FAGRAPPORT
TECHNICAL REPORT

A/S SULFIDMALM Kopiert 15/6-95 (1)

Dato/Date	Rapport Nr./Report No	Kartblad/Mapsheet	Project/prosjekt
2.3.1983	541.35.1983	1825 I	905.35.

Forfatter
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Tittel/Title

MÅLVIKEN SCHEELITE OCCURRENCE, BINDAL REGION, NORWAY.

Resyme/Summary

This short report gives a summary of the regional geology of the Bindal region within which the Målviken scheelite occurrence is located.

The Målviken occurrence is described and assay results are reported.

In summary the scheelite bearing skarns at Målviken represent an interesting economic potential. Skarn mineralization has been observed over a strike length of 700 m with a vertical elevation difference of 400 m. Several zones seem to be present and although there is in places severe lack of outcrops the entire zone seems to show good continuity.

Scheelite mineralization seems to be consistent throughout the zone and assays indicate good grades over appreciable widths.

Andre relevante rapp
Other relevant reps.

Kommentarer/Comments

Fordeling
Distribution

- [ ] Canada
- [ ] Nikkelverket
- [ ] Kristiansand
- [ ] Oslo
- [x] A/S Sydvaranger
- [ ]
- [ ]
- [ ]

Regional geology of the Bindal Area

Both the Kolsvik and Bindal agreement areas are located within the Helgeland Nappe which is the highest tectono-stratigraphic unit in the northern part of Norway. The rocks of the area can be divided into two main groups: - plutonic rocks of the Bindal Batholith, and a sequence of predominantly supracrustal rocks into which the plutonic rocks have been intruded.

There has been little detailed work carried out on the geology of the Helgeland Nappe Complex but in recent years Sulfidmalm geologists and workers from the University of Bergen have carried out detailed mapping in both the metasedimentary sequence and plutonic complex.

The metasedimentary rocks show considerable variety both in their lithologic character and in their degree of metamorphism through the area. The dominant lithologies include a range of micaschists both pelitic and semi-pelitic, meta-sandstones, quartzites, substantive developments of limestones, calc-silicates and calc-phyllites / schists together with much conglomerate. In the main the metasediments appear to represent shallow to moderate depth marine sediments, though that in some areas continental conditions pertained is indicated by development of braided stream clastics and the preservation of sub-aerial weathering profiles on ophilitic sub-strate.

Minor development of oceanic sediments also occur in relation to ophiolitic terranes.

No fauna has yet been recovered anywhere in the Helgeland Nappe Complex and reliable sedimentary structures are infrequent. The meta-sediments are traditionally assumed to be of Cambro-Silurian age but this is mostly based on inference and lithological comparison with other areas.

Significant amounts of greenstones, gabbros and ultramafics are present within the Helgeland Nappe Complex. During the course of recent investi-gations it has become apparent that many of these rocks represent dismem-bered portions of one or several ophiolite slabs.

The implication of this greenstone/gabbro/ultramafic association re-presenting ophiolitic materials is that they formed as the result of an oceonic spreading mechanism and are not compatible with the essentially shallow marine and in part continental metasedimentary rock associations with which they are now juxtaposed.

Clearly defined primary sedimentary contacts are to be observed between different parts of the ophiolitic substrate and an overlying cover sequence. This latter can be seen to rest with profound unconformity on the respective ophiolite fragment.

These initial deposits above the unconformity show considerable differences on the regional scale from continental fluviatile conglomerate dominated braided stream deposits to shallow marine limestone dominated sequences.

Thus the immediate carapace to granitic rocks of the region would appear to be of oceanic crust with an unconformable Palaeozoic cover sequence. The latter by correlation being almost certainly of Ordovician-Silurian age.

The results of reconnaissance studies reveal that these are possibly at least four major basement (ophiolite)-cover thrust complexes which are developed throughout the area. This produces a series of repetitions of lithological units within a vertical stock and this fact is highly significant in producing repetitions of stratabound mineralized horizons.

Internally the nappe units show a complex of deformations with three major episodes of deformations producing folds and fabrics being recognized. The peak of metamorphism predates the third (03) deformation phase.

The metasedimentary rocks and ophiolitic fragments have been intruded by plutonic rocks of the Bindal Batholith. The batholith represents one of the largest granitic masses in the Scandinavian Caledonides extending N/S for some 150 km as a branching irregular body. The body exhibits a variety of rock types forming a series of intrusive bodies of variable composition and texture. Granitic and granodioritic types are the most common but also large areas of intermediate to basic rocks occur.

The evolution of the plutonic association has taken place over a long time span and most of the rock types typical of batholitic plutonism have been observed.

Rb - Sr dating has given an age of 424 ± 26 Ma.

Many of the rocks in the area show mineral assemblages which place them in the almandine-amphibolite facies. Very often the minerals staurolite, kyanite and sillimanite occur as index minerals but to date distinctive metamorphic zones have not been determinable on a regional scale Contact metamorphism has been recorded in places and metasomatic alteration is an important feature of the region with a widespread development of skarns

in limestone and calc-silicate rocks. Many of these skarns contain economically important ore minerals such as scheelite, galena, sphalerite, silver and gold.

Mineralization of economic potential in the area consists of several types i.e. gold, wolfram, lead-zinc-silver and chromite.

Gold mineralization is dominantly associated with quartz and arsenopyrite in tectonic zones near granite-country rock contacts. Several areas of gold mineralization are known and at Kolsvik detailed investigations of the gold potential are in progress.

Wolfram mineralization is widespread in the area with scheelite being the dominant ore mineral, associated with skarns. Several interesting areas have been outlined and detailed sampling at Målviken has given encouraging results.

Lead zinc-silver mineralization with minor gold and copper is known to be associated to the metasedimentary sequence near granite contacts in the Husvik area.

The ultramafic cumulates of ophiolite affinity in the area contain major zones of chromite bearing dunites.

The chromite may be present as banded ore, disseminated ore or may be in part bodyform. Although no major areas of high concentration have yet been identified one is in the type of environment where major podiform deposits could be expected to occur.

MÅLVIKEN SCHEELITE SHOWING

The Målviken scheelite skarn deposit was discovered in 1972 by P. Skårup while carrying out a reconnaissance survey with ultra-violet lamps.

Skarn mineralization has been traced from sea level 700 m up the northern side of Tosenfjord to an elevation of 450 m. At least two skarn horizons are present in outcrop but to date it has not been established whether this is due to repetition by folding or truly represents separate horizons.

The actual skarn bearing sequence consists of psammitic migmatites with occasional quartzite and thin pelite horizons, the latter being enriched in calc-silicate minerals.

The area is cut by granite veins, of which three generations have been identified. The nearest larger intrusive granitic body is located some 500 m to the east.

The sedimentary rocks have been polyphasally deformed and a minimum of three major deformation phases are recorded in the rocks. It is possible to see that the metasedimentary lithologies possessed considerable variation in internal competence differences. This has had a quite marked influence on the deformation mode, and during D_2 deformation extensive boudinage of the more competent horizons is a characteristic structured style.

To date lack of continuous outcrop has hindered the study of the skarn horizons relationships with the wall rocks, although they do seem to be parallel to the regional layering.

On a more regional scale the Målviken zone appears to lie on the eastern flank of a late F_3 fold and indeed minor scheelite mineralization has been discovered some 300 m to the west on the supposed western flank of the fold.

Again due to sporadic outcrops, true skarn thicknesses are difficult to observe. True thicknesses of 5 m plus however have been established although thicknesses in the range 1 - 3 m seem to be more representative.

The skarns belong to the traditional garnet-pyroxene association with addition of epidote, amphibole and quartz veins. Detailed work on their mineralogy is being carried out.

Several minor bodies of granitic rocks are present in the area and

these exhibit a complex series of structural styles. In terms of structural evolution pre D_2, syn D_2, post D_2, syn D_3 and post D_3 granites have been identified. Pre D_2 granites are often seen to contain much muscovite and are often associated with muscovite and tourmaline bearing pegmatites. The large granodiorite body some 500 m to the east comprises essentially rocks of massive texture.

The Målviken zone has been sampled by chip and grab samples from outcrops over the entire known zone. The results are encouraging and are shown on fig. 1

Scheelite occurs as disseminations throughout the skarn horizons and also in various localities as layers of coarse scheelite grains which have apparently grown as porphyroblasts across the steep crenulation cleavage recrystallisation.

Assays range from 0.2 % WO_3 up to 16 % WO_3 in the coarse layers. Where more continuous sections have been able to be sampled assays have given

1.48 % over 3.4 m 1.27 % over 5.10 m
2.14 % over 1.9 m
3.48 % over 1.65 m
1.58 % over 5 m

All samples have been assayed for Cu, Mo, Zn, Bi and Au. Average Cu values are <0.01 %, average zinc <0.02 %, and Mo <0.002 % which indicates a clean impurity free scheelite. Bi values range from 0.05 % to 0.24 % with an average of 0.029 %. Gold values varied from 0.003 oz/t to 0.060 oz/t (2.05 g/t) with an average of 0.010 oz/t (0.33 g/t). Bismuth and gold values show a strong positive correlation and suggest the presence of bismuth tellurides. There is no positive correlation between high WO_3 and high Bi/Au.

Regarding the origin and timing of scheelite deposition it is of interest to consider observations made on the granitic rocks in the area with respect to the scheelite mineralization.

The Målvika skarns are apparently folded by the F_3 Målvika Antiform. Further, scheelite grains in specimen are often seen in elongated streaks and large crystals can sometimes be observed to have an augen form in a steeply disposed crenulation cleavage. This would imply that scheelite mineralization was essentially pre D_3 although post cleavage recrystallization is present.

The major granodiorite body to the east, however, truncates the Målviken Antiform and appears to be a "dry" granite. When these observations are viewed together it would appear highly unlikely that the scheelite mineralization was related to the emplacement of the granodiorite. It seems more likely to consider that the scheelite mineralization was associated with one or more of the earlier (Pre D_3) generations of granitic rocks with perhaps the most likely candidates being the muscovite-tourmaline bearing varieties.

Another possible mode of origin is that the Målvika skarns are so-called reaction skarns being formed by exchange of material between limestone-calc silicate horizons and bordering supracrustal rocks, and thus may be of a non stratabound nature.

This question of origin is however at the moment unresolved but is of extreme importance in further exploration.

In summary the scheelite bearing skarns at Målviken represent an extremely interesting economic potential. Skarn mineralization has been observed over a strike length of 700 m with a vertical elevation difference of 400 m. Several zones seem to be present and although there is in places severe lack of outcrop the entire zone seems to show good continuity and indeed may well be repeated some 200-300 m to the west due to folding.

The style of tectonic deformation indicates the possibility of steeply plunging skarn zones or boudines which together with the general topographic situation are a positive factor for mining.

Scheelite mineralization seems to be consistent throughout the zone and assays indicate good grades over appreciable widths.

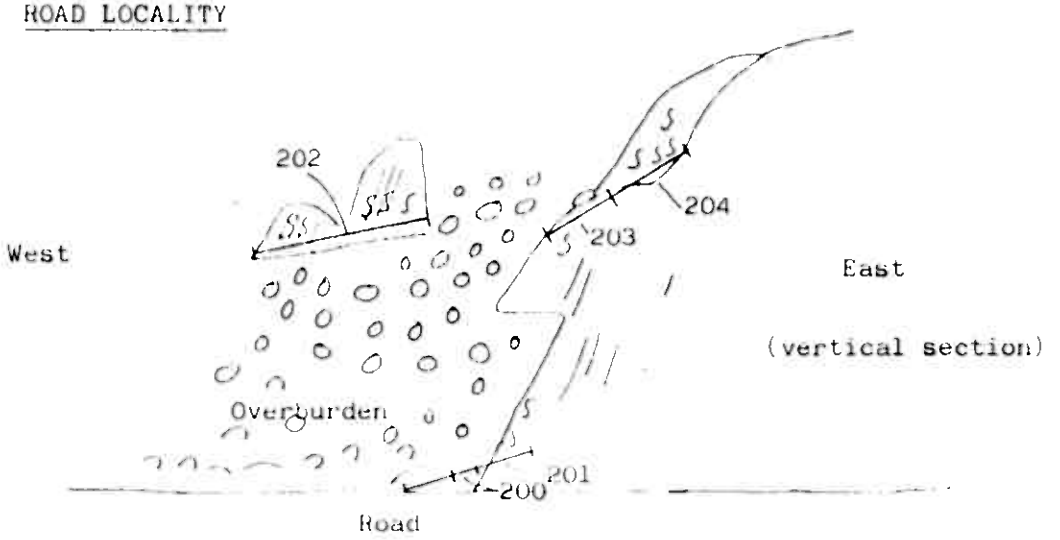
The work carried out to date however has been of preliminary nature and detailed follow up work in the form of detailed topographic geological and structural mapping. Detailed trenching, sampling and diamond drilling is planned for 1983.

NB. Koordinater relaterer til 1982-grid.

MÄLVIKA

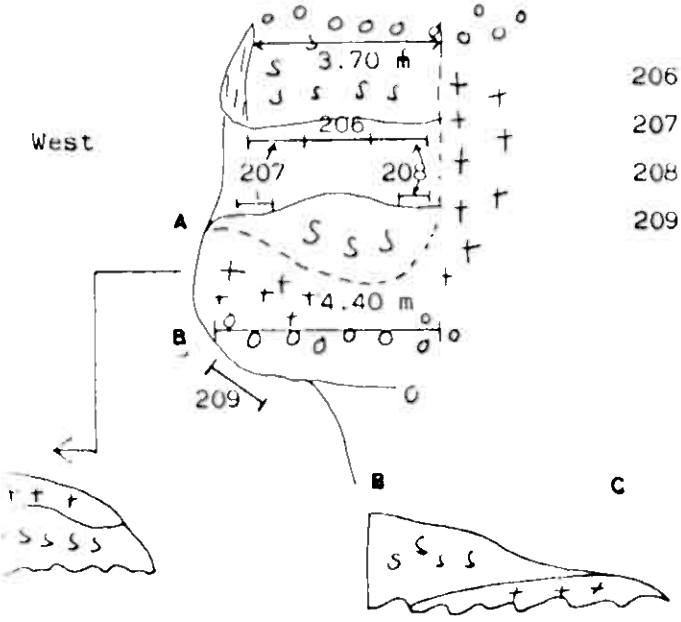
Sampling

ROAD LOCALITY



200	-	30 cm band rich scheelite			1.42 % WO_3
201	-	Skarn zone 1.40 m, zone defined to east - covered to west			0.70 % WO_3
202	-	5 m above 201.	Skarn 1.40 m		0.55 % WO_3
203	-	Skarn 1 m	3.04 % WO_3	2 m =	2.14 % WO_3
204	-	Skarn 1 m	1.25 % WO_3		

a 20 m along strike from road local.



206	Skarn 3.70 m	1.70 % WO_3
207	West contact 1 m	0.57 % WO_3
208	East contact	0.06 % WO_3
209	Skarn 70 cm	1.48 % WO_3

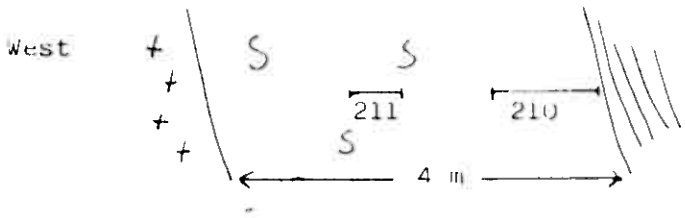
GRANITE

SKARN

GNEISS

OVERBURDEN

C Approx. 50 m along strike from road

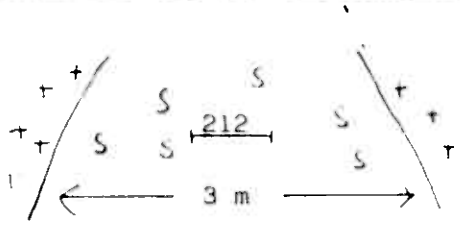


Vertical section

210	1 m skarn	0.40 % WO_3
211	10 cm scheelite band	0.41 % WO_3

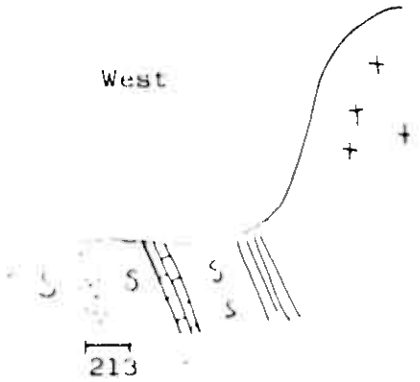
Samples taken from areas of skarn which gave best U.V. colours.

D Few meters south east of 210 and 211



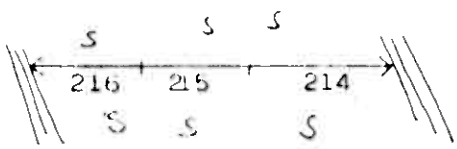
212	0.5 m scheelite zone in skarn	0.82 % WO_3

E Approx. 80 m from road



213	25 cm scheelite zone in skarn with layers of marble	2.92 % WO_3

100 N / 45 E



Vertical section

214	1 m on east contact	2.12 % WO_3
215	0.5 m	?
216	0.5 m	0.95 % WO_3

G 90 N / 50 W

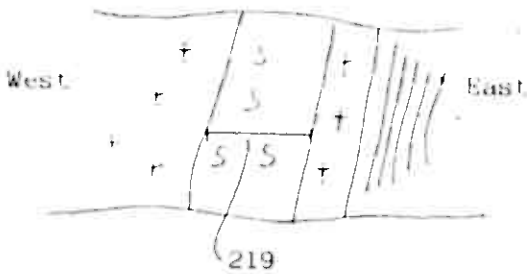
217 30 cm small outcrop 2.34 % WO_3

H 100 N / 5 W

218 10 cm wide band 0.21 % WO_3

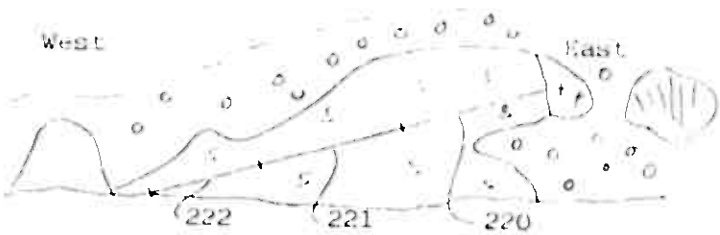
difficult to determine width of skarn in this area due to overburden - but sporadic outcrops would indicate approx. 2 m.

I 120 N / 0



219 0.5 m skarn 1.60 % WO_3

J 150 N / 15 E



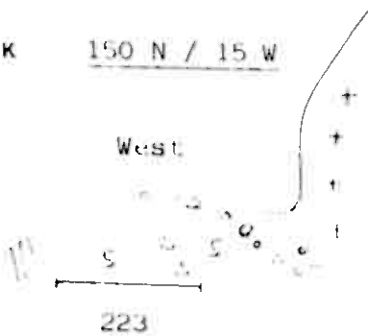
220 60 cm 1.91 % WO_3

221 1.0 m 2.48 % WO_3

222 30 cm 1.45 % WO_3

2.137 % WO_3 over 1.9 m

K 150 N / 15 W



223 0.8 m west side of 3.20 % WO_3

1.3 m wide skarn

L 395 N/ 5-10 E

5 m wide skarn zone

236	0 - 1 m	from W to E	0.85 % WO_3		
237	1 - 2 m	" "	3.04 % WO_3		
238	2 - 3 m	" "	1.24 % WO_3	5 m	1.578 % WO_3
239	3 - 4 m	" "	0.80 % WO_3		

M 420 N/ 0

1.8 m wide skarn zone

234	0 - 0.5 m	W - E	1.61 % WO_3	1.8 m	1.328 % WO_3
235	0.5 - 1.8 m	W - E	1.22 % WO_3		

N 435 N / 30 W

Two poorly exposed skarn zones

231	60 cm	skarn west	3.32 % WO_3
232	20 cm	skarn east	2.12 % WO_3
233	20 cm	skarn east	2.56 % WO_3

O 620 N / 17 - 20 W

1 - 2 m wide skarn band

230 Grab 9.23 % WO_3

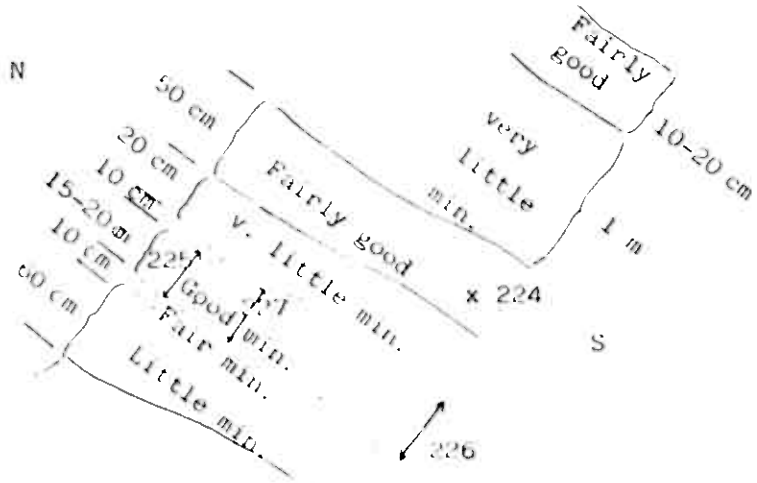
Has now been chip sampled

P 660 N / 45 - 47 E

1.65 m wide skarn

228	60 cm of good scheelite zone	3.96 % WO_3
229	4 m along strike from 228 represents entire 1.65 m section	3.48 % WO_3

Q 690 N / 0



Three gold layers outlined. Access difficult but has now been properly chip sampled here and farther north. Assays awaiting.

Results of first sampling

225	20 cm		4.32 % WO_3
226	20 cm	15 m down slope from	16.8 % WO_3
227	20 cm	4 m down from 225	14.0 % WO_3
224	Grab sample		2.66 % WO_3

G 90 N / 50 W

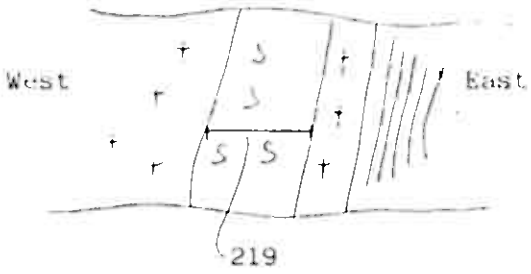
217 30 cm small outcrop 2.34 % WO_3

H 100 N / 5 W

218 10 cm wide band 0.21 % WO_3

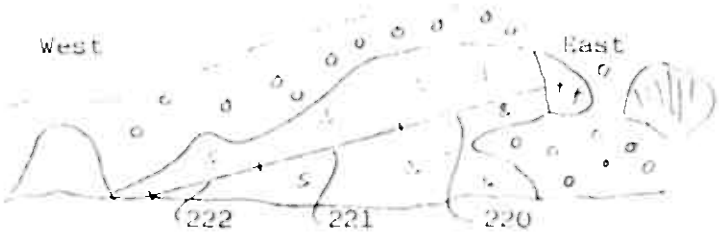
difficult to determine width of skarn in this area due to overburden - but sporadic outcrops would indicate approx. 2 m.

I 120 N / 0



219 0.5 m skarn 1.60 % WO_3

J 150 N / 15 E



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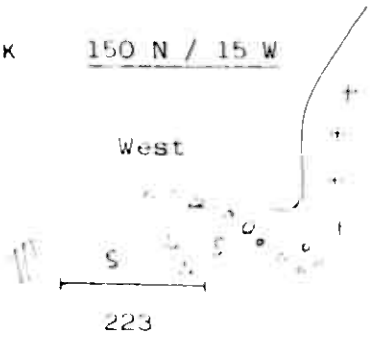
2.137 % WO_3 over 1.9 m

K 150 N / 15 W



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5 m wide skarn zone

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1.8 m wide skarn zone

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N 435 N / 30 W

Two poorly exposed skarn zones

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1 - 2 m wide skarn band

230 Grab 9.23 % WO_3

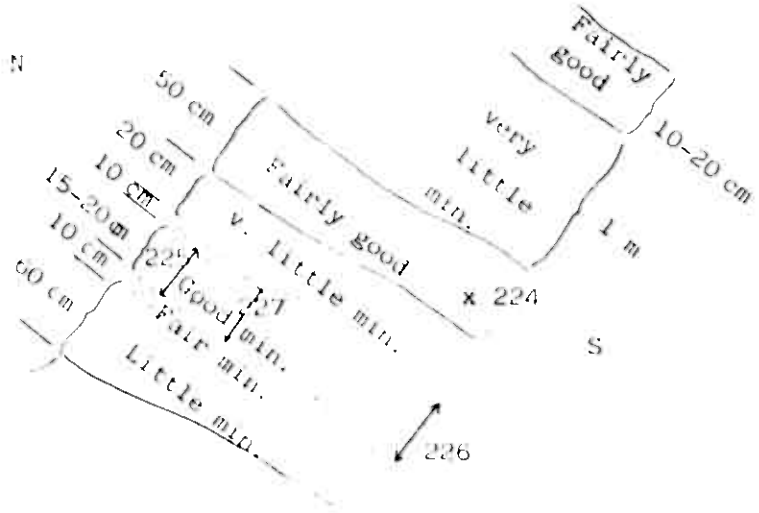
Has now been chip sampled

P 650 N/ 45 - 47 E

1.65 m wide skarn

228	60 cm of good scheelite zone	3.96 % WO_3
229	4 m along strike from 228 represents entire 1.65 m section	3.48 % WO_3

Q 690 N / 0



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226	20 cm	15 m down slope from	16.8 % WO_3
227	20 cm	4 m down from 225	14.0 % WO_3
224	Grab sample		2.66 % WO_3

241. Grab sample from the topographically upper part of upper main skarn: outcrop — 8.76 % WO_3.

242. 0.35 m wide scheelite rich layer. possibly the strike continuation of layer 1 from the previous sketch. — 10.2 % WO_3

243. 0.4 m wide layer from the upper part of skarn horizon at approx 629N/24W — 0.6 % WO_3 +

244. 1m chip-sample just below the last mentioned locality. — 1.83 % WO_3

245. Grab sample from approx 620N/18W — 7.12 % WO_3

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CERTIFICATE OF ASSAY

: A/C SULFIDMALM

4601 KRISTIANSAND S.
NORWAY
POSTBOKS 497

MÅLVIKEN

CERT. # : A8214340-001-A
INVOICE # : I8214340
DATE : 16-NOV-88
P.O. # : NONE

Sample description	Prep code	Cu %	Mo %	Zn %	Ni %	Au FA oz/t	g/t	
35/82/200	214	<0.01	0.002	0.02	0.007	0.003		--
35/82/201	214	<0.01	0.001	0.04	0.011	0.005		--
35/82/202	214	<0.01	<0.001	0.02	0.044	0.024	0.82	--
35/82/203	214	<0.01	<0.001	0.01	0.075	0.028	0.959	--
35/82/204	214	<0.01	<0.001	0.01	0.057	0.024	0.82	--
35/82/206	214	<0.01	0.001	0.01	0.014	0.006		--
35/82/207	214	<0.01	<0.001	0.01	0.006	0.005		--
35/82/208	214	<0.01	<0.001	0.01	0.008	0.003		--
35/82/209	214	<0.01	0.001	0.01	0.016	0.003		--
35/82/210	214	<0.01	0.001	0.01	0.032	0.006		--
35/82/211	214	<0.01	0.001	<0.01	0.007	0.003		--
35/82/212	214	<0.01	<0.001	0.02	0.014	0.003		--
35/82/213	214	<0.01	0.001	0.01	0.005	0.003		--
35/82/214	214	0.03	0.001	0.01	0.092	0.022	0.754	--
35/82/216	214	0.03	<0.001	0.01	0.005	0.003		--
35/82/217	214	<0.01	<0.001	0.02	0.071	0.010	0.34	--
35/82/218	214	<0.01	<0.001	0.04	0.006	0.003		--
35/82/219	214	0.09	0.001	0.01	0.006	0.008		--
35/82/220	214	<0.01	0.002	0.03	0.042	0.012	0.411	--
35/82/221	214	<0.01	0.001	0.04	0.023	0.014	0.479	--
35/82/222	214	<0.01	0.001	0.02	0.037	0.030	1.028	--
35/82/223	214	<0.01	0.004	0.02	0.012	0.016	0.548	--
35/82/224	214	<0.01	0.002	0.01	0.006	0.003		--
35/82/225	214	<0.01	0.002	0.02	0.008	0.005		--
35/82/226	214	<0.01	0.002	0.01	0.004	<0.003		--
35/82/227	214	<0.01	0.004	0.02	0.240	0.060	2.05	--
35/82/228	214	<0.01	0.003	0.02	0.011	0.003		--
35/82/229	214	<0.01	0.003	0.02	0.008	0.005		--
35/82/230	214	<0.01	0.003	0.02	0.006	0.006		--
35/82/231	214	<0.01	<0.001	0.02	0.005	<0.003		--
35/82/232	214	<0.01	0.001	0.02	0.180	0.044	1.508	--
35/82/233	214	<0.01	0.003	0.02	0.014	0.006		--
35/82/234	214	<0.01	0.002	0.01	0.013	0.005		--
35/82/235	214	<0.01	0.002	0.02	0.033	0.012	0.411	--
35/82/236	214	<0.01	0.001	0.02	0.005	0.003		--
35/82/237	214	<0.01	0.002	0.03	0.013	0.005		--
35/82/238	214	<0.01	0.001	0.01	0.012	0.005		--
35/82/239	214	<0.01	0.003	0.01	0.010	0.005		--
35/82/240	214	<0.01	0.001	0.01	0.003	<0.003		--

B. Stewart

Registered Assayer, Province of British Columbia

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) : A/S SULFIDMALM

4601 KRISTIANSAND S.
NORWAY
POSTBOKS 457

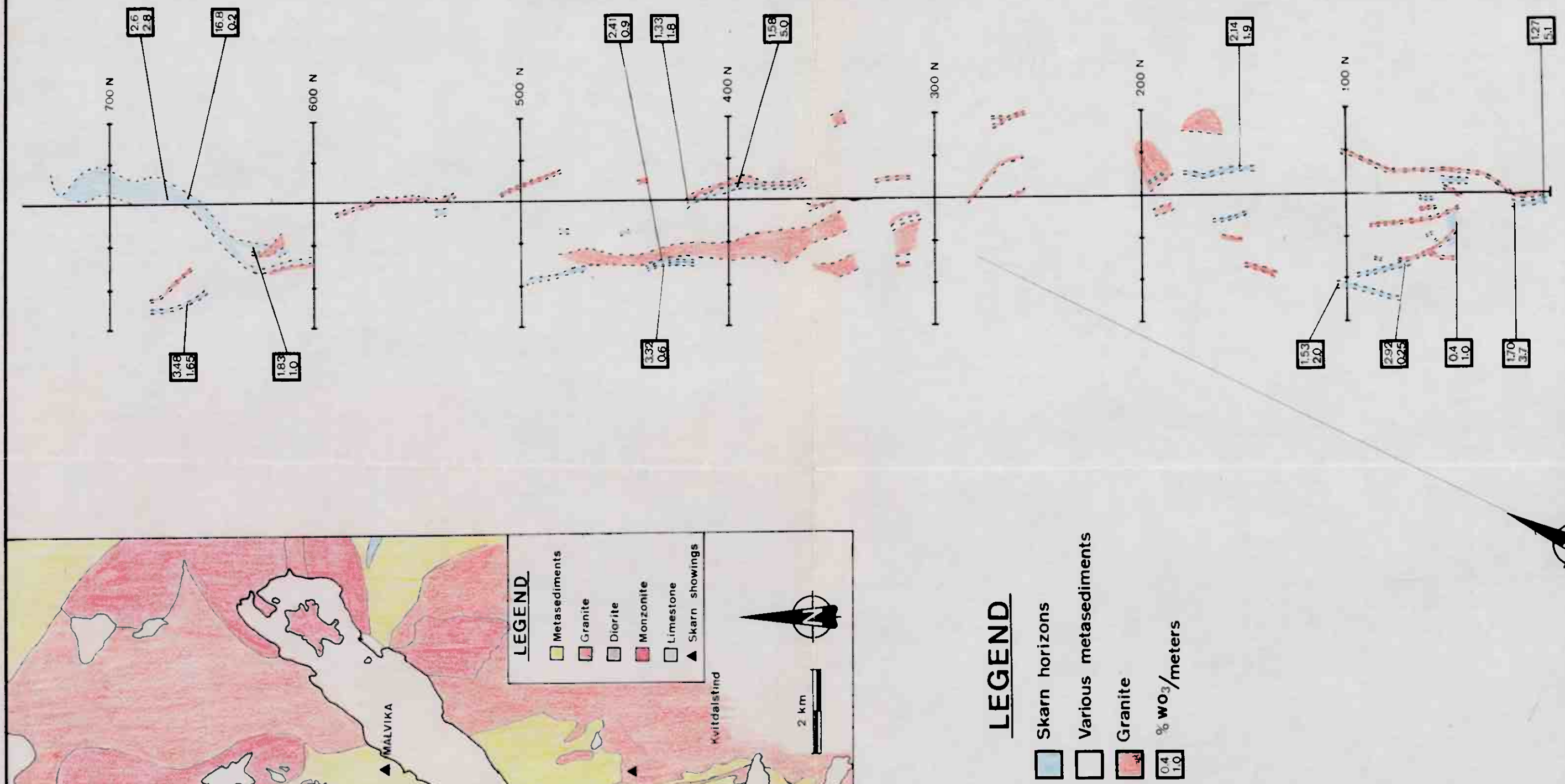
ATTN: K. KJAERSRUD

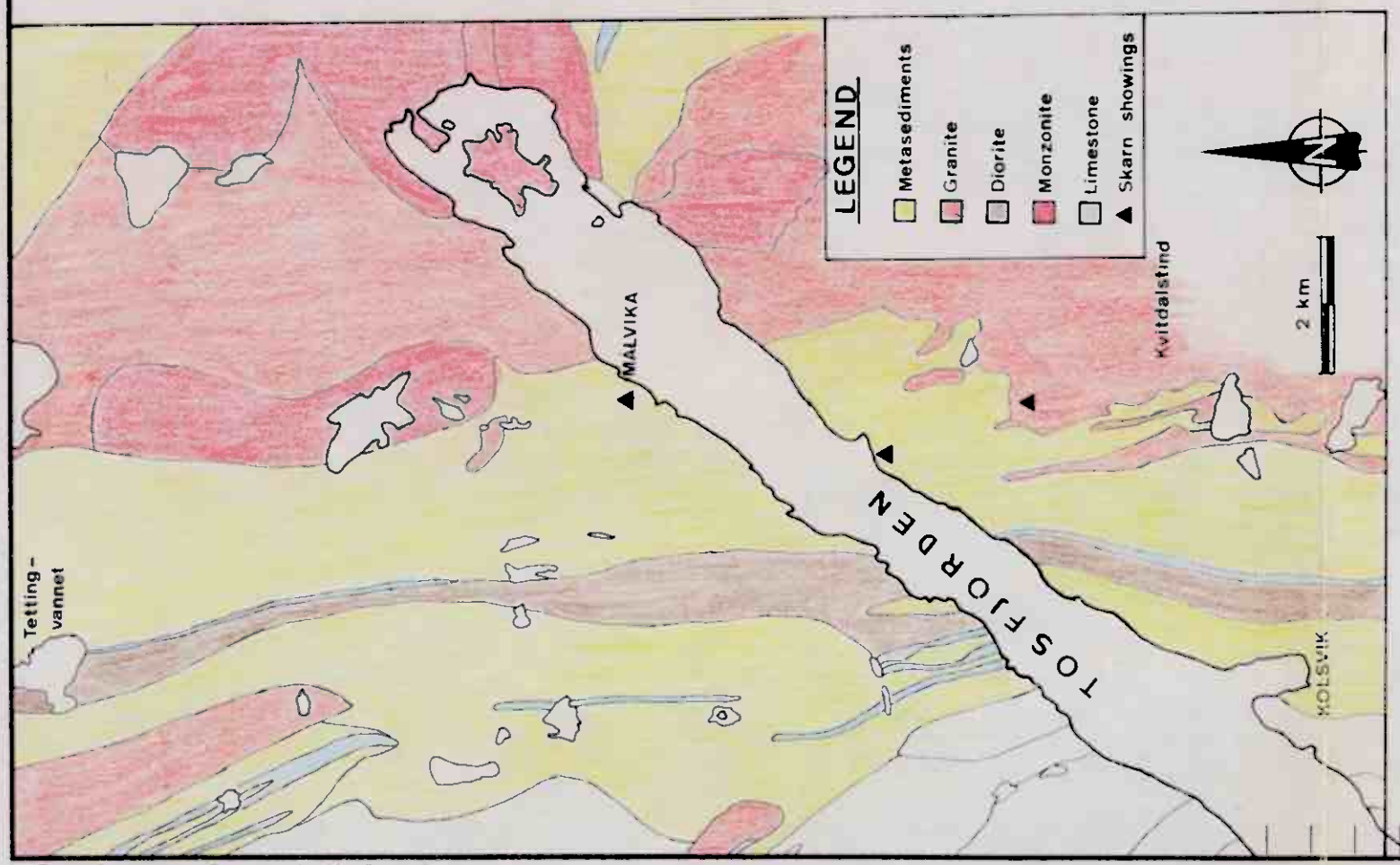
CERT. # : A8213520-001-
INVOICE # : I8213520
DATE : 4-OCT-82
P.O. # : NONE

Sample description	Prep code	WO3 %					
35/82/200	208	1.42	--	--	--	--	--
35/82/201	208	0.70	--	--	--	--	--
35/82/202	208	0.55	--	--	--	--	--
35/82/203	208	3.04	--	--	--	--	--
35/82/204	208	1.25	--	--	--	--	--
35/82/206	208	1.71	--	--	--	--	--
35/82/207	208	0.57	--	--	--	--	--
35/82/208	208	0.06	--	--	--	--	--
35/82/209	208	1.48	--	--	--	--	--
35/82/210	208	0.40	--	--	--	--	--
35/82/211	208	0.41	--	--	--	--	--
35/82/212	208	0.82	--	--	--	--	--
35/82/213	208	2.92	--	--	--	--	--
35/82/214	208	2.12	--	--	--	--	--
35/82/216	208	0.95	--	--	--	--	--
35/82/217	208	2.34	--	--	--	--	--
35/82/218	208	0.21	--	--	--	--	--
35/82/219	208	1.60	--	--	--	--	--
35/82/220	208	1.91	--	--	--	--	--
35/82/221	208	2.48	--	--	--	--	--
35/82/222	208	1.45	--	--	--	--	--
35/82/223	208	3.20	--	--	--	--	--
35/82/224	208	2.66	--	--	--	--	--
35/82/225	208	4.32	--	--	--	--	--
35/82/226	208	16.80	--	--	--	--	--
35/82/227	208	14.00	--	--	--	--	--
35/82/228	208	3.96	--	--	--	--	--
35/82/229	208	3.48	--	--	--	--	--
35/82/230	208	9.23	--	--	--	--	--
35/82/231	208	3.32	--	--	--	--	--
35/82/232	208	2.12	--	--	--	--	--
35/82/233	208	2.56	--	--	--	--	--
35/82/234	208	1.61	--	--	--	--	--
35/82/235	208	1.22	--	--	--	--	--
35/82/236	208	0.85	--	--	--	--	--
35/82/237	208	3.04	--	--	--	--	--
35/82/238	208	1.24	--	--	--	--	--
35/82/239	208	1.96	--	--	--	--	--
35/82/240	208	0.80	--	--	--	--	--

B. Swaste

Registered Assayer, Province of British Columbia





LEGEND

- Skarn horizons
- Various metasediments
- Granite
- % WO_3/meters (0.4 / 1.0)

GEOLOGY OF THE MAALVIKA SCHEELITE SHOWING (BINDAL, NORWAY)

SULFIDMALM

SCALE	1:2000
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DRAW.	KK
TRAC.	KK
CHK.	
MAP NO.	
MAP SHEET	

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