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ROBERTSON RESEARCH COMPANY LIMITED

REPORT NO. 681

RECONNAISSANCE EXPLORATION FOR MOLYBDENUM AND TUNGSTEN IN THE LAKSAADALEN AND SPILDERDALEN AREAS OF NORTHERN NORWAY

by

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Project No. IIIA/132

January, 1972

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INTRODUCTION

A reconnaissance exploration survey for molybdenum (Mo) and tungsten (W) has been carried out in the Laksaadalen and Spilderdalen area (in the Gildeskaal and Meloy administrative districts) of Northern Norway, some 50 kilometres south of Bodo.

The project was undertaken for British Oxygen Minerals in accordance with our quotation No. 649/271. The survey, which covered the two areas delineated on Enclosure 1, was aimed at locating potential large-scale molybdenum-tungsten ore-bodies.

In the Northern area around Laksaadalen, which covers approximately 15 square kilometres numerous occurrences of molybdenum mineralisation occur, two of which have been commercially exploited under wartime conditions. Significant molybdenum mineralisation has not been recorded in the southern area around Spilderdalen, which covers about 12 square kilometres. It was investigated, however, because it is geologically similar to the northern area.

In both areas the work involved geochemical stream sediment sampling at an average density of approximately 13 samples per square kilometre, and in the northern area selected rock chip sampling was also undertaken. The two abandoned molybdenum mines and virtually all the recorded molybdenite occurrences were examined in the field in order to determine the geological controls of the mineralisation and to assist the interpretation of the geochemical results.

Prior to undertaking the field investigation, and at the request of British Oxygen Minerals, certain aspects of the geology of the area were discussed with Dr. M.K. Wells of University College London, who has done considerable geological research in this part of Norway.

II

GENERAL GEOLOGY

2.1. Summary of Geology (Enclosure 1)

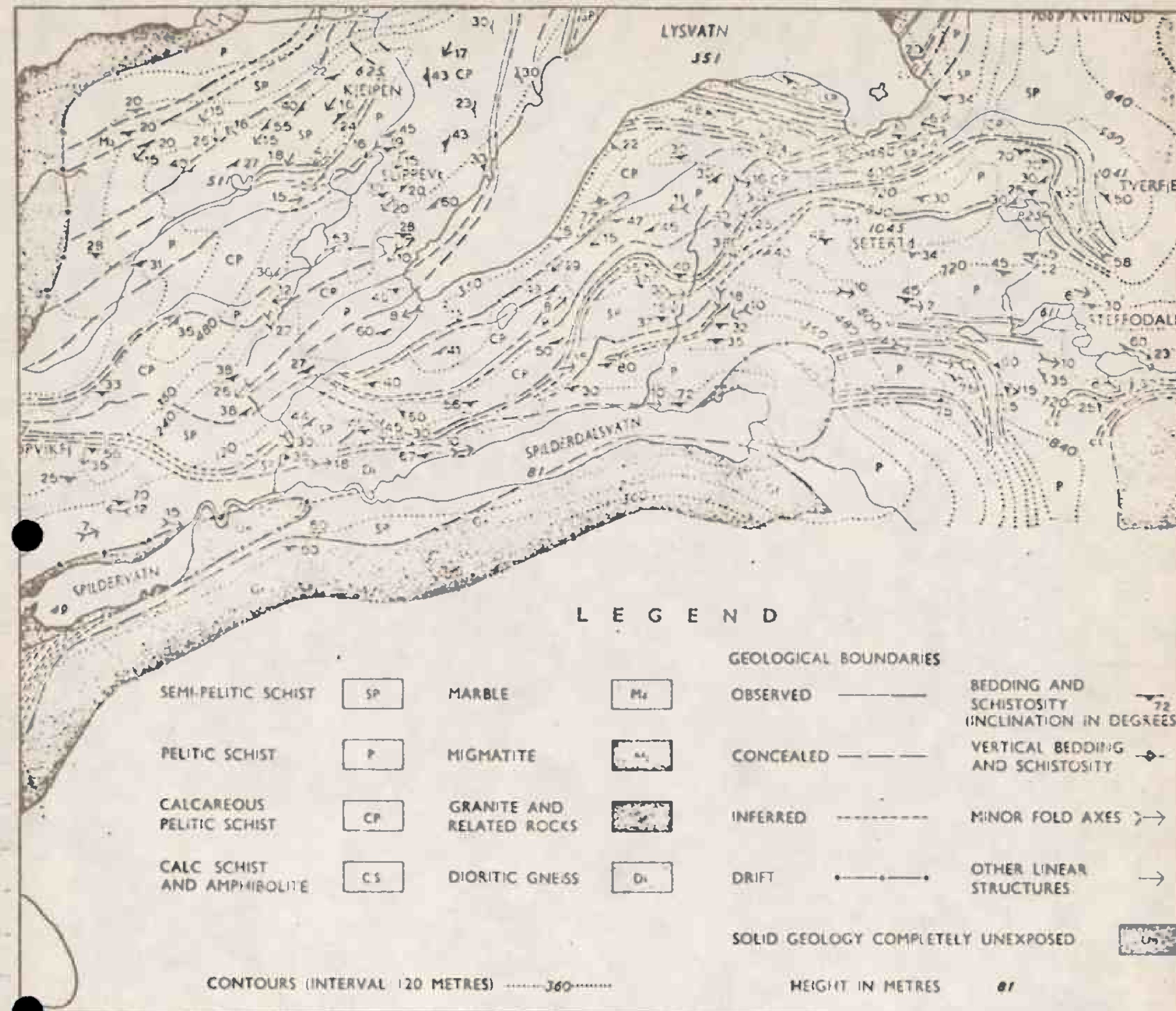
The structural and metamorphic history of the Laksaadalen - Spilderdalen area is moderately well established and has been described in several publications the most recent and relevant of which are Holmes (1966) and Wells and Bradshaw (1970).

The rocks of the area lie within the Caledonian fold belt of Northern Norway and consist of a basal granite-gneiss of probable Precambrian age overlain by a sequence of semi-pelitic, pelitic and calcareous metasedimentary rocks of possible Cambro-Ordovician age. The whole succession was intensely tectonised in at least three phases of deformation during the Caledonian orogeny, and raised to amphibolite grade metamorphic facies.

2.2. Stratigraphic, Structural and Petrogenetic Relationships

The geology of the Laksaadalen area is shown in detail Enclosure 2 (after Wells and Bradshaw, 1970) and that of the Spilderdalen area in Figure 1 (after Holmes 1966).

The granite-gneiss massif of Bjellatind in the Laksaadalen area and the northern part of the Glomfjord granite-gneiss are largely or entirely derived from the granitisation of sedimentary rocks of probable Precambrian age. Holmes (1966) presents evidence which suggests that the granitisation of these sediments to rocks of probable granodioritic composition was completed before the covering rocks (the present schists) were deposited. Consequently the granite or granite-gneiss forms the stratigraphic basement of this sequence of sedimentary rocks and it cannot be considered in any way intrusive into the latter. Subsequently the granite and its sedimentary cover were involved in Caledonian orogenic movements which resulted in the dislocation of some of the original stratigraphic boundaries, the formation of a complex series of folds during at least three periods of deformation, the regional



GEOLOGY OF THE SPILDERDALEN AREA

FROM HOLMES (1966)

FIGURE 1.

metamorphism of the rocks to amphibolite facies and at least locally potassium metasomatism. This caused the introduction or re-distribution of potash feldspar (microcline) in the granite-gneiss and surrounding metasedimentary rocks including the formation of a series of pegmatites generally parallel to the composition banding of the latter, and was possibly associated with the deposition of molybdenum and tungsten. This diffusion process, which has not produced a discrete or separate potash-granite mass, was operative during and after the second phase of deformation and was contemporaneous with the production of the major fold structures of the area.

Structurally the area is complex due to the interaction of three or more phases of deformation. However around Laksaadalen only a few major structures are relevant to this study, and are shown on Figure 2. The Nonshaugen fold is a large recumbent anticline which was produced during the second phase of deformation. Its axis trends west and its core, composed of the Bjellatind granite-gneiss, is mantled by metasedimentary rock. A similar structure occurs in the Glomfjord granite-gneiss south of Spilderdalen. Both structures can be seen in cross-section in Figure 3A. Approximately at right angles to the Nonshaugen fold is the Sorfjord - Bjellatind antiform which was produced during the third period of deformation. It refolds the axis of the former causing it to plunge east and west on either side of its own northerly trending axis. It is shown in cross-section in Figure 3C. Most of the rocks and structures east of the granite-gneiss are separated from the latter by a major tectonic slide (Lysvatn Slide) the outcrop of which approximately follows the valley of the Laksaadal River.

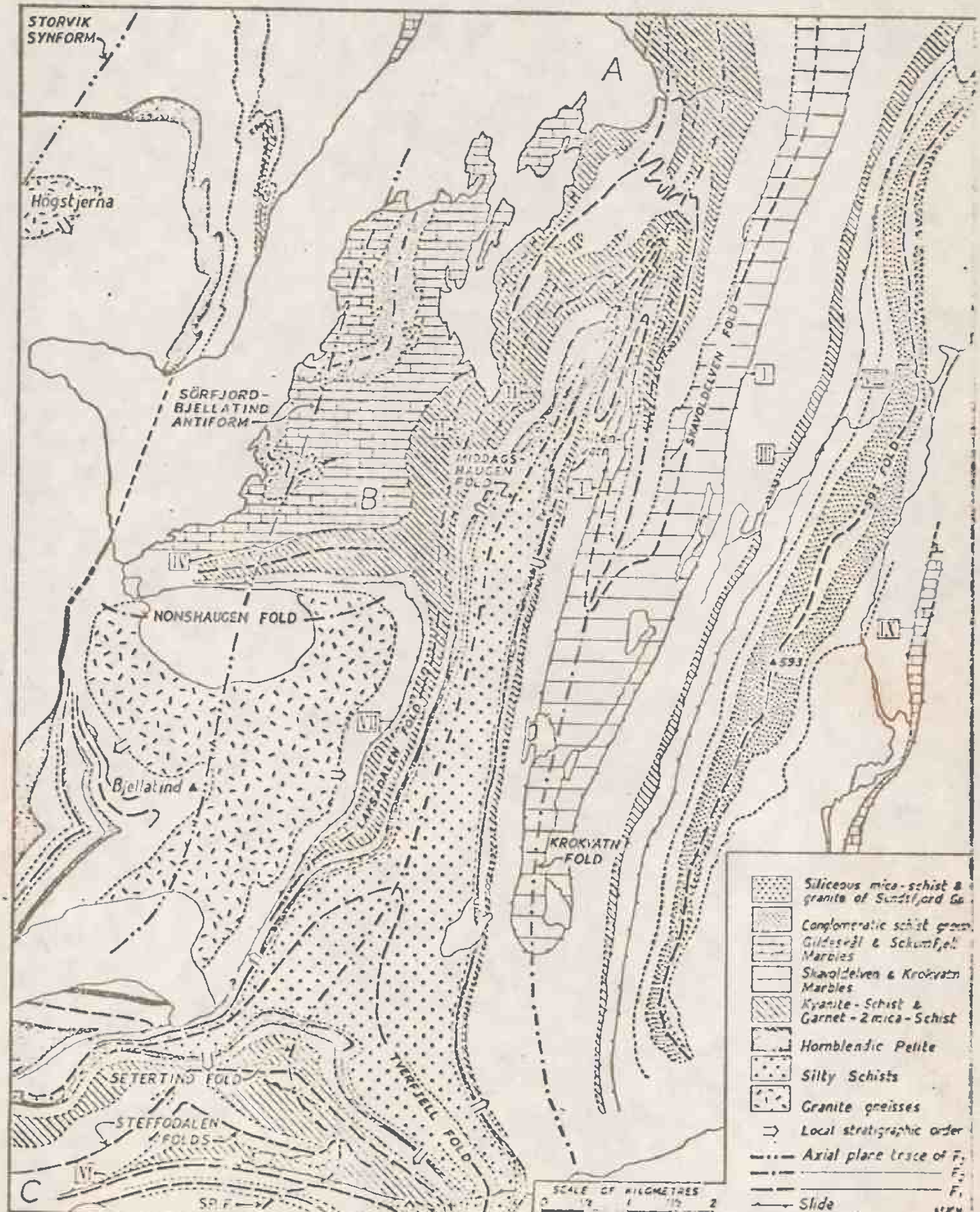
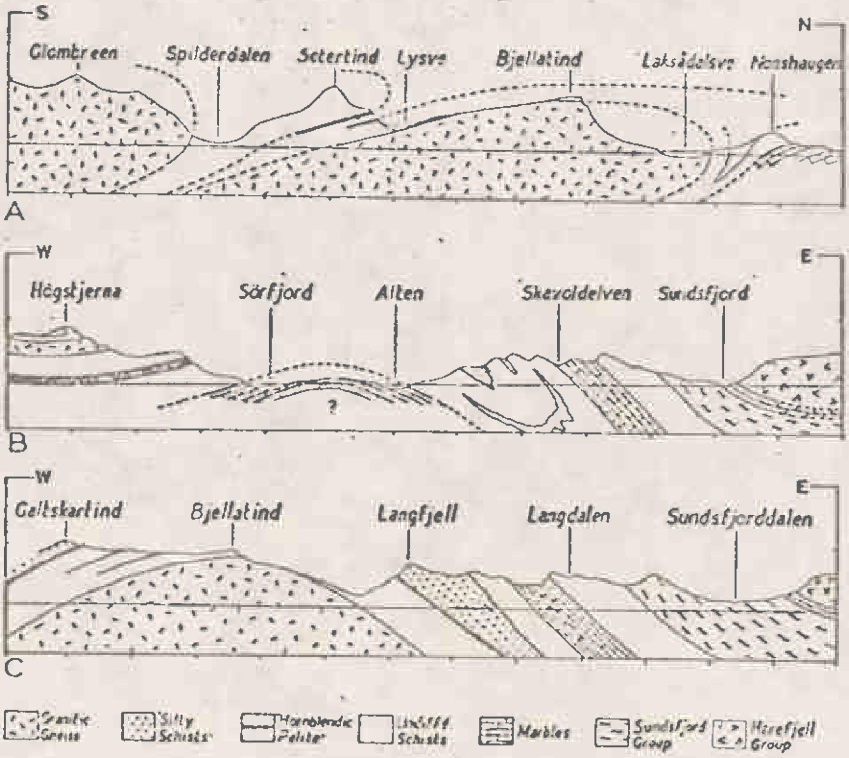


FIGURE 2

MAJOR STRUCTURES OF THE LAKSAADALEN AREA



<u>FIGURE 3</u>

<u>DIAGRAMMATIC CROSS-SECTIONS OF STRUCTURES IN THE</u>

<u>LAKSAADALEN-SPILDERDALEN AREA</u>

from WELLS and BRADSHAW (1970)

III

KNOWN MOLYBDENUM-TUNGSTEN MINERALISATION IN THE LAKSAADALEN AREA

3.1. General

Molybdenum and minor tungsten mineralisation occurs in several pegmatites in the schists around the northern margin of the Laksaadalen granite-gneiss. Molybdenum has been mined from two such bodies at the Laksaadals and Osterstrand Mines principally during the First and Second World Wars. Several trials have also been opened in other similar bodies in the same general area. Disseminated molybdenite is also present in parts of the granite-gneiss and although claims have been taken out over such areas in the past no exploitation has occurred.

The previously recorded ore-bodies of the area, seem unlikely to have sufficient reserves of molybdenum-tungsten ore for the requirements of British Oxygen Minerals (see Chapter 3.4). However, the two principal mines and most of the trials and occurrences were examined during the present survey to determine the mode of occurrence of the mineralisation and to provide a control for the geochemical stream sediment survey.

3.2. Mineral Occurrence

3.2.1. Laksaadal Mine

The Laksaadal Mine is situated in near-vertical westerly striking schists about 150 metres north of Laksaadals Vatn in the nose of a large recumbent anticline. The molybdenum is contained in three pipe-like pegmatite bodies (Ostgang, Midtgang and Vestgang) which plunge westwards at about 40° and are essentially concordant with the country-rock. These are shown in plan and section in Figures 4 and 5 respectively.

Most of the ore-bodies with the exception of part of the Ostgang pegmatite have been worked out above the present water level of the mine but according

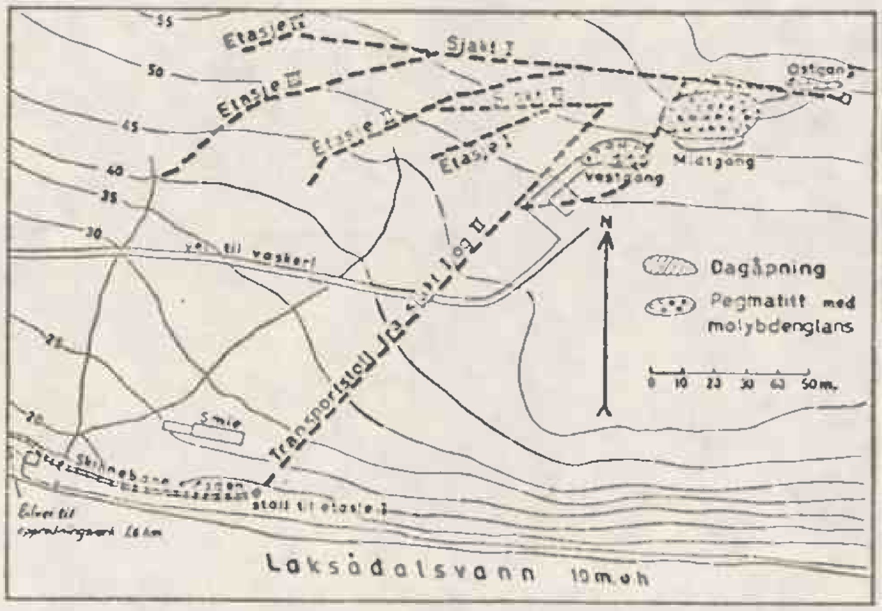


FIGURE 4

PLAN OF THE LAKSAADAL MINE

from BUGGE (1963)

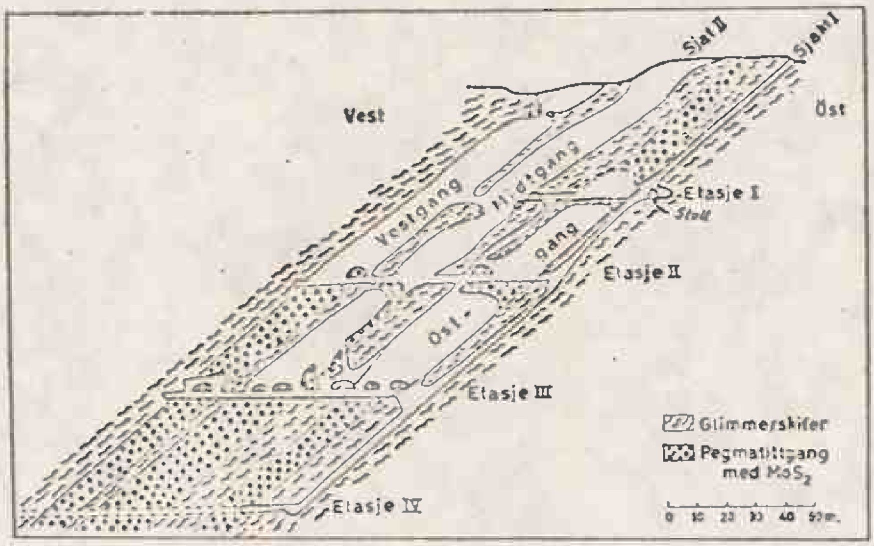


FIGURE 5

CROSS-SECTION OF THE LAKSAADAL ORE-BODIES

from BUGGE (1963)

to Flood (1963) the Ostang pegmatite was about 2 metres thick and contained an average of about 1% molybdenite, although Bugge (1963) quoted an overall grade of 0.3% molybdenite for this lode. The Midtgang pegmatite which was about 9 metres thick reputedly contained massive lumps of molybdenite weighing several kilograms (Flood 1963, and local information) although the overall grade extracted was only 0.25% (Bugge 1963). The four metres thick Vestgang yielded 0.2% molybdenite. Downwards the lodes apparently merge and the overall molybdenite content of the ore-bodies is said to have averaged 0.25%. There appear to be no records of tungsten minerals occurring in the lodes here. However, when the accessible parts of the underground workings were examined with an ultra-violet lamp, traces of a blue-fluorescing mineral were detected in parts of the Ostang lode and the adjacent schistose country rock. The mineral occurs as small extremely rare, white crystals up to about 5mm across in the pegmatite, and in equally rare, but more diffuse areas of fine-grained granular material in the adjacent schists. Grab samples (BOC 30, 30A) of this fluorescent mineral, containing of necessity much surrounding country-rock, were collected and analysed colorimetrically for tungsten and molybdenum. The analyses are given in Table 1. The sample from the pegmatite contain 0.2% tungsten and that from the schist contains in excess of 1% tungsten. The mineral therefore, is almost certainly scheelite.

3.2.2. Oterstrand Mine

The Oterstrand Mine worked one of a series of lenticular pegmatites which are intruded semi-concordantly into schists dipping at a low angle westwards a few metres above the granite-gneiss margin. Approximately twelve such lenticular bodies the principal of which are shown in plan on Figure 6 occur over a strike length of one kilometre. Most contain molybdenite and have been exposed by working, although major exploitation has been confined to one body (occurrence 6 on Figure 6 and on the 'Molybden I Gildeskal' map.)*

* See Footnote overleaf

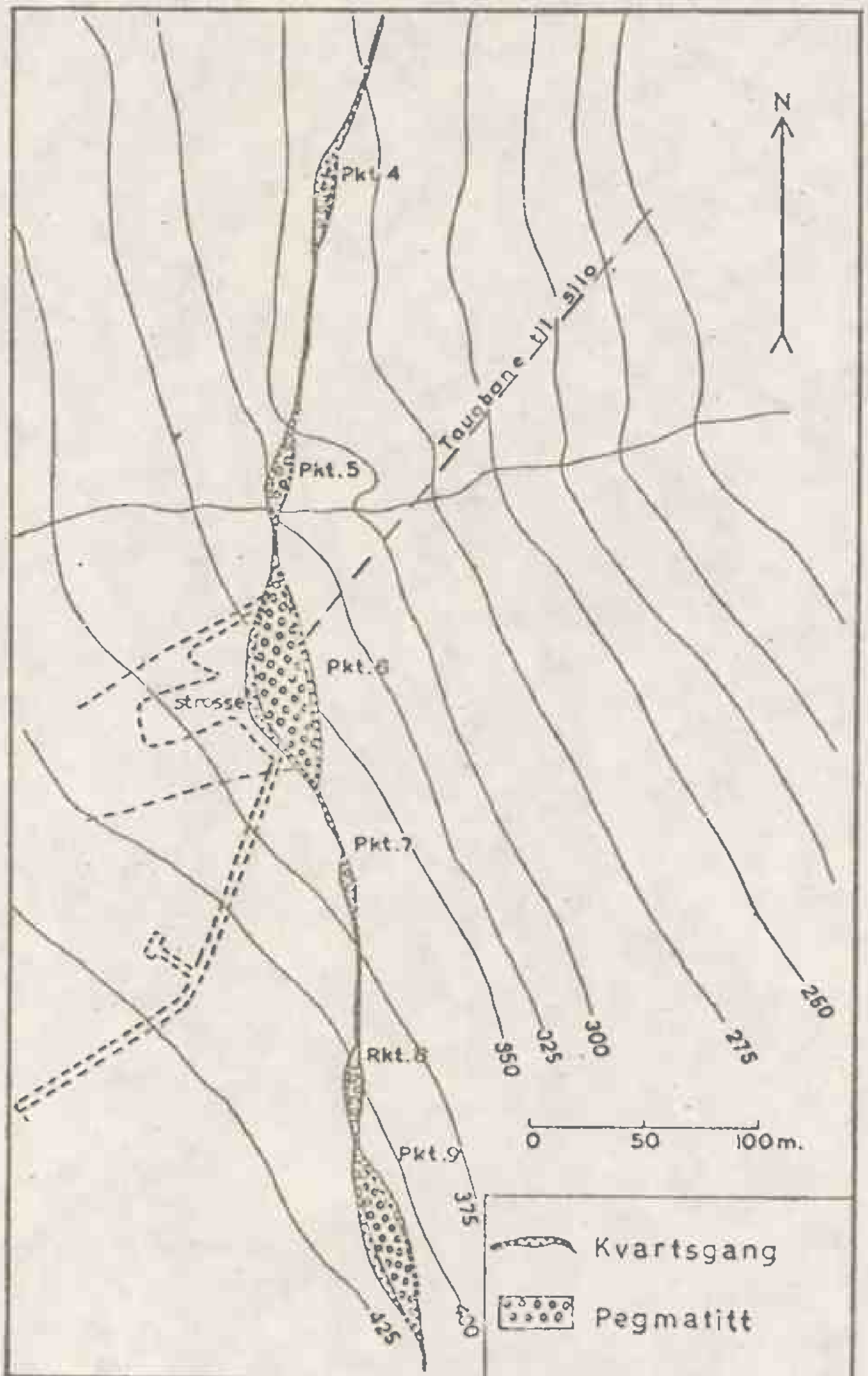


FIGURE 6

PLAN OF THE OTERSTRAND MINE AND ADJACENT PEGMATITES

from BUGGE (1963)

The overall dimensions of this body are unknown, although maximum strike extension is 100 metres and thickness is perhaps five or six metres. It is elleptical in cross-section with major and minor axis in the order of 100 metre and 6 metres long respectively. Its total extent down dip has not been determined, although it has been stoped out for about 100 metres. The molybdenite content of the pegmatite is said to have averaged about 0.5%. Very small quantities of a mineral which fluoresces blue in short wave ultra violet light also occur in this body particularly near its southern margin. A grab sample (BOC 35) from diffuse area of blue fluorescence contained 0.05% tungsten suggesting the presence of sparsely disseminated, fine grained scheelite mineralisation in local areas.

About 250 metres south of Oterstrand Mine, another lenticular molybdenite-bearing pegmatite occurs. (Occurrence 9 and Figure 6 and on the 'Molybden I Gildeskal' map). This body was apparently discovered towards the end of the Second World War and has been partly exposed although it has not been exploited to any significant extent. The pegmatite appears to be of similar dimensions to the Oterstrand Mine ore-body but is considerably richer in molybdenite, (1% molybdenite - Bugge 1963). At that time it was considered to be the most promising source of molybdenite discovered in the area.

* Footnote.

'Molybden I Gildeskal' is a map held by British Oxygen Minerals showing the location of molybdenum occurrences in the Laksaadalen area, based largely on the work of Flood.

3.2.3. Other Occurrences

Many other occurrences of molybdenite have been recorded in the Laksaadalen area although none have been commercially exploited to any significant extent. The principal of these are briefly described below.

(i) About 300 metres east of the eastern end of Laksaadals Vatn a small level about 60 metres long has been driven northwards into the hillside. This is refered to as Øvre Laksaadal on the 'Molybden I Gildeskal' map. Here schists dip steeply south and are intruded by a semi-concordant pegmatite mass about four metres thick. Very little molybdenite is exposed in the pegmatite in the level although it is present in the waste dump. The level is terminated in barren schist country rock.

(ii) Approximately 400 metres east of the latter occurrence molybdenite occurs in a small irregular pegmatite mass in near-vertical, westerly trending flaggy pelitic schists, exposed in the bank of the Laksaadal River, above the water level. Molybdenite mineralisation is sparse but shows a strong tendency to be concentrated in the margins of the pegmatite immediately adjacent to the pelitic schists.

(iii) Approximately 500 metres east-northeast of the latter occurrence small highly irregular pegmatite masses occur in the steeply dipping, westerly trending flaggy schists about 30 metres above the southern bank of the Laksaadal River. The pegmatites here, unlike those previously examined, are biotite-rich and pass almost imperceptively into the biotite-rich schists. The bodies are roughly parallel to the schist foliation but are cross-cutting in places. Molybdenite occurs in the felspathic portions of the pegmatite with no apparent concentration near the margins.

(iv) At numerous places molybdenite occurs in the schists immediately overlying the granite-gneiss along its eastern flank. These occurrences are numbered 9 to 19 on the 'Molybden I Gildeskal' map and are all located in irregular feldspathic masses in the flaggy mica-schists within about 10 metres of the granite-schist contact. The feldspathic masses often pass imperceptibly into feldspar-rich flaggy schists, but the mineralised portions which are generally characterised by a rusty weathering crust are rarely more than a few metres in diameter. The schists lying between these mineral occurrences, which are typically 100 to 200 metres apart, appear to be unmineralised. Consequently the overall molybdenite grade in this mineralised schist zone is extremely low.

(v) On the well exposed dip slopes east of Laksaadals Vatn and south of Laksaadal River disseminated molybdenite occurs in the granite-gneiss particularly near its contact with the schist. Molybdenite flakes up to about 5mm are very widely dispersed and typically separated by several metres of apparently unmineralised rock. The overall grade of the mineralisation therefore is extremely low.

3.3. Genesis and Controls of Mineralisation

The known molybdenite mineralisation shows a strong spatial association with the Bjellatind granite-gneiss, occurring either as disseminations in the latter or in microcline rich pegmatites in the schists immediately surrounding the granite-gneiss. However, as the granite-gneiss, sensu-stricto, does not intrude the schists but merely forms the stratigraphic (or tectonic) base of the sequence, the mineralisation is presumably genetically related to a later period of (Caledonian) potash metasomatism, in which case the mineralisation might be expected to extend to areas outside the granite-gneiss, unless the molybdenite is a re-mobilised original constituent of the latter.

Dr. M.K. Wells of University College, London has suggested that the mineralisation has been controlled into areas of low hydrodynamic pressure. Such a process might explain the association of much of the molybdenite mineralisation with the northerly margin of the granite-gneiss, which also corresponds to the axis of the recumbent Nonshaugen Fold.

A further lithological or chemical control is possibly exerted by the schists. The greatest known concentrations of molybdenite do not occur in the granite-gneiss but in pegmatitic masses within the schists. This control may be responsible for the common association of molybdenum mineralisation with the granite-schist contact, a phenomenon which is particularly strikingly shown in the distribution of mineral occurrences along the eastern margin of the Bjellatind granite-gneiss. Lithological control may also operate on a smaller scale, for within many of the pegmatitic masses the molybdenite is concentrated near the margin in immediate contact with the surrounding schists.

3.4. Commercial significance of the known molybdenum mineralisation

The known types of molybdenum mineralisation in the area are briefly assessed to determine whether they are likely to yield ore-bodies of the size required b·· the British Oxygen Minerals. This is understood to be 10 to 20 million tons of molybdenite ore, assuming a grade of about 0.25% to 0.5%. A lower tonnage or grade is understood to be acceptable if tungsten is present in significant amounts.

There is insufficient information to calculate the possible reserves in the two mines although an approximate yield can be deduced. The overall cross-sectional area of the three ore-bodies in the Laksaadal Mine is approximately 90 square metres (based on Flood's quoted dimensions, and assuming a roughly cylindrical form). Therefore for each metre depth worked downdip, 90 cubic metres or approximately 200 metric tons of ore would be obtained, probably averaging about 0.25% molybdenite. To obtain 10 million tons of ore, therefore, the body in its known form would have to be worked 50 kilometres downdip which is clearly an academic consideration.

Some of the lenticular pegmatites in the Oterstrand field are considerably larger possibly having major and minor axes up to about 100 metres and 6 metres respectively, giving cross-sectional areas of about 500 square metres

TABLE 1

COLORIMETRIC ANALYSES OF MISCELLANEOUS ROCK CHIP SAMPLES

FOR Mo AND W

Sample No.	Grid Reference	Description	Mo ppm	W ppm
BOC1	546257	Pegmatite Ovre Laksadal	< 2	16
BOC2	546257	Schist. Ovre Laksadal	3	12
BOC3	551256	Schist	2	16
BOC4	551256	Psammite	5	12
BOC5	553258	Quartzo-feldspathic schist	4	12
BOC9	513255	Pink feldspathic gneiss	2	12
BOC10	512254	Feldspathic gneiss	8	< 4
BOC11	512254	Calcite vein material	6	< 4
BOC14	542257	Quartz lens with sulphides	1000	12
BOC17	519245	Pegmatitic granite	25	< 4
BOC18A	521244	Granite-gneiss	< 2	12
BOC18B	521244	Pegmatitic granite	< 2	12
BOC19	549256	Flaggy schist	20	16
BOC20A	549255	Flaggy schist	2	< 4
BOC22	553257	Schist	2	8
BOC24A	552255	Schist	6	16
BOC24B	552255	Granite-gneiss	5	20
BOC24C	552255	Granite-gneiss	50	12
BOC24D	552255	Granite-gneiss	60	16
BOC24E	552255	Granite-gneiss	5	< 4

TABLE 1 Continued

Sample No.	Grid Reference	Description	Mo ppm	W ppm
BOC24F	552255	Granite-gneiss	5	< 4
BOC24G	552255	Granite-gneiss	5	12
BOC24H	552255	Granite-gneiss	6	< 4
BOC29	555243	Feldspathic schist	40	12
BOC30	538257	Ostgang pegmatite with fluorescent mineral	100	2000
BOC30A	538257	Schist with fluorescent mineral	40	> 1%
BOC33	518249	Molybdenite bearing pegmatite	> 1%	60
BOC33A	518249	Pegmatite with fluorescent mineral	500	280
BOC35	517245	Pegmatite with fluorescent mineral	60	500
BOC36	517242	Rusty weathering pegmatite	8	12
BOC37	555242	Flaggy schist	15	8
BOC38	554241	Flaggy schist	8	16
BOC39	554240	Flaggy schist	15	12
BOC40	553239	Flaggy schist	2	12
BOC41	555238	Flaggy schist	3	12
BOC41A	554238	Flaggy schist	2	12
BOC41B	553238	Granite-gneiss	5	12
E1	547246	Granite-gneiss	> 2	4
E2	545245	Granite-gneiss	2	12
E3	542244	Granite-gneiss	> 2	< 4
E4	539243	Granite-gneiss	2	4
D9A	534234	Schist	25	100

Even, a body of this size, however, would have to be worked for about 10 kilometres downdip to yield 10 million tons of ore. Clearly therefore the known pegmatites in themselves cannot be considered as a potential source of molybdenum on the scale required by British Oxygen Minerals.

Widespread disseminated mineralisation either in the granite-gneiss or the schists would be more likely to yield the required size of ore body.

IV

RECONNAISSANCE GEOCHEMICAL STREAM SEDIMENT SURVEY

4.1. General

A geochemical stream sediment survey has been carried out over an area of about 15 square kilometres in the north around Laksadaals Vatn and 12 square kilometres in the south around Spildervatn and Spilderdals Vatn. The total area investigated is thus considerably larger than that specified in our quotation (No. 649/271) and was extended to include all nearby environments which were considered favourable for molybdenum-tungsten mineralisation. A total of 364 samples were collected giving an average sample density of 13 per square kilometres which is considered adequate to detect significant mineralisation.

All the samples were analysed colorimetrically for molybdenum (Mo) and tungsten (W) and approximately 10% of the samples were subsequently analysed spectrographically for a wide range of metals.

4.2. Chemical Analysis

The stream sediment samples were dried and separated into +80 and -80 B.S. sieve fractions using a nylon screen. Representative sub-samples of the -80 mesh fraction were subjected to colorimetric analysis for Mo and W by the methods of Stanton(1966). Subsequently approximately 10% of the samples (-80 mesh fraction) were ground to -200 B.S. mesh and analysed spectrographically for nickel, cobalt, chromium, copper, lead, zinc, tin, bismuth, silver, manganese and titanium.

4.3. Discussion of Results

The geochemical stream sediment survey results are discussed separately for the two areas below.

4.3.1. Laksaadalen Area; Molybdenum (Mo)

The Mo values of stream sediment samples in this area range from less than

2 p.p.m. to 50 p.p.m. The values are given in the Appendix and plotted in four classes (< 3 p.p.m., 3-5 p.p.m., 6-10 p.p.m., > 10 p.p.m.) on Enclosure 3. Samples containing more than 6 p.p.m. Mo are designated 'possibly anomalous', and those containing greater than 10 p.p.m. Mo 'probably anomalous'.

4.3.1a Orientation

Initially it is necessary to consider the type and magnitude of anomalies produced by known bodies of Mo mineralisation in the area in order to interpret the significance of anomalies outside the area of known mineralisation. The effects of several known masses of Mo mineralisation in this area are therefore discussed below.

i. The abandoned Oterstrand Mo mine is situated in a large pegmatitic body intruded into the schists immediately above the eastern granite-schist contact. A number of other small Mo bearing pegmatites also outcrop north and south of the mine. A moderate amount of Mo-bearing mine waste is present in the vicinity. The drainage system in the region is poorly developed although a number of small streams, some of which are intermittent, flow across the granite-schist contact near the mine and down the steep granite face to enter Katt Vann, or the larger stream flowing from Katt Vann into Laksaadals Vatn. Comparatively low concentrations of Mo were found in all these streams. One moderately large and probably permanent stream descends in a conspicuous waterfall about 25 metres north of the main mine workings. Three samples (2089, 2090, 2091) taken at 100 metre intervals downstream from the foot of the waterfall, contain 2 p.p.m., 2 p.p.m. and 8 p.p.m. of Mo respectively, and a fourth sample (2092) taken 150 metres downstream from the confluence of this stream with the larger stream flowing from Katt Vann to Laksaadals Vatn contains 5 p.p.m. Mo.

Approximately 50 metres southeast of Oterstrand Mine a second torrential, and probably intermittent stream occurs. A sample (2093) from this stream, at the foot of the steep slope below the mine workings contains the anomalous level of 30 p.p.m. Mo. A further four small streams occur in the next 300 metres southeast. No samples from these streams contain more than 3 p.p.m. Mo.

ii. The Laksaadals Mine is situated in schistose country rocks north of Laksaadals Vatn, and worked a westerly plunging pipe-like complex of pegmatites. There is now comparatively little surface exposure of the Mo-bearing pegmatite and very little mine waste, except in the rough track leading to the mine. No streams directly drain the immediate mine area, but a number of very small streams arise in the marshy ground west of the mine, above the subsurface strike extension of the pegmatite complex. A number of trials have also been opened in small Mo bearing pegmatites in this area. None of the samples from these streams (2308-2311) contain more than 3 p.p.m. Mo.

iii. About 400 metres east of Laksaadals Mine a small stream draining into Laksaadals Vatn intersects a small, irregular quartz lens containing traces of molybdenite, pyrite and chalcopyrite. A sample (2315) taken approximately 20 metres below this lens contains less than 2 p.p.m. Mo.

iv. East of Laksaadals Vatn a small trial level (Øvre Laksaadals), probably opened in the 19th Century, is located in a small north bank tributary of the Laksaadal River. The course of this tributary is displaced by a small dump of mine waste containing sparse molybdenite. Samples taken 80 metres (2204) and 250 metres (2203) downstream from the adit and dump contain levels of 2 p.p.m. and 5 p.p.m. Mo respectively. A third sample (2205) taken about 20 metres upstream from the dump contains less than 2 p.p.m. Mo as does the fourth sample (2206) taken near the origin of the stream on the edge of a bog.

v. On the south side of the Laksaadal River about 250 metres east of the lake, extensive dip slopes of granite are exposed. Widely dispersed flakes of molybdenite up to about 5 mm across occur in the granite here and have resulted in the pegging of a number of claims in the past. By visual estimation the granite here contains much less than 0.1% molybdenite. Several intermittent rills flow down the granite dip slope and contain occasional pockets of granitic sediment. Five samples (2105, 2323-6) were collected and found to contain 3 p.p.m. to 15 p.p.m. Mo.

In conclusion, therefore, the known molybdenite-bearing pegmatites of the Laksaadals area, even where these have been exposed by working, appear to produce comparatively low value and localised stream sediment anomalies, a maximum detected value of 30 p.p.m. Mo occurring in the stream below Oterstrand Mine. The disseminated molybdenite mineralisation of the granite gneiss, which is typically developed in the exposed slope east of Laksaadals Vatn, appears to produce values of 3-15 p.p.m. Mo.

4.3.1b Distribution of Values

The schists lying northwest of the granite are drained by a well developed system of streams including the Galtskartind bekken. This stream system was extensively sampled at approximately 250 metre intervals and all stream intersections. No highly anomalous values are present in this sytem and in most cases the samples contain less than 2 p.p.m. Mo, which is the detection limit of the analytical method. One sample (2081) contains the possibly anomalous level of 8 p.p.m. Mo, and several (2075-2078, 2082) contain 3 p.p.m. to 5 p.p.m. Mo. Consequently it is considered that there is very little possibility of widespread Mo mineralisation existing in the catchment area of these streams.

Southeast, in the region of Oterstrand Mine on the western granite-schist contact the drainage system is poorly developed and an anomalous value detected here is derived from the known pegmatitic mineralisation, the commercial significance of which has been discussed in Chapter III.

East of Oterstrand and south of Laksaadals Vatn a number of small rills and one larger stream drain the precipitous northerly facing granite-gneiss slope. Most of these streams die out in the scree slope before entering the lake. No anomalous values occur in these streams, a maximum level of 5 p.p.m. Mo being recorded in sample 2102. The sample density in this region is of necessity low, but the stream sediment evidence, in conjunction with that of the rock-chip survey (see Chapter V) suggests that possible moblydenum mineralisation in the north face of the granite-gneiss is limited to the sparsely disseminated, probably non-commercial type previously described.

North of Laksaadals Vatn where the schists structurally underlie the granite-gneiss the terrain is generally poorly exposed and rather boggy. No well developed stream system exists although a number of small streams arise in the boggy ground to the north and drain directly into Laksaadals Vatn. Several of the streams cross the strike extensions of the Laksaadal and other minor molybdenite-bearing bodies. Only one sample (2306), collected about 1 kilometre west of the mine is possibly anomalous, with a content of 6 p.p.m. Mo.

East of Laksaadals Vatn the Laksaadal River and associated streams form a well developed drainage system, principally in the schists but closely following the eastern granite-schist contact. Several samples from this system contain anomalous levels of Mo, the distribution of which is discussed below.

In its lower course the Laksaadal River flows over the granite-gneiss although bedrock is not exposed in the stream. It is joined by several tributaries from the north mainly arising in schistose country rock, and a number of very small watercourses from the south, arising directly on the exposed granite-gneiss slopes. In the main course of the river here only one sample (2202) containing 6 p.p.m. Mo is possibly anomalous. High levels of Mo do not occur in the north bank tributaries except for that draining the Ovre Laksaadal trial (2203, 5 p.p.m.). South of the main river, several samples (2105, 2323-2326) from small rills draining the granite-gneiss contain levels of 3-15 p.p.m. Mo. These values are probably derived from the sparsely disseminated molybdenite mineralisation in the latter. Upstream from here (approximately G.R. 550255) the course of the Laksaadal River is confined to terrain underlain by schist (mainly garnet, two-mica schist).

Between approximately G.R. 553258 and G.R. 558259 the river flows in a steep gorge in which fine sediment is generally lacking. Samples from the foot of the gorge 2220 and the head of the gorge (2221) contain 50 p.p.m. and 40 p.p.m. Mo respectively.

About 1 kilometre upstream at G.R. 561251 the river is joined by a large east bank tributary arising entirely over schistose rocks. A sample from this stream (2230) and a northern, second order tributary of the latter (2229) contain anomalous levels of 20 p.p.m. and 10 p.p.m. Mo respectively. A third sample (2236) in the Laksaadal River immediately upstream from this confluence contains 40 p.p.m. Mo. No further anomalous samples occur in the main river or its tributaries for approximately 2 kilometres upstream.

Upstream from G.R. 551231 several anomalous values occur in the main stream (2262 - 20 p.p.m.; 2263 - 10 p.p.m.) and in small west bank tributaries directly draining the granite-gneiss margin (2264 - 15 p.p.m.; 2266 - 10 p.p.m.).

4.3.2. Laksaadalen Area; Tungsten (W)

The geochemical stream sediment analyses for W are plotted in four classes (< 5 p.p.m., 5-10 p.p.m., 11-15 p.p.m., > 15 p.p.m.) on Enclosure 4. They show a broadly similar distribution to those for molybdenum, with anomalous values ranging up to 60 p.p.m. W. The distribution of values is discussed briefly below.

In the Galtskar bekken and associated streams, northwest of Laksaadals Vatn which entirely drain schistose rock, most samples contain less than 4 p.p.m. W, which is the detection limit of the colorimetric method. Three samples (2288-2291) in the upper part of the system contain high background levels of 8 p.p.m. W, and two isolated samples (2300 and 2078) contain possibly and probably anomalous levels of 12 p.p.m. and 20 p.p.m. W, respectively.

Around Oterstrand Mine several samples contain anomalous or high background levels of W. Sample 2107 (G.R. 520240) collected over schistose rock, immediately above its contact with the granite-gneiss contains the probably anomalous level of 32 p.p.m. W. Samples 2089, 2093, 2097 and 2099.collected over the granite-gneiss below the contact contain possibly anomalous levels of 12 p.p.m. W. A further sample (2112) collected over schists also contains 12 p.p.m. W.

South of Laksaadals Vatn in the streams directly draining the northern face of the granite-gneiss only one sample (2327, 12 p.p.m. W) is possibly anomalous.

North of Laksaadals Vatn, near the abandoned mine, most samples contain 4 p.p.m. W or less, only sample 2306, containing 20 p.p.m. W is anomalous.

In the Laksaadal River system the distribution of tungsten values is similar to that for molybdenum. Anomalous values up to 60 p.p.m. W occur in samples 2201, 2202, 2211, 2212, 2216, 2217, 2219 and 2220, all of which are from the lower course of the main river. Anomalous values do not occur in sediments from the tributaries in this part of the system.

Further upstream a sample (2222), from a small tributary entering the main river at G.R. 560258, containing 12 p.p.m. W is possibly anomalous and a further possibly anomalous value occurs in sample 2234 from the east bank tributary entering the main river at G.R. 561251. Samples 2238 and 2240 from the main river upstream from this confluence contain 12 p.p.m. or 16 p.p.m. W respectively, and sample 2241 from a small east bank tributary (G.R. 558239) also contains 12 p.p.m. W.

No anomalous values occur in the next kilometre upstream, but samples 2253 and 2261 from east and west bank tributaries entering the main river at G.R. 552232 both contain probably anomalous levels of 16 p.p.m. W. Sample 2255 in a small second order tributary at G.R. 549231 draining the granite-gneiss margin contains the possibly anomalous level of 12 p.p.m. W, and sample 2266 (G.R. 546227) also from a west bank tributary draining the granite-gneiss margin contains 16 p.p.m. W.

4.3.3. Spilderdalen Area; Mo

4.3.3a General

In the Spilder Vatn and Spilderdals Vatn area a well developed drainage system exists in the schists lying north of the granite-gneiss, but drainage over the latter rock type is largely confined to small rills flowing down the precipitous north face of Spilderhesten. East of Spilderdals Vatn, however, a moderately large riversystem drains the eastern granite-schist contact. No significant molybdenum mineralisation has been reported in this area although the geological setting is very similar to that around Laksaadals Vatn.

4.3.3b Distribution of Values

The streams draining the schistose rocks north of Spilder Vatn and Spilderdals Vatn were sampled at a moderate density. The stream sediment samples are characterised by an almost complete absence of anomalous levels of Mo. Only one sample (2053) containing 10 p.p.m. Mo is possibly anomalous. Nine samples contain high background levels of Mo (3-5 p.p.m.) and the remainder (over 100 samples) contain less than 3 p.p.m. Mo. Consequently it is considered that there is very little possibility of large scale commercial molybdenum mineralisation being discovered in these rocks.

South of the two lakes in the streams directly draining the granite-gneiss, many of the sediment samples contain high background or anomalous values. Samples 2067, 2068, 2069, 2071 and 2446-9 are all probably anomalous, containing between 12 p.p.m. and 25 p.p.m. Mo, and samples 2066, 2070, 2430, 2437, 2438 and 2445 containing 7 p.p.m. or 8 p.p.m. Mo are possibly anomalous.

4.3.4. Spilderdalen Area; W

North of the lakes, where the streams drain schistose rocks in a similar structural setting to those north of Laksaadals Vatn the vast majority of samples contain low background (< 5 p.p.m.) levels of W. The exceptions are samples 2030, 2335, 2402, 2410, 2417 and 2422 containing high background levels of 8 p.p.m. W, and samples 2000, 2004, 2359, 2360, 2398 and 2408 containing anomalous levels of 12 p.p.m.-60 p.p.m. W. Of these, samples 2000 (28 p.p.m. W) in the main river at the head of Spilderdals Vatn and 2398 (36 p.p.m. W) in the river flowing from Spilderdals Vatn could be derived from the granite-gneiss. In general the anomalies have a scattered distribution and do not indicate an extensive source of mineralisation.

South of Spilder Vatn and Spilderdals Vatn about 30% of the samples contain high background or possibly anomalous values ranging up to 12 p.p.m. W. Such samples are largely confined to the area south of Spilderdals Vatn mainly from streams directly draining the granite-gneiss, although those at the western end of the lake drain the granite-schist contact.

4.3.5. Laksaadalen-Spilderdalen Area; Other Metals

Thirty-nine samples have been analysed spectrographically for the following metals; Ni, Co, Cu, Ag, Sn, Bi, V, Cr, Pb, Zn, Mn and Ti. Of these samples, 27 were stream sediment samples and the remainder rock chip samples. In the former case the analysis was carried out on a sub-sample of the minus 80 mesh (BS) fraction of the sediment, ground to minus 200 mesh (BS). Sixteen of the samples were from the Laksaadalen area and 11 from the Spilderdalen area giving an average sample density of about one per square kilometre. The analytical results are given in Table 2.

None of the samples contain anomalous levels of the metals which were sought, and on the basis of the stream sediment survey there is no indication that significant deposits of these metals occur within the survey areas.

TABLE 2

Spectrographic Analyses of Selected Stream Sediment Samples

Sample No.	Metal Content of Samples in ppm							Stream Sediment Samples					
	Ni	Co	Cu	Ag	Sn	Bi		V	Cr	Pb	Zn	Mn %	Ti %
BOC2000	40	25	30	<1	<5	<5		100	100	30	90	0.2	>0.5
BOC2004	30	15	20	<1	<5	<5		70	100	20	110	0.1	>0.5
BOC2053	40	25	15	<1	<5	<5		100	150	20	110	0.2	0.5
BOC2067	20	10	10	<1	<5	<5		70	50	40	70	0.1	0.5
BOC2069	20	10	15	<1	<5	<5		70	50	50	70	0.1	0.5
BOC2093	60	20	40	<1	<5	<5		150	200	20	100	0.2	<0.5
BOC2201	30	15	30	<1	<5	<5		150	200	20	100	0.2	>0.5
BOC2209	40	15	20	<1	<5	<5		200	200	20	95	0.2	>0.5
BOC2215	30	10	15	<1	<5	<5		50	100	20	90	0.1	>0.5
BOC2220	50	25	30	<1	<5	<5		200	200	20	-	0.3	>0.5
BOC2229	60	25	30	<1	<5	<5		200	200	20	100	0.2	>0.5
BOC2230	50	25	30	<1	<5	<5		200	300	20	100	0.3	>0.5
BOC2236	40	20	30	<1	<5	<5		100	250	40	140	0.3	>0.5
BOC2246	30	20	40	<1	<5	<5		70	70	40	160	0.1	>0.5
BOC2260	50	20	20	<1	<5	<5		200	100	20	130	0.2	>0.5
BOC2262	50	15	40	<1	<5	<5		200	100	70	110	0.2	>0.5
BOC2265	50	15	20	<1	<5	<5		100	100	60	110	0.1	>0.5
BOC2287	50	20	30	<1	<5	<5		200	300	20	100	0.3	>0.5
BOC2300	30	15	20	<1	<5	<5		200	100	20	90	0.1	>0.5
BOC2315	15	5	5	<1	<5	<5		70	100	20	45	0.2	>0.5
BOC2321	15	10	10	<1	<5	<5		100	70	20	80	0.1	>0.5
BOC2335	50	20	40	<1	<5	<5		200	150	20	110	0.3	>0.5
BOC2350	50	30	40	<1	<5	<5		100	150	50	170	0.4	0.3
BOC2360	50	15	30	<1	<5	<5		150	150	15	110	0.2	>0.5
BOC2402	50	15	40	<1	<5	<5		200	150	15	55	0.3	>0.5
BOC2418	30	10	30	<1	<5	<5		100	100	20	90	0.2	0.5
BOC2449	10	<5	3	<1	<5	<5		70	50	20	50	0.1	0.5

NOTE: Grid references for these samples are given in the Appendix, Table 1A.

V

ROCK CHIP SURVEY

5.1. General

In order to determine whether the Bjellatind granite-gneiss is likely to contain commercial concentrations of molybdenum or tungsten mineralisation a rock chip survey was carried out over the accessible parts of the mass.

The eastern flank of the granite-gneiss is well exposed in extensive dip slopes inclined at about 30° eastwards stretching from the northern limit of the Laksadaal River to Lys Vatn in the south. This area was selected for a reconnaissance rock chip survey because of its accessibility, good exposure (almost 100%) and the presence of traces of molybdenite particularly near the northern and northeastern margin of the mass. Elsewhere the granite-gneiss is less amenable to detailed sampling. On the eastern flank between Bjellatind and Galtskartind it is overlain by later metasedimentary rocks, whilst in the northwest around Oterstrand and Katt Vann it is largely obscured by superficial deposits. In the northerly facing wall, immediately south of the lake the granite-gneiss is well exposed but is too precipitous for detailed sampling, although a number of rock chip samples were obtained from the base of the wall immediately above the scree slope.

5.2. Grid Samples; (Mo and W)

A total of 76 rock chip samples were collected over the eastern flank of the granite-gneiss on an approximate 250 metre grid basis, to assess the possibility of disseminations of molybdenite-scheelite within the granite generally. The samples were obtained on four traverse lines (traverses A to D) with an approximate 250 metre separation, oriented parallel to the strike of the granite gneiss (i.e. south to southwest). The traverse lines are shown on Figure 7. Traverse D is terminated northeastwards by the edge of the Bjellatind corrie. Because the ground surface here is largely controlled by the dip slope the samples collected on this grid system represent essentially a single structural and stratigraphical level of the granite-gneiss.

The Mo and W contents of these chip samples, none of which contain visible or fluorescent mineralisation, are shown in Table 3, the analyses being determined colorimetrically.

The Mo content of the samples ranges from less than 2 p.p.m. to 20 p.p.m. and the W content from less than 4 p.p.m. to 20 p.p.m. The average Mo content of the samples is 3 p.p.m. (including samples less than 2 p.p.m. as 2 p.p.m.) and the average W content is 6 p.p.m. (including samples less than 4 p.p.m. as 4 p.p.m.).

Although the granite-gneiss here contains an above average content of Mo and W for such a rock, in no case do individual samples approach a potentially commercial grade (several thousand p.p.m. combined Mo and W). The occasional higher values which do occur (a maximum of 32 p.p.m. combined Mo and W) have an apparently random distribution and show no progressive increase in values which might suggest a greater concentration at depth.

5.3. Miscellaneous Rock Chip Samples; (Mo and W)

A number of other rock chip samples have been collected in the granite or the schists immediately overlying the granite, either individually or in short traverses. These are discussed below.

i. South of Laksadaals Vatn the steep northerly facing wall of the granite-gneiss was sampled immediately above the scree slope. The samples were collected at approximately 200 metre intervals between grid reference 547246 and 539243 and represent a much lower structural/stratigraphical level of the granite-gneiss than the grid samples. The Mo and W contents of the samples (E1-E4) are shown in Table 1. The highest levels are 2 p.p.m. molybdenum and 12 p.p.m. tungsten, which do not indicate the presence of economic mineralisation within the sampled area.

ii. Immediately south of the Laksadaal River disseminated molybdenite

TABLE 3

Colorimetric Analyses of Granite-Gneiss

Rock Chip Samples for Mo and W

Sample No.	Mo ppm	W ppm
A1	20	12
A2	6	12
A3	2	12
A3A	5	< 4
A4	4	< 4
A5	< 2	< 4
A6	6	< 4
A7	3	< 4
A8	< 2	12
A9	< 2	12
A10	4	< 4
A11	7	12
A12	4	< 4
A13	2	< 4
A14	2	< 4
A15	2	12
A16	< 2	< 4
A17	4	< 4
A18	2	< 4
A19	< 2	< 4
A19A	2	< 4
A20	2	12
A21	8	16
B1	2	< 4
B2	< 2	< 4
B3	< 2	< 4
B4	< 2	< 4
B5	< 2	< 4
B6	< 2	< 4
B7	2	< 4
B8	< 2	< 4

Table 3 Continued

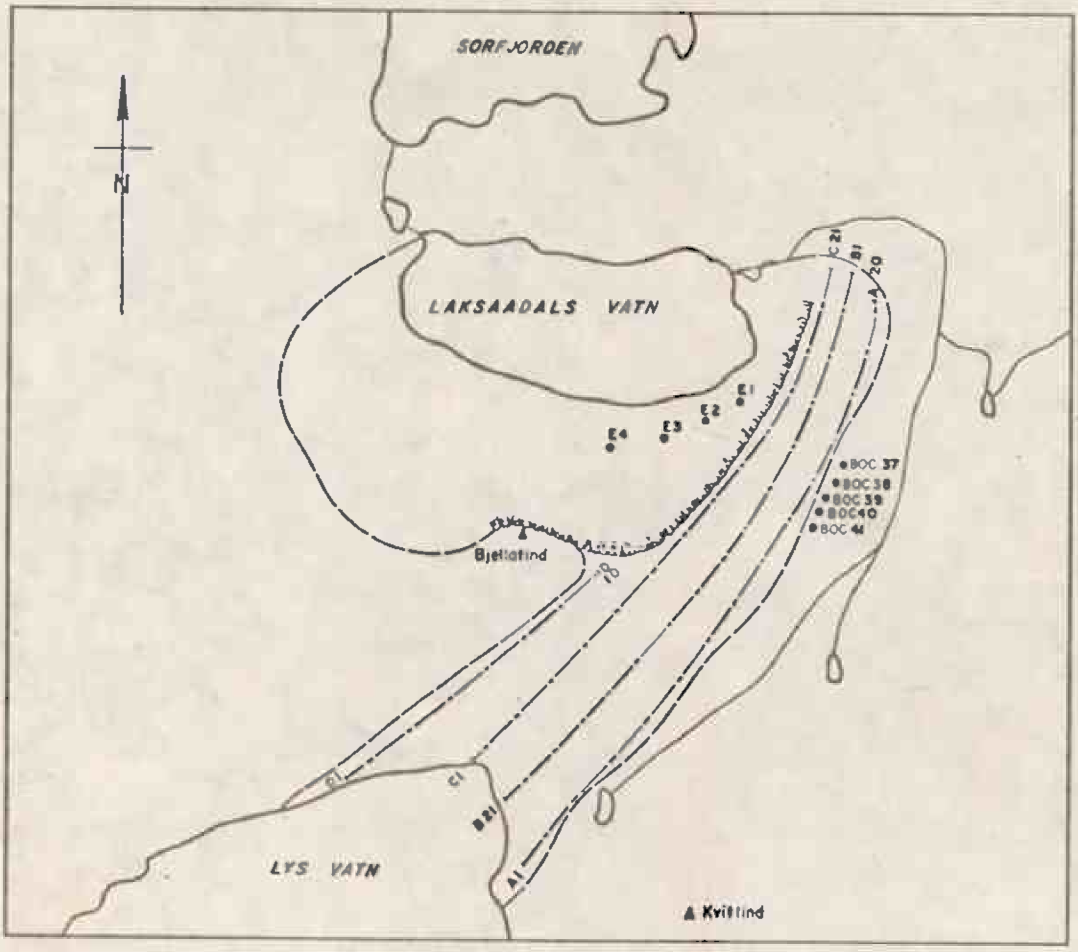
Sample No.	Mo ppm	W ppm
B9	< 2	8
B10	< 2	8
B11	10	12
B12	< 2	< 4
B13	< 2	< 4
B13A	< 2	< 4
B14	< 2	< 4
B15	3	< 4
B15A	< 2	< 4
B16	< 2	20
B17	3	< 4
B18	2	< 4
B19	< 2	< 4
B20	< 2	< 4
C1	2	< 4
C2	< 2	< 4
C3	2	< 4
C4	2	< 4
C5	< 2	< 4
C6	< 2	< 4
C7	< 2	< 4
C8	< 2	< 4
C9	< 2	< 4
C10	8	12
C11	< 2	< 4
C12	< 2	< 4
C13	2	< 4
C14	< 2	< 4
C15	2	< 4
C16	< 2	< 4
C17	< 2	< 4

Table 3 Continued

Sample No.	Mo ppm	W ppm
C18	< 2	< 4
C19	2	12
C20	< 2	< 4
C21	< 2	12
D1	2	< 4
D2	< 2	< 4
D3	< 2	< 4
D4	< 2	< 4
D5	2	< 4
D6	< 2	12
D7	2	< 4
D8	3	12
D9	< 2	< 4
D10	< 2	12

Footnote:

The samples were collected at approximately 250 metre intervals along four traverse lines, A-D shown on Figure 7.



ROCK CHIP TRAVERSES AND SAMPLE LOCATIONS

SCALE 1:50,000 KILOMETERS

0 1 2 3

LEGEND

Granite – Gneiss margin

Rock chip traverse, sampled at 250 metre intervals C1 — C21

Other rock chip sample positions • BOC 37

FIGURE 7

mineralisation occurs in the granite-gneiss near its northeastern contact with the schists. Molybdenite flakes up to 5 mm across are sparsely disseminated in the granite, commonly one metre or more apart. Irregular feldspathic veins and masses in the immediately overlying schists also locally contain molybdenite.

In order to determine the level of molybdenum or tungsten mineralisation, chip samples were collected in the schist (sample BOC24A), and in the granite gneiss at intervals of 1, 2, 4, 6, 8, 15 and 30 metres (samples BOC24B-24M respectively) from the contact. None of the collected samples contained macroscopic Mo and W mineralisation. The analytical results are shown in Table 1. Two of the samples from the granite-gneiss contain moderately high molybdenum and tungsten values (maximum of 76 p.p.m. combined Mo and W), but none approach ore-grade.

iii. On the eastern margin of the granite-gneiss sparsely disseminated molybdenite also occurs within the granite but greater concentrations occur locally in small irregular feldspathic masses in the flaggy schists immediately overlying the granite-gneiss. Most of these occurrences are located on the map entitled 'Molybden I Gildeskal' held by British Oxygen Minerals.

Though the visible mineralisation here is probably sub-economic, seven chip samples of the schist in this zone were collected at 100 metre intervals in a south-southwesterly direction (between occurrences 14 and 19 on the 'Molybden I Gildeskal' map); they are located on Figure 7 The Mo and W contents of the samples are given in Table 1. Samples BOC36 to 41 are from the schists approximately 1 metre above the granite contact. Sample BOC41A was collected at the southwestern end of the traverse in the schists about 60 metres east of, and about 10 metres structurally or stratigraphically above the contact and sample BOC41B was collected in the granite 25 metres west of the contact.

The metal contents range from 2 p.p.m. to 15 p.p.m. Mo and from 8 p.p.m. to 16 p.p.m. W. Thus, although there are small, local concentrations of molybdenite in the schist, and to a lesser extent the granite here, there appears to be no extensive enrichment of the rocks to ore-grade mineralisation.

5.4. Rock Chip Samples; (Other Metals)

Twelve rock chip samples have been analysed spectrographically for the following metals; Ni, Co, Cu, Ag, Sn, Bi, V, Cr, Pb, Zn, Mn and Ti. The analytical results are given in Table 4. Samples A21, B16, C10 and D9a are from the grid sampling, of the Bjellatind granite-gneiss and the remainder are miscellaneous samples mainly from the vicinity of the Laksaadal and Oterstrand Mines.

High levels of copper occur in samples BOC14 (1000 p.p.m.), BOC30 (500 p.p.m.), BOC33A (300 p.p.m.) and BOC35 (1000 p.p.m.). Sample BOC14 was collected from a small pegmatite east of Laksaadal Mine at GR.542257. The pegmatite contains visible traces of molybdenite, pyrite and chalcopyrite. Sample BOC30 is from the Ostgang pegmatite of the Laksaadal Mine. It was collected because of the presence of a blue-fluorescent mineral (scheelite) but does not contain visible copper mineralisation. Sample 33A is from a pegmatite (No. 3 on Figure 6) in the Oterstrand area and Sample 35 is from the Oterstrand Mine pegmatite (No. 6 on Figure 6) both of which were collected because of the presence of a blue-fluorescent mineral.

Probably, therefore, the molybdenite-bearing pegmatites of the Laksaadal-Oterstrand area contain above average levels of copper, at least locally. Significant levels of the other metals sought spectrographically do not occur in the rock chip samples.

TABLE 4

Spectrographic Analyses of Selected Rock Chip Samples

Sample No.	Metal Content of Samples in ppm										%	
	Ni	Co	Cu	Ag	Sn	Bi	V	Cr	Pb	Zn	Mn	Ti
A21	5	<5	40	<1	<5	<5	20	50	60	40	0.1	0.3
B16	5	<5	5	<1	<5	<5	40	50	40	65	0.1	0.5
C10	5	<5	5	<1	<5	<5	30	50	50	50	0.1	0.5
D9(a)	10	<5	50	<1	<5	<5	150	70	40	120	0.1	>0.5
BOC7	5	<5	5	<1	<5	<5	30	50	30	30	0.1	0.2
BOC14	30	<5	1000	2	<5	<5	40	70	30	75	0.1	0.4
BOC27	30	5	15	<1	<5	<5	70	70	50	80	0.1	0.4
BOC30	300	80	500	<1	>5	<5	30	70	<5	25	0.1	0.2
BOC30A	50	20	15	<1	15	<5	70	70	30	60	0.1	0.5
BOC33	10	<5	50	<1	<5	<5	20	30	20	15	1.0	0.2
BOC33A	500	100	300	<1	<5	<5	20	70	<5	15	0.05	0.1
BOC35	10	20	1000	<1	<5	<5	20	50	30	20	0.05	0.2

Footnote:

Samples A21, B16 and C10 are granite-gneiss samples from the traverse lines shown in Figure 7. The remainder are miscellaneous samples, mainly from the mine areas, the grid references of which are given in Table 1.

VI

CONCLUSIONS

Known occurrences of molybdenum associated locally with minor tungsten and copper mineralisation are widespread around Laksaadals Vatn. They occur principally in pegmatitic bodies in the schists surrounding the Bjellatind granite-gneiss massif, and to a lesser extent as disseminations in the latter. Two of the larger pegmatites have been exploited in the past, but in both cases the known ore reserves are much too small for the requirements of British Oxygen Minerals. The present survey was carried out in order to determine whether other, more viable Mo or W mineralisation occurs around Laksaadal Vatn, or around Spilderdalen further south which is in a geologically similar environment. This involved geochemical stream sediment sampling in both areas and rock chip sampling over parts of the granite-gneiss in the north.

On the basis of this work it has been possible to delineate two main anomalous areas, one in Laksaadalen and one in Spilderdalen, which are possibly related to significant and potentially viable Mo-W mineralisation, and to show that elsewhere within the survey area, deposits of the size sought by British Oxygen Minerals are unlikely to be discovered. These points are discussed in further detail below.

Laksaadalen Area

An extensive group of anomalies occurs in the lower part of the Laksaadal River from the head of the gorge (approximately G.R. 558258) downstream. Some anomalies, in the lowest part of this section may be derived from the disseminated mineralisation in the granite-gneiss to the south, but those upstream from approximately G.R. 550250 are probably associated with mineralisation within the schists. Anomalous values of W extend discontinuously upstream approximately as far as G.R. 546227 but Mo anomalies are grouped around

G.R. 560250 and 550230. The former group is possibly derived from mineralisation within the schists and the latter from the granite or granite-schist. The grade of the possible mineralisation is presently unknown but the indications, particularly for W, are widespread in the Laksaadal River system. Elsewhere within the Laksaadalen area, in the granite-gneiss itself, and in the schists northwest of the massif there is no indication of viable concentrations of Mo and W, on the scale required by British Oxygen Minerals.

Spilderdalen Area

On the southern side of Spilderdalen high background and anomalous levels of Mo (up to 25 p.p.m.) and W (up to 12 p.p.m.) occur in many of the streams directly draining the granite-gneiss or its contact with the schists. Most of these are at the western end of the massif, between Spilder Vatn and Spilderdals Vatn. The anomalies may be derived from disseminations in the granite-gneiss, or, disseminations or segregations in the schists although it is possible that low pH conditions prevailing in the boggy ground here have produced spurious concentrations of Mo. At this stage, however, the anomalies are considered to be potentially significant, and possibly indicative of commercial Mo-W mineralisation.

In the extensive area of schists north of the granite-gneiss very few anomalous stream sediment samples occur, and with the possible exception of a small group of anomalous W values around G.R. 513193, it is very unlikely that a significant source of Mo or W will be discovered in these rocks.

VII

RECOMMENDATIONS

It is recommended that further work is carried out to locate the sources of the Mo and W anomalies delineated by the reconnaissance stream sediment survey in the Laksaadalen and Spilderdalen areas, and to determine whether they are derived from viable mineralisation on the scale required by British Oxygen Minerals. It is recommended that this work is executed on the following basis :

7.1 Laksaadalen Area

i. In the Laksaadalen area overburden and rock chip sampling (depending on the terrain) should be carried out over the anomalous areas of schistose country rock lying to the east and northeast of the Bjellatind granite-gneiss.
It is suggested that, initially, the samples are collected on a 100 metre grid from two sub-areas delineated below -
Sub-Area 1 bounded by grid lines 545, 260, 565 and 245, excluding the granite-gneiss within this area which has already been sampled with negative results;
Sub-Area 2 This smaller, less important area lies southeast of the granite-gneiss margin centred on G.R. 550230 and extending approximately 500 metres from northwest to southeast, and 1000 metres from southwest to northeast.
This stage of the work would involve the collection of 300-350 samples, the analysis of which should ideally be carried out concurrently with the field operations.

ii. If justified on the basis of stage (i) of the work outlined above, an anomalous area or areas should be selected for detailed geophysical work to determine the extent and form of possible ore-bodies, probably utilising electromagnetic or induced polarisation techniques.

iii. Assuming positive results were obtained in stages (i) and (ii) diamond core drilling should be carried out over the anomalous areas to determine the type, grade and reserves of the possible mineralisation.

7.2 <u>Spilderdalen Area</u>

i. In the Spilderdalen area further work should be undertaken initially to locate the source of the Mo and W anomalies occurring on the south side of tne valley between Spilder Vatn and Spilderdals Vatn. This would involve the following -

a. overburden, and rock chip sampling of accessible parts of the granite-gneiss and surrounding schists at the foot of the steep northern face of Spilderhesten between (eastings) 468 and 490;

b. stream sediment and rock chip sampling over accessible parts of the granite-gneiss on the southern flanks of Spilderhestern, south of the present survey area.

This stage would involve a maximum of about 200 samples, and could best be carried out between stages (i) and (ii) of the recommended work in the Laksaadalen area.

ii. If justified on the basis of stage (i) described above, geophysical and drilling investigations should be undertaken as outlined in stages (ii) and (iii) of the recommendations for the Laksaadalen area.

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* Includes detailed geological bibliography

APPENDIX

TABLE 1A

Colorimetric Analyses of Stream Sediment Samples for Molybdenum and Tungsten (ppm)

Sample No.	Grid Reference	Mo ppm	W ppm
2000	520182	3	28
2001	521182	< 2	< 4
2002	523181	4	< 4
2003	523182	3	< 4
2004	524182	3	36
2005	524180	2	4
2006	525180	3	< 4
2007	527183	2	< 4
2008	525180	2	< 4
2009	525179	3	< 4
2010	526178	3	< 4
2011	526177	3	< 4
2012	527177	2	< 4
2013	528178	3	< 4
2014	527178	3	< 4
2015	531176	3	< 4
2016	533176	3	< 4
2017	533175	3	< 4
2018	533174	2	< 4
2019	532174	3	< 4
2020	530176	5	< 4
2021	528177	3	< 4
2022	527176	5	< 4
2023	525176	2	< 4
2024	524178	2	< 4
2025	524177	3	< 4
2026	523179	2	< 4
2027	523180	2	< 4
2028	521181	2	< 4
2029	478183	< 2	< 4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2030	478183	3	8
2031	478183	< 2	< 4
2032	478184	2	< 4
2033	478184	< 2	< 4
2034	477186	2	< 4
2035	477188	3	< 4
2036	478192	3	< 4
2037	479191	2	< 4
2038	479193	< 2	< 4
2039	480193	< 2	< 4
2040	481193	2	< 4
2041	482194	2	< 4
2042	483195	3	< 4
2043	476185	2	< 4
2044	477182	3	< 4
2045	477178	2	< 4
2046	476180	< 2	< 4
2047	475180	2	< 4
2048	475183	< 2	< 4
2049	473181	< 2	< 4
2050	470177	< 2	< 4
2051	469176	2	< 4
2052	467175	3	< 4
2053	465175	10	4
2054	462175	2	< 4
2055	459174	3	4
2056	457173	2	< 4
2057	457167	2	< 4
2058	458167	4	< 4
2059	459167	8	< 4
2060	461167	3	< 4
2061	462168	5	< 4
2062	463168	3	< 4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2063	465169	4	< 4
2064	466169	3	< 4
2065	468170	5	4
2066	469171	8	< 4
2067	471172	15	< 4
2068	473173	15	< 4
2069	474174	20	< 4
2070	481177	8	< 4
2071	482177	15	12
2072	483177	7	< 4
2073	484177	4	8
2074	522263	2	< 4
2075	520263	3	< 4
2076	518263	3	< 4
2077	518262	5	< 4
2078	516262	3	20
2079	513261	2	< 4
2080	513262	< 2	< 4
2081	513262	8	< 4
2082	515262	3	< 4
2083	523258	3	< 4
2084	522258	3	24
2085	521255	3	< 4
2086	519255	3	< 4
2087	520255	3	4
2088	517253	2	< 4
2089	519246	2	12
2090	520247	2	8
2091	521247	8	8
2092	522248	5	< 4
2093	520246	30	12
2094	520245	3	< 4
2095	521244	2	< 4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2096	522244	2	< 4
2097	523243	2	12
2098	528242	3	8
2099	528243	3	12
2100	535245	3	< 4
* 2102	532246	5	< 4
2103	530247	4	< 4
2104	525251	4	< 4
2105	552255	15	< 4
2106	521239	4	< 4
2107	520240	3	32
2108	519240	3	< 4
2109	519242	2	< 4
2110	516245	2	< 4
2111	516246	2	< 4
2112	516247	3	12
2114	551257	< 2	< 4
2201	545255	2	24
2202	546255	6	24
2203	546255	5	8
2204	546256	2	8
2205	546257	< 2	4
2206	546258	< 2	< 4
2207	547255	< 2	8
2208	548255	< 2	8
2209	549256	3	16
2210	548256	< 2	< 4
2211	548256	4	16
2212	548256	< 2	24
2213	548256	2	4
2214	547257	2	< 4
2215	547258	< 2	< 4
2216	551256	< 2	16
* 2101	533246	4	< 4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2217	551257	< 2	60
2218	552257	< 2	8
2219	552257	< 2	60
2220	553258	50	32
2221	558258	40	< 4
2222	561258	< 2	12
2223	560258	2	< 4
2224	561258	< 2	8
2225	561256	< 2	4
2226	561254	< 2	8
2227	562251	< 2	< 4
2228	561251	< 2	4
2229	564251	10	< 4
2230	564250	20	< 4
2231	566252	< 2	< 4
2232	566252	< 2	< 4
2233	565247	< 2	8
2234	564248	< 2	12
2235	560252	2	8
2236	561249	40	< 4
2237	560250	2	4
2238	559248	< 2	12
2239	559245	< 2	< 4
2240	558242	< 2	16
2241	558239	< 2	12
2242	557239	< 2	< 4
2243	556235	< 2	< 4
2244	555235	2	< 4
2245	555234	< 2	< 4
2246	554230	2	< 4
2247	554228	< 2	4
2248	554231	< 2	< 4
2249	554235	< 2	< 4
2250	553234	< 2	8

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2251	552233	< 2	< 4
2252	552233	< 2	4
2253	552231	2	16
2254	550232	2	< 4
2255	549231	< 2	12
2256	550230	< 2	8
2258	546229	< 2	< 4
2259	557239	< 2	< 4
2260	556236	2	< 4
2261	551232	2	16
2262	551231	20	< 4
2263	550229	10	< 4
2264	548228	15	< 4
2265	548227	3	< 4
2266	546227	10	16
2267	548227	2	< 4
2268	547226	< 2	8
2269	545225	< 2	< 4
2270	544224	< 2	< 4
2271	543223	< 2	8
2272	542223	< 2	< 4
2273	540222	< 2	< 4
2274	538220	< 2	< 4
2275	539220	< 2	< 4
2276	538218	< 2	< 4
2277	527226	< 2	< 4
2278	528227	< 2	4
2279	522263	< 2	4
2280	521262	< 2	< 4
2281	520261	< 2	< 4
2282	519260	< 2	< 4
2283	518260	< 2	< 4
2284	518259	< 2	< 4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2285	517257	< 2	4
2286	515256	< 2	4
2287	514255	< 2	< 4
2288	512254	< 2	< 4
2289	512253	< 2	8
2290	510252	< 2	8
2291	509251	< 2	8
2292	510248	< 2	< 4
2293	511245	< 2	4
2294	507247	< 2	4
2295	508249	2	< 4
2296	517261	< 2	< 4
2297	515259	< 2	< 4
2298	514257	< 2	< 4
2299	513257	< 2	4
2300	512256	< 2	12
2301	512256	2	4
2257	548229	5	8
2302	513257	< 2	< 4
2303	519261	< 2	4
2304	518261	< 2	< 4
2305	517261	< 2	4
2306	528257	6	20
2307	529257	< 2	< 4
2308	532257	< 2	4
2309	535257	< 2	< 4
2310	536257	3	< 4
2311	537257	< 2	< 4
2312	541256	2	< 4
2313	541259	< 2	< 4
2314	541258	< 2	< 4
2315	542257	< 2	4
2316	542559	< 2	4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2317	543(4)257	< 2	4
2318	544257	< 2	4
2319	544259	< 2	4
2320	545257	< 2	4
2321	546257	< 2	8
2322	546258	< 2	4
2323	551255	6	4
2324	550255	4	4
2325	549255	3	8
2326	548255	8	4
2327	547244	3	12
2328	545243	3	8
2329	543243	2	4
2330	538243	< 2	< 4
2331	535245	< 2	4
2332	532246	5	< 4
2333	493182	< 2	< 4
2334	492182	< 2	< 4
2335	493183	< 2	8
2336	494184	2	< 4
2337	494183	< 2	< 4
2338	495184	< 2	< 4
2339	497184	< 2	4
2340	499186	< 2	4
2341	500186	< 2	4
2342	501187	< 2	< 4
2343	503187	< 2	< 4
2344	504188	< 2	< 4
2345	505188	< 2	< 4
2346	506188	< 2	4
2347	505188	< 2	4
2348	505192	< 2	4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2349	506192	< 2	< 4
2350	505194	2	< 4
2351	507193	< 2	< 4
2352	507194	2	4
2353	507195	3	< 4
2354	507196	2	< 4
2355	508196	3	4
2356	508197	< 2	< 4
2357	509197	< 2	4
2358	508197(8)	< 2	< 4
2359	513195	< 2	12
2360	513193	< 2	60
2361	513191	< 2	< 4
2362	513189	< 2	< 4
2363	512189	< 2	< 4
2364	511187	< 2	< 4
2365	510187	< 2	< 4
2366	509185	< 2	4
2367	490181	< 2	< 4
2368	488181	< 2	< 4
2369	487180	< 2	4
2370	485180	< 2	4
2371	499187	< 2	< 4
2372	499188	< 2	< 4
2373	498189	< 2	< 4
2374	499189	< 2	< 4
2375	499190	< 2	< 4
2376	499192	< 2	< 4
2377	498192	< 2	< 4
2378	498193	< 2	< 4
2379	492197	< 2	< 4
2380	492194	< 2	4
2381	492193	< 2	4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2382	491193	< 2	4
2383	489192	< 2	< 4
2384	489191	< 2	4
2385	488189	< 2	< 4
2386	488189	< 2	4
2387	485188	< 2	4
2388	482186	< 2	< 4
2389	481186	< 2	< 4
2390	480184	< 2	< 4
2391	480184	< 2	4
2392	480183	< 2	4
2393	479183	< 2	< 4
2394	478180	< 2	4
2395	484180	< 2	< 4
2396	482180	< 2	< 4
2397	477177	< 2	< 4
2398	477177	< 2	36
2399	476177	< 2	< 4
2400	475177	< 2	< 4
2401	474176	2	12
2402	474177	< 2	8
2403	472177	< 2	4
2404	514184	< 2	< 4
2405	514187	< 2	4
2406	514189	< 2	4
2407	514192(3)	< 2	4
2408	514193	< 2	12
2409	515192(3)	< 2	< 4
2410	515184	< 2	8
2411	516185	< 2	4
2412	517185	< 2	4
2413	517185	< 2	4
2414	517186	< 2	4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2415	517186	2	< 4
2416	518186	2	< 4
2417	520187	2	8
2418	519187	3	4
2419	521185	< 2	4
2420	522187	< 2	4
2422	523187	< 2	8
2423	524187	< 2	< 4
2424	523188	< 2	< 4
2425	524188	< 2	< 4
2426	525190	< 2	< 4
2427	517179	< 2	4
2428	516180	< 2	< 4
2429	515180	< 2	< 4
2430	514180	8	12
2431	513180	3	< 4
2432	510181	2	4
2433	508180	2	8
2434	505179	3	4
2435	503178	3	8
2436	499177	4	8
2437	496177	7	12
2438	493177	8	4
2439	493177	8	8
2440	492177	2	4
2441	490175	3	< 4
2442	489175	2	< 4
2443	489176	2	< 4
2444	489177	2	4
2445	488176	8	8
2446	487176	15	12
2447	487177	20	12
2448	486176	12	4

Table 1A continued

Sample No.	Grid Reference	Mo ppm	W ppm
2449	485176	25	8
2450	521183	< 2	4

NOTE: Many of the streams from which sediment samples were collected are not shown on the available topographic maps of the area. The grid references given in Table 1A are intended to locate sample positions on Enclosures 3 and 4, and are not precise field positions.