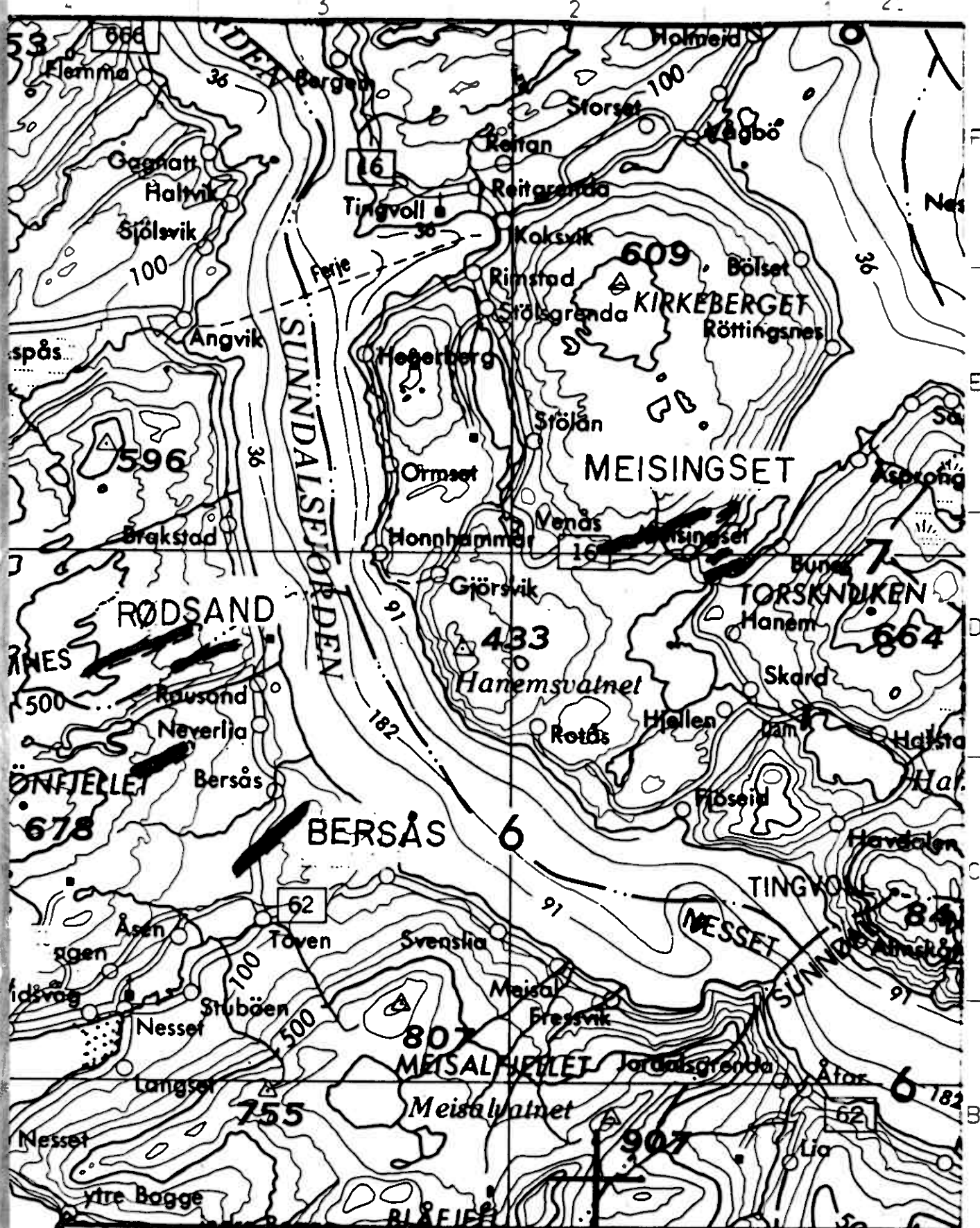
The largest proven reserves are those in the mine. Approximately 16 million tons are developed between the - 220 and - 340 levels. These could be produced at fairly reasonable costs; however, the production of additional undeveloped reserves would be prohibitively expensive. (See Fig. 10 and 11) The ore averages approximately 27% magnetite.

The Rødsand ore, as well as that of the other deposits in the area contains about 5% ilmenite and about .5% copper. The mine has previously produced concentrates of both minerals. The ore also contains some nickel and cobalt.

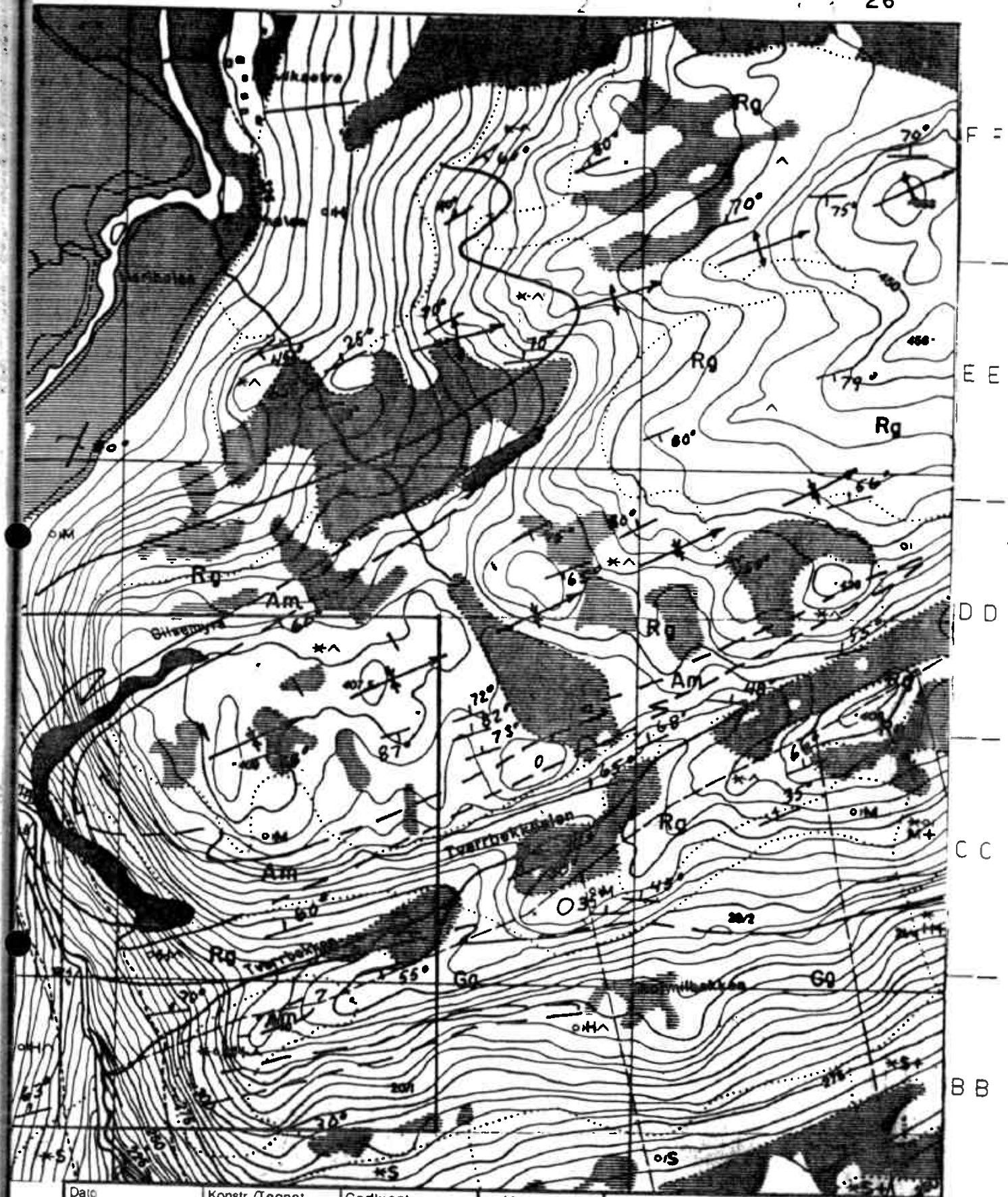
Total reserves of the mine are estimated to be 136 million mtn. (Sanetra, 1985)

HEINDALEN DEPOSIT

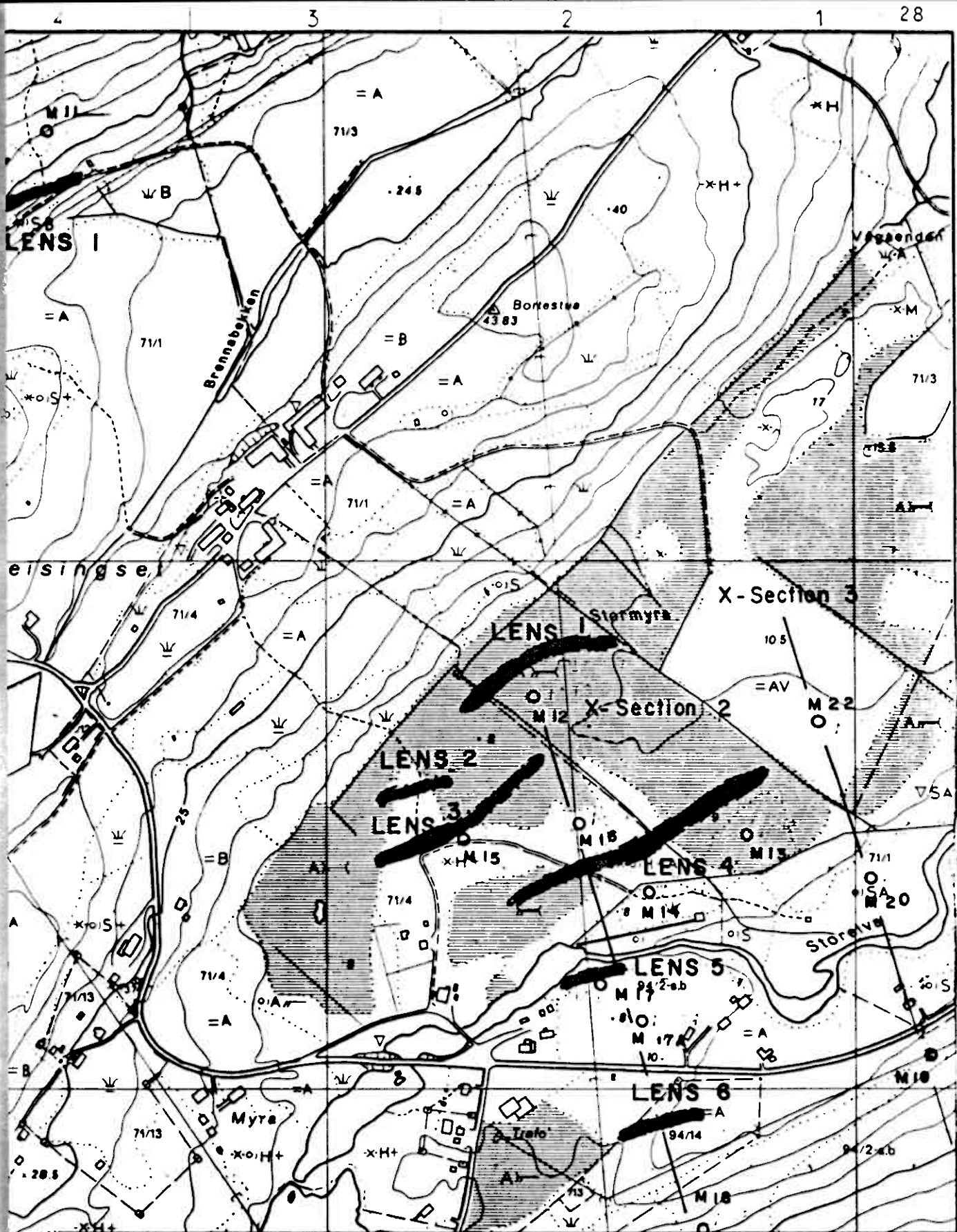
The most interesting deposit in this area economically speaking, is the Heindalen deposit which is located about 14 km. southwest of the Rødsand mine. There are actually two deposits here, one on either side of Heindalen Creek. The one on the west side contains approximately 2 million mtn. of strippable magnetite ore whereas the deposit on the east side contains approximately 24 million mtn. of ore that could be mined by combined room and pillar - sublevel caving mining techniques.



Dato	Konstr./Tegnet	Godkjent	Målestokk		
20-3-87	JS	JS	1:100 000	Erstatning for:	Erstattet av:
MAGNETITE DEPOSITS IN THE RØDSAND REGION				FIG. 7	
Henvisning		Beregning			



Dato	Konstr./Tegnet	Godkjent	Målestokk	Geological mapping by A.M. Gautier 1977	
20 - 3 - 87	JS	JS	1 : 5000	Erstatning for	Erstattet av
HEINDALEN DEPOSIT				FIG. 8	
Henvising		Beregning			

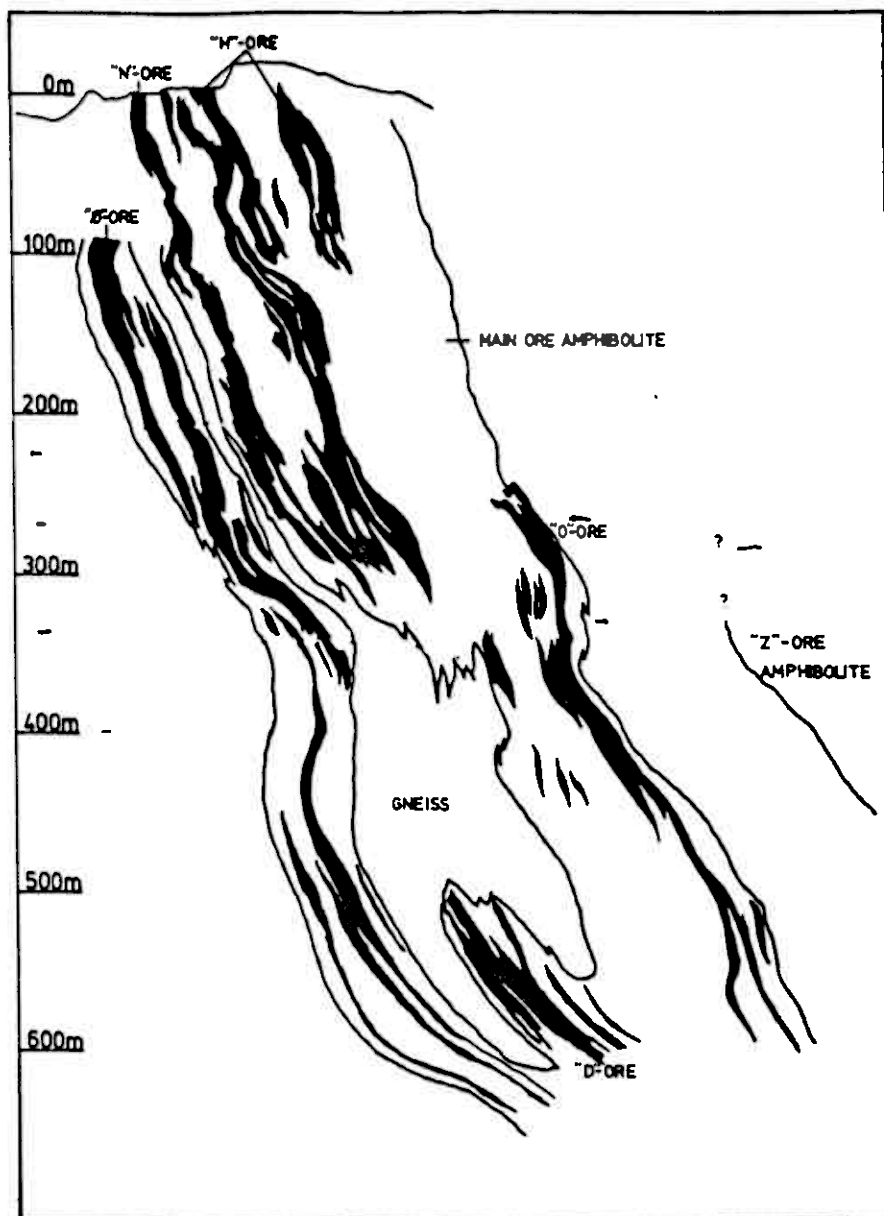


Dato	Konstr. Tegnet	Godkjent	Målestokk	Copied from Rødsand Gruber map of 1976	
20-3-87	JS	JS	1:5000		
MEISINGSET DEPOSIT				Erstatning for:	Erstattet av:
				Mapping by Stenso / Dundahl	
Henvising		Beregning		FIG. 9	

TABLE 3 RØDSAND AREA ORE RESERVES

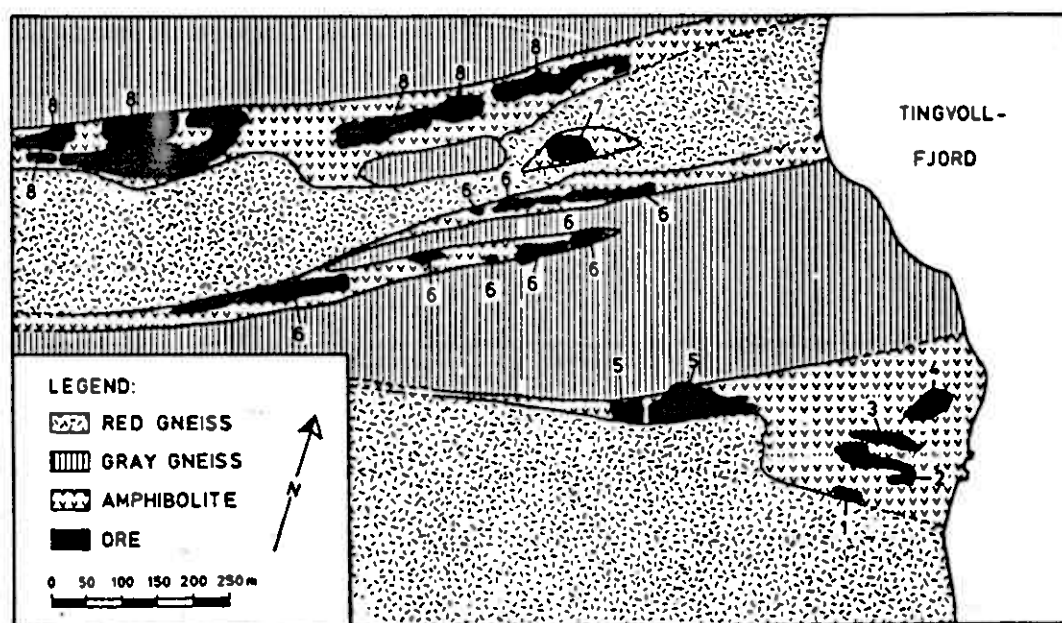
	Mtn. x 1000
Rødsand Mine	
Proven ore levels -220 to -340	16,000
Probable ore levels -340 to -600	120,000
Heindalen Deposit	
Proven strippable	2,000
Proven underground	4,000
Probable underground	20,000
Meisingset Deposit	
Proven strippable	1,500
Proven underground	9,000
Probable underground	10,000
Total	
Proven strippable	3,500
Proven room and pillar	13,000
Proven sublevel stope	16,000
Probable underground	150,000
Grand Total	182,500
Average Grade	30% Magnetite

Taken from Rødsand Gruber estimates and NGU Bulletin 402



Profile of
structures, the
main ore zone.

FIG. 10

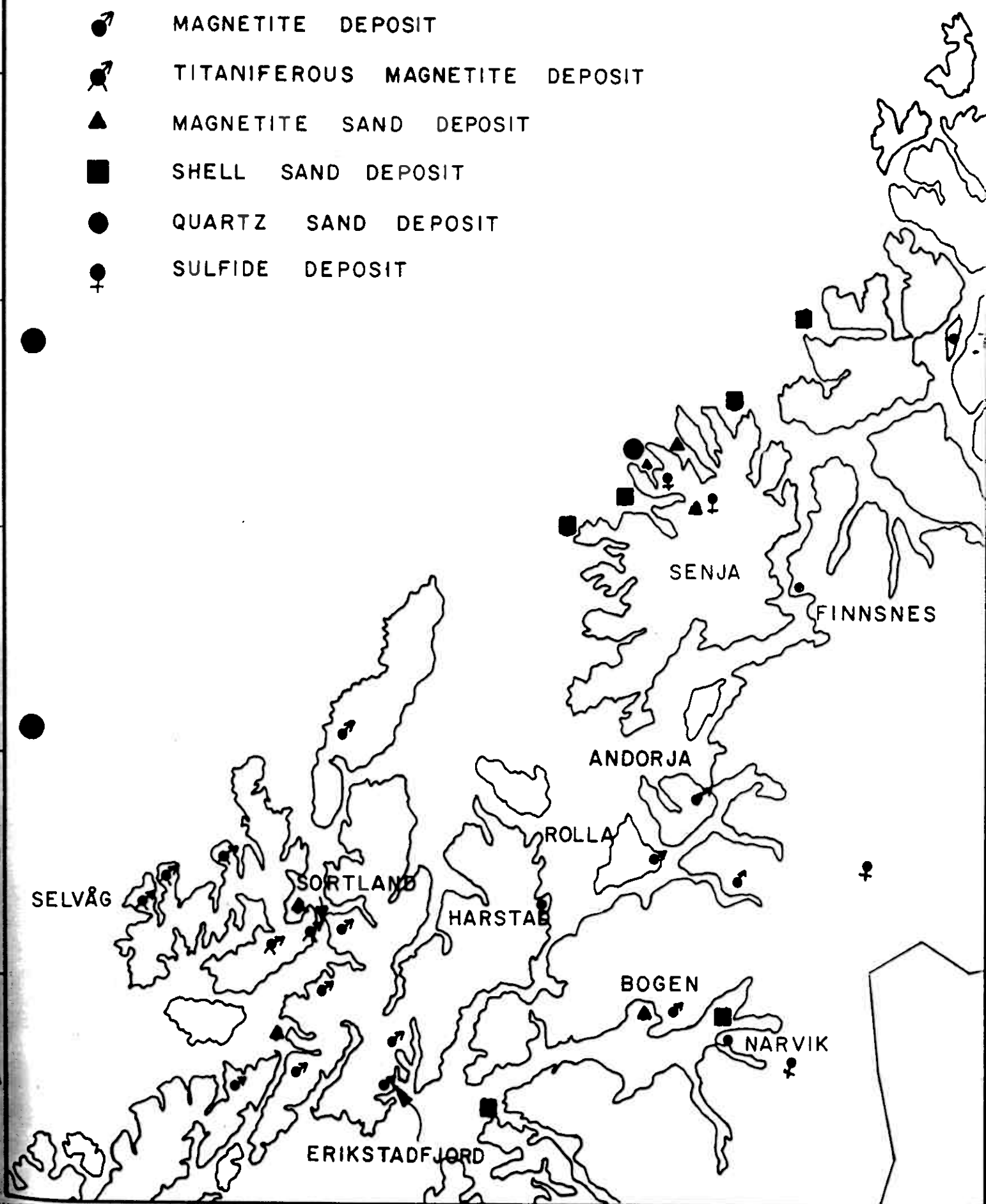


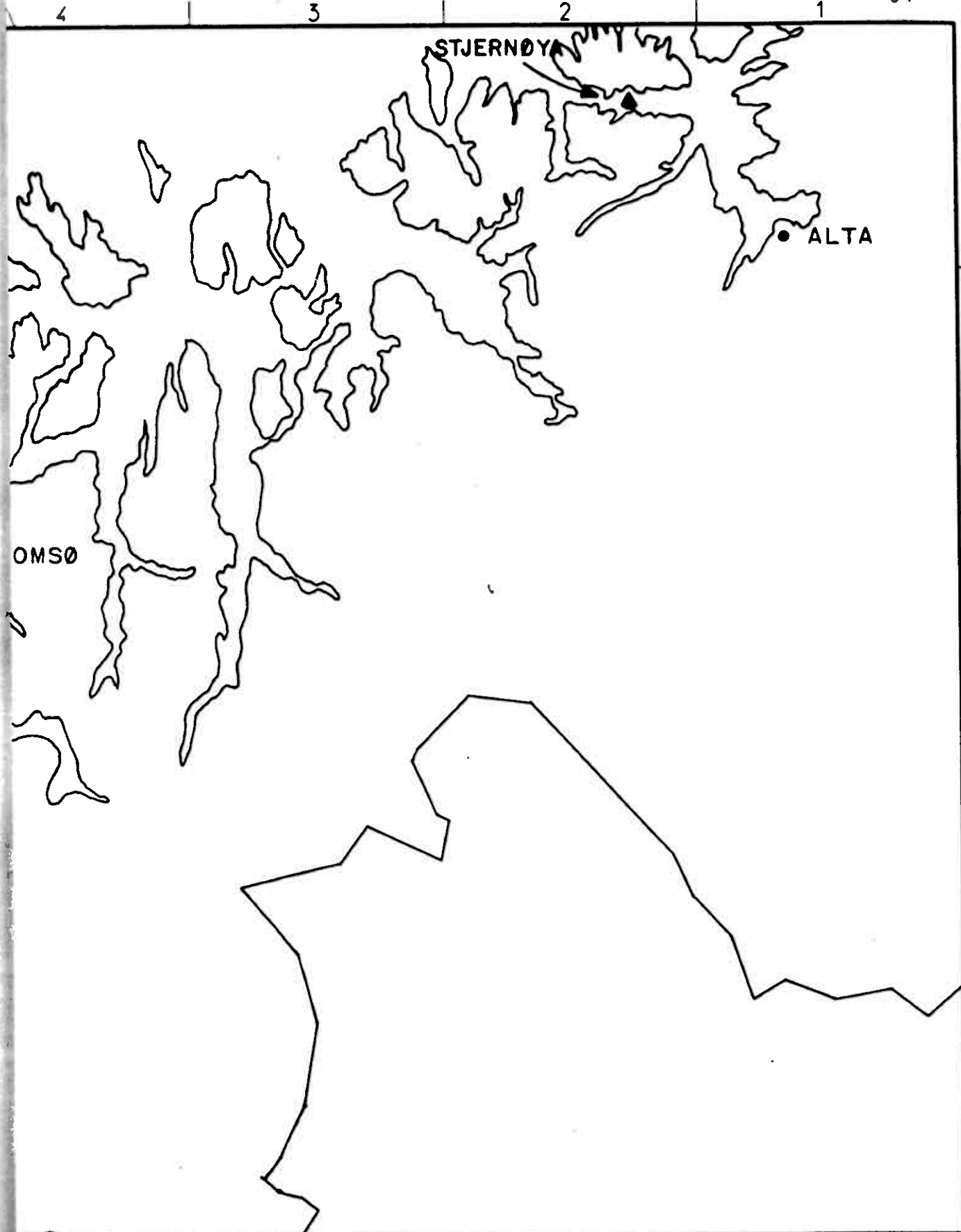
Map showing the location of the ore bodies 1 = 'L'-ore, 2 = 'Ø'-ore, 3 = 'N'-ore, 4 = 'H'-ore, 5 = 'D'-ore, 6 = 'Z'-ore, 7 = 'R'-ore, 8 = 'Bergmester'-ore (geis 1965).

FIG. 11

LEGEND

- ♂ MAGNETITE DEPOSIT
- ♂ TITANIFEROUS MAGNETITE DEPOSIT
- ▲ MAGNETITE SAND DEPOSIT
- SHELL SAND DEPOSIT
- QUARTZ SAND DEPOSIT
- ♀ SULFIDE DEPOSIT





Dato	Konstr./Tegnet	Godkjent	Målestokk		
21 - 3 - 87	JS	JS	1 : 1 mill.	Erstatning for:	Erstattet av:
DEPOSITS IN NORTHERN NORWAY				FIG. 12	
Henvisning:		Beregning:			

The Heindalen deposit contains essentially the same kind of ore and the same geological environment as that in the Rødsand mine. One can produce ore here and deliver it to the mill for essentially the same price as from the Rødsand mine. The reason it is more interesting is that Heindalen has more cheaply producible ore and that an investment here could be fairly easily recovered whereas an investment in the old mine probably could not be recovered. The plant at Heindalen would be very similar to a typical crushed aggregate plant and therefor readily moved or sold.

MEISINGSET DEPOSIT

The Meisingset deposit is located across the Sunndals Fjord approximately 10 km. northeast of Rødsand. It contains approximately 20 million mtn. of ore of approximately the same type and grade as at Rødsand.

The ore here could also be produced very cheaply by the same methods as at Heindalen but transporting it over the fjord would make it somewhat more expensive. It should; however, be kept as a reserve in case of an increase in demand or for possible later development utilizing a portable mill.

DEPOSITS IN NORTH NORWAY

The Lofoten - Ofoten region contains literally hundreds of magnetite deposits. The deposits which were investigated in this study were:

1. Selvåg
2. Erikstadsfjord
3. Bogen
4. Gratangen
5. Salangen
6. Rolla
7. Andorja
8. Magnetite sands
 - a. Sortland
 - b. Bogen
 - c. Hanøyvika
 - d. Skaland
 - e. Stjernøya

The Bogen, Gratangen and Sallangen deposits have ore containing only about 20% iron and were therefor quickly eliminated.

The Erikstadsfjord, Rolla and Andorja deposits have ore containing approximately 30% magnetite but are all relatively small deposits. They could be additional reserves for a transportable mill. (See Fig. 12)

MAGNETITE SAND DEPOSITS

The magnetite sand deposits are all fairly small (a few million mtn.) and hold approximately 20% magnetite. Total identified reserves are about 10 million mtn. One could not justify an investment based on just one of these deposits but they could all be very cheap feed for a transportable mill. (See Fig. 12)

SELVAG DEPOSIT

The most interesting deposit in northern Norway is the Selvåg deposit. It contains well over 100 million mtn. of ore. There are approximately 44 million mtn. of proven ore containing 30% magnetite in what is called the "North Ore Body" (Øverlie, 1956)

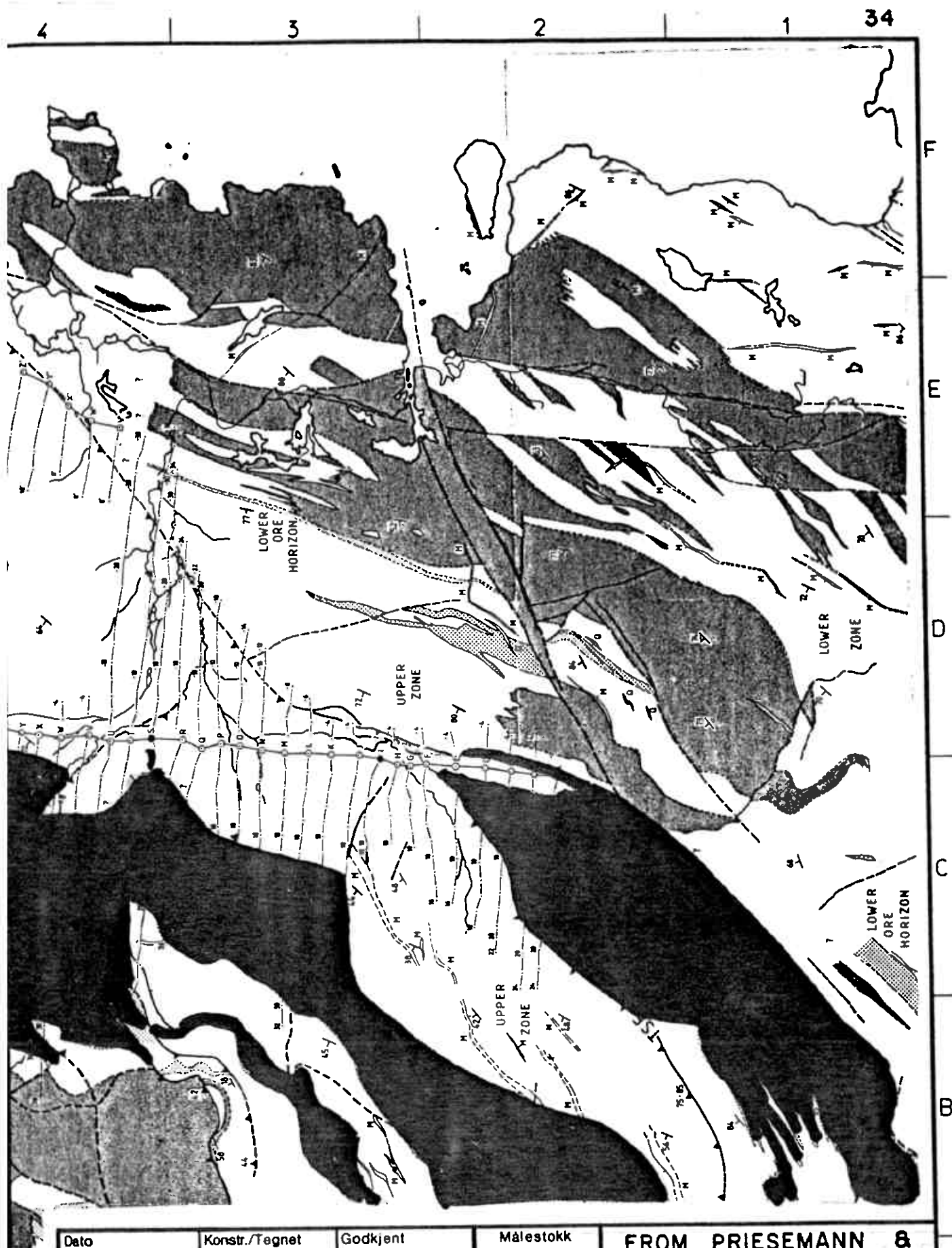
The ore body stretches for about 7 km. and is up to 350 meters thick. (See Fig. 13 and 14)

The ore here is also a titaniferous magnetite, a massive, strataform deposit of igneous origin. The ore here is enclosed by gabbros.

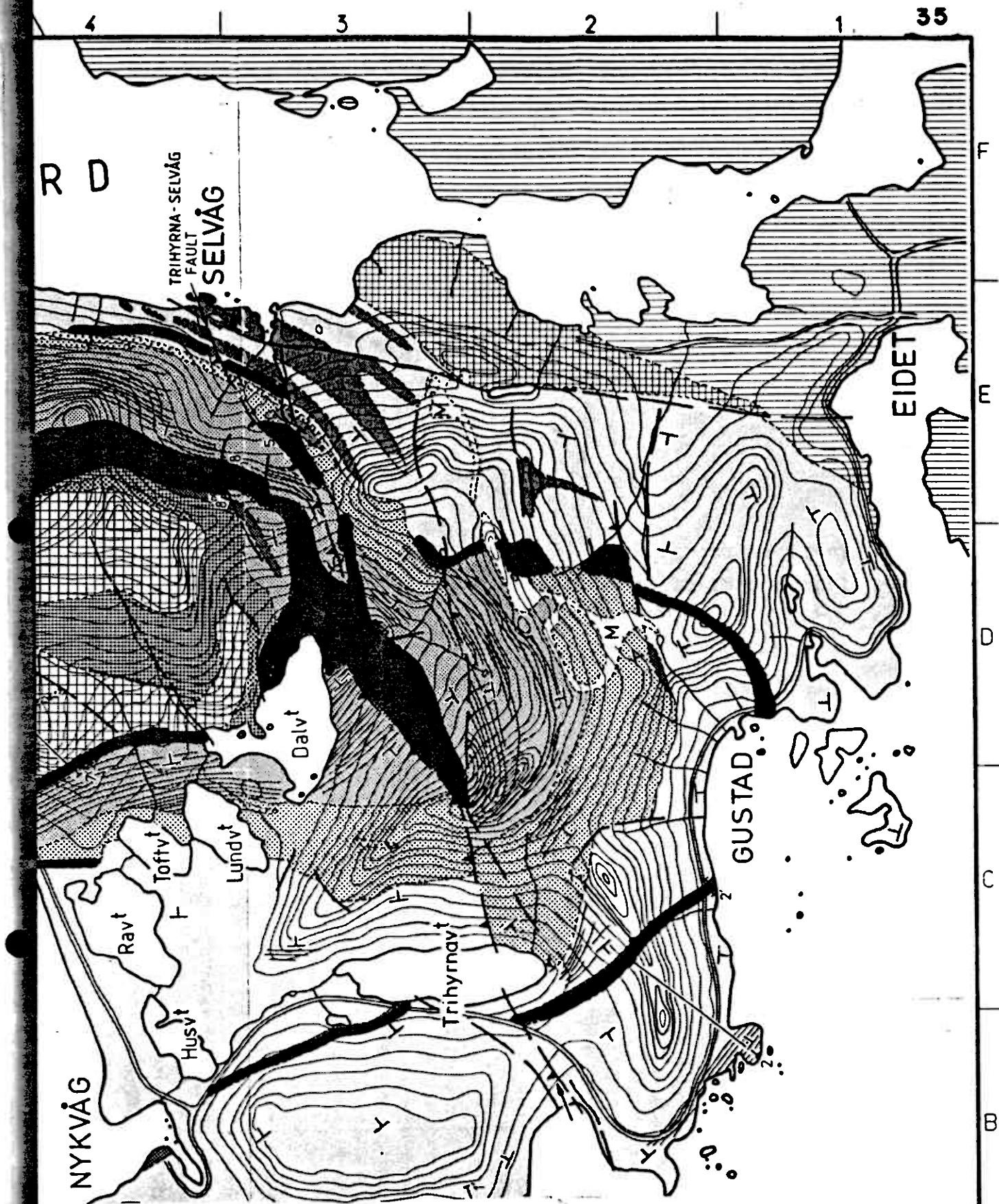
This deposit could very easily be developed utilizing a portable mill and is also interesting for the following reasons:

1. It has tremendous reserves that could be developed by cheap mining methods.
2. The mill could be located within 1 km. of the deposit thereby greatly reducing transportation costs.
3. The deposit has a large amount of high grade ore (50 - 60% magnetite) and can therefor readily produce RBC.
4. The magnetite is enclosed in a gabbro which sells readily in the area for about 100 kroner per mtn. This would be more than double the price recieved for aggregates at Rødsand.

The deposit was given a lot of attention in the 1950's and 60's by Christiania Spigerverk A/S (Elkem) as a possible iron ore producer. There was a tremendous amount of drilling done as well as extensive metallurgical studies.



Dato	Konstr./Tegnet	Godkjent	Målestokk	FROM PRIESEMANN & KRAUSE, 1985	
				Erstatning for:	Erstattet av:
GEOLOGICAL MAP OF THE SELVÅG DEPOSIT				FIG. 13	
Henvisning:		Beregning:			



Dato	Konstr./Tegnet	Godkjent	Målestokk	FROM PRIESEMANN & KRAUSE, 1985	
				Erstatning for:	Erstattet av:
GEOLOGICAL MAP OF THE SELVÅG DEPOSIT				FIG. 14	
Henvisning:		Beregning:			

This is probably Norway's largest deposit of magnetite. It was rejected because it was not possible to separate the very finely laminated ilmenite from the magnetite and therefore could not be used as an iron ore. The presence of ilmenite would not have any affect on its use as heavy media or the other industrial magnetite products.

The deposit is open for staking and should be claimed as an optional magnetite source.

ADDITIONAL GEOLOGIC DATA

Additional geologic data in the form of maps, cross sections and drill core logs are presented as an annex to this report.

EVALUATION OF PRODUCTION ALTERNATIVES

PRODUCTION ALTERNATIVE 1 - RØDSAND MILL - HEINDALEN DEPOSIT TRUCK HAULAGE

Rødsand has a production history of over 50 years. It produced feed for a ferro-vanadium smelter until that operation became uneconomical about 1980. The underground mine was shut down in 1982 but they continued to produce magnetite as a heavy media material with ore taken from a nearby open pit. This operation is still continueing but lack of ore in the present pit will soon force closure unless a new operation is started utilizing one of the nearby deposits. Rødsand's production history from 1960 is presented in Table 4 and the production costs for 1983 are presented in Table 5.

PROPOSED PRODUCTION PLAN

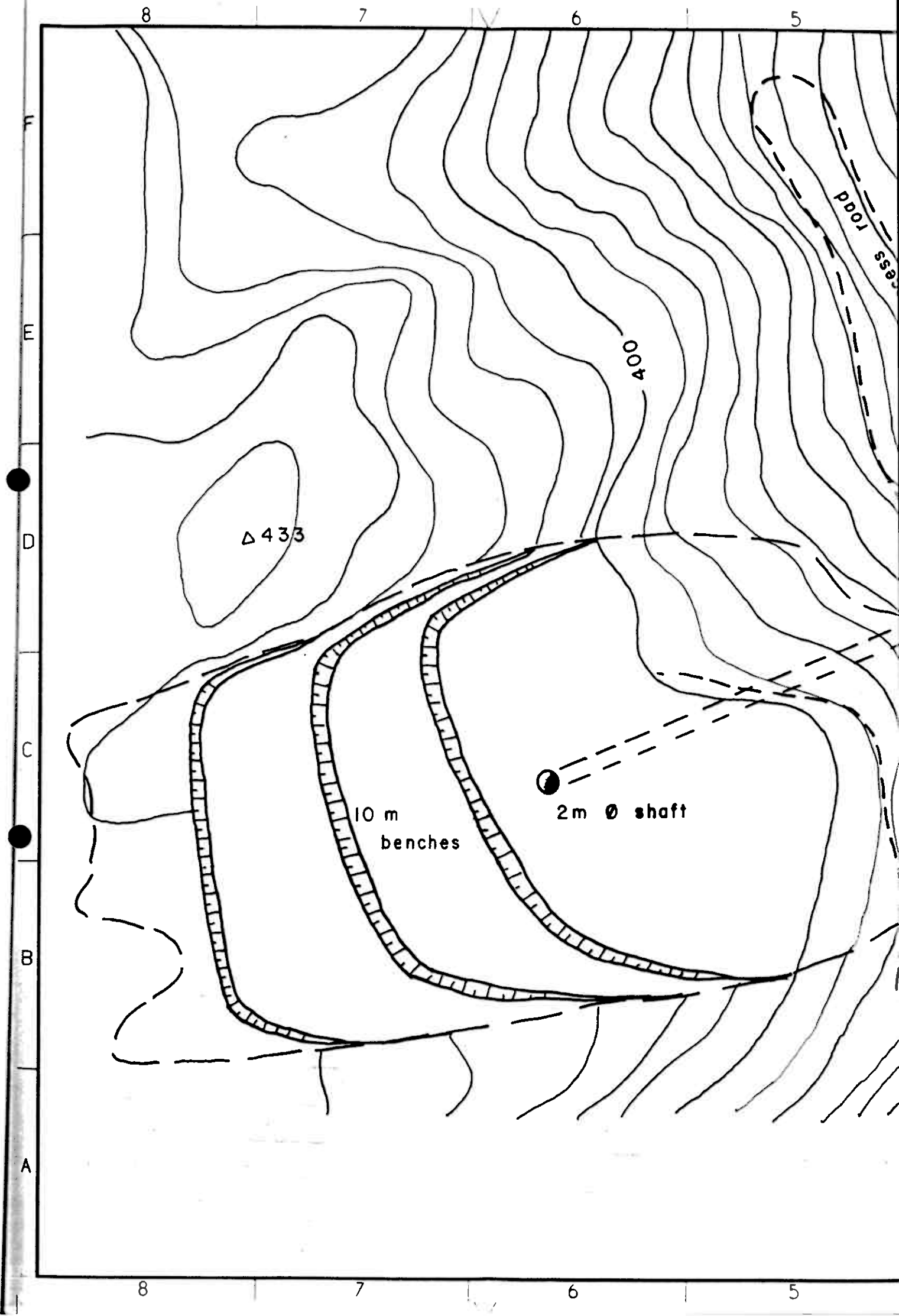
As previously stated, the old Rødsand mine contains approximately 16 million mtn. of developed ore that could be produced rather inexpensively; however, the best alternative appears to be production from the Heindalen deposit.

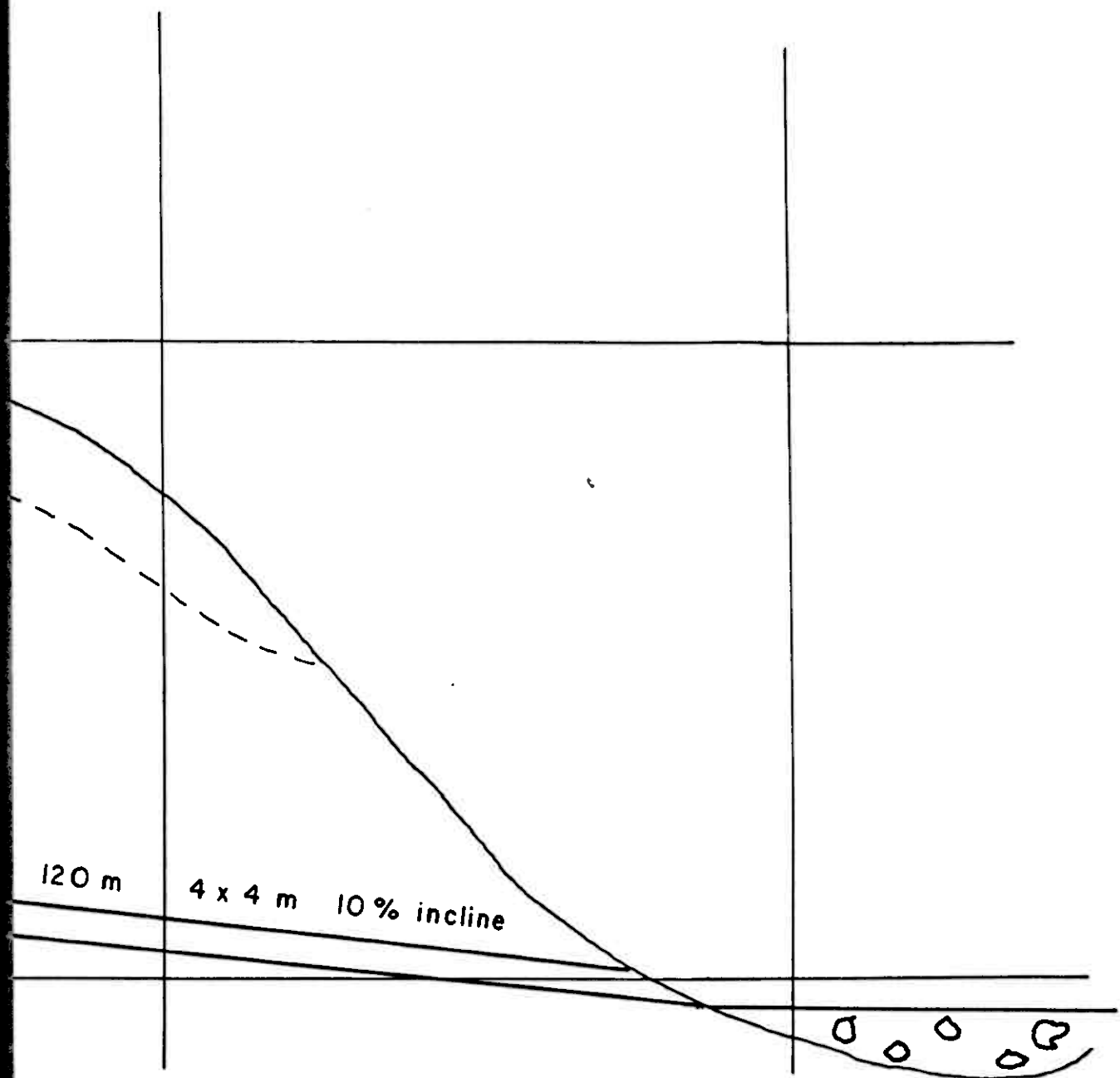
This alternative involves the developement of the heindalen deposit by combined open pit and room and pillar/open stoping mining techniques. (See Fig. 15, 16 and 17)

The proposed production would be as shown in Table 5.

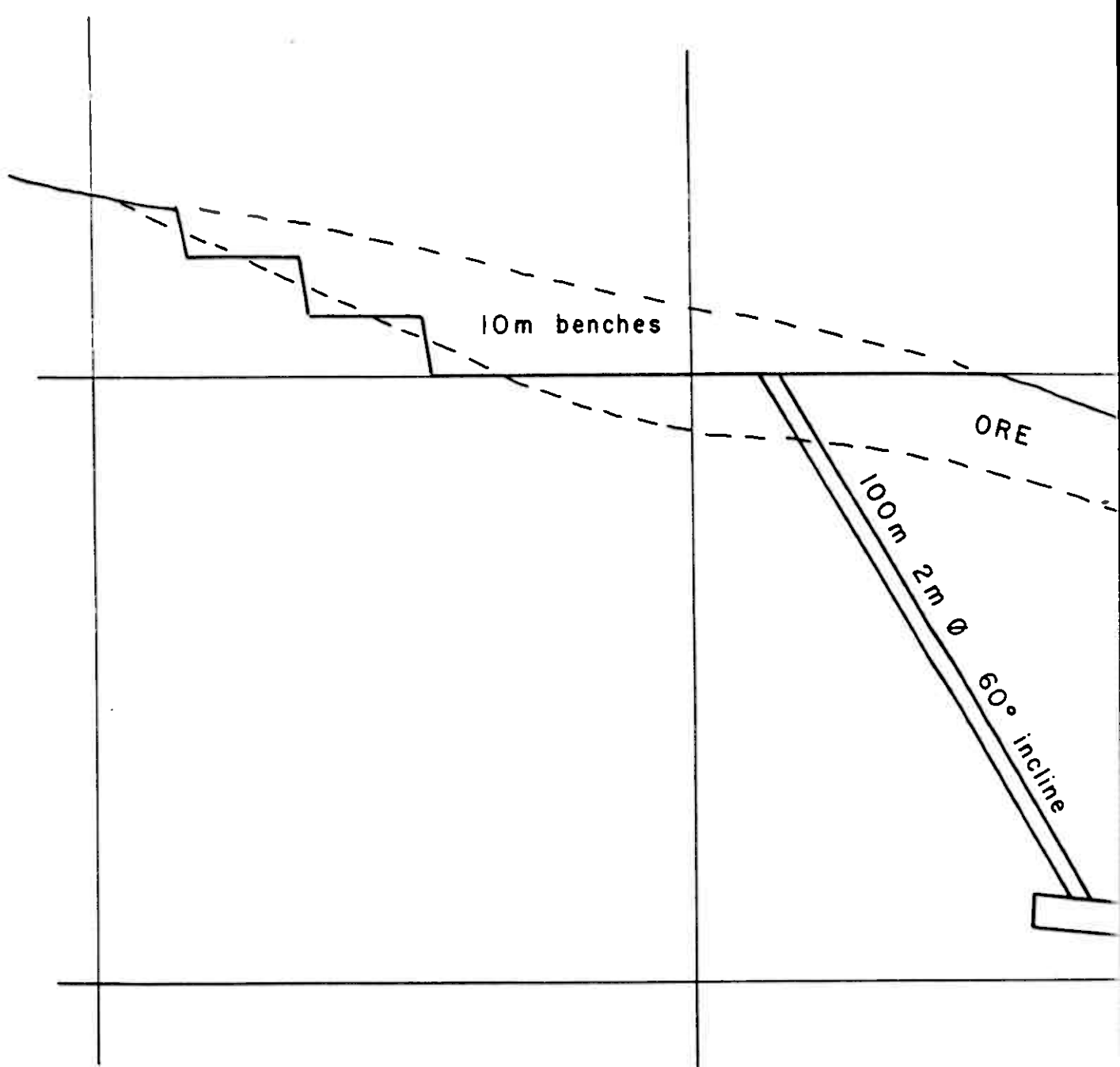
MINING EQUIPMENT

The mining equipment utilized here would be normal open pit type of equipment and will not be discussed further.



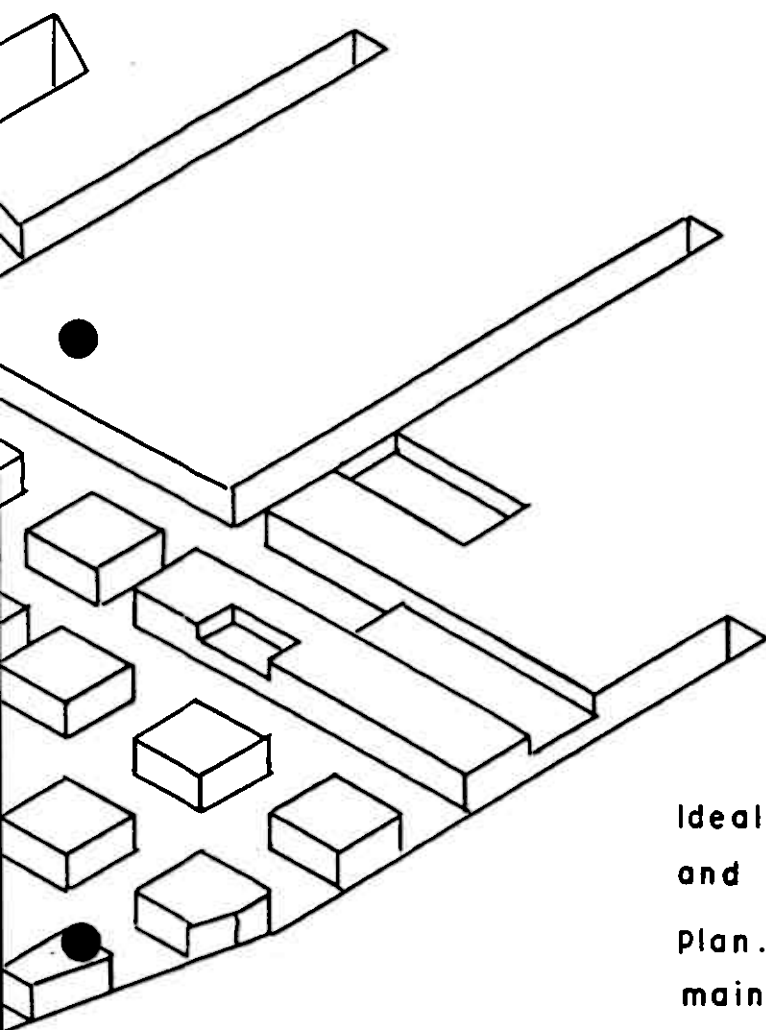


Dato	Konstr./Tegnet	Godkjent	Målestokk		
7 - 4 - 87	JS	JS	1:1000	Erstatning for:	Erstattet av:
LONG - SECTION OF PIT HEINDALEN WEST DEPOSIT				FIG. 16	
Henvisning:		Beregning:			



3

A



Idealized layout showing combined room and pillar and sublevel caving mine Plan. The pillars are 20 x 20 m, the main haulage drifts are 10 x 10 m, the rooms are 20 x 10 m.

The actual configuration will be adjusted to fit the true shape of the ore body.

Dato	Konstr./Tegnet	Godkjent	Målestokk		
26 - 3 - 87	JS	JS	1 : 5000	Erstatning for:	Erstattet av:
ISOMETRIC VIEW - MINING LAYOUT - HEINDALEN EAST				FIG. 17	
Henvisning:		Beregning:			

8

7

IV

6

5

F

E

D

C

B

A

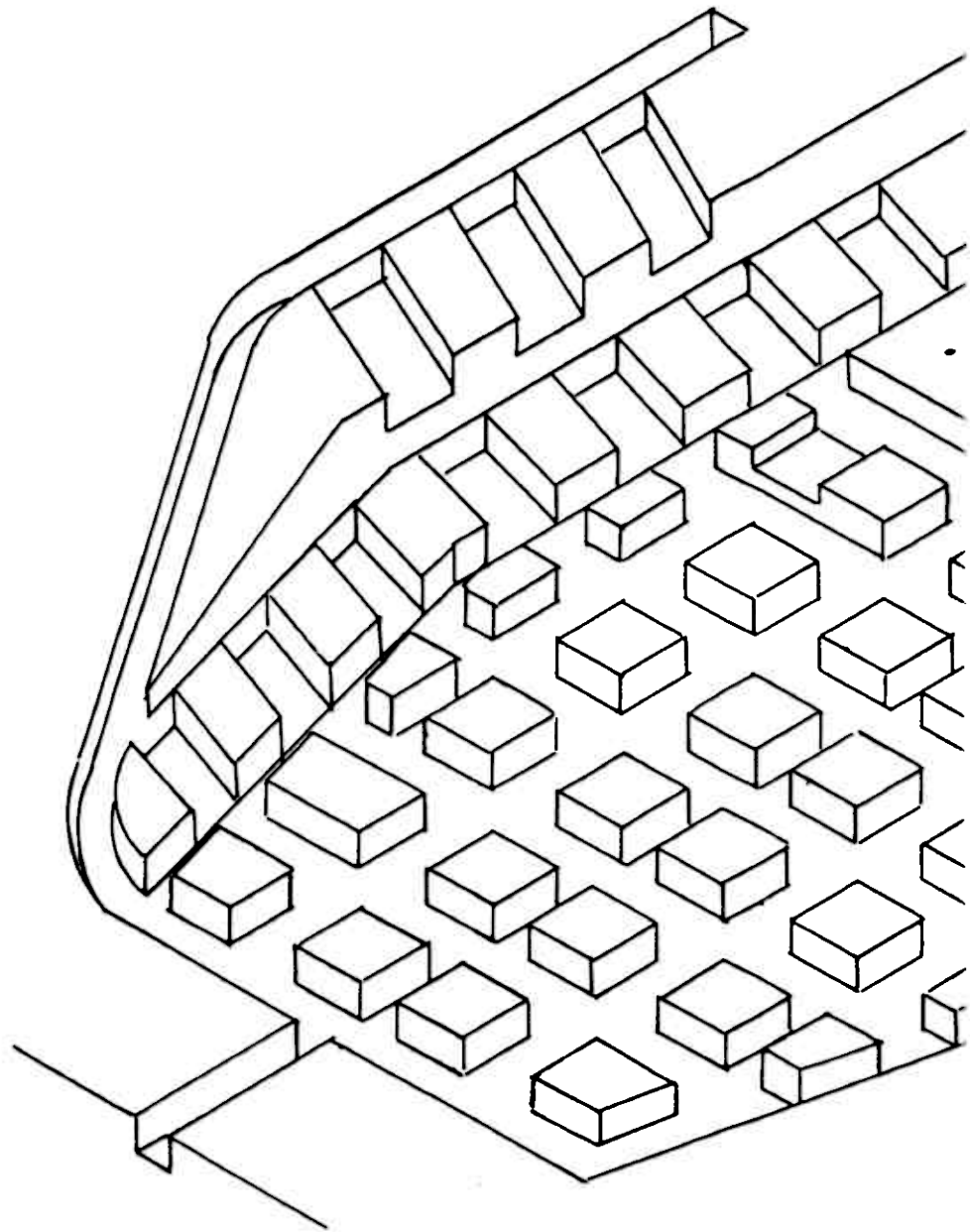


TABLE 4 PRODUCTION HISTORY OF THE RØDSAND MINE

YEAR	PRODUCTION MTS X 1000					SALES Nkr.x1000	NET PROFIT Nkr.x1000	EMPLOYEES
	ORE	MAGNETITE	ILMENITE	GRAVEL	ASPHALT			
1960	347	103	2.3					198
1961	329	101	3.0					
1962	339	105	3.0					
1963	434	137	3.1					
1964	449	134	2.1					
1965	479	137	3.7					
1966	452	132	3.3	98				
1967	475	129	4.8	137				
1968	600	162	7.0	163	24			143
1969	645	150	9.4	233	49			
1970	652	155	9.1	252	35			190
1971	671	144	7.5	254	47			
1972	553	120	5.9	245	67			176
1973	420	95	7.6	162	69			181
1974	516	98	8.6	157	86			167
1975	780	148	8.6	226	65		- 936	169
1976	653	143	8.9	201	84	31,670	- 769	171
1977	592	122	5.5	238	100	30,459	-2,477	165
1978	586	102	3.9	258	96	30,567	-2,988	171
1979	720	141	4.0	244	66	30,342	-4,053	167
1980	702	138	3.4	270	72	33,347	-5,532	158

TABLE 5 RØDSAND MINE PRODUCTION COSTS FOR 1983
RØDSAND GRUBER - PRODUCTION COSTS 1983

		Kroner x 1000
Materials		
Asphalt		6,040
Grinding balls, crusher parts		278
Drill steel, bits		211
Explosives		427
Contract haulage		2,250
Misc. contract work		<u>1,170</u>
	Sum	10,376
Fuel		798
Wages		5,435
Cost of sales		4,601
Depreciation		3,649
Uncollectable accounts		3,141
Adjustments for later uncollectables		155
Inventory loss		<u>874</u>
	Total	Nkr. 25,972

PRODUCTION - 1983

	Mtn.
Asphalt	80,000
Gravel	100,000
Magnetite	10,000

EMPLOYEES - 1983 38

The equipment utilized for transporting the ore to the mill is, however, quite important as this is the key item in this alternative. It is proposed that this is done by a semi-trailer rig capable of transporting approximately 38 mtn. of ore over normal roads. (See Fig. 18 and 19)

It is assumed that the entire mining operation be contracted out.

REQUIRED INVESTMENTS

Aside from the mining equipment which will be provided by the contractor, this alternative requires some investments in the new mine, the haulage road and improvements to the concentrator as presented in Table 6.

ORGANIZATION

This alternative requires 25 employees (excluding the contractor) as presented in Table 7. By comparing that with the manpower levels presented in the production history one can see that this is a great reduction, but it should be sufficient.

PRODUCTION COSTS

The production cost evaluation presented in Table 5 shows a cost of Nkr. 40.97 per mtn. of ore or Nkr. 95 per mtn. magnetite the operation should show an annual profit of 4.613 million Nkr. Or, at zero profit, a cost of Nkr. 77.56 per mtn. magnetite.

CASH FLOW ANALYSIS

A cash flow analysis of this alternative is presented in Table 8. It shows a payback period of $4\frac{1}{2}$ years and a DCF rate of return of 25 %.

ORIGINATOR: **TABLE 8 CASH FLOW ANALYSIS - ALTERNATIVE 1**

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	YEAR	INVESTMENT	OPERATING INCOME	DEPR. & DEPL.	TAXABLE INCOME	TAXES (50%)	NET PROFIT AFTER TAX	CUM. NET CASH FLOW	ANNUAL NET CASH FLOW	TRIAL 15% INTEREST RATE		TRIAL 25% INTEREST RATE		TRIAL % INTEREST RATE		TRIAL % INTEREST RATE	
										FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE
BEFORE ZERO	-2																
	-1	18,312					-	18,312	-18,312	-18,312	-18,312	-18,312	-18,312				
AFTER ZERO	1		6,444	1,831	4,613	2,306	2,307	14,174	4,138	.9332	3,861	.8962	3,708				
	2		6,444	1,831	4,613	2,306	2,307	10,036	4,138	.8115	3,357	.7170	2,966				
	3		6,444	1,831	4,613	2,306	2,307	5,898	4,138	.7056	2,919	.5736	2,373				
	4		6,444	1,831	4,613	2,306	2,307	-1,760	4,138	.6136	2,534	.4589	1,898				
	5		6,444	1,831	4,613	2,306	2,307	2,378	4,138	.5336	2,208	.3671	1,519				
	6		6,444	1,831	4,613	2,306	2,307	6,516	4,138	.4640	1,920	.2936	1,214				
	7		6,444	1,831	4,613	2,306	2,307	10,654	4,138	.4034	1,669	.2349	972				
	8		6,444	1,831	4,613	2,306	2,307	14,792	4,138	.3508	1,451	.1879	777				
	9		6,444	1,831	4,613	2,306	2,307	18,930	4,138	.3050	1,262	.1503	621				
	10		6,444	1,831	4,613	2,306	2,307	23,068	4,138	.2652	1,097	.1203	497				
	11		6,444		6,444	3,222	3,222	26,290	3,222	.2306	742	.0962	309				
	12		6,444		6,444	3,222	3,222	29,512	3,222	.2006	646	.0769	247				
	13		6,444		6,444	3,222	3,222	32,734	3,222	.1744	561	.0615	198				
	14		6,444		6,444	3,222	3,222	35,956	3,222	.1516	488	.0492	158				
	15		6,444		6,444	3,222	3,222	39,178	3,222	.1319	424	.0394	126				
	16		6,444		6,444	3,222	3,222	42,400	3,222	.1146	369	.0315	101				
	17		6,444		6,444	3,222	3,222	45,622	3,222	.0997	321	.0252	81				
	18		6,444		6,444	3,222	3,222	48,844	3,222	.0867	279	.0201	64				
	19		6,444		6,444	3,222	3,222	52,066	3,222	.0754	242	.0161	51				
	20		6,444		6,444	3,222	3,222	55,288	3,222	.0655	211	.0129	41				
											8,254		- 391				
	TOTALS																

1. ECONOMIC INDICATORS —

DCF RATE OF RETURN 25 %

REQUIRED RATE OF RETURN %

PV AT REQUIRED RATE \$

PAYBACK PERIOD 4 1/2 YRS.

MAXIMUM CASH EXPOSURE \$

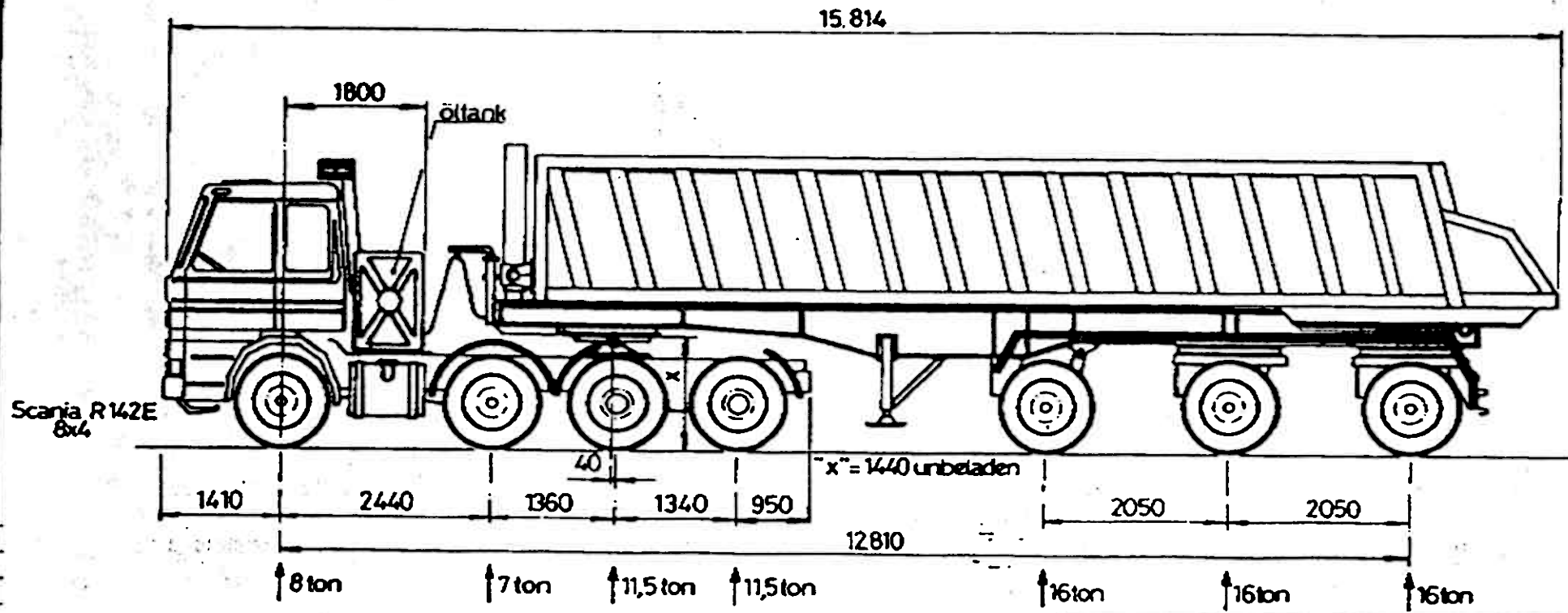
2. COMMENTS —

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ECEIVE

718. 78 SENTRAILER FOR TRANSPORTING HEINDALEN ORE



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3201 SANDEFJORD
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TABLE 5 PRODUCTION ALTERNATIVE 1 - PRODUCTION COSTS

Production/Sales FOB Mine		Nkr. x 1000	
Magnetite	150,000 mtn. x 140	21,000	
Aggregate	150,000 mtn. x 40	6,000	
Aggregate	50,000 mtn. x 25	1,250	
Sand	50,000 mtn. x 25	1,250	
Ilmenite	9,000 mtn. x 170	<u>1,530</u>	
Total Sales		31,030	\$ 4,137
Production Costs			
Mining 600,000 mtn. x Nkr. 25 (Contract mining - 25% ore)		15,000	
Materials			
Grinding balls, parts		855	
Reagents		<u>100</u>	955
Fuel			800
Wages			5,000
Administration			1,000
Interest (10%)		<u>1,831</u>	
Sum Prod. Cost		24,586	\$ 3,278
Gross Profit		<u>6,444</u>	
Depreciation (Nkr. 18,312 ÷ 10 yrs)		<u>1,831</u>	
Net Profit Before Tax		Nkr. 4,613	\$ 615

Production costs per mtn. ore = Nkr. 40.97

Or, at 0 profit, net cost per mtn. magnetite Nkr. 77.56

Net cost per stn. magnetite \$ 8.61

TABLE 6 PRODUCTION ALTERNATIVE 1 - REQUIRED INVESTMENTS

	Nkr. x 1000	
Purchase of Rødsand (assumed price)	5,000	
Mine		
Mobile Equipment (Contractor)		
Front end loader	2,000	
LHD	2,500	
Drill rig	1,600	
Utility vehicle	200	
Semitrailers 5	<u>15,000</u>	
	21,300	
Stationary Equipment		
Move crusher	1,000	
Road (1 km.)	1,000	
Foundations	150	
Ore bin w/feeder	1,000	
Stripping	500	
Tunnel 100 m	500	
Shaft 100 m	<u>500</u>	
	4,650	
Concetrator		
Storage silo for ilmenite	1,500	
Pumps and cyclones	500	
Bridge improvements	1,000	
General improvements	<u>2,000</u>	
	5,000	
Unforseen 15%	2,197	
Engineering 10%	<u>1,465</u>	
Total investment	39,612	
Less contractor	<u>21,300</u>	
Owner investment	18,312	\$ 2,441

TABLE 7 PRODUCTION ALTERNATIVE 1 - MANNING TABLE

Administration

Manager	1
Clerk	<u>2</u>
	3

Mine (Contractor)

Mine Supt.	<u>1</u>
	1

Concentrator

Mill Supt.	1
Lab Tech.	1
Operators (3 men x 5 shit)	15
Maintenance Supv.	2
Mechanic	<u>2</u>
	21

Total	25
-------	----

PRODUCTION ALTERNATIVE 2 -RØDSAND CONCENTRATOR - HEINDALEN DEPOSIT - PUMPING

The only difference between this and alternative 1 is that here the ore will be transported to the mill as a pumped slurry. To accomplish the primary ball mill must be moved up to the mine site. An additional required investment in this case will be for the installation of a pumping plant and pipe line.

PROPOSED PRODUCTION PLAN

The production methods used here would be the same as for alternative 1. Production quantities are shown in Table 9. Because of the pumping it is not possible to produce a crushed aggregate.

REQUIRED INVESTMENT

The pumping facility will require 2 pumps with a capacity of approximately 20 m³ / min. and associated building, tanks and pipeline plus some of the investments presented for alternative 1. (See table 9)

ORGANIZATION

Alternative 2 will require 30 employees as presented in Table 10.

PRODUCTION COSTS

The production costs per mtn. of ore is Nkr. 35.62.

TABLE 9 PRODUCTION ALTERNATIVE 2 - REQUIRED INVESTMENTS

	Nkr. x 1000	
Purchase of Rødsand	5,000	
Mine		
Mobile Equipment (Contractor)		
Front end loader	2,000	
LHD	2,500	
Drill rig	1,600	
Utility vehicle	<u>200</u>	
	6,300	
Stationary Equipment		
Move crusher	1,000	
Road (1 km.)	1,000	
Tunnel 100 m	500	
Shaft 2 m x 100 m	500	
Foundations	150	
Ore bin and feeders	1,000	
Stripping	<u>500</u>	
	4,650	
Pumping Facility		
Building	1,000	
Installation	500	
Pumps	2,060	
Tanks	2,500	
Electric	600	
Piping	<u>2,000</u>	
	8,660	
Unforeseen 15%	2,746	
Engineering 10%	<u>1,831</u>	
Total	29,187	
Less Contractor	<u>6,300</u>	
Owner Invest. Nkr.	22,887	\$ 3,051

TABLE 11 PRODUCTION ALTERNATIVE 2 - PRODUCTION COSTS

Production/Sales FOB Mine		Nkr. x 1000	
Magnetite	150,000 mtn. x 140	21,000	
Sand	50,000 mtn. x 25	1,250	
Ilmenite	9,000 mtn. x 170	<u>1,530</u>	
Total Sales		Nkr. 23,780	\$ 3,170
Production Costs			
Mining	600,000 mtn. x 15	9,000	9,000
Materials			
	Grinding balls, parts	855	
	reagents	<u>100</u>	
		955	
Fuel		1,500	
Wages		6,000	
Administration		1,000	
Interest (10%)		<u>2,918</u>	
Total Prod. Cost		21,373	\$ 2,849
Gross Profit		<u>2,407</u>	\$ 320
Depreciation (29,187 ÷ 10 yrs.)		<u>2,918</u>	
Net Profit Before Tax		--511	\$ - 68

Production cost per mtn. ore = Nkr. 35.62 or \$4.74

TABLE 10 PRODUCTION ALTERNATIVE 2 - MANNING TABLE

Administration	
Manager	1
Clerks	<u>2</u>
	3
Mine (Contractor)	
Mine Supt.	1
Pump Operators (1 x 5 shift)	<u>5</u>
	6
Concentrator	
Mill Supt.	1
Lab Tech.	1
Operators (3 x 5 shift)	15
Maintenance Supv.	2
Mechanic	<u>2</u>
	21
Total	<u>30</u>

PRODUCTION ALTERNATIVE 3 RØDSAND CONCENTRATOR - MEISINGSET
DEPOSIT - TRUCKING AND BARGE

The deposits at Meisingset are very similar to those at Rødsand. The big difference being that the Meisingset ore has to be transported over the Sunndals Fjord.

PROPOSED PRODUCTION PLAN

Here again can one utilize a combined open pit and room and pillar mining operation.

Production costs will be approximately the same here as for Heindalen, but the additional cost of transporting the ore by barge or ship over the fjord will make it about 10 Nkr. per mtn. more expensive. Continued investigation of this alternative seems, therefor, unnecessary.

The deposit could, however, be held as additional reserves.

PRODUCTIONAL ALTERNATIVE 4 TRANSPORTABLE CONCENTRATOR -
SELVÅG DEPOSIT

The use of transportable concentrators is nothing new. They have been used in dredge mining for many years. Polaris, the world's most northerly mine, was recently developed utilizing a concentrator mounted on a barge. The barge cost \$4,455,000, but was specifically designed and built for this operation. A recent purchase of a normal 20 m x 60 m barge went for a price of \$ 410,000.

The total capital costs for the Polaris mine amounted to \$ 89,000,000 (Legget, 1982).

The proposal presented here is somewhat different in that it proposes the use of an old ship (50,000 to 150,000 Dwt.). In addition to providing a ready made enclosure for the concentrator, the ship can also provide the following:

1. Ore storage bins.
2. Dock facilities.
3. Housing and office space.
4. Power generation.
5. Maintenance facilities.

The use of this approach also has the following advantages:

1. Cheaper to build.
2. The investment can be recovered if economics change.
3. Can make development of smaller remote deposits feasible.
4. Better construction techniques under the controlled conditions of a ship yard.
5. Can be constructed near the source of the mill equipment and then moved as a whole to the site.
6. Deposits in very rugged terrain can be developed without extremely high costs for mill site excavation.

A cost comparison between a new - standard type of concentrator and a transportable concentrator utilizing used equipment mounted in a ship is presented in Table 12. The production capacity in both cases is 2000 mtn. ore per day. Prices for the new standard concentrator are taken from (Ohara, 1980).

TABLE 12 COST COMPARISON OF A STANDARD 2000 MTN CONCENTRATOR AND A SHIP MOUNTED CONCENTRATOR

Site excavation	\$ 4.5 million
Foundations	5
Building	8
Grinding pland	10
Prosessing plant	8
Power plant	8
Water	2
Storage bins	7
Dock facilities	3
Housing	2
Total for new mill	\$ 57.5 million
Ship	\$.5 million
Used mill equipment	.3
Installation	
Equipment	.4
Electrical	.4
Plumbing	.3
Storage	
Piping	.1
Filters	.2
Transportation	.4
Set up	.3
Total for Transp. mill	\$ 2.2 million

PROPOSED PRODUCTION PLAN

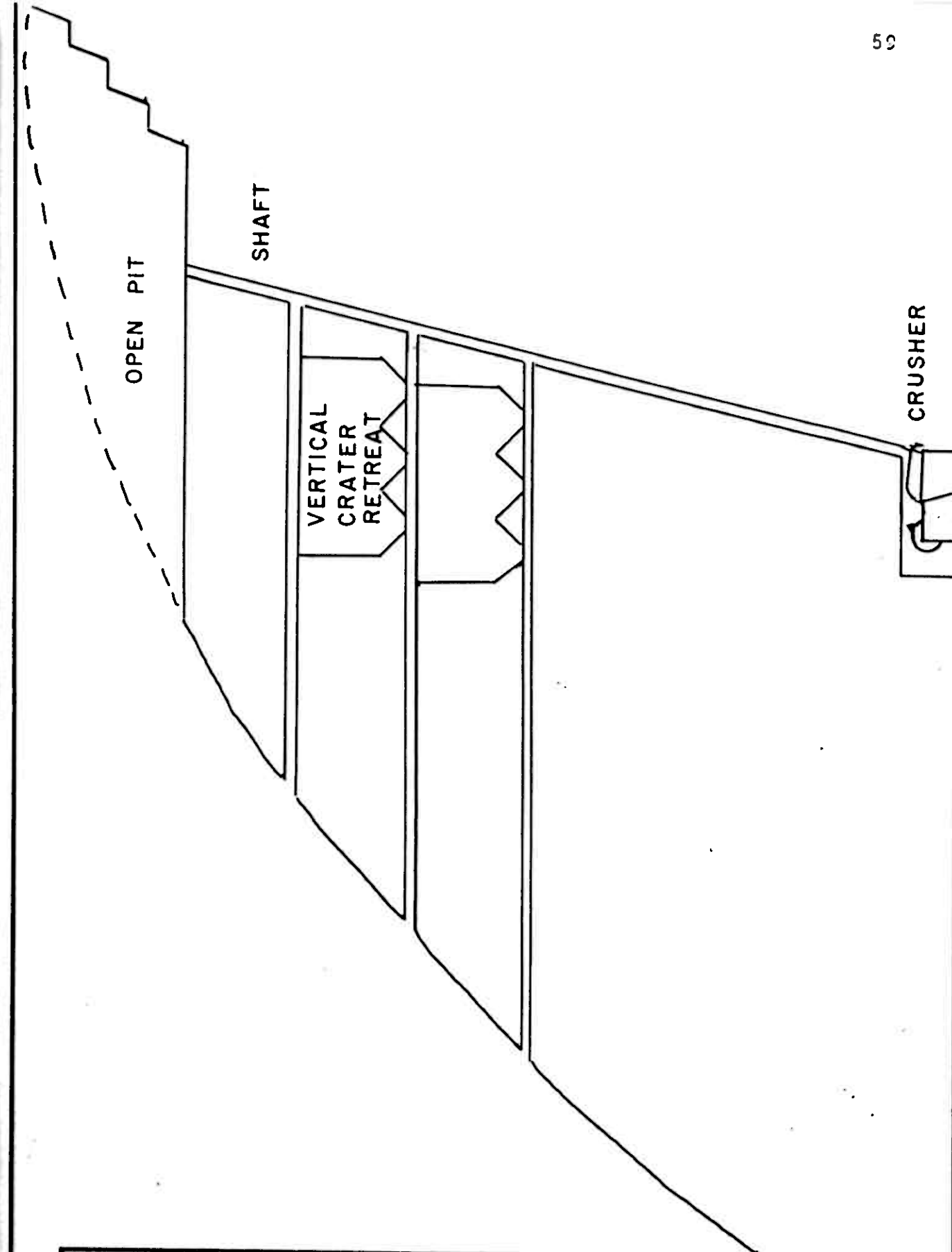
Here again, the mining method will be based on a combined open pit and underground operation. Fig. 20 and 21 show the proposed mining methods. The proposed mill is shown in Fig. 22, , placement of the mill is shown in Fig. 23.

The products will consist of heavy media, RBC and crushed aggregate. Production quantities are listed in Table 15.

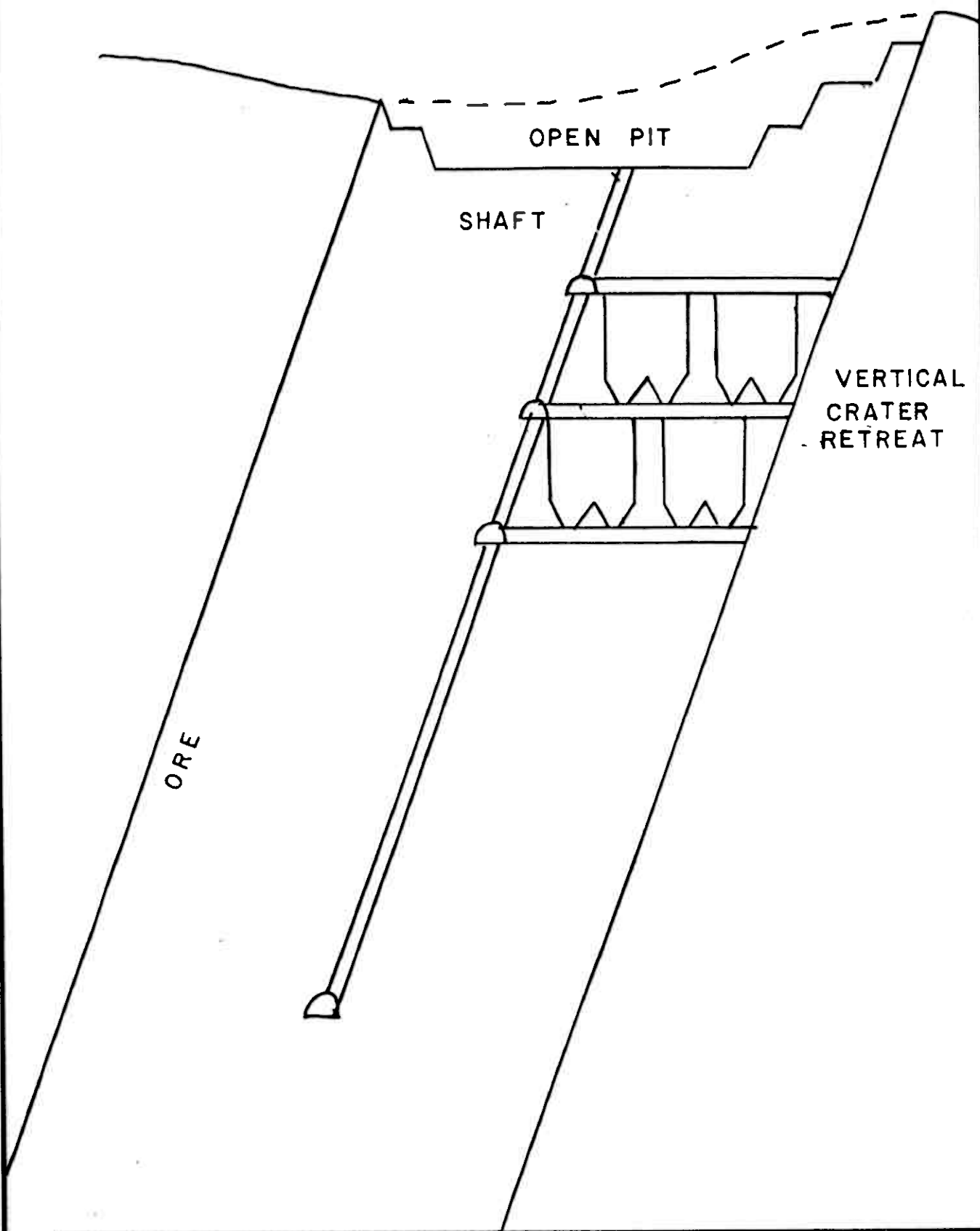
The mining is assumed to be done by a contractor delivering the ore to the crushing for Nkr. 15 per mtn.

ORGANIZATION

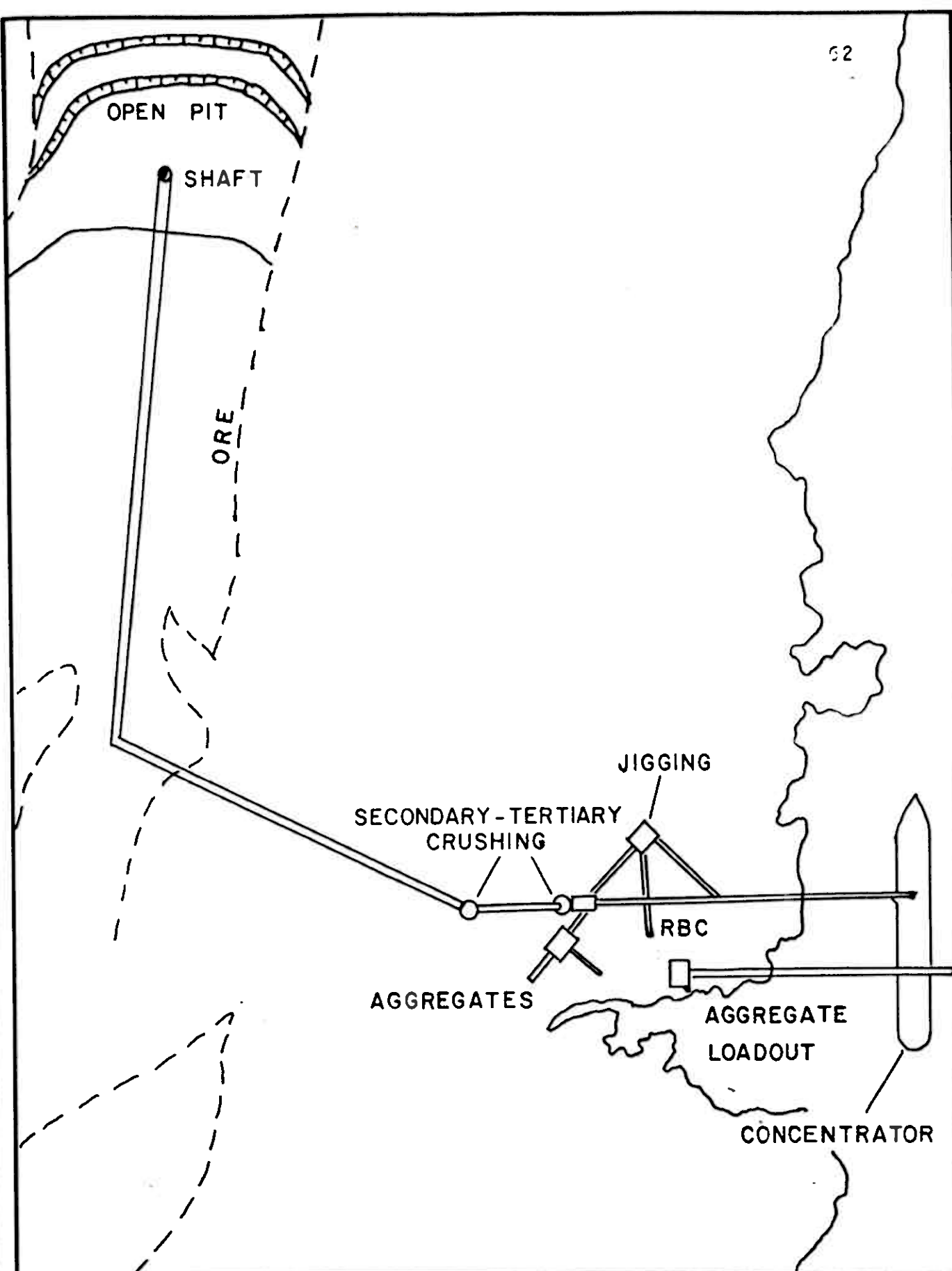
This alternative will require 33 employees as outlined in Table 13.



Dato	Konstr./Tegnet	Godkjent	Målestokk		
3 - 5 - 87	JS	JS		Erstatning for:	Erstattet av:
MINING METHODS SELVÅG DEPOSIT				FIG. 20	
Henvisning:		Beregning:			



Dato	Konstr./Tegnet	Godkjent	Målestokk		
3 - 5 - 87	JS	JS		Erstatning for:	Erstattet av:
MINING METHODS SELVÅG DEPOSIT				FIG. 21	
Henvisning:		Beregning:			



Dato	Konstr./Tegnet	Godkjent	Målestokk		
3 - 5 - 87	JS	JS		Erstatning for:	Erstattet av:
PLANT LAYOUT SELVÅG DEPOSIT				FIG. 23	
Henvisning:		Beregning:			

INVESTMENT COSTS

Total investment costs amount to Nkr. 57,500,000 including the contractors equipment which amounts to Nkr. 12,500,000. The investment costs are outlined in Table 14.

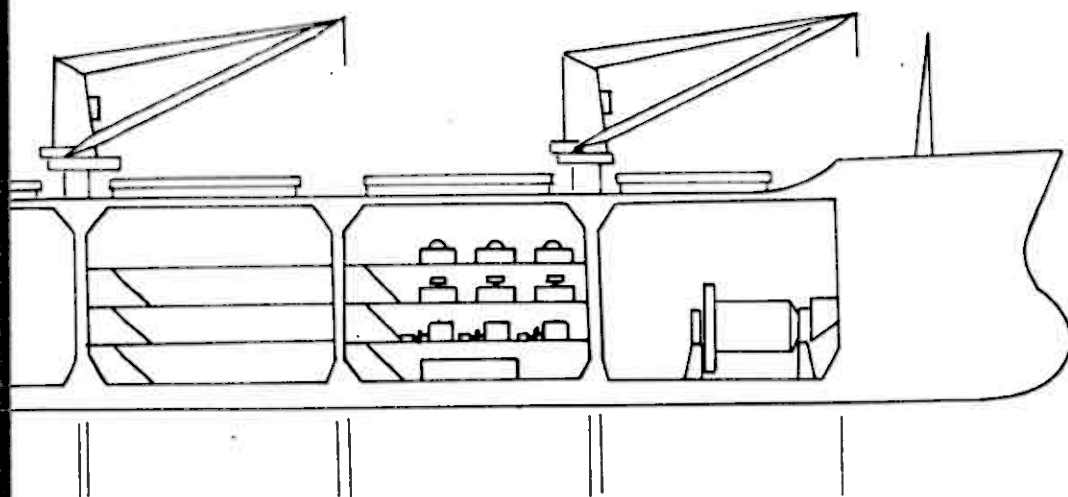
A graph showing costs of used ships is presented as Fig. 23.

PRODUCTION COSTS

An analysis of sales and production costs is presented as Table 15. It shows that this operation will have a net annual profit of Nkr. 18,480,000. It also shows a production cost of Nkr. 37.96 per mtn. ore. Or, at 0 profit there is no cost for the production of heavy media. That is to say all of the production costs are covered by biproduct sales.

CASH FLOW ANALYSIS

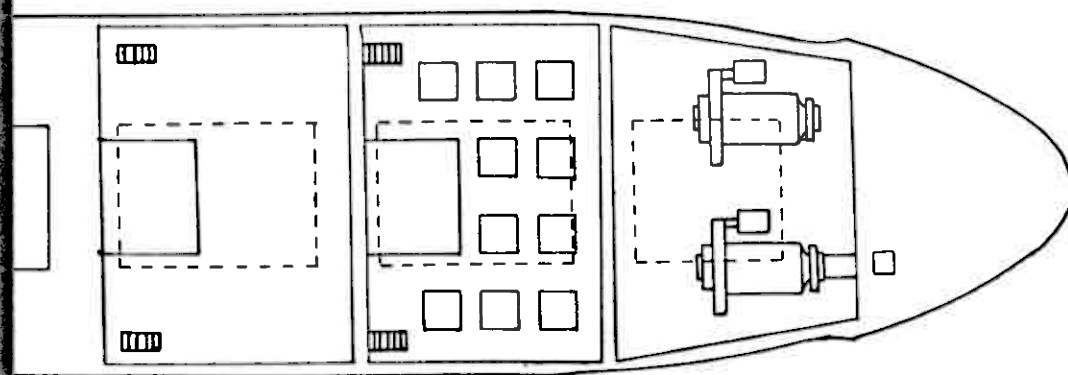
A cash flow analysis of this alternative is presented in Table 16. It shows a payback period of 3 years and a DCF rate of return of about 31%.



SHOP

SEPERATORS

GRINDING PLANT



Date	Konstr. / Tegnet	Godkjent	Målestokk		
				Erstatning for	Erstatning av
PROPOSED PLANT LAYOUT				FIG. 22	
Tegnet av		Beregnet			

FIG. 23

**Nominal Second-Hand Values Of A Standard 50,000Dwt Bulk Carrier
Built 1967**



TABLE 13 PRODUCTION ALTERNATIVE 4 - MANNING TABLE

Administration

Manager	1
Clerk	<u>2</u>
	3

Mine (Contractor)

Mine Supt.	<u>1</u>
------------	----------

Concentrator

Mill Supt.	1
Lab Technician	1
Maintenance Supv.	2
Crusher Operator (1 man x 5 shift)	5
Mill Operators (3 men x 5 shift)	15
Mechanics	4
Electrician	<u>1</u>
	29

Total	33
-------	----

TABLE 14 PRODUCTION ALTERNATIVE 4 - REQUIRED INVESTMENTS

Mine			Nkr. x 1000	
Mobile Equipment (Contractor)				
Front end loader	2,000			
35T Dumpers 3	6,000			
Drill rig	1,600			
Utility vehicles 2	400			
Hydraulic shovel	<u>2,500</u>			
			12,500	
Stationary Equipment				
Roads	2,000			
Stripping	1,000			
Tunnel 300 m	<u>1,500</u>			
			4,500	
Concentrator				
Ship	3,000			
Equipment	2,000			
Installation	8,000			
Storage bins	1,500			
Transportation	2,500			
Set up	2,000			
Crushing plant	<u>10,000</u>			
			29,000	
Unforeseen 15%			6,900	
Engineering 10%			<u>4,600</u>	
Total Investment	Nkr. 57,500			
Less Contractor	<u>12,500</u>			
Owner investment	Nkr. 45,000			\$ 6,000

TABLE 15 PRODUCTION ALTERNATIVE 4 - PRODUCTION COSTS

Production/Sales FOB mine		Nkr. x 1000	
Magnetite RBC	50,000 mtn. x 400	20,000	
Magnetite	150,000 mtn. x 140	21,000	
Ilmenite	5,000 mtn. x 170	850	
Crushec Agg.	100,000 mtn. x 100	10,000	
Sand	50,000 mtn. x 50	<u>2,500</u>	
Total Sales		54,350	\$ 7,246
Production Costs			
Mining	800,000 mtn. x 20	16,000	
Materials			
Grinding balls, parts	1,137		
Reagents	<u>133</u>		
		1,270	
Fuel		1,000	
Wages		6,600	
Administration		1,000	
Interest		<u>4,500</u>	
Total Prod. Cost		30,370	\$ 4,049
Gross Profit		<u>23,980</u>	
Depreciation (45,000 ÷ 10 yrs.)		<u>4,500</u>	
Net Profit Before Tax		19,480	\$ 2,597

Production cost per mtn. ore = Nkr. 37.96 \$ 5.06

Or, at 0 profit, cost of heavy media = 0

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DATE:
PAGE: OF

	YEAR	INVESTMENT	OPERATING INCOME	DEPR. & DEPL.	TAXABLE INCOME	TAXES (50 %)	NET PROFIT AFTER TAX	CUM. NET CASH FLOW	ANNUAL NET CASH FLOW	TRIAL 15% INTEREST RATE		TRIAL 25% INTEREST RATE		TRIAL 30% INTEREST RATE		TRIAL % INTEREST RATE	
										FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE	FACTOR	PRESENT VALUE
BEFORE ZERO	-2																
	-1	45,000						-45,000	-45,000		-45,000		-45,000		-45,000		
AFTER ZERO	1		23,980	4,500	19,480	9,740	9,740	30,760	14,240	.9332	13,288	.8962	12,761	.7692	10,953		
	2		23,980	4,500	19,480	9,740	9,740	16,520	14,240	.8115	11,555	.7170	10,210	.5917	8,425		
	3		23,980	4,500	19,480	9,740	9,740	2,280	14,240	.7058	10,047	.5736	8,168	.4552	6,482		
	4		23,980	4,500	19,480	9,740	9,740	11,960	14,240	.6136	8,739	.4589	6,534	.3501	4,985		
	5		23,980	4,500	19,480	9,740	9,740	26,200	14,240	.5336	7,598	.3671	5,227	.2693	3,834		
	6		23,980	4,500	19,480	9,740	9,740	40,440	14,240	.4640	6,607	.2936	4,180	.2072	2,950		
	7		23,980	4,500	19,480	9,740	9,740	54,680	14,240	.4034	5,744	.2349	3,344	.1594	2,269		
	8		23,980	4,500	19,480	9,740	9,740	68,920	14,240	.3508	4,995	.1879	2,675	.1226	1,745		
	9		23,980	4,500	19,480	9,740	9,740	83,160	14,240	.3050	4,343	.1503	2,140	.0943	1,342		
	10		23,980	4,500	19,480	9,740	9,740	97,400	14,280	.2652	3,776	.1203	1,713	.0725	1,032		
	11		23,980		23,980	11,990	11,990	109,390	11,990	.2306	2,764	.0962	1,153	.0558	669		
	12		23,980		23,980	11,990	11,990	121,380	11,990	.2006	2,405	.0769	922	.0429	514		
	13		23,980		23,980	11,990	11,990	133,370	11,990	.1744	2,091	.0615	737	.0330	395		
	14		23,980		23,980	11,990	11,990	145,360	11,990	.1516	1,817	.0492	589	.0254	304		
	15		23,980		23,980	11,990	11,990	157,350	11,990	.1319	1,581	.0394	472	.0195	233		
	16		23,980		23,980	11,990	11,990	169,340	11,990	.1146	1,374	.0315	377	.0150	179		
	17		23,980		23,980	11,990	11,990	181,330	11,990	.0997	1,195	.0252	302	.0116	139		
	18		23,980		23,980	11,990	11,990	193,320	11,990	.0867	1,039	.0201	240	.0089	106		
	19		23,980		23,980	11,990	11,990	205,310	11,990	.0754	904	.0161	193	.0068	81		
	20		23,980		23,980	11,990	11,990	217,300	11,990	.0655	785	.0129	154	.0053	63		
											47,645		17,091		1,700		
	TOTALS																

1. ECONOMIC INDICATORS —

DCF RATE OF RETURN 31 %
REQUIRED RATE OF RETURN %
PV AT REQUIRED RATE \$

PAYBACK PERIOD 3 YRS.
MAXIMUM CASH EXPOSURE \$

2. COMMENTS —

PRODUCTION ALTERNATIVE 5 TRANSPORTABLE CONCENTRATOR - MAGNETITE SANDS

The mining of magnetite sands is also nothing new. New Zealand Ltd. produces about 1.6 million tons per year of magnetite concentrate from such ironsand deposits on the North Island of New Zealand. Because of fairly recent glaciation, the deposits in Norway are fairly small and individually are certainly uneconomic. Combined, they could be of interest for a transportable concentrator.

PROPOSED PRODUCTION PLAN

The material would be mined by a dredge that would then pump the material to the shipborne concentrator presented under alternative 4. In this alternative the ship would be seaworthy and also serve as the shipping vessel. Fig. 24 shows the proposed dredging equipment.

In this case production will be based totally on heavy media.

INVESTMENT COSTS

The necessary investment costs for this alternative are presented in Table 17. The concentrator is essentially the same as for alternative 4; however, in this case the ship is seaworthy. The total investment costs amount to Nkr. 64,250,000.

MANNING TABLE

The manning table for this alternative is presented in Table 18 and calls for a total of 32 employees.

PRODUCTION COSTS

With the production of 200,000 mtn. of magnetite, the production costs are Nkr. 35.65 per mtn. ore. Net profit before taxes becomes Nkr. 13,050,000. Production costs for this alternative are presented in Table 19.

TABLE 17 PRODUCTION ALTERNATIVE 5 - INVESTMENT COSTS

	Nkr. x 1000	
Dredge	2,100	
Piping	1,000	
Concentrator from Alt. 4	29,000	
Seaworthy ship	19,000	
Service boat	300	
Sum	51,400	
Unforeseen 15%	7,710	
Engineering	5,140	
Total Investment	64,250	\$ 8,566

TABLE 18 PRODUCTION ALTERNATIVE 5 - MANNING TABLE

Administration

Manager	1
Clerk	<u>2</u>
	3

Dredge

Operator (1 x 3 shift)	3
------------------------	---

Concentrator

Mill Supt.	1
Lab Technician	1
Operators(3 x 5 shift)	15
Maintenance Supv.	2
Mechanic	<u>4</u>
	23

Ship

Captain	1
Navigator	1
Engineer	<u>1</u>
	<u>3</u>

Total	32
-------	----

TABLE 19 PRODUCTION ALTERNATIVE 5 - PRODUCTION COSTS

		Nkr. x 1000	
Production/Sales FOB mine			
Magnetite	200,000 mtn. x 140	28,000	
Shipping	200,000 mtn. x 100	<u>20,000</u>	
	Total Sales	48,000	\$ 6,400
Production Costs			
Dredging	800,000 mtn. x 5	4,000	
Materials			
	Grinding balls, parts	500	
Fuel		10,000	
Wages		6,600	
Administration		1,000	
Interest (10%)		<u>6,425</u>	
	Total Prod. Cost	28,525	\$ 3,803
	Gross Profit	<u>19,475</u>	
	Depreciation (64,250 ÷ 10 yrs.)	<u>6,425</u>	
	Net Profit	13,050	\$ 1,740
	Before Tax		

Production cost per mtn. ore = Nkr. 35.65

Production cost per mtn. magnetite = Nkr. 142.62 CIF New Orleans

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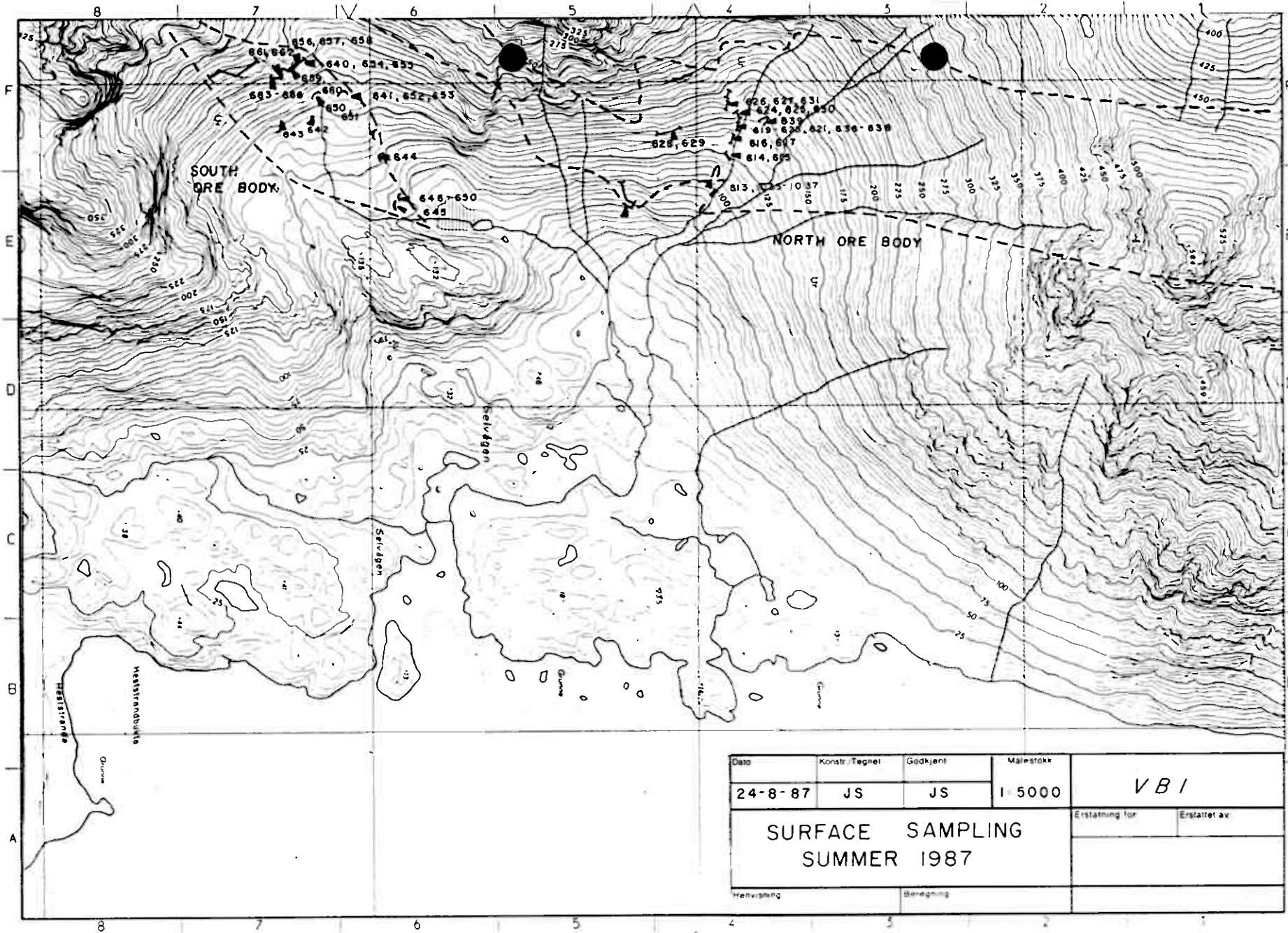
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AS 1000000 10 27 45 1402 NS 1417 NS 1415



80233 1195

ADN 80233 1195

No.

80233 1195 Sep 04.87 12:06 P.01

Sample#	Lab#	Au, ppm	Ag, ppm	Cu, ppm	Co, ppm	Ni, ppm	Zn, ppm	Fe, %	Ti, %	Li, ppm	Sr, ppm	Sc, ppm
613	7H02-1	<0.010	<0.5	240	78	58	190	27.	3.10	4	64	1
614	2	<0.010	<0.5	120	110	50	170	24.	2.60	3	80	1
615	3	<0.010	<0.5	160	120	64	160	24.	2.70	3	35	1
616	4	<0.010	<0.5	130	84	34	180	24.	2.70	3	59	1
617	5	<0.010	<0.5	100	60	15	160	24.	2.90	3	47	1
618	6	<0.010	<0.5	93	86	25	190	28.	3.10	3	39	<1
619	7	<0.010	<0.5	55	88	12	180	27.	3.00	2	32	1
620	8	<0.010	<0.5	86	84	21	180	26.	2.90	3	58	1
621	9	<0.010	<0.5	55	110	24	180	27.	3.40	6	44	1
622	10	<0.010	<0.5	52	100	15	180	28.	3.20	3	33	<1
623	11	<0.010	<0.5	72	83	15	200	27.	3.10	4	37	<1
624	12	<0.010	<0.5	56	93	17	180	26.	2.90	4	30	1
625	13	<0.010	<0.5	44	82	10	150	25.	3.00	3	47	<1
626	14	<0.010	<0.5	45	73	9	160	24.	3.10	3	53	1
627	15	<0.010	<0.5	43	87	11	190	28.	2.70	3	26	<1
628	16	<0.010	<0.5	360	100	110	170	25.	3.10	5	48	1
629	17	<0.010	<0.5	380	88	100	170	26.	2.80	4	67	1
630	18	<0.010	<0.5	110	100	51	160	24.	2.60	3	57	1
631	19	<0.010	<0.5	79	68	14	170	23.	2.70	4	67	1
632	20	<0.010	<0.5	300	95	110	170	24.	2.70	3	50	1
633	21	0.010	0.5	32	5	20	18	6.0	0.44	22	55	4
634	22	<0.010	<0.5	240	100	190	80	15.	1.30	23	100	<1
635	23	<0.010	<0.5	72	12	47	91	4.0	0.71	52	230	<1
1858	24	<0.010	<0.5	71	4	3	13	1.3	0.09	6	49	2
1859	25	<0.010	<0.5	13	<1	<1	3	0.25	0.03	12	240	<1
1860	26	<0.010	<0.5	130	17	39	77	4.8	0.10	21	100	2
1861	27	<0.010	<0.5	65	3	<1	3	1.1	0.02	7	91	1
1862	28	<0.010	<0.5	110	9	9	38	3.7	0.57	9	340	5
1863	29	<0.010	<0.5	12	1	<1	15	0.95	0.06	7	120	<1

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GEITSKAR - BOTNSKAR KOPPER-NIKKEL-KOBOLT-SJELDNE JORDART
FOREKOMSTER I BERG KOMMUNE PÅ SENJA

FORSLAG TIL FORPROSJEKT

AV

JOHANNES SØYLAND

DEC 1, 1987

HISTORIKK

Forekomstene ble først oppdaget av Johannes Søyland i forbindelse med ARCO's malmlettingsprogram for Nord-Norge i 1983. Når ARCO's malmlettingsprogram ble nedlagt i 1985 ble forekomstene og prosjektet tatt opp av Johannes Søyland sammen med Tove Brandtzæg.

Videre kartlegging og prøvetaking viste mineralisering av kopper-nikkel og kobolt. Prospekteringen ble gjenopptatt i 1987 og prøvetakingen viste også mineralisering av sjeldne jordarter, litium og gull. (Se på vedlagt rapport, Fig. 10 og Tabeller 1, 2, 3 og 4.

VIDERE PROSJEKTERING

Det som kreves nå er et forprosjekt som inneholder:

1. Diamantboring (ca. 1200 meter)
2. Analysering
3. Kartlegging
4. Økonomiske Analyser
5. Markedsføring

FORVENTEDE RESULTATER

Størrelsen på blottningene og de hittil lovende resultater fra geokjemiske prøvetaking tilsier at forekomstene har en god sjanse til drivverdighet. Prosjektet har mulighet til å skape 35 til 50 arbeidsplasser.

SULFID / SJELDNE JORDART-FOREKOMSTER

GEITSKAR, BOTNSKAR OG FOSSENG. (Se fig. 3 & 4). Dette dreier seg om to forekomster som er lite kjent og ikke oppboret, men er veldig interessant fordi:

1. Geokjemisk prøvetaking viser høyere innhold av kopper, nikkel, kobolt og sjeldne jordarter. Noen flekker av gull er også funnet. (Se tabell 1 og 2 for analyse-resultater).
2. Begge forekomstene ligger på sterk nordvestgående slepper eller strukturelle krysser. Fig. 5 er et satelittbilde av Nord-Norge som viser slepper og strukturelle krysser. Fig. 6 og 7 er topografiske kart som viser sleppene og forekomstens beliggenhet. Bilde 1 og 2 viser sleppsonen på Senja der Geitskar-Botnskar ligger. Bilde 3 (fargebilde) viser godt bløttingen til Geitskar.
3. Begge forekomstene ligger på sterk magnetiske anomalier som strekker seg parallelt med sleppesonene. (se på fig. 8 og 9).

Analysene viser at forekomstene inneholder opptil 0.9% kopper, 0,15% kobolt, 0,6 % nikkel, 46 gm/tonn Scandium, 92 gm/tonn Lantan og 170 gm/tonn Cerium. Lantan og Cerium er like verdifullt som Scandium. Selvåg inneholder ~~bare~~ 50 gm/tonn av kun Scandium.

Geitskar har en bløtting på 80 x 700 meter med muligens flere lenser av lignende størrelse ca. 200 meter øst. (se på fig. 10).

Botnskar har en bløtting på 10 x 500 meter med en lignende lense ca. 1000 meter til syd. (se på fig. 10).

Fosseng har en tynn uregelmessig blottning, men som strekker seg ca. 4 km langs elvebunnen eller sleppsonen.

Begge områder ser ut til å være veldig gode prospekteringsmål.

MAGNETITTSAND FOREKOMSTER

Vi kjenner her til syv sand-forekomster. 2 ligger i Vesterålen, en i Ofoten, 3 på Senja og 1 på Stjernøya. (se på fig. 3).

Analysering av forekomsten på Senja viser innhold av 58 ppm koppar, 250 ppm nikkel, 39 ppm kobolt, 15 % jern, 28 ppm Scandium 110 ppm Lantan og 190 ppm Cerium (se på tabell 1 og 2).

Disse forekomstene er for små for vanlig bergverksdrift, men kan godt være billig tilleggsmalm for Selvågen eller et oppredningsverk som bygges for Geitskar-Botnskar forekomstene.

ANDRE FOREKOMSTER

SKJELLSAND

Det finnes store mengder av skjellsand både i Nord-Norge og i Trøndelag. Jeg mener at dette kan være en billig malm til produksjon av mikroniserte filler til malings- og plastproduksjon. Et enkelt laboratorieforsøk kan bevise dette.

BUDSJETT

	NKR
Diamantboring (ca. 1200 m.)	500.000
Analysering	50.000
Reiseutgifter	50.000
Konsulentttjenester	360.000
Lønn og Admin.	<u>200.000</u>

SUM NKR 1.160.000

TIDSPLAN GEITSKAR-BOTNSKAR

	JULI	AUG	SEPT	OKT	NOV	DES
Diamantboring						
Analysering						
Kartlegging						
Økonomiske Analyser						
Markedsføring						

TABELL 1

Sample#	Lab#	Au, ppm	Ag, ppm	Cu, ppm	Co, ppm	Ni, ppm	Zn, ppm	Ba, %	Fe, %	Ti, %	Li, ppm	Sr, ppm	Se, ppm
613	7H02-1	<0.010	<0.5	240	78	58	190	<0.02	27.	3.10	4	64	1
614	2	<0.010	<0.5	120	110	50	170	<0.02	24.	2.60	3	80	1
615	3	<0.010	<0.5	160	120	64	160	<0.02	24.	2.70	3	35	1
616	4	<0.010	<0.5	130	84	34	180	<0.02	24.	2.70	3	59	1
617	5	<0.010	<0.5	100	60	15	160	<0.02	24.	2.90	3	47	1
618	6	<0.010	<0.5	93	86	25	190	<0.02	28.	3.10	3	39	<1
619	7	<0.010	<0.5	55	88	12	180	<0.02	27.	3.00	2	32	1
620	8	<0.010	<0.5	86	84	21	180	<0.02	26.	2.90	3	58	1
621	9	<0.010	<0.5	55	110	24	180	<0.02	27.	3.40	6	44	1
622	10	<0.010	<0.5	52	100	15	180	<0.02	28.	3.20	3	33	<1
623	11	<0.010	<0.5	72	83	15	200	<0.02	27.	3.10	4	37	<1
624	12	<0.010	<0.5	56	93	17	180	<0.02	26.	2.90	4	30	1
625	13	<0.010	<0.5	44	82	10	150	<0.02	25.	3.00	3	47	<1
626	14	<0.010	<0.5	45	73	9	160	<0.02	24.	3.10	3	53	1
627	15	<0.010	<0.5	43	87	11	190	<0.02	28.	2.70	3	26	<1
628	16	<0.010	<0.5	360	100	110	170	<0.02	25.	3.10	3	48	1
629	17	<0.010	<0.5	380	88	100	170	<0.02	26.	2.80	4	67	1
630	18	<0.010	<0.5	110	100	51	160	<0.02	24.	2.60	3	57	1
631	19	<0.010	<0.5	79	68	14	170	<0.02	23.	2.70	4	67	1
632	20	<0.010	<0.5	300	95	110	170	<0.02	24.	2.70	3	50	1
633	21	0.010	0.5	32	5	20	18	0.05	6.0	0.44	22	55	4
634	22	<0.010	<0.5	240	100	190	80	0.03	15.	1.30	23	100	<1
635	23	<0.010	<0.5	72	12	42	91	0.06	4.0	0.71	52	230	<1
1858	24	<0.010	<0.5	71	4	3	13	<0.02	1.3	0.09	6	49	2
1859	25	<0.010	<0.5	13	<1	<1	3	<0.02	0.25	0.03	12	240	<1
1860	26	<0.010	<0.5	130	17	39	77	<0.02	4.8	0.10	21	100	2
1861	27	<0.010	<0.5	65	3	<1	3	<0.02	1.1	0.02	7	91	1
1862	28	<0.010	<0.5	110	9	9	38	0.08	3.7	0.57	9	340	5
1863	29	<0.010	<0.5	12	1	<1	15	0.03	0.95	0.06	7	120	<1

Fossens
 Steinbjør
 Geitskar

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TABELL 1

Sample#	Lab#	Sc, ppm	La, ppm	Ce, ppm	Nd, ppm	Sa, ppm	Eu, ppm	Yb, ppm	Lu, ppm	U, ppm	Th, ppm
613	7H02-1	69	1.3	<3	<5	1.3	0.4	0.6	0.11	<1	<1
614	2	79	1.4	<3	<5	1.5	0.4	0.9	0.13	<1	<1
615	3	76	1.4	<3	<5	1.4	0.5	0.9	0.14	<1	<1
616	4	79	1.5	3	<5	1.5	0.6	1.1	0.11	<1	<1
617	5	84	1.6	<3	<5	1.6	0.5	0.8	0.14	<1	<1
618	6	73	1.3	4	<5	1.4	0.4	0.9	0.11	<1	<1
619	7	74	1.4	6	<5	1.4	0.4	0.9	0.14	<1	<1
620	8	76	1.6	8	<5	1.5	0.4	0.8	0.11	<1	<1
621	9	65	1.2	6	<5	1.2	0.3	0.7	0.14	<1	<1
622	10	74	1.4	3	<5	1.5	0.4	0.9	0.13	<1	<1
623	11	66	1.1	4	<5	1.2	0.3	0.6	0.10	<1	<1
624	12	79	1.6	4	<5	1.6	0.5	0.9	0.12	<1	<1
625	13	58	1.2	4	<5	1.2	0.3	0.6	0.07	<1	<1
626	14	93	2.0	4	<5	1.8	0.6	0.9	0.15	<1	<1
627	15	61	1.2	<3	<5	1.2	0.4	0.6	0.10	<1	<1
628	16	59	1.2	6	<5	1.1	0.4	0.6	0.06	<1	<1
629	17	65	2.4	7	<5	1.4	0.3	0.8	0.12	<1	<1
630	18	70	1.3	4	<5	1.3	0.5	0.8	0.12	<1	<1
631	19	64	1.2	<3	<5	1.1	0.4	0.9	0.12	<1	<1
632	20	63	1.2	6	<5	1.3	0.4	0.9	0.10	<1	<1
633	21	18	29.	40	20	3.7	0.7	2.2	0.32	5	6
634	22	29	16.	<3	<5	4.2	0.6	1.8	0.25	2	<1
635	23	15	28.	43	23	4.4	1.2	1.5	0.27	3	7
1858	24	1	3.6	4	<5	0.1	0.3	0.3	0.10	<1	<1
1859	25	<1	11.	8	<5	0.1	0.4	<0.2	<0.05	<1	<1
1860	26	46	39.	56	<5	5.1	0.4	1.6	0.27	<1	2
1861	27	<1	3.2	3	<5	<0.1	0.2	<0.2	<0.05	<1	<1
1862	28	14	92.	170	8	17.	1.2	3.6	0.43	2	7
1863	29	<1	34.	26	<5	0.3	0.3	<0.2	<0.05	<1	11

Fossens
Steinkjer

Geitskar

Sample#	Lab#	As, ppm	Sb, ppm	Mo, ppm	N, ppm	Ta, ppm	Cr, ppm
613	7H02-1	<2	<0.2	<5	<3	<1	70
614	2	<2	<0.2	<5	<3	<1	45
615	3	<2	<0.2	<5	<3	<1	46
616	4	<2	<0.2	<5	<3	<1	36
617	5	<2	<0.2	<5	<3	<1	40
618	6	<2	<0.2	<5	<3	<1	56
619	7	<2	<0.2	<5	<3	<1	30
620	8	<2	<0.2	<5	<3	<1	27
621	9	<2	<0.2	<5	<3	<1	22
622	10	<2	<0.2	<5	<3	<1	23
623	11	<2	<0.2	<5	<3	<1	20
624	12	<2	<0.2	<5	<3	<1	31
625	13	<2	<0.2	<5	<3	<1	21
626	14	<2	<0.2	<5	<3	<1	20
627	15	<2	<0.2	<5	<3	<1	17
628	16	<2	<0.2	<5	<3	<1	54
629	17	<2	<0.2	<5	<3	<1	86
630	18	<2	<0.2	<5	<3	<1	35
631	19	<2	<0.2	<5	<3	<1	30
632	20	<2	<0.2	<5	<3	<1	56
633	21	18	1.5	<5	<3	<1	100
634	22	16	<0.2	<5	<3	<1	95
635	23	<2	<0.2	<5	<3	1	64
1858	24	<2	<0.2	190	<5	<1	8
1859	25	<2	<0.2	<5	<3	<1	2
1860	26	<2	<0.2	<5	<3	<1	120
1861	27	<2	<0.2	<5	<3	<1	2
1862	28	<2	<0.2	<5	<3	1	32
1863	29	<2	<0.2	<5	<3	<1	<2

ANALYSERAPPORT

Materiale : Stein og sandprøver.
Prøver mottatt 25.09.85

Oppdragsgiver : J. Søyland, Tana

Oppdragets art. : Elementbestemmelser (Co, Ni, Li, V, Fe) i
samtlige prøver.
Magnetittandel i sandprøvene.

Prøve mrk.	Fe %	Fe ₃ O ₄ %	Ni %	Co %	Li %	V %
1 Steinprøve fra Bergsbotn I	14.8	-	0.36	0.040	0.001	0.048
2 " " " II	15.8	-	0.21	0.13	< 0.001	0.050
3 " " " III	8.8	-	0.61	0.030	< 0.001	0.028
4 " " " IV	17.5	-	0.14	0.048	< 0.001	0.057
5 Sandprøve, 85 I	11.1	0.85	1.03	0.004	0.001	0.009
6 " " II	7.1	0.60	0.36	0.003	0.002	0.009
7 Sandprøve, Botnvatten	8.8	1.95	0.69	0.003	0.001	0.011
8 " Ersfjord	2.7	0.83	0.21	0.002	< 0.001	0.004
9					:	

Merknader :

Uttrekt magnetisk jern (uten videre nedknusing) ga et ureint produkt og lavt utbytte. Materialet ble derfor fri-malt før magnetseparasjon.
Sikteanalyse ble derfor ikke utført.

Mo i Rana, 16.12.85

T. Juliussen

ANALYSERAPPORT

Materiale : Stein og sandprøver.
Prøver mottatt 25.09.85

Oppdragsgiver : J. Søyland, Tana

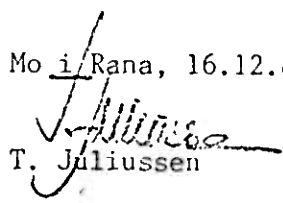
Oppdragets art. : Elementbestemmelser (Co, Ni, Li, V, Fe) i
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9					:	

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Uttrekt magnetisk jern (uten videre nedknusing) ga et ureint produkt og lavt utbytte. Materialet ble derfor fri-malt før magnetseparasjon.
Sikteanalyse ble derfor ikke utført.

Mo i Rana, 16.12.85


T. Juliusen

CORTEZ GOLD MINES

TIME: .

CERTIFICATE OF ASSAY

DATE 11-8-1986*Bob's Specials Fire*

SAMPLE NO.	SAMPLE IDENTIFICATION	Ass			
1	# 1007	01T			
2	1016	TR			
3	1017	.014	Berg Foss		
4	1019	.006	Skr		
5	1020	.006	Tennevoll		
6	1022	TR			
7	1023	TR			
8	1025	TR			
9	1027	.004	NAF		
10	1030	.006	Skulvatne		
11	1833	TR			
12	1836	TR			
13	1013	TR			
14					
15					
16					
17					
18					
19					
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21					
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23					
24					
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26					
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31					
32					
33					
34					

ASSAYER

Harold Mc. Ritz

TOTAL P.03

303 238 5718

01/13/1988 15:36 SHIPPING CONNECTION #5

303 238 5718 P.01

FORM NO 85-208
PRINTED IN USA

7K12

VBI: Soyland

FAX 011-47-02-45901

page 1 of 3

Sample (rock)

Lab # Fe % Cu ppm Ni Co Se

636	1	25.	110	50	59	70
637	2	24.	45	45	59	70
638	3	26.	46	50	76	71
639	4	29.	98	77	96	59
640	5	25.	160	110	86	72
641	6	24.	210	91	77	73
642	7	27.	260	120	100	67
643	8	65.	560	240	200	30
644	9	22.	330	110	67	68
645	10	19.	230	100	59	68
646	11	23.	160	99	59	80
647	12	21.	300	110	65	72
648	13	13.	250	110	64	75
649	14	23.	150	120	74	76
650	15	27.	250	91	84	65
651	16	27.	170	130	99	62
652	17	26.	220	110	99	68
653	18	27.	230	91	74	68
654	19	22.	140	76	79	76
655	20	27.	160	100	87	47
656	21	18.	170	96	65	46
657	22	26.	220	91	73	44
658	23	22.	190	83	64	66
659	24	26.	250	110	80	58
660	25	29	300	100	70	66
661	26	32.	300	160	130	53
662	27	23.	220	120	75	66
663	28	26.	350	140	92	44
664	29	26.	300	180	120	38
665	30	18.	110	84	45	43
667	31	6.5	110	45	7	8
668	32	23.	90	39	<2	9
669	33	11.	58	250	39	27
670	34	15.	7	120	38	28
671	35	7.2	120	110	29	5
672	36	11	54	37	<2	9
673	37	13	510	510	410	10

[illegible]

A S I O R K O P I HD 2 / NS 1402, NS 1417, NS 1415

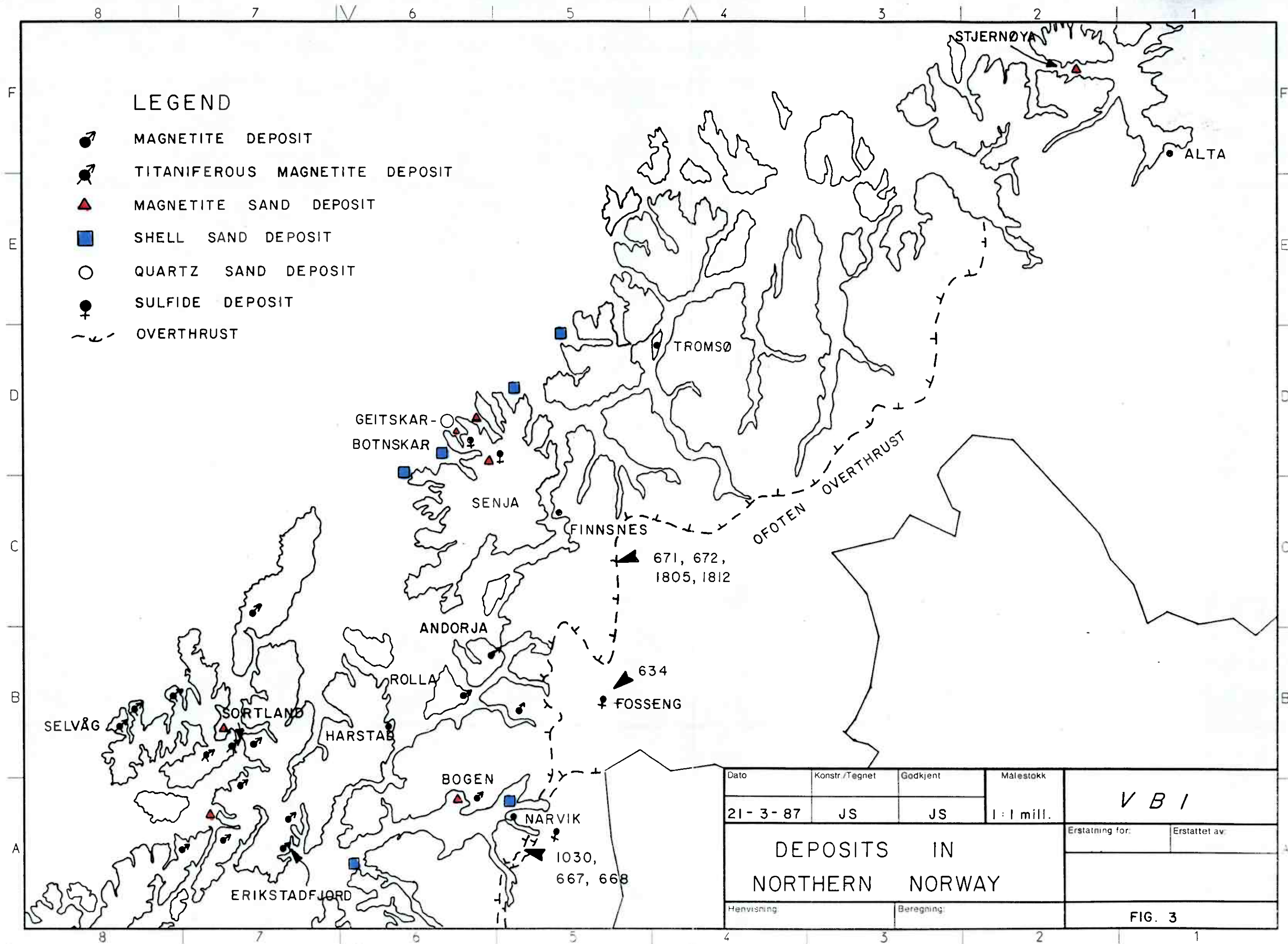
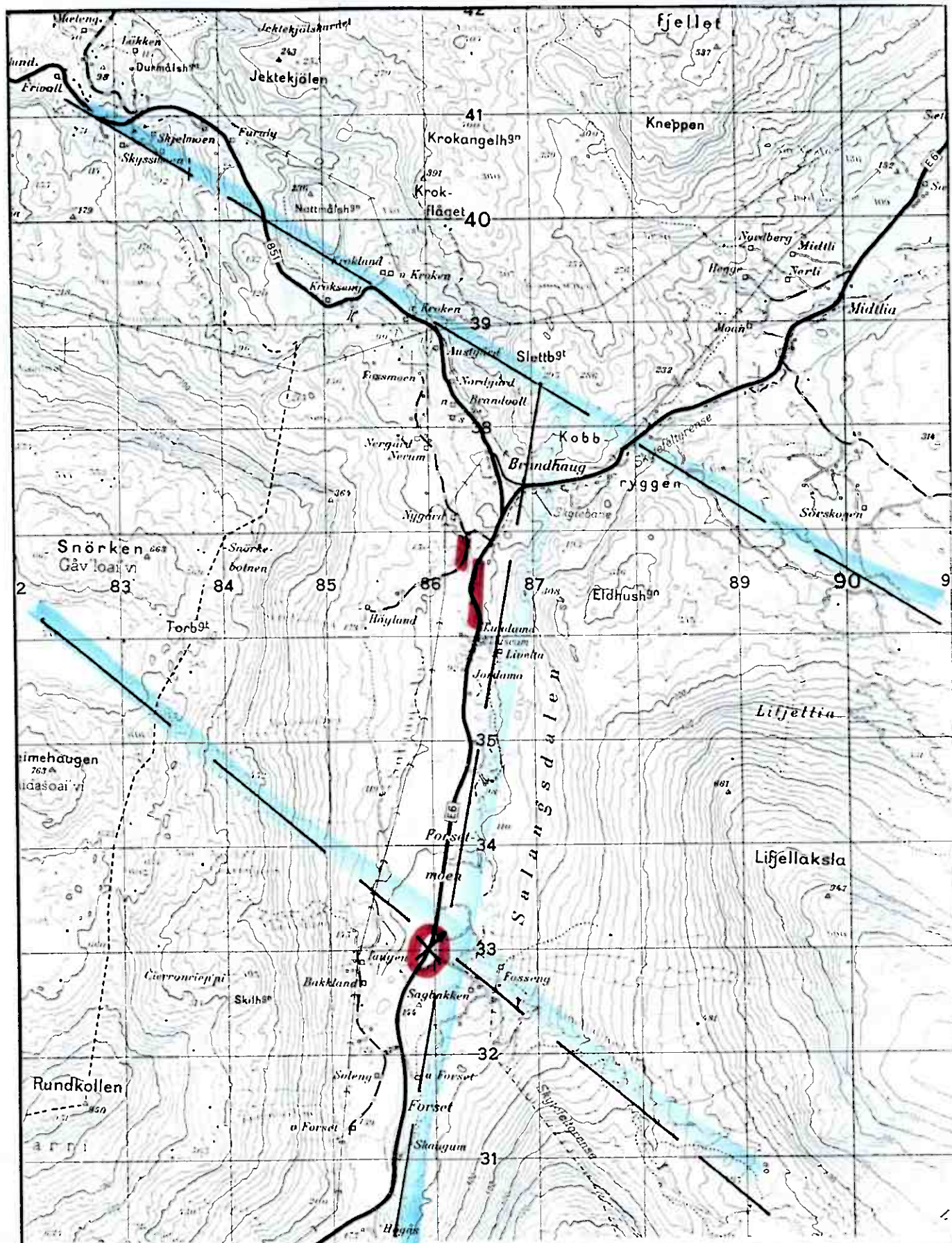


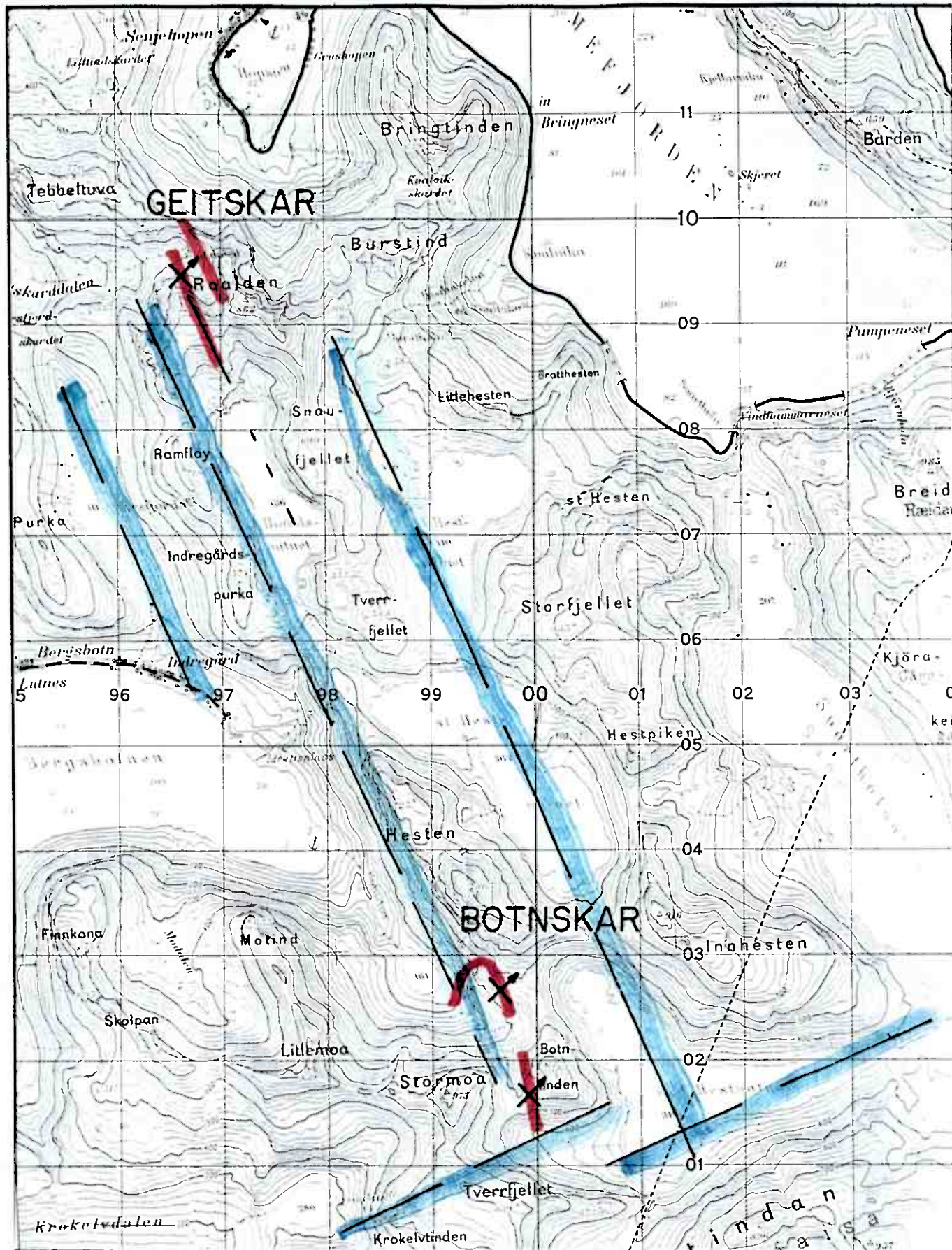


FIG. 5

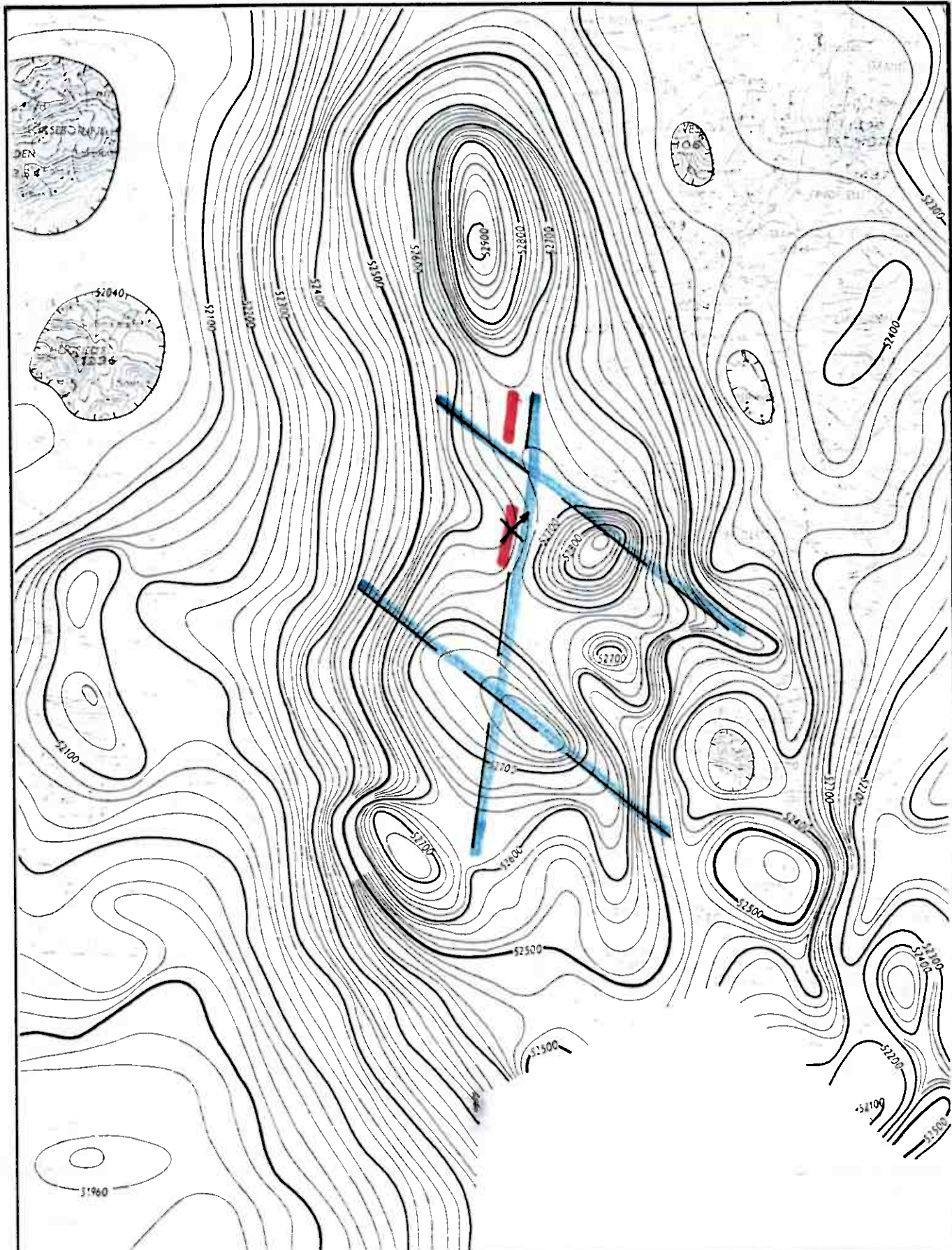
SATELITBILDE AV NORDNORGE



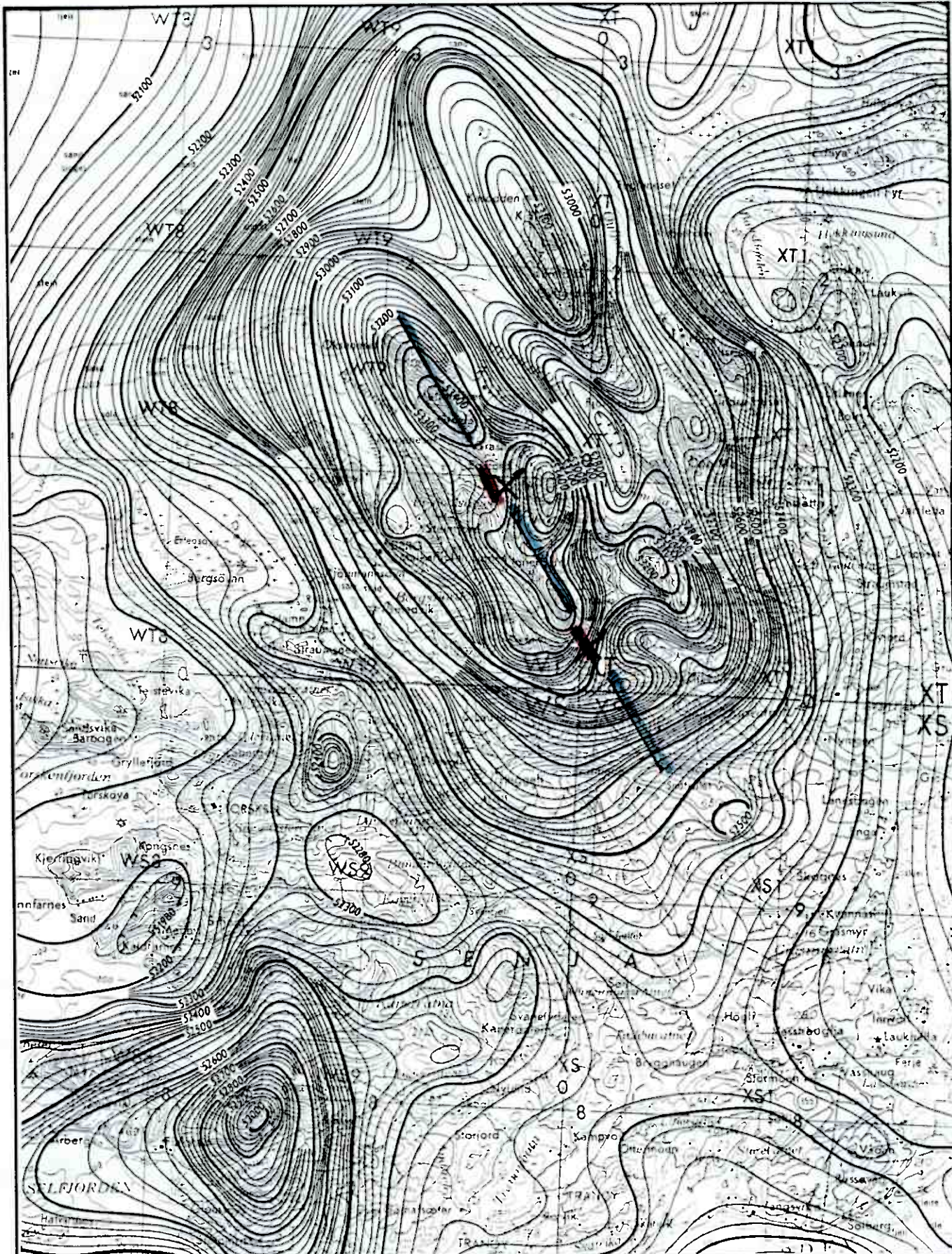
Dato	Konstr. Tegnet	Godkjent	Målestokk	V B I	
28-9-87	JS	JS	1:50 000		
FOSSENG DEPOSIT SHOWING STRUCTURAL TRENDS				Erstatning for:	Erstattet av:
				BARDU	1432 I
Henvisning:		Beregning:		FIG. 6	



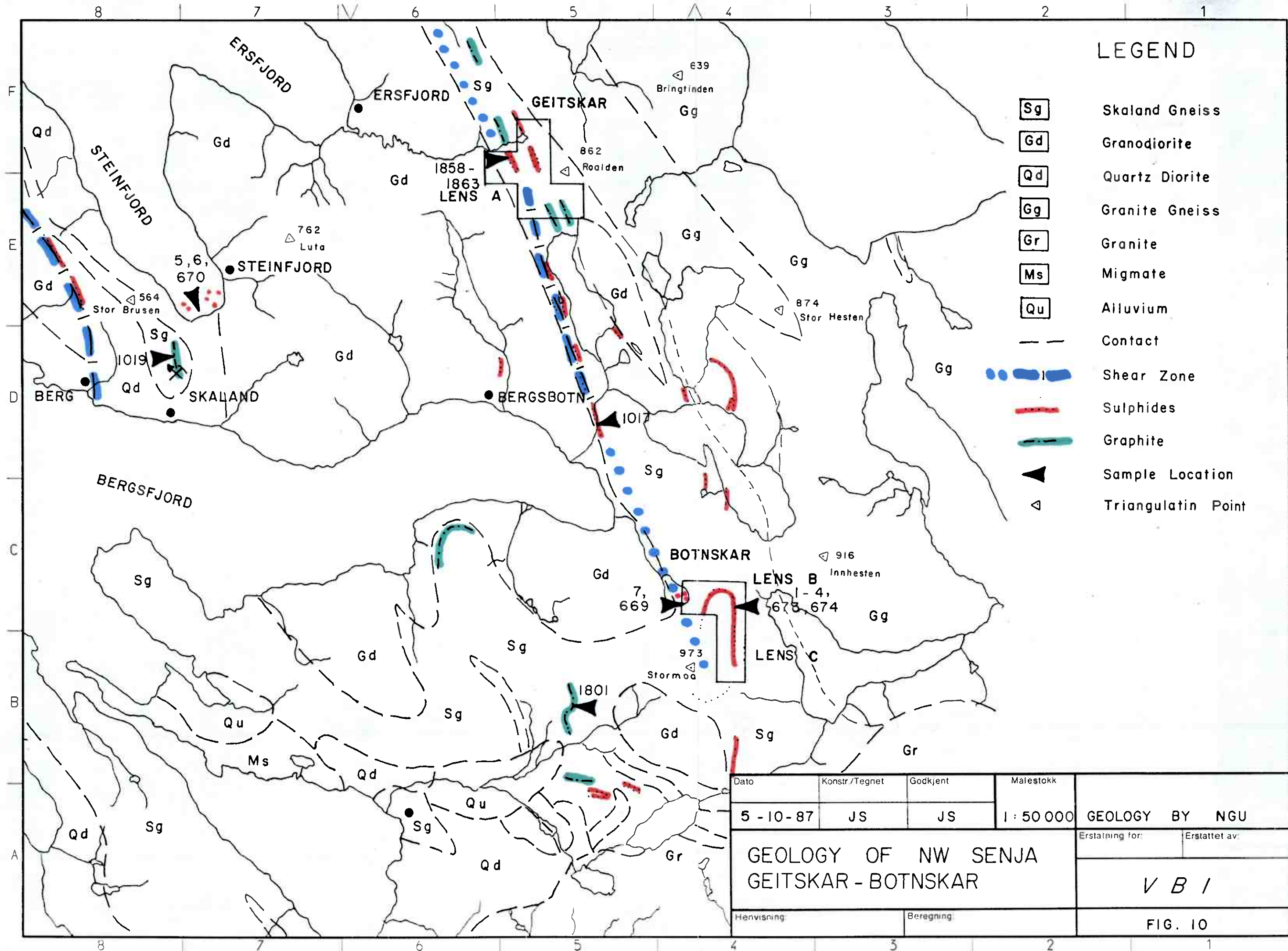
Dato	Konstr / Tegnet	Godkjent	Maalestokk	V B I	
28 - 9 - 87	JS	JS	1:50 000		
GEITSKAR - BOTNSKAR AREA WITH STRUCTURAL TRENDS				Erstatning for	Erstattet av
				MEFJORDBOTN	1433 IV
Henvisning		Beregning		FIG. 7	



Dato	Konstr. / Tegnet	Gjekkent	Målestokk	V B I	
28 - 9 - 87	JS	JS	1: 250 000		
AEROMAGNETIC MAP OF THE FOSSENG DEPOSIT				Erstating for	Erstallert av
				NGU - NARVIK	
Heravising		Beregning		FIG. 8	



Dato	Konstr. / Tegnet	Godekjent	Målestokk	V B I	
28 - 9 - 87	JS	JS	1:250 000		
AEROMAGNETIC MAP OF SENJA				Erstatning for	Erstattet av
				NGU - TROMSØ	
Henvisning		Bilag		FIG. 9	



BILDE 3

GEITSKAR FOREKOMSTEN

3436



69



PRODUKSJON AV MIKRONISERT FYLLSTOFFER FRÅ SKJELLSAND

FORSLAG TIL FORPROSJEKT

AV

JOHANNES SØYLAND

DEC 1, 1987

RESERVER

Det finnes store mengder av skjellsand langs Norges kyst. Området rundt senja og andre steder i Nord-Norge samt området rundt ytre Sør-Trøndelag har meget store forekomster. Disse forekomster er omtalt i NGU Rapport 94 og er vist på kart her i Fig. 1 og 2.

TIDLIGERE PRODUKSJON

Skjellsand har vært produsert i Norge til bruk i hønsemat og andre jordbruksformål, men aldri som fyllstoffer. En enkelt undersøkelse i "Minerals Yearbook of 1966" viser imidlertid at skjellsand har vært produsert i USA til bruk i sement og også som fyllstoffer i maling og plast. (Se på Vedl. 1)

MULIG MARKED

Den siktede marked er i første omgang mikronisert fyllstoffer til bruk i maling og plast, men vi vil også ta sikt på å selge produktene til jordbruk og andre industri mineral forbruk.

FORPROSJEKT

Det som kreves nu er et forprosjekt for å undersøke:

1. Om et akseptabelt produkt kan lages. En enkelt laboratorieforsøk kan bevise dette.
2. Om prosjektet økonomisk drivverdig.
3. Forekomstene.

Forprosjektet vil bestå av:

1. Kartlegging av forekomstene.
2. Oppsamling av prøver til et oppredningsforsøk.
3. Oppredningsforsøk.
4. Markedsundersøkelse.
5. Markedsføring kontakter.
6. Økonomiske Analyser.

Oppredningsforsøket vil bestå av:

1. Utsikting av store skjell, stein og planter.
2. Cyclonisering for å skille skjellsand frå gråberg.
3. Utvasking av alkalia.
4. Nedmalling og mikronisering.

FORLØPIG ØKONOMISK ANALYSE

En enkelt analyse basert på nåværende priser for kalkmel og forventede kostnader viser lovende resultater. (Se på Tabell 7)
Prosjektet kan skape 21 arbeidsplasser. (Se på Tabell 5)

BUDSJETT

KARTLEGGING OG PRØVETAKING

	NKR
Reiseutgifter	20.000
Konsulentttjenester	60.000
Analyser	5.000
Lønn og Admin.	30.000

OPPREDNINGSFORSØK

Reiseutgifter	10.000
Konsulentutgifter	80.000
Analyser	15.000
Lønn og Admin.	30.000

MARKEDSUNDERSØKELSE - MARKEDSFØRING

Reiseutgifter	25.000
Konsulentttjenester	120.000
Lønn og Admin.	60.000

ØKONOMISKE ANALYSER

Konsulentttjenester	120.000
Lønn og Admin.	<u>60.000</u>

SUM	635.000
-----	---------

TIDSPLAN SKJELLSANDPROSJEKTET

	MARS	APR	MAI	JUNI	JULI	AUG
Kartlegging						
Prøvetaking						
Oppredningsforsøk						
Analysering						
Markedsundersøkelser						
Markedsføring						
Økonomiske Analyser						

TABELL 5
MANNING TABLE - SHELL SAND PROJECT

		Salary + Ben. Nkr. x 1000
Administration		
Manager	1	450
Clerk	1	250
Dredge		
Operator (1 x 2 shift)	2	250
Concentrator (Ship)		
Mill Supt.	1	300
Lab Tech	1	190
Operator (3 x 3 Shift)	9	250
Maintenance Supv.	2	275
Mechanic	2	250
Electrician	1	250
Navigator	<u>1</u>	300
Total	21	

TABELL 6
INVESTMENT COSTS - SHELL SAND PROJECT

	Nkr. x 1000
Dredge	2,100
Piping	1,000
Ship	20,000
Concentrator	10,000
Service boat	<u>300</u>
Sum	33,400
Unforeseen 15%	5,010
Engineering 10%	<u>3,340</u>
Total Investment	41,750
DUF Grant	<u>5,437</u>
Net Investment	36,313

DISCOUNTED CASH FLOW - RATE OF RETURN ANALYSIS

[illegible]

PROPOSED NON-COMPETITION AGREEMENT

We the undersigned are interested in examining the

project as presented by Vesterålen Bergindustri A/S.

We accept the condition and agree that, should we decide not to participate in the project under the terms presented, we will not attempt to take over the prospect area, or establish a similar project in the near vicinity, or adopt any new process which has been presented by VBI.

We also agree not to disclose any of the received data to any third party.

Firm Name _____

Representative _____

Place _____ Date _____

PROJECT FINANCING PROPOSAL

PREFEASIBILITY STUDY - CAPITAL REQUIREMENT Nkr. 100,000

Ownership Rights

Johannes Søyland - Idea

Investor - Nkr. 100,000

50%	50%
-----	-----

PROJECT - CAPITAL REQUIREMENT Nkr. 10 MILLION

Ownership Rights

Prefeasibility Investors
Studie

Project Investors
Nkr. 10 million

50%	50%
-----	-----