REGIONAL PROSPECTION IN SW-NORWAY IN 1984

Norske Fina A/S - Folldal Verk A/S

Joint Venture

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ABSTRACT.

During a five-day period in august 1984 limited field work was done in SW-Norway.

The work comprised follow-up of lead-zinc anomalies within the Fauerfjeld metasediments and collection of pyrrhotite-rich samples from both within the gneiss basement and the Egersund anorthosite complex.

The source of the lead-zinc anomalies could not be identified. Soil samples collected this year confirm the anomaly with content of up to 800 ppm Zn and 260 ppm Pb. However, because of the small dimensions of the area in question no further work is recommended.

The pyrrhotite bearing samples from the gneiss basement are enriched in Ni, Cu, Co, Zn, Ti and Mo, but as the average content is quiet low, no further work is recommended.

The sulphide bearing samples from the anorthosite originate from a unique setting of very small dimension, and although the content of Cu, Ni and Co is interesting, no further work is recommended.

INTRODUCTION.

In 1982 the joint venture Norske Fina A/S - Folldal Verk A/S conducted an exploration programme in SW-Norway. One of the results was the identification of lead-zinc anomalies in the Vikeså area. The investigation this year comprised partly follow-up of these anomalies, partly sampling of pyrrhotite-rich samples from different geological settings in the area.(Fig. 1).

The field-work was carried out during a five-day period from 27/8 to 31/8 1984, partly in coorperation with Olav Limyr and Jan Inge Tollefsrud. Supplementary rock samples from localities not visited was obtained from Henrik Stendal at the University of Copenhagen.

GEOLOGY AND MINERALIZATION.

The area mainly comprises a gneissic basement consisting of quartz-feldspar gneisses, banded gneisses, augen gneisses and graphite-ironsulphide bearing garnet gneisses. Enclosed in the gneisses occurs in limited areas a sequence of supracrustal rocks - the Fauerfjeld metasediemnts. The area is intruded anorthosites (the Egersund complex) and granites.

Several types of mineralization can be discriminated within the area:

Within the gneisses:

- Vein type Mo-W-Cu mineralization, generally in close spatial contact with the garnet gneisses as at Ørsdalen and Gursli.
- Large alteration zones, mineralized with Mo and Cu as at Knaben.
- Pyrrhotite mineralization with minor Cu and Mo, generally spatially associated with amphibolites and garnet gneisses as at Kvittingen and Gilja.

Within the intrusive rocks:

- Magmatic accumulations of ilmenite/titanomagnetite within anorthosite and layered anorthosite/gabbro.
- Intrusive noritic plugs enriched in ilmenite/titanomagnetite.

GEOCHEMICAL EXPLORATION.

Follow-up of Pb-Zn anomalies 5 km NE of Vikeså.

The area comprises a 10-100 m thick slice of the Fauerfjeld metasediments dipping 10-20 degree to the east, and concordantly enclosed in grey banded

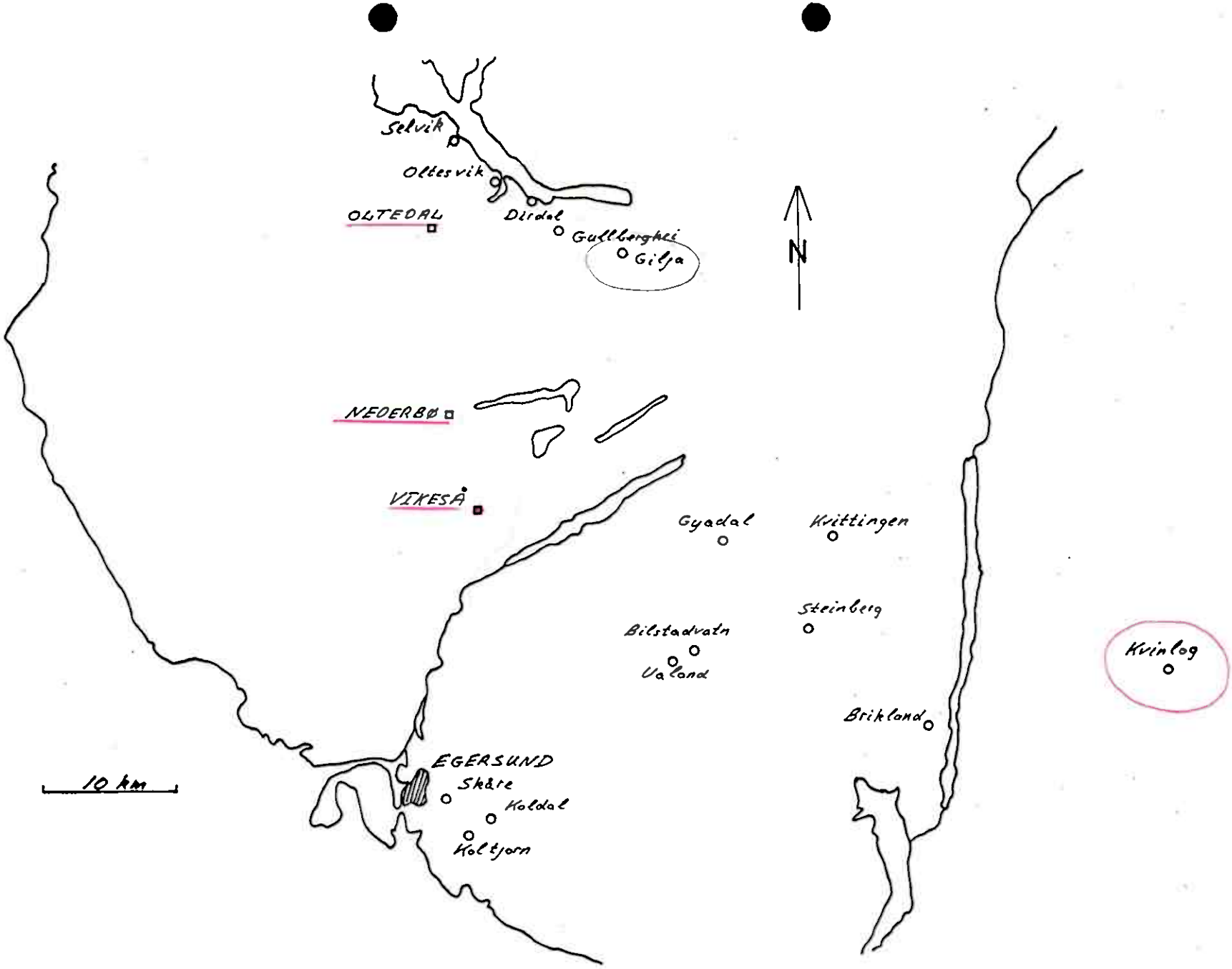

Fig. 1. Locality map, SW-Norway.

gneisses. In 1982 stream sediment samples revealed the existence of zinc lead anomalies.
This year it was unsuccessfully tried to locate the source by boulder tracing. At the locality, the metasediments outcrop in a app. 100 m high cliff, and as no mineralization could be found, it was decided to collect soil samples. Four soil samples were collected along the bottom of the cliff and three samples from a profile (Fig. 2). All samples are anomalous in zinc (570 to 800 ppm) and lead (170 to 260 ppm) as the copper and silver contents are quiet low (less than 60 ppm and 2 ppm respectively) (Table 1). The source for the anomaly must be situated near the top of the cliff. This means that the dilution effect is quiet low, and the lead-zinc mineralization which must exist is assumed to be of low grade. U_3O_8 ? (Hier nicht)

No further work is recommended.

Follow-up of geochemical anomalies west of Nederbø.

Also this area comprises Fauerfjeld metasediments. Analyses of heavy-mineral concentrates from this area indicate anomalous and enhanced content of tungsten and gold respectively.
Additional collection of stream sediment samples was done this year (Fig. 3), and the samples have been analysed for Cu, Pb, Zn, W and Au (Table 1). Apart from one sample enhanced in lead no anomalies were revealed.

No further work is recommended.

Collection of stream sediment samples from an area north of Oltedal.

Also this area comprises limited outcrops of Fauerfjeld metasediments.
Four stream sediment samples were collected from the area (Fig. 4) and analysed for Cu, Pb and Zn (Table 1). A single sample is slightly anomalous in Pb and Zn.

No further work is recommended.

VISIT TO IRON-SULPHIDE MINERALIZED LOCALITIES IN SW-NORWAY.

A total of 25 samples from 16 localities have been described (Appendix A). The main target was investigation of iron-sulphide mineralization associated partly with the gneisses, partly with the anorthosites. The samples

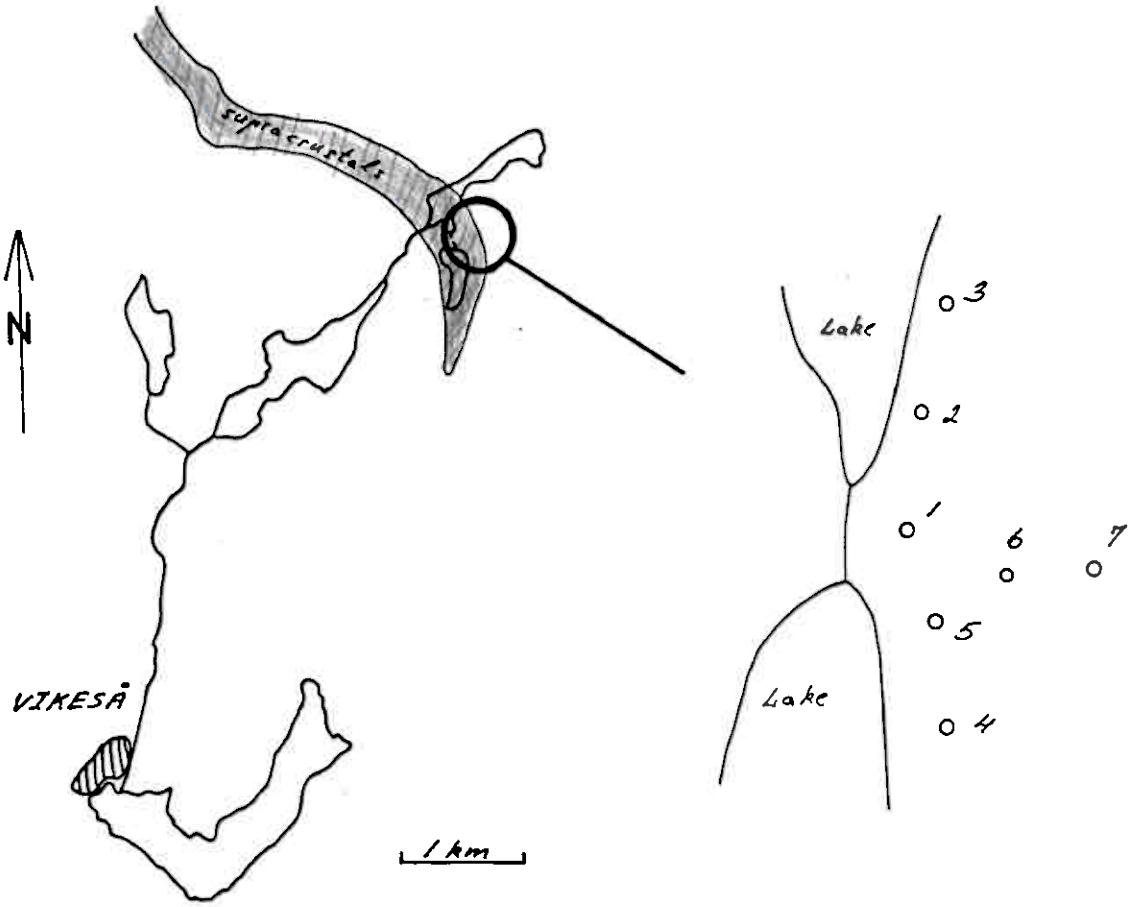

Fig. 2. Stream sediment sample locality map, Vikeså area.

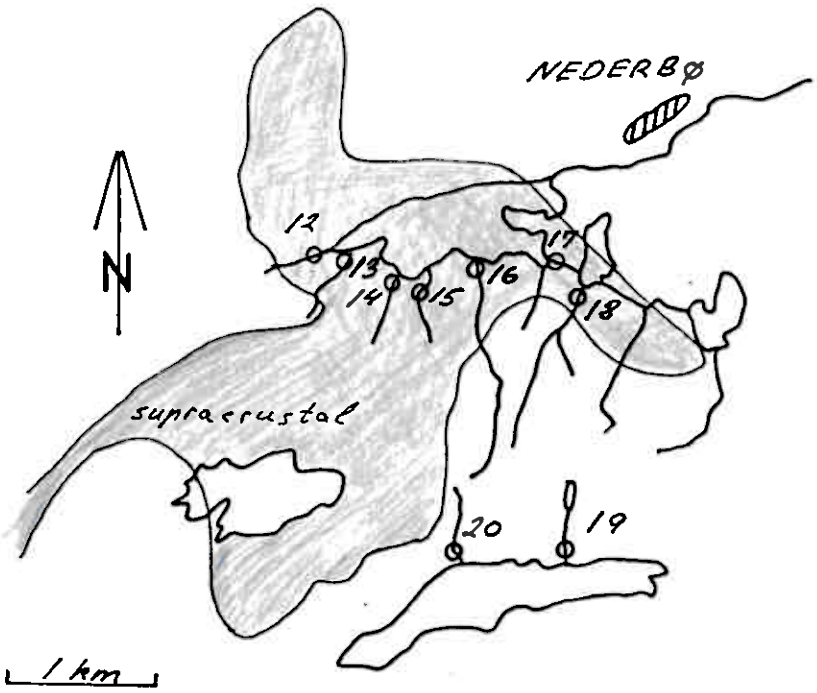

Fig. 3. Stream sediment sample locality map, Nederbø area.

	Sample No.	Cu ppm	Pb ppm	Zn ppm	W ppm	Au ppm
Vikeså	84- 1	15	210	720		
	2	20	200	650		
	3	45	200	690		
	4	35	150	570		
	5	15	260	800		
	6	25	180	650		
	7	65	170	570		
Oltedal	8	10	25	90		
	9	5	40	45		
	10	10	75	250		
	11	5	<5	65		
Nederbø	12	5	40	45	<5	<0.1
	13	5	35	30	<5	<0.1
	14	5	20	25	<5	<0.1
	15	15	120	60	<5	<0.1
	16	10	25	50	<5	<0.1
	17	15	35	55	<5	<0.1
	18	15	45	45	<5	<0.1
	19	10	40	40	<5	<0.1
	20	15	<5	60	<5	<0.1

Table 1. Geochemical analyses of stream sediment samples

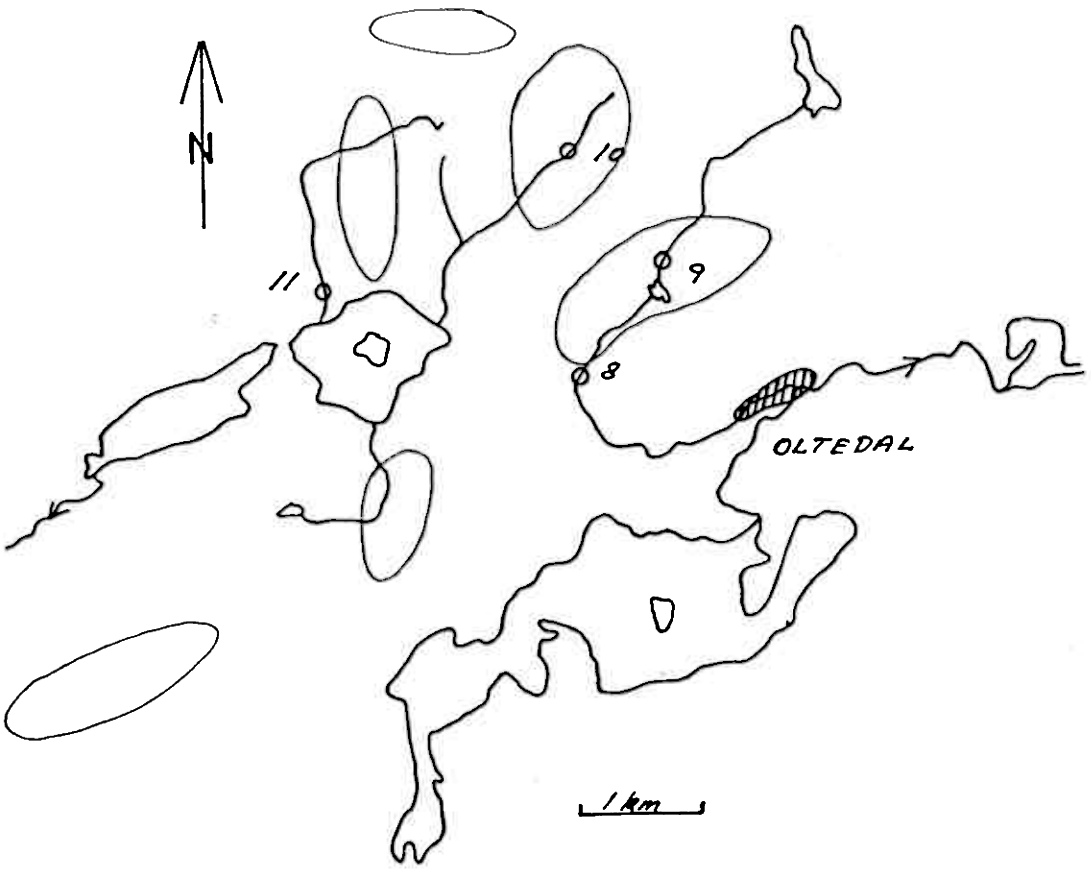

Fig. 4. Stream sediment sample locality map, Oltedal area.

have been analysed by semi-quantitative spectrographic method for a wide range of elements. As the detection limit for Au, Pt and Pd by this method is very high (app. 10 ppm), it was the intension that the samples also should have been analysed by neutron activation for these elements. However, the samples disappeared on their way to Canada, and as the spectrographic analyses were rather disappointing no replacement samples have been sent.

Iron-sulphide occurrences within the gneiss area.

Sulphide bearing samples from Steinberg (no 7), Kvittingen (no 8 to 11), Brikland (no 12), Gyadalen (no 13), Oltesvik (no 16 and 17), Dirdal (no 18), Gullberghei (no 19), Gilja (no 21 and 22) and Flottorp (no 25) (Fig. 1) have been analysed for a wide range of elements (Table 1 and Appendix A).

The samples are enriched in titanium (up to 2.5 %), nickel (up to 0.15 %), cobolt (up to 500 ppm), copper (in general up to 0.5 %), zinc (up to 700 ppm) and molybdenum (up to 200 ppm). The very high contents of copper and molybdenum come from samples rich in chalcopyrite and molybdenite respectively. It is characteristic that high copper contents are associated with high silver contents. The Cu/Ag ratio corresponds to the ratio described in sulphide rich samples from Gursli and Knaben (Pedersen 1982), and in general the chemical signature of the analysed samples corresponds well with the samples from the molybdenum occurrences in the area.

As with the vein type molybdenum occurrences, it is proposed that the sulphide accumulations have been formed as the result of mobilization during metamorphism.
With the low enrichment of nickel and copper it is unlikely that the precious metal content can be especially enriched.

No further work is recommmended.

Iron-sulphide samples from the anorthosite complex.

Only one sample rich in pyrrhotite and chalcopyrite has been collected from this setting, namely from Skåre just east of Egersund. It originates from vein fillings associated with a 3 m wide circular, vertical, joint/breccia zone. It is enriched in copper (1.75 %), nickel (0.3 % and cobolt (0.15 %), which is a typical liquid-magmatic association. Although this represents interesting values, the potential for finding larger tonnages does not exist.

No further work is recommended.

OTHER PROSPECTS.

Two ilmenite/titanomagnetite bearing samples from the layered Bjerkreim-Hauge intrusion (no 1 and 6) are of no further interest.

The fluorite bearing samples from Kvinlog originate from intensely altered lenses (up to 0.2 m by 0.5 m). Such altered lenses make up 10-20 % of a 1 m to 4 m thick horizon within the gneisses. The strike length is unknown. The overall fluorite content is very low.

REFERENCES.

Pedersen, J. (1982). Mineral exploration in 1982 in the Ørsdalen, Gursli, Knaben, Vikeså-Ålgård, Lyngdal and Viglandsvatn areas in SW-Norway. By Norske Fina A/S - Folldal Verk A/S joint venture.

Gilja

TABLE 2

Analyses of rock samples from SW Norway

Levy Nr 5478 17 st. bergarts-prøver Liste 3.10-84 / J.K. Lab. Nr 511

DATA SHEET Nº 2 Outokumpu analyses

CARD number	type	sub-comp.	multi-an.(1-9)	SAMPLE number year	gp.	sub-no.	① Li	② Be	③ B	④ Ti	⑤ V	⑥ Cr	⑦ Mn	⑧ Fe	⑨ Co	⑩ Ni	KEY CODE	Ident.
2				84		1	Ø	Ø	Ø	1.75	.Ø15	Ø	.15	1Ø.	.ØØ7	.ØØ2		
2				84		9	Ø	Ø	Ø	.2	.ØØ1	Ø	.Ø4	35.	.15	.3		
2				84		6	Ø	Ø	Ø	2.5	.1	Ø	.15	12.5	.Ø1	.ØØ3		
2				84	S	7	Ø	Ø	Ø	.35	.Ø15	.ØØ7	.Ø4	7.	.ØØ3	.ØØ5		
2				84	S	8	Ø	Ø	Ø	.25	.ØØ7	.Ø15	.1	12.5	.Ø1	.Ø15		
2				84	S	9	Ø	Ø	Ø	.5	.Ø4	.Ø3	.2	12.5	.ØØ7	.Ø1		
2				84	S	1Ø	Ø	Ø	Ø	.Ø3	.Ø1	.Ø15	.Ø7	22.5	.Ø5	.Ø5		
2				84	S	11	Ø	Ø	Ø	.1	.Ø15	.Ø15	.Ø8	17.5	.ØØ7	.Ø25		
2				84	S	12	Ø	Ø	Ø	2.5	.Ø5	.Ø1	.2	17.5	.Ø3	.Ø2		
2				84	S	13	Ø	Ø	Ø	.5	.Ø2	.Ø2	.Ø8	8.5	.ØØ3	.Ø1		
2				84	S	16	Ø	Ø	Ø	1.75	.Ø3	.Ø4	.25	1Ø.	.Ø15	.Ø5		
2				84	S	17	Ø	Ø	Ø	.15	.Ø3	.Ø6	.25	17.5	.Ø3	.15		
2				84	S	18	Ø	Ø	Ø	2.5	.1	.3	.25	3Ø.	.Ø2	.Ø7		
2				84	S	19	Ø	Ø	Ø	1.5	.Ø5	.2	.25	2Ø.	.Ø3	.1		
2				84	S	21	Ø	Ø	Ø	.25	.Ø1	.Ø3	.Ø15	7.	.Ø2	.Ø3		
2				84	S	22	Ø	Ø	Ø	1.25	.Ø3	.Ø6	.3	25.	.Ø3	.15		
2				84	S	25	Ø	Ø	Ø	.15	.ØØ3	.ØØ7	.Ø2	7.	.Ø1	.Ø1		
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Levy Nr 5478 17 st. bergartsprøver Liste 2.10-84 / J.P. Lab. Nr 011

DATA SHEET Nº 3 Outokumpu analyses

CARD number	type	sub-comp.	multi-an.(1-9)	SAMPLE number year	gp.		sub-no.	(11) Cu	(12) Zn	(13) Ga	(14) Ge	(15) As	(16) Zr	(17) Nb	(18) Mo	(19) Pd	(20) Ag	Ident.
1			4	6	8	10	12	14 16 18	20 22 24	26 28 30	32 34 36	38 40 42	44 46 48	50 52 54	56 58 60	62 64 66	68 70 72	73 80
3				84		1		.007	.03	.005	0	0	0	0	.001	0	0	
3				84		3		1.75	.05	.003	0	0	0	.04	.007	0	0	
3				84		6		.007	.03	.004	0	0	0	0	.001	0	0	
3				84		7		.02	.01	.003	0	0	.02	0	0	0	0	
3				84		8		.04	.03	.002	0	0	.01	0	.015	0	0	
3				84		9		.03	.05	.004	0	0	0	0	.003	0	0	
3				84		10		.1	.06	.002	0	0	0	.05	.004	0	.0025	
3				84		11		20.	.07	.002	0	0	0	.03	.004	0	.025	
3				84		12		.1	.03	.003	0	0	.01	0	.002	0	0	
3				84		13		.03	.02	.003	0	0	.01	0	.002	0	0	
3				84		16		.03	.04	.003	0	0	.03	.03	.002	0	0	
3				84		17		.3	.04	.002	0	0	0	0	.002	0	0	
3				84		18		.4	.05	.007	0	0	.02	0	.003	0	0	
3				84		19		.2	.05	.005	0	0	.02	0	.004	0	0	
3				84		21		.5	.02	.004	0	0	.02	0	.001	0	0	
3				84		22		.3	.07	.003	0	0	.01	.03	.003	0	0	
3				84		25		1.25	.07	.002	0	0	.02	0	2.5	0	.0008	
3																		
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3																		
3																		
3																		
3																		
1			4	6	8	10	12	14 16 18	20 22 24	26 28 30	32 34 36	38 40 42	44 46 48	50 52 54	56 58 60	62 64 66	68 70 72	73 80

Levy N[illegible] [illegible] [illegible]gartsprøver [illegible] 3.10-84 / J.P. [illegible]

DATA SHEET № 4 Outokumpu analyses

Card number	Sample number: year	gp.	no.	sub-no.	21 Sn	22 Sb	23 Ba	24 Hf	25 Ta	26 W	27 Pt	28 Au	29 Pb	30 Bi	Ident.
4	84		1		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ2	Ø	
4	84		3		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ2	Ø	
4	84		6		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ2	Ø	
4	84		7		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.Ø1	Ø	
4	84		8		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.Ø1	Ø	
4	84		9		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ5	Ø	
4	84		1Ø		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ3	Ø	
4	84		11		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.Ø2	Ø	
4	84		12		.ØØ3	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ3	Ø	
4	84		13		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ4	Ø	
4	84		16		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ3	Ø	
4	84		17		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ3	Ø	
4	84		18		.ØØ2	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ3	Ø	
4	84		19		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ3	Ø	
4	84		21		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ4	Ø	
4	84		22		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ2	Ø	
4	84		25		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø	.ØØ4	Ø	
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Levy № 5478 17st bergartsprøver Liste 3.10-84 [signature] Lab. N: 511

DATA SHEET № 5 Outokumpu analyses

CARD number	type	sub-comp.	multi-an. (1-9)	SAMPLE number year	gp.		sub-no.	(31) Th	(32) U	(33) Y_2O_3	(34) La_2O_3	(35) CeO_2	(36) Nd_2O_3	(37) Eu_2O_3	(38) Gd_2O_3	(39)	(40)	Ident.
5				84		1		Ø	Ø	.ØØ5	Ø	Ø	Ø	Ø	Ø			
5				84		3		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		6		Ø	Ø	.ØØ5	Ø	Ø	Ø	Ø	Ø			
5				84		7		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		8		Ø	Ø	.ØØ6	Ø	Ø	Ø	Ø	Ø			
5				84		9		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		1Ø		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		11		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		12		Ø	Ø	.ØØ7	Ø	Ø	Ø	Ø	Ø			
5				84		13		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		16		Ø	Ø	.Ø25	.Ø3	Ø	Ø	Ø	Ø			
5				84		17		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		18		Ø	Ø	.Ø1	.Ø2	Ø	Ø	Ø	Ø			
5				84		19		Ø	Ø	.ØØ5	Ø	Ø	Ø	Ø	Ø			
5				84		21		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		22		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
5				84		25		Ø	Ø	Ø	Ø	Ø	Ø	Ø	Ø			
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LIST OF ROCK SAMPLES

Ualand (outcrop along E18)	84-1	Gabbro/anorthosite with 5-10 % ilmenite
Skåre	84-2	Coarse grained intergrown ilmenite, plagioclase, pyroxene with minor pyrite.
	84-3	Coarse grained intergrown pyrrhotite, pyrite, chalcopyrite and plagioclase with minor ilmenite
Koldal	84-4	Coarse grained massive aggregate of ilmenite with minor plagioclase and trace of pyrite.
Koltjern	84-5	Anorthosite with a few pyroxen aggregates. Trace of pyrite (less than 1 %).
Bilstadvatn	84-6	Vaguely "foliated" gabbro with disseminated ilmenite (c. 10 %).
Steinberg	84-7	Vaguely banded, rusty gneiss with disseminated pyrite (c. 1 %).
Kvittingen	84-8	Siliceous, foliated, coarse grained garnet-gneiss with diss. pyrite (c. 1 %), aggregates of pyrite and traces of molybdenite.
	84-9	Mafic, fine grained biotite-hornblende gneiss with diss. pyrite.
	84-10	Semi-massive pyrrhotite in a matrix of hornblende. Trace of molybdenite and chalcopyrite.
	84-11	Semi-massive chalcopyrite in a quartz-rich matrix.
Brikland	84-12	Amphibolite with diss. pyrite (c. 5 %).
Gyadal	84-13	Graphite-bearing garnet gneiss with diss. pyrite (less than 1 %).
Oltesvik	84-14	Altered amphibolite with aggregates of pyrrhotite (c. 5 %).
	84-15	Epidotized gneiss with diss. pyrite (c. 1 %).
	84-16	Mafic gneiss with bands rich in magnetite and a few aggregates of pyrrhotite.
	84-17	Altered amphibolite with aggregates of semi-massive pyrrhotite and minor chalcopyrite.
Dirdal (at fjord bottom)	84-18	Altered amphibolite with aggregates of magnetite (c. 10 %), pyrite (5 %) and trace of chalcopyrite.
Gullberghei	84-19	Altered amphibolite with 20 % magnetite, pyrrhotite and pyrite.

Gilja	84-20	Garnet-biotite gneiss with trace of pyrite.
	84-21	Mafic gneiss with diss. pyrrhotite (c. 5 %) and trace of chalcopyrite.
	84-22	Semi-massive pyrrhotite with trace of chalcopyrite and molybdenite in altered amphibolite.
Kvinlog	84-23	Pegmatite composed of kalifeldspar, quartz, fluorite (30 %) and trace of bornite and chalcopyrite. From alteration zone in gneiss.
Selvik	84-24	Fragments of brecciated granite cemented by quartz and hematite.
Flottorp (old Mo-mine)	84-25	Siliceous gneiss with disseminated molybdenite and chalcopyrite.