TASMANIA MINES LIMITED

A REVIEW OF THE GEOLOGY OF THE KARA AREA

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for

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SUMMARY

Scheelite has been produced from Tasmines' Kara properties since 1978 and magnetite has been sold since 1983.

Scheelite has been discovered in many outcropping and one blind scheelite-magnetite skarns.

Tasmines' Kara leases and licences have been explored for tungsten, tin, magnetite, gold and wollastonite.

Tungsten occurs as scheelite in scheelite-magnetite skarns; tin occurs in all skarns in trace to significant amounts as tin silicates; a small gold anomaly has been identified near Kara North.

Scheelite-magnetite skarns occur within rocks of the Transition Series and, less commonly, in Gordon limestone within 1 km of Devonian granite intrusions.

The Kara granites are separate from the Ringwood and Housetop Granites. At Kara No 1, the basement and outcrop granites are different, the basement granite being greisenised.

The granite most closely associated with the scheelite-magnetite skarns has been described as a megagranite with anomalous metal sulphide content.

A new view of the geology of the Kara area is based on the existence of a structural trend in the folded Palaeozoic sedimentary rocks, marked by the presence of several granite dykes, containing all the known economic scheelite-magnetite skarns and the only identified gold anomaly in the Kara area, and exhibiting mineral zoning along its length.

The priority for exploration for gold and tungsten in the immediate future should be along the structural trend described above. Exploration should not be blinkered by searching only for ore associated with massive magnetite.

1 INTRODUCTION

W.S. (Bill) Singline was granted an Exploration Licence which covered the Kara No 1 and Kara No 2 areas on the 4th of November 1968. His aim was to assess the potential of the Licence as a source of magnetite. The Licence was transferred to Tasminex NL on the 4th of August 1969. A joint venture with the Australia and New Zealand Exploration Company (ANZECO) ran from 1971 to 1974 with tungsten as the principal target. A second joint venture with McIntyre Mines (Australia) Pty Ltd ran from 1977 to 1985, also with tungsten as the principal target.

Tasminex NL changed its name to Tasmania Mines NL in 1985/86 and to Tasmania Mines Ltd in 1986/87.

Production of scheelite at Kara No 1 commenced in 1978. Magnetite fines, which were originally stockpiled during scheelite production, have been sold for use in cement manufacture since 1983 and as blast furnace feed since 1988: see Tables 1 and 2.

Mining at Kara No 1 continues today despite falling scheelite prices: see Appendix 1.

Magnetite lump and fines have been mined at Kara No 2 South since mid 1993 and sold for use in ferrosilicon, ferromanganese, cement and steel manufacture.

Since 1985, Tasmines has explored the Kara area with a view to its tungsten, tin, magnetite, wollastonite and gold potential. Understandably, the principal exploration target has been scheelite. In more recent years, as scheelite prices have fallen, magnetite, wollastonite and gold have been sought.

The search for scheelite-magnetite skarns has been undertaken using traditional exploration methods: geological mapping, soil and chip sampling, and ground and aerial magnetic surveys followed, where warranted, by diamond drilling. This approach has been successful in identifying not only outcropping magnetite bodies, but also one scheelite-magnetite skarn zone masked by Tertiary Basalt - the L5 deposit. At L5, drilling of a magnetic anomaly resulted in the discovery of the blind scheelite-magnetite skarn: see Figure 9.

Sampling of rock outcrops and diamond drill core has been undertaken to determine the tin content of the known skarns. Tin does occur in significant amounts in some skarns but, unfortunately, the tin is in the form of metallurgically unamenable tin silicates.

TABLE 1

KARA NO 1[1] - SCHEELITE PRODUCTION

financial year ending	ore mined[2] tonnes	high grade[3] concentrate tonnes	low grade[4] concentrate tonnes
1978[5]			119.5
1979			119
1980	39 844		143.5
1981	97 500		161.8
1982	126 823	286.2	29.7
1983	137 266	288.4	38.9
1984	113 435	363.8	9
1985	108 253	432	14
1986[6]	163 132	564	
1987	219 712	437	119
1988	88 112	511	
1989	129 260	478	37
1990	100 103	223	394
1991	74 886	90	561
1992	84 577		587
1993[7]	256 087	41	284

NOTES:
1 Nearly all Tasmines' scheelite production has come from Kara No 1 and the nearby Bob's Bonanza Pits.
2 Nearly all ore mined has come from Kara No 1 and Bob's Bonanza Pits.
3 High grade scheelite has a WO_3 content in excess of 65%.
4 Low grade scheelite has a typical WO_3 content of about 40%.
5 Scheelite production commenced in December 1977.
6 The new mill was built in the 1985/86 year.
7 The 1993 financial year ran for 18 months, ending December 1993.

TABLE 2

KARA NO 1 - SALES OF MAGNETITE FINES

financial year ending	ore mined tonnes	iron ore fines sold
1983	137 266	5 635
1984	113 435	none recorded
1985	108 253	7 700
1986	163 132	none recorded
1987	219 712	9 682
1988	88 112	31 024
1989	129 260	117 220
1990	100 103	93 890
1991	74 886	169 088
1992	84 577	100 094
1993[1]	256 087	243 709

NOTES:
1 The 1993 financial year ran for 18 months, ending December 1993.

Outcrops of a wollastonite deposit along Limestone Creek were identified during geological mapping and have been tested by diamond drilling. Laboratory testing of samples from the deposit was undertaken in the late 1980s to determine whether a commercially acceptable wollastonite concentrate could be produced; some testwork was also undertaken so that a beneficiation process could be designed. Current market conditions are such that it is unlikely that production of a wollastonite concentrate would be economically viable.

Gold exploration began with stream sediment sampling and analysis of existing diamond drill core samples. The early conclusion was that no gold anomalism existed (Whitehead, 1987). However, a recent review of the data, followed by further sampling of diamond drill core, has identified a gold anomaly in the Kara North area (McKeown, 1994).

This report summarises the understanding of the geology of the Kara area at the end of 1992, suggests changes to the current geological interpretation, and outlines the course of future exploration.

2 THE GEOLOGICAL DATABASE

A lot of geological data have been collected since exploration commenced, however, the data are dispersed amongst a plethora of annual and progress reports. Until now, there has been little attempt to organise the geological database. For example, there is no consolidated file of drill logs and the drill logs do not show all assays which have been completed nor all core, and associated petrological, descriptions by various workers.

Results of diamond drilling have generally been presented on cross sections. However, the cross section positions have not always been chosen systematically and each prospect has its own stand-alone set of sections. At Kara No 1, mining has been guided by cross sections and a subsequent computer based ore model based on those sections; this ore model has been a reasonable guide to mining.

There is no systematic set of geological plans. An interpretation of regional geology was made by McIntyre Mines staff during the joint venture (1977 to 1985) and has been in use ever since: see Figure 1. Routine geological mapping of the Kara No 1 pit has not been carried out.

Generally, there has been a tendency to concentrate on some aspects of data collection, e.g. chip and rock sampling, and to ignore others, e.g. detailed geological mapping. There has also been a tendency to collect data and not to use it to synthesise a coherent geological interpretation. Where effort has been put into geological interpretation, most attention has been directed at a few problems of a petrological nature This is evident in many reports where a few items arise repetitiously:

- the origin of the quartz-epidote rock at the skarn-granite contact,
- the location of concentrations of scheelite within skarns, and
- the petrology of the granite immediately adjacent to scheelite skarns.

Structural aspects of the geology have been given little attention and a generalised structural interpretation has been accepted; the interpretation shows no faults and all granite occurrences are assumed to be part of a large, structurally homogeneous intrusion: see Figure 2. A significant exception was the report by Hopwood (1985) in which geological structure was given a high priority.

3 REGIONAL GEOLOGY

3.1 STRATIGRAPHIC SEQUENCE

The stratigraphic succession in the Kara area is shown in Table 3.

3.2 STRUCTURE IN THE SEDIMENTARY ROCKS

A regional structure of the folded Palaeozoic sedimentary rocks was presented by Pike in 1964; Figure 3 is a schematic summary of Pike's structural interpretation. The geological structure of the Kara area is dominated by a series of north-south striking folds in Palaeozoic sedimentary rocks.

Tasmines' traditional interpretation of the structure in the Kara No 1 area is shown in Figures 2 and 4. To the west of Kara No 1, a prominent anticline in Palaeozoic rocks occurs at Valentines Peak. The known economic scheelite-magnetite deposits occur along the limbs of the Kara Syncline with its axis running from just west of Kara South deposit, through the Kara North magnetite deposit towards L13. To the east, another syncline has its axis along Limestone Creek.

The scheelite-magnetite skarns occur mainly within rocks of the Transition Series, for example at Kara No 1, and less commonly, in the Gordon Limestone, for example parts of L5.

Cambrian hornfels and volcanics outcrop to the south and the west of Kara No 1 where they occupy the cores of anticlines and are flanked by Ordovician rocks.

3.3 GRANITES

The folded Palaeozoic rocks have been intruded by Devonian granite: for example, see Figure 5. Turner (1989) quotes McDougall (pers. comm.) as giving the Housetop Granite a K-Ar age of 353-370 Ma and a Rb-Sr age of 367+/-10 Ma.

TABLE 3

KARA AREA
STRATIGRAPHIC SUCCESSION

SEDIMENTARY ROCKS

Tertiary	Sub-basalt sediments	siltstone, mudstone, claystone, minor gravels
	Unconformity	
Silurian	Eldon Group	sandstone, quartzite
Ordovician	Gordon Limestone	limestone, minor calcareous sandstone
Ordovician	Transition Series	calcareous sandstone, sandstone, siltstone, minor limestone
Ordovician	Moina Sandstone	sandstone, minor quartzite siltstone, shale, slate and conglomerate
Ordovician	Roland Conglomerate	conglomerate, sandstone
	Unconformity	
Cambrian[1]	"Hornfels Group"	cherty hornfels, calc-silicate hornfels
Cambrian		laminated silty limestone
Cambrian		fossiliferous shale, mudstone and sandstone
Cambrian	"Acid Volcanics"	lavas, pyroclastics,tuffaceous sediments
Cambrian	undifferentiated	greywacke, slate, quartzite, acid lavas, tuff, mudstone, siltstone

IGNEOUS ROCKS

Tertiary		vesicular basalt
Devonian	Housetop, Ringwood and Kara Granites	biotite granite, pegmatite, quartz-feldsdpar porphyry, microgranite

Note:
1 The subdivision of the Cambrian sequence is that of Pike (1964).

The large outcrop of granite which lies to the east of the Kara area is known as the Housetop Granite. The smaller outcrop of granite to the west of Kara No 1 has been referred to by Tasmines' as the Ringwood Granite, and the granite outcrops in the Kara No 1 to Kara North area as the Kara granites.

All these granites are outcrops of part of a large granite mass which stretches beneath most of the Tasmanian west coast. The Housetop Granite differs physically from other Tasmanian granites in two respects: the Housetop Granite is denser than most other Tasmanian granites with a specific gravity of 2.63 - 2.65 compared with 2.61 for the Meredith Granite and 2.62 for the Heemskirk Granite; and not surprisingly, the Housetop Granite is also more magnetic than other Tasmanian granites (Leaman and Richardson, 1985).

The outcrops of the Ringwood Granite and the Kara granites are shown as continuous in Figure 5 and some other published maps, for example, on the Tasmania Mines Department 1:50000 St Valentines sheet. In fact, the granite outcrop is not continuous and Tasmines' maps show an outcrop of Cambrian sedimentary rocks between the Ringwood Granite outcrop and the outcrops of the Kara No 1 granites: see, for example, Figure 1.

3.4 MINERALISATION

Several magnetite skarns lie within, or adjacent to, the outcrops of the Housetop, Ringwood and Kara granites. Turner (1989) lists magnetite skarns at Kara No 1, Kara No 2, Sutton's, Hampshire (near the railway crossing), Redwater Creek, Laurel Creek and Peak Hill Farm. These magnetite bodies were worked sporadically in the past as sources of iron for steel making, e.g. at Pearson's workings in the Kara No 2 Main orebody.

Some of the magnetite skarns contain economic concentrations of scheelite e.g. those in the Kara No 1 area. Tungsten also occurs within the granites, probably in greisen zones or quartz tourmaline veinlets (Whitehead, 1981b). Brandt (1974) reported that granite at Kara No 1 contains small hydrothermal veins and disseminations of titano-haematite with tungsten in an "unknown form".

Tin anomalies occur in some of the magnetite bodies e.g. near the north and west margins of Kara No 2 Main (Whitehead, 1981a), but, as in other skarn deposits in Tasmania and Queensland, the tin occurs mainly in tin bearing silicates (Whitehead, 1981a). Table 4 gives details of the tin contents of various skarn bodies.

TABLE 4

KARA AREA
TIN CONTENT OF KNOWN SKARNS

0% to 1% Sn	Kara North 266 Zone Kara No 2 Main Zone Eastern Ridge Western Limb
up to 3000 ppm Sn	Bob's Bonanza Kara South
up to 1000 ppm Sn	Kara No 2 East Sutton's Skarn Lohrey's Pits L13 L11 Kara No 1
up to 500 ppm Sn	Kara No 2 South L4 Companion Skarn

This list has been adapted from a table in Whitehead, 1981a.

A tin anomaly has been described within the Ringwood Granite adjacent to L10 (Whitehead, 1981b). In addition to these primary tin occurrences, tin anomalies are known related to accumulations of cassiterite in Tertiary sedimentary sequences beneath Tertiary Basalt flows e.g. at L4 (Whitehead, 1981b).

At the Hampshire Silver Mine, tin anomalism associated with fluorine anomalism occurs separate from any large magnetite occurrence. Samples of metamorphosed Ordovician sedimentary rocks assayed up to 8.9%F (Whitehead, 1981a).

Small lead anomalies are known in cherty sandstone adjacent to the eastern margin of the Ringwood Granite at L10 in Cambrian hornfels (Whitehead, 1981b).

A small gold anomaly has recently been identified in the Kara North area (McKeown, 1994).

Wollastonite outcrops occur along the valley of Limestone Creek.

4 THE KARA GRANITES

4.1 ROCK TYPES

Based on his study of outcrop and drill core from the Kara area, Brandt (1974) described the most common granite as medium to coarse grained with an interlocking texture, quartz rich, with K feldspar more abundant than plagioclase feldspar and with accessory mafic minerals mainly biotite: 35% quartz, 40% K feldspar, 24% plagioclase feldspar, 1% mafics. He described granite sub-types including pegmatitic granite, microgranite, quartz porphyry and pegmatite and considered the presence of a porphyritic granite to be a controlling factor in the mineralisation process. In this porphyritic granite, K feldspar crystals have coronas of white plagioclase feldspar; he postulated that the calcium in the coronas could have originated from the nearby, now replaced, sedimentary rocks.

Barrett (1980) confirmed Brandt's general description of the granites. In addition, he differentiated between what he termed outcropping granite and basement granite. Outcropping granite around Kara No 1 is medium grained to porphyritic with 40% quartz, 30 to 40% K feldspar and 10 to 20% plagioclase feldspar and with accessory biotite, chlorite, epidote after Ca feldspar, and magnetite. Basement granite is an aplitic to porphyritic greisen; epidote has extensively replaced Ca feldspar, chlorite has replaced biotite, the K feldspars are saussuritised and sphene, calcite and fluorite have been introduced. The original basement granite composition is probably the same as the outcropping granite composition (Barrett, 1980).

3.2 STRUCTURE OF THE KARA GRANITES

Brandt (1974), described the granite at Kara No 1 as discordant to the adjacent Ordovician rocks and Lindberg (1978) described the granite adjacent to the Kara No 1 skarn as a "steep westerly dipping granite dyke". However, Whitehead's cross sections suggest that he considered the granite to be a homogeneous mass: see Figure 2.

5 MINERALISATION AND PARAGENESIS

5.1 THE SKARNS

It has been generally accepted that the chemistry of the original host rocks is the most important controlling factor in skarn formation. Adjacent to the Housetop, Ringwood and Kara granites, skarns are known to have developed in at least two stratigraphic layers:

- at Kara No 1 in the Transition Series between the siliceous Moina Sandstone and the overlying calcareous Gordon Limestone,

- at Redwater Creek and L5 in the Gordon Limestone.

The locations of the known skarn occurrences in the Kara area are shown in Figure 1.

Whitehead (1985) recognised two distinct mineralogical skarn facies in the Kara No 1 area: a magnetite-amphibole facies with 30 to 70 % magnetite, and a garnet-diopside-magnetite facies with 10 to 40% magnetite, the amphibole facies being the more common along the west limb of the Kara syncline, both facies occurring along the east limb.

In a similar classification, Turner (1989) described two principal skarn lithologies: a magnetite rich lithology and a grossular-andradite rich lithology.

Table 5 below lists the minerals which have been described from the Kara No 1 skarns.

TABLE 5

KARA NO 1
MINERALS IDENTIFIED IN SKARNS

magnetite	garnet
scheelite	grossularite
powellite	andradite
chalcopyrite	epidote
haematite	vesuvianite
molybdenite	biotite
bismuthinite	tremolite
pyrite	ferrohastingsite
galena	chlorite
sphalerite	quartz
arsenopyrite	orthoclase
	sphene
	apatite
	fluorite
	calcite
	hedenbergite
	amphibole
	diopside
	wollastonite

At Kara No 2 Jack (1963) described magnetite with andradite, diopside, epidote, clinozoisite, vesuvianite and chlorite; Tasmines' geologists have described very minor scheelite and tin as tin silicates.

5.4 CONTROLS ON SCHEELITE OCCURRENCE WITHIN THE SKARNS

In early reports concerning the exploration of the Kara No 1 skarns much emphasis was placed on determining the exact location of concentrations of scheelite within the skarns.

Brandt (1974) maintained that scheelite is most common in skarns which are closely folded and fractured: "scheelite ... is associated with microfracturing and veining". He considered that the scheelite and much of the magnetite were formed from hydrothermal solutions after the granite had solidified.

Lindberg (1978) suggested that maximum scheelite content occurs in skarn with low to moderate magnetite content adjacent to, but separate from, garnet skarn: see Figure 6.

Halligan (1979) considered that scheelite is common in garnet rich skarns, occurring at garnet-magnetite crystal boundaries; in diopside skarns, scheelite occurs frequently, at diopside-magnetite grain boundaries. He concluded that scheelite occurs almost exclusively in magnetite bearing skarns at contacts between grains of calc-silicates and magnetite, "with no sign of control by structural features, though occasionally it does appear to follow joints and rare veins. It seems most likely that the scheelite was introduced together with magnetite during fluid emplacement and the wholesale formation of the skarn". He also described scheelite in thin quartz veinlets within the granite with or without epidote and scheelite.

5.5 GRANITE ASSOCIATED WITH THE SKARNS

Brandt reported that the granite which is found in closest association with the tungsten bearing skarns is porphyritic with large phenocrysts of quartz, K feldspar and plagioclase in a fine grained groundmass. All phenocrysts are rounded with coronas of white plagioclase surrounding cores of pink K feldspar. The coronas were formed by calcium absorption, with the calcium source being the adjacent calcareous Ordovician rocks. "The field distribution of the megagranite indicates strongly that its presence is a controlling factor in the mineralization process" (Brandt, 1974).

Halligan concluded that there are several phases of granite at Kara No 1 with significant cooling between the phases. The main granite is medium to coarse grained, equigranular to porphyritic and is intruded by fine grained aplite and pegmatite which occurs as sharp edged segregations and veins. Cases of granite intrusion into skarn indicate that there is some post skarn granite intrusion. (Halligan, 1979)

Whitehead is reported by Hopwood (1985) as believing that granite adjacent to scheelite-magnetite skarns contains traces of base metal sulphides including molybdenite, chalcopyrite and bismuthinite.

6 ORE CONTROLS

The controls on the locations of scheelite-magnetite skarns which have been described by various workers are:

- the existence of suitable host rocks: calcareous members of the Transition Series or the Gordon Limestone and
- proximity to Devonian granite.

The importance of suitable host rocks has been mentioned by many workers and Leaman and Richardson (1985) noted that all known tungsten mineralisation around the Housetop Granite occurs within 1.0 to 1.5 km of the granite roof.

The source of the mineralising fluids is generally believed to have been the Devonian granite but the pathways taken by the mineralising fluids have rarely been considered except by Brandt (1974): see section 5.3 MINERALISATION PROCESS above.

7 A NEW VIEW

7.1 INTRODUCTION

The preceding sections of this report have been a summary of the geology of the Kara area based on a review of the published and unpublished reports in the Tasmines' collection. This section presents a new view of the geology of the Kara area.

The key to the new view is the identification of a linear structural trend to the west of the outcrop of the Housetop Granite proper. This structural trend:

- occurs within the folded Palaeozoic sedimentary rocks, parallel to the strike of the folds,
- is marked by the presence of several granite dykes,
- contains all the known economic scheelite-magnetite skarns in the Kara area,
- contains the only identified gold anomaly in the Kara area, and
- exhibits mineral zoning along its length.

Figure 7 shows the location of this structural trend.

A second important key is the possibility that, although all known economic deposits in the Kara area appear to occur in host rocks from a restricted stratigraphic range, economic deposits may occur in other rocks.

A third key is that undiscovered deposits may not be associated with extensive magnetite development.

7.2 THE KARA 1 STRUCTURAL TREND

7.2.1 DESCRIPTION OF THE STRUCTURAL TREND

The Kara structural trend parallels the strike of the folded Palaeozoic sedimentary rocks, coinciding, in the main, with the position of the Kara Syncline. The trend contains the orebodies from the Kara South deposit northwards through Kara No 1, Bob's Bonanza, Eastern Ridge, Kara North 266, Kara North and L5 to the Hampshire Silver Mine.

A series of dykes, with strikes parallel to the strike of the enclosing rocks, occurs along the trend. The outcrops of these dykes are obscured in places by Tertiary Basalt flows. Figure 7 shows an interpretation of the sub-basalt granite outcrop pattern along the structural trend. It should be remembered that, where a dyke outcrop is shown as continuous, the outcrop may in fact be discontinuous where dykes pinch and swell or are en echelon.

7.2.2 THE KARA GRANITE DYKES

The granite outcrop at Kara No 1 is shown on most maps as a stock with several dykes extending to the north of the Kara No 1, deposit: see Figure 1. The interpretation shown in Figure 7 suggests that most of the granite outcrops at Kara No 1 could be dykes. In fact, the patterns of most of the granite outcrops in the area from Kara No 1 to Kara North can only be interpreted as representing the outcrops of steeply dipping tabular bodies. This idea is supported by an interpretation of the granite intersections at L5 which suggests that the granite beneath the deposit is a dyke which extends from Eastern Ridge northwards through L5 and L4: see Figure 9 and 10.

The Kara granite dykes occur above a flat shelf in the top of the buried granite batholith between the outcrop of the south-western corner of the Housetop Granite and the Ringwood Granite: see Figure 5. The dykes strike approximately north-south, i.e. they tend to parallel the strike of the enclosing Palaeozoic sedimentary rocks, and dip relatively steeply.

By implication, this new interpretation supports the idea that the Kara granites were not formed by a single intrusive event, but are the result of multiple intrusions. Such multiple intrusions are known in other Devonian batholiths in Tasmania, notably at the Anchor Tin Mine where the Poimena Adamellite is intruded by the Lottah Granite. Leaman and Richardson (1985) also suggested that the Housetop Granite could be a result of multiple intrusions. In this light, the descriptions of granite sub-types in section 4 ROCK TYPES above are, indeed, descriptions of different phases of multiple granite intrusions. In particular, Barrett (1980) considered that the basement granite and the outcropping granite dykes are petrologically different, the basement granite has been greisenised, further evidence of the occurrence of multiple intrusive phases.

7.2.3 THE METALLIC MINERAL DEPOSITS WITHIN THE STRUCTURAL TREND

In the Kara area, all the known scheelite-magnetite skarns, and the only known gold anomaly, are close to the granite dykes along the structural trend: see Figure 7.

7.2.4 MINERAL ZONING ALONG THE STRUCTURAL TREND

The known metallic mineral deposits are shown in Figure 7. These deposits exhibit the type of mineral zoning which is well known around other Tasmanian Devonian granites, for example, the Heemskirk and Pine Hill Granites. Mineral zoning around the nearby Dolcoath Granite has also been described by Leaman and Richardson (1985).

In the Kara area, perusal of the Loongana Metallic Mineral Deposits Map 1:50000 reveals that all tin occurrences occur within the outcrop of the Housetop Granite; most scheelite occurrences, and all economic scheelite occurrences, occur outside, but close to, the outcrop of the Housetop Granite. Silver, copper, lead and zinc occurrences occur outside the outcrop of the Housetop Granite more distantly than scheelite. Little is known of gold in the Kara area, but around the nearby Dolcoath Granite gold occurrences lie between the tungsten and silver-lead-zinc deposits: see Figure 11.

Along the structural trend from Kara No 1 to the Hampshire Silver Mine, there is a hint of mineral zoning from scheelite at Kara No 1, through the gold anomaly near Kara North to silver at the Hampshire Silver Mine.

7.3 OCCURRENCE OF ORE DEPOSITS

7.3.1 SOURCES OF MINERALISATION

The granite which is the source of the scheelite-magnetite mineralisation has not yet been identified. However, the fact that the basement granite has been greisenised suggests that the source is deeper than the top of the basement granite.

Gold mineralisation probably has its source in Cambrian volcanic rocks which underlie the Ordovician sedimentary rocks (McKeown, 1994). All outcrops of Ordovician rocks in the Kara area were originally underlain by Cambrian rocks which are possible sources of gold mineralisation.

7.3.2 PATHWAYS FOR MINERALISING FLUIDS

Few faults are shown on current maps of the geological interpretation of the Kara area. The apparent lack of faulting in the area is unusual when other areas in Tasmania above, or adjacent to, intrusions of Devonian granite are considered, for example, Renison Bell, Storeys Creek, Aberfoyle and Zeehan. On this basis alone, the likelihood of the presence of, so far undetected, faults at Kara is high.

Hopwood (1985) suggests that "there are a series of major, parallel, north east trending cross faults indicated in the aeromagnetics" i.e. the faults are cross relative to the general north-south structural trend.

It is likely that granite dykes were intruded along planes of weakness in the folded Palaeozoic rocks. It is also likely that the pathways of mineralising fluids followed these same planes of weakness. This proposition is supported by the fact that the granite most closely associated with scheelite-magnetite skarns has anomalous metal sulphide content, the metal sulphides possibly representing the footprints of the mineralising fluids.

7.3.3 HOST ROCKS FOR ORE DEPOSITION

It has been generally assumed that there is a limited stratigraphic sequence which is susceptible to replacement and metasomatism: see section 5.1 THE SKARNS above. However, other factors are also important. For example, solidification of skarn minerals will occur when temperature conditions are suitable and mineralisation may develop when this occurs rather than only where the chemical conditions are suitable. If, when temperature conditions are correct, calcareous rocks occur, then skarn will develop, otherwise the mineralisation may take a different form, for example, vein mineralisation as reported within the granites themselves (Brandt, 1974).

The occurrence of multiple mineralisation styles originating from a Devonian granite is known at the Renison tin mine: economic deposits of cassiterite mineralisation not only occur where dolomite has been replaced, but also in brecciated quartzite - the Melba orebody - and as fault infill - the Bassett Federal orebodies.

The likelihood of multiple mineralisation styles suggests the possibility that ore may be found in host rocks other than those in which ore has been found to date. Also, there is a possibility that scheelite ore which is not associated with massive magnetite, may exist.

5.2 PARAGENESIS

The paragenesis shown in Table 6 is that devised by Barrett (1980) for the Kara No 1 deposit.

TABLE 6

KARA NO 1
PARAGENETIC SEQUENCE

1 vesuvianite + wollastonite
2 diopside + hedenbergite
3 magnetite
4 grandite garnet
amphibole?
5 scheelite + fluorite (?)
6 epidote and haematite
7 vein filling calcite, quartz, fluorite, sulphides

5.3 MINERALISATION PROCESS

The metallic mineral deposits which have been identified to date are magnetite-garnet skarns with or without scheelite. The skarns have developed where mineralising hydrothermal fluids have had access to suitable host rocks. In most cases the host rocks have been members of the Transition Series, although skarns within Gordon Limestone have been identified, for example at L5.

The pathways from the fluid source to the preferred host rocks have not been identified. Brandt (1974) reported that small hydrothermal veins and disseminations containing titano-haematite and tungsten occur within the exposed granite and

> "The pattern of the veins suggests a system of conjugate shear zones in the granite, which acted as channelways by which iron and tungsten-bearing hydrothermal solutions arose through the already solidified hood of the batholith ... where these solutions encountered hospitable carbonate-bearing host rocks on the granite margin or in roof pendants, the iron was precipitated as magnetite and the tungsten as scheelite."

8 THE FUTURE

The testing of known outcropping magnetite skarns as sources of iron and scheelite should continue.

Exploration for new gold and tungsten deposits in the immediate future should be concentrated along the structural trend described above. Exploration should not be blinkered by searching only for ore associated with massive magnetite.

In addition, several specific tasks are recommended:

- all data related to diamond drilling should be compiled into a useable form,

- mapping of granite outcrop should be undertaken with a view to discriminating between granite varieties,

- all intersections of granite in diamond drill holes should be plotted and contoured.

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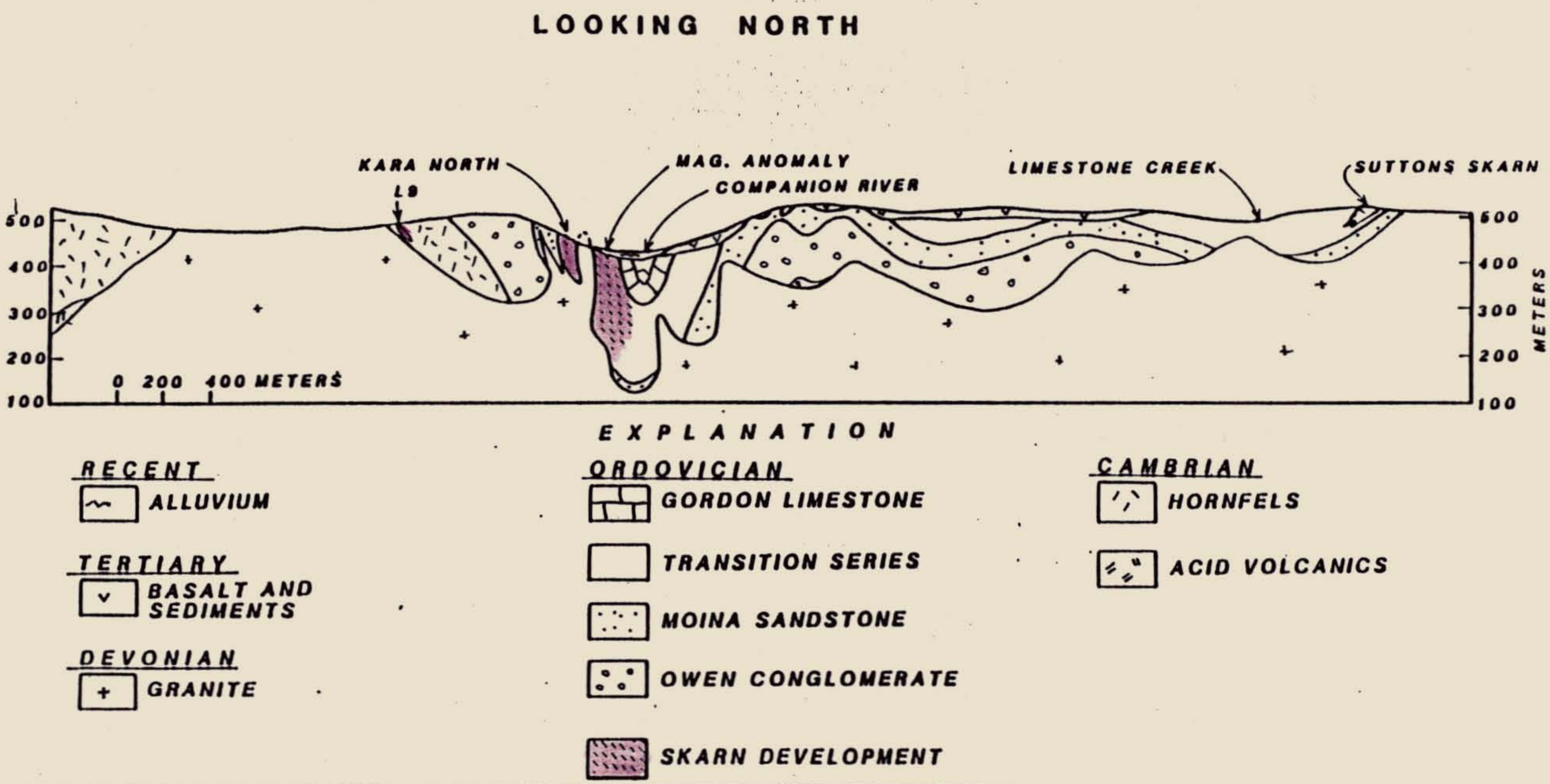
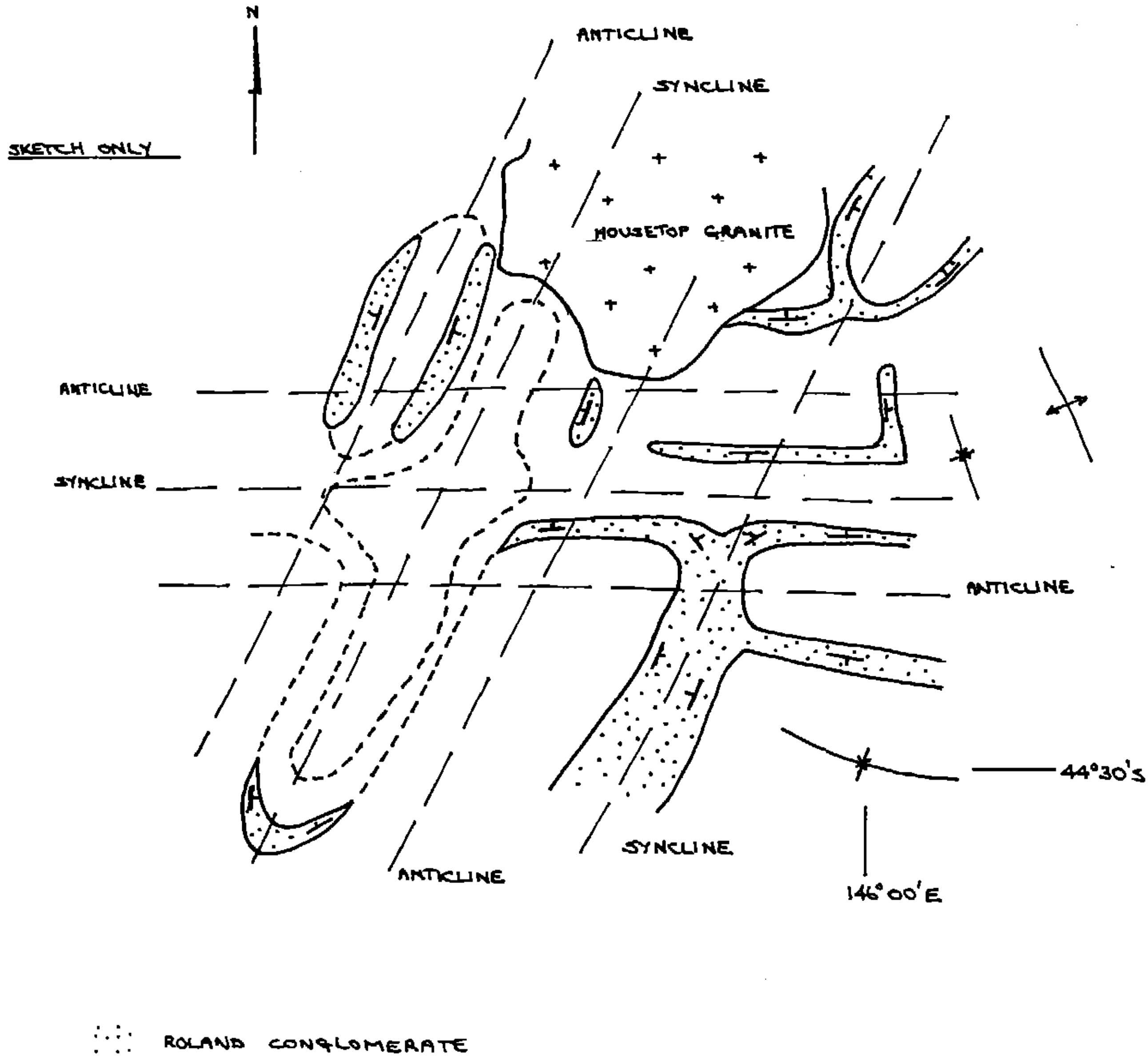


FIGURE 2: Cross section through the Kara No 1 area (Whitehead)



GENERALISED D GRAM SHOWING PROPOSED INTERSECTING FOLD TRENDS. THE MAIN OUTCROPS OF ORDOVICIAN CONGLOMERATE ARE SHOWN, AND ALSO A DOTTED LINE HAS BEEN DRAWN TO SHOW POSSIBLE LINES OF CONNECTION OF VARIOUS OUTCROPPING CONGLOMERATES

FIGURE 3: Plan of the regional structure in the Palaeozoic sedimentary rocks from Valentines Peak to Gunns Plains (Pike)

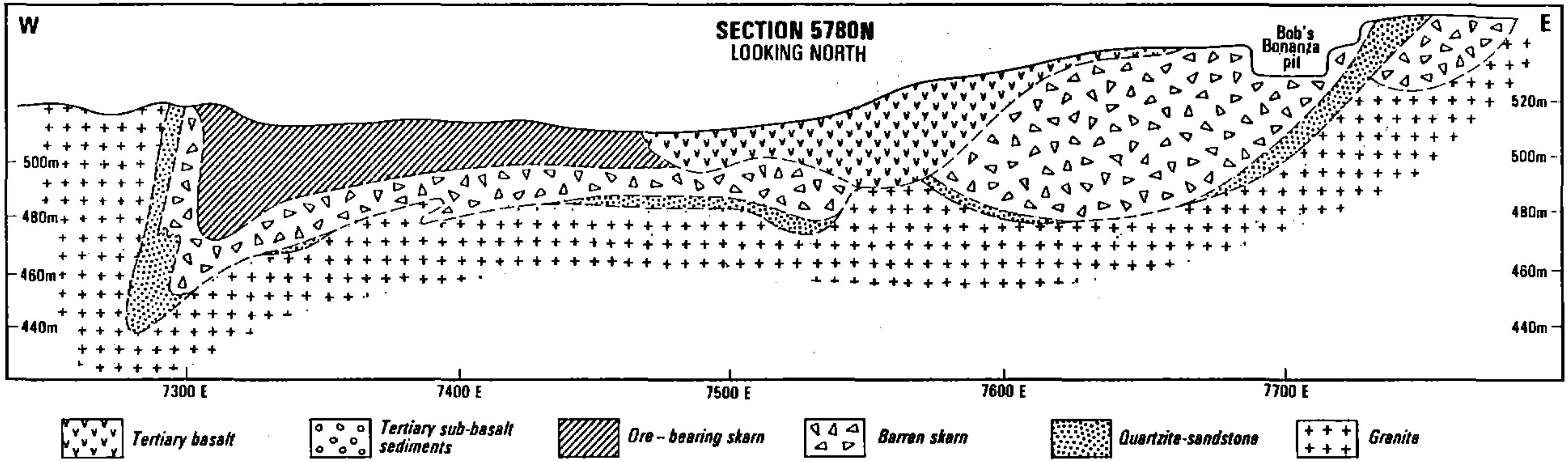


FIGURE 4: Schematic cross section through the Kara No 1 deposit (Whitehead)

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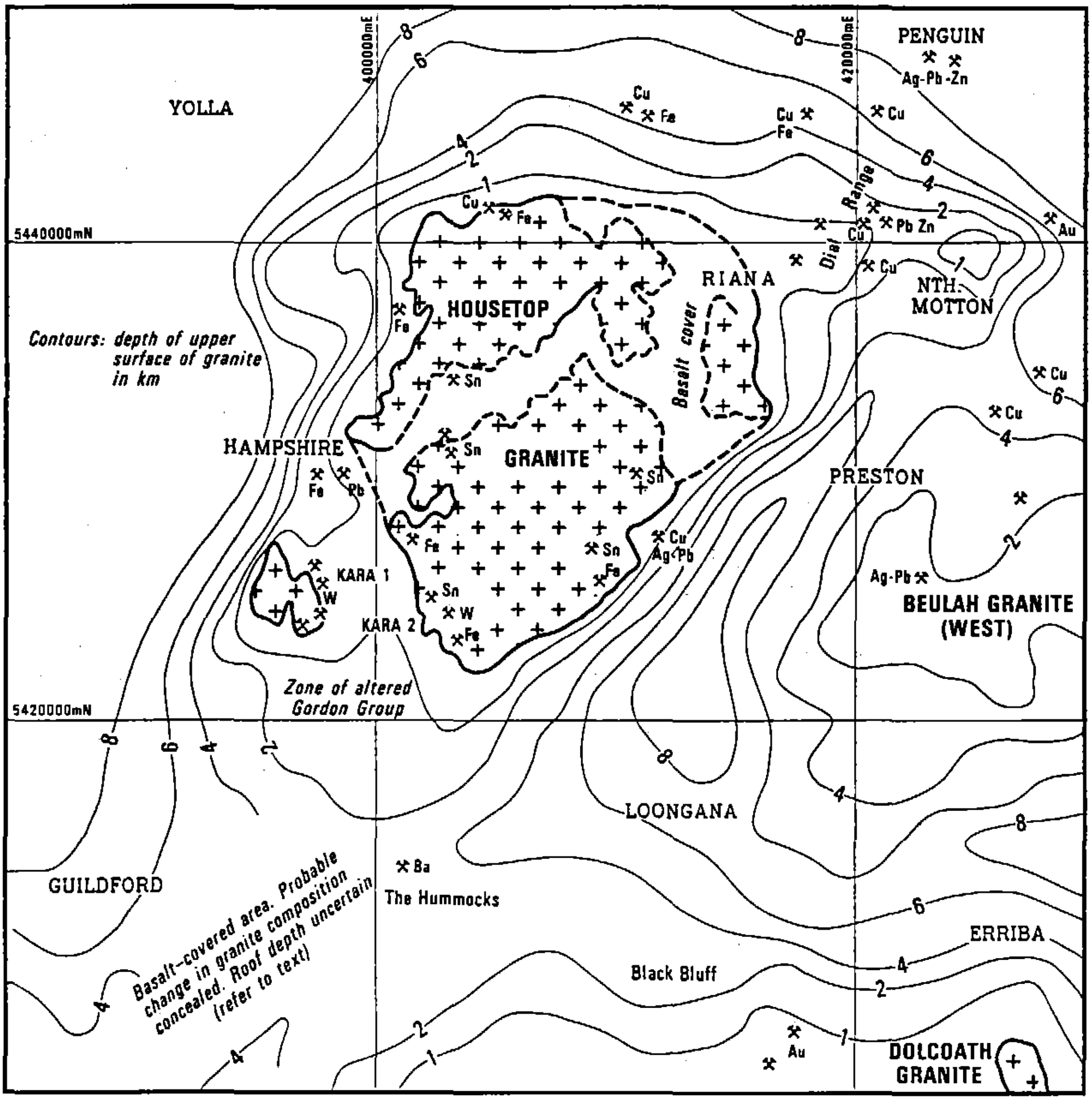
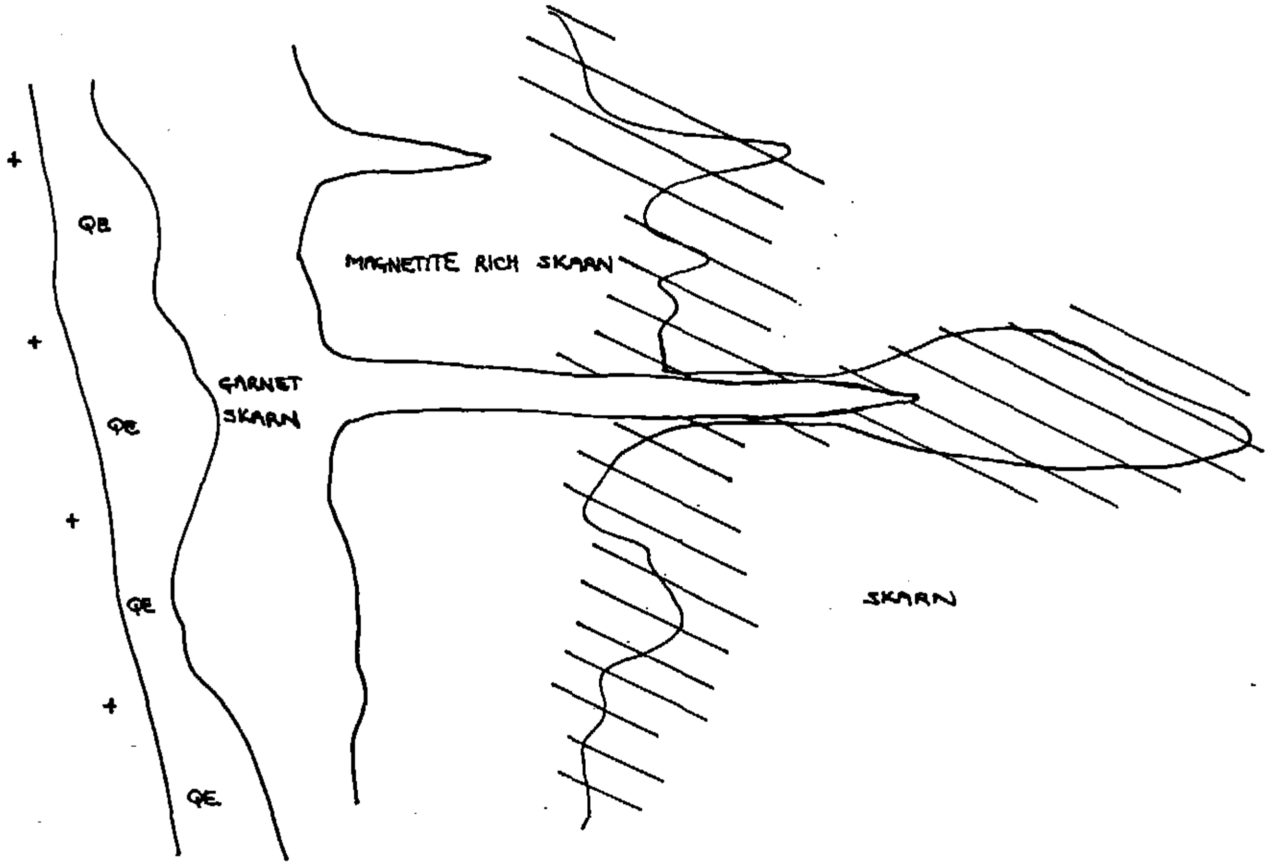


FIGURE 5: Form of the Housetop Granite (Leaman and Richardson)



SCHEELITE CONCENTRATION INDICATED BY CROSS HATCHING

FIGURE 6: Location of scheelite concentration within skarns (Lindberg)

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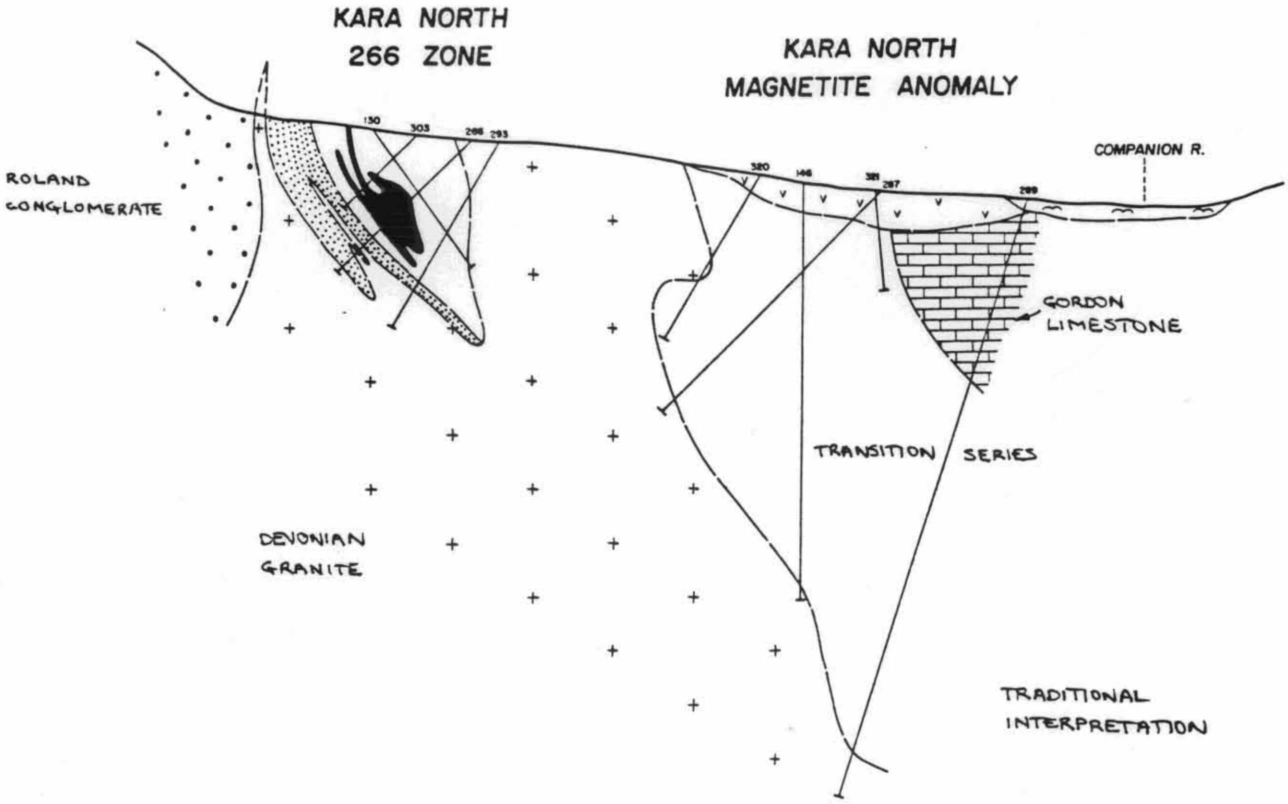

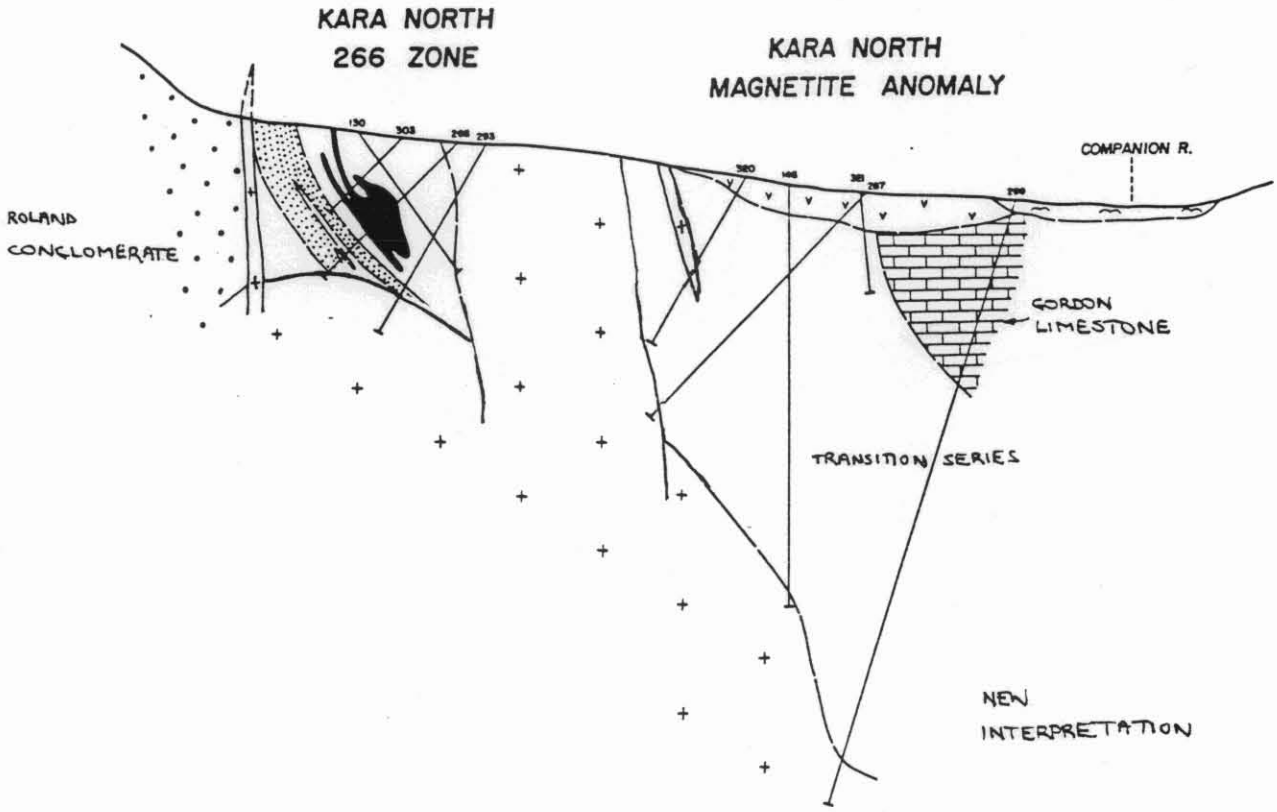

SECTIONS LOOKING NORTH

100 m

5 cm

FIGURE 8: Kara North cross section at 7020N

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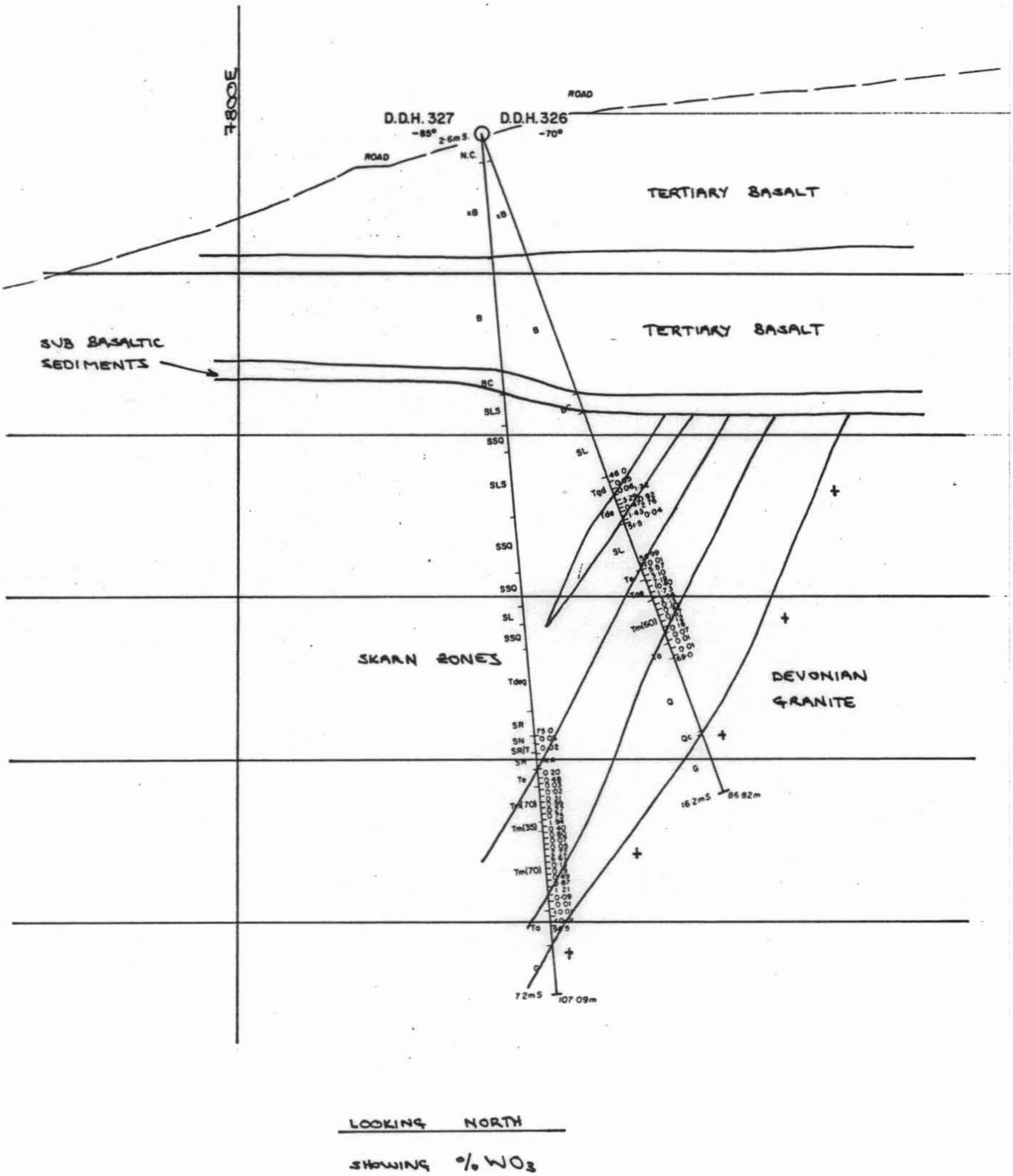

FIGURE 9: L5 cross section at 7670N

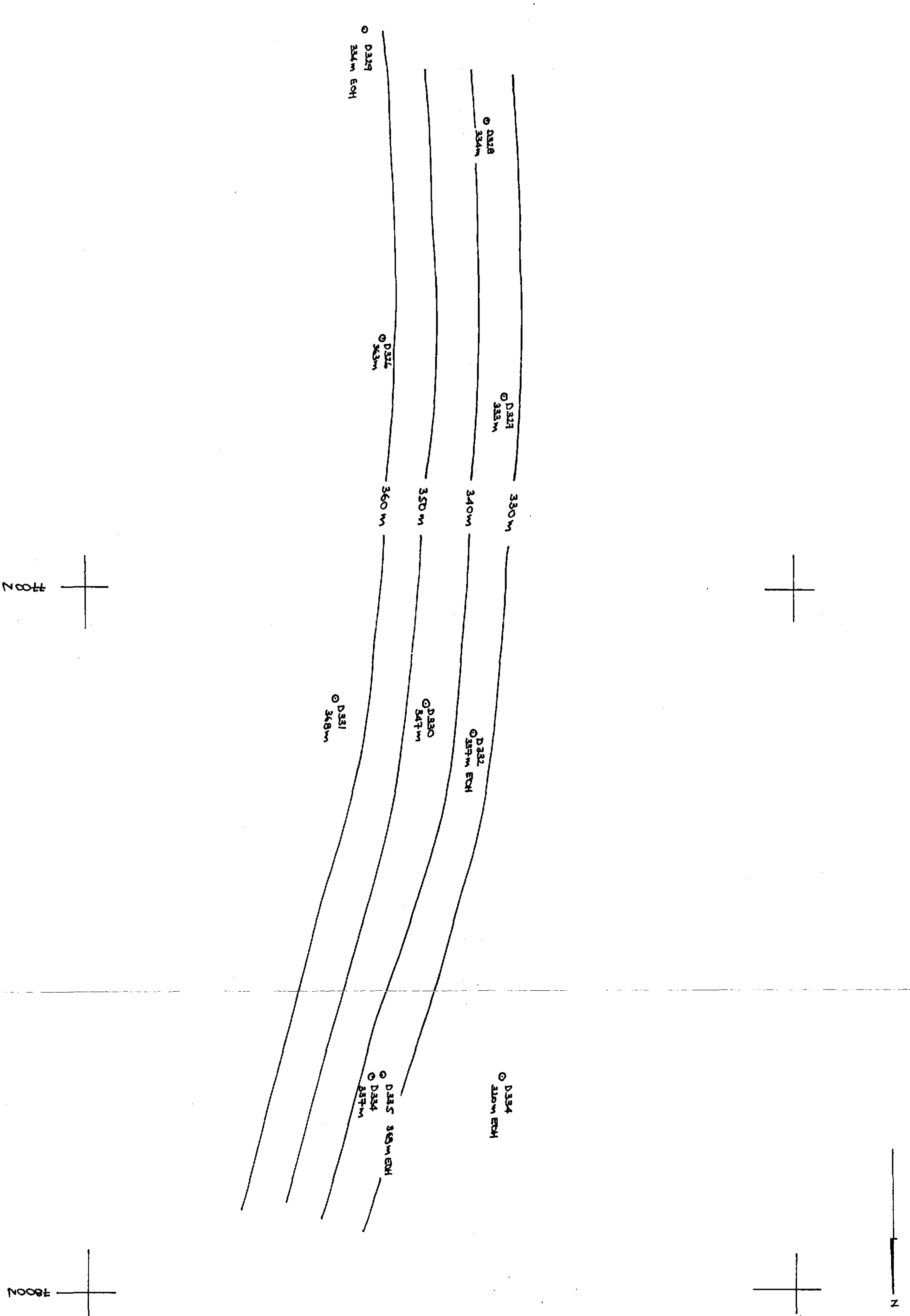

FIGURE 10: Structure contours of granite intersections at L5

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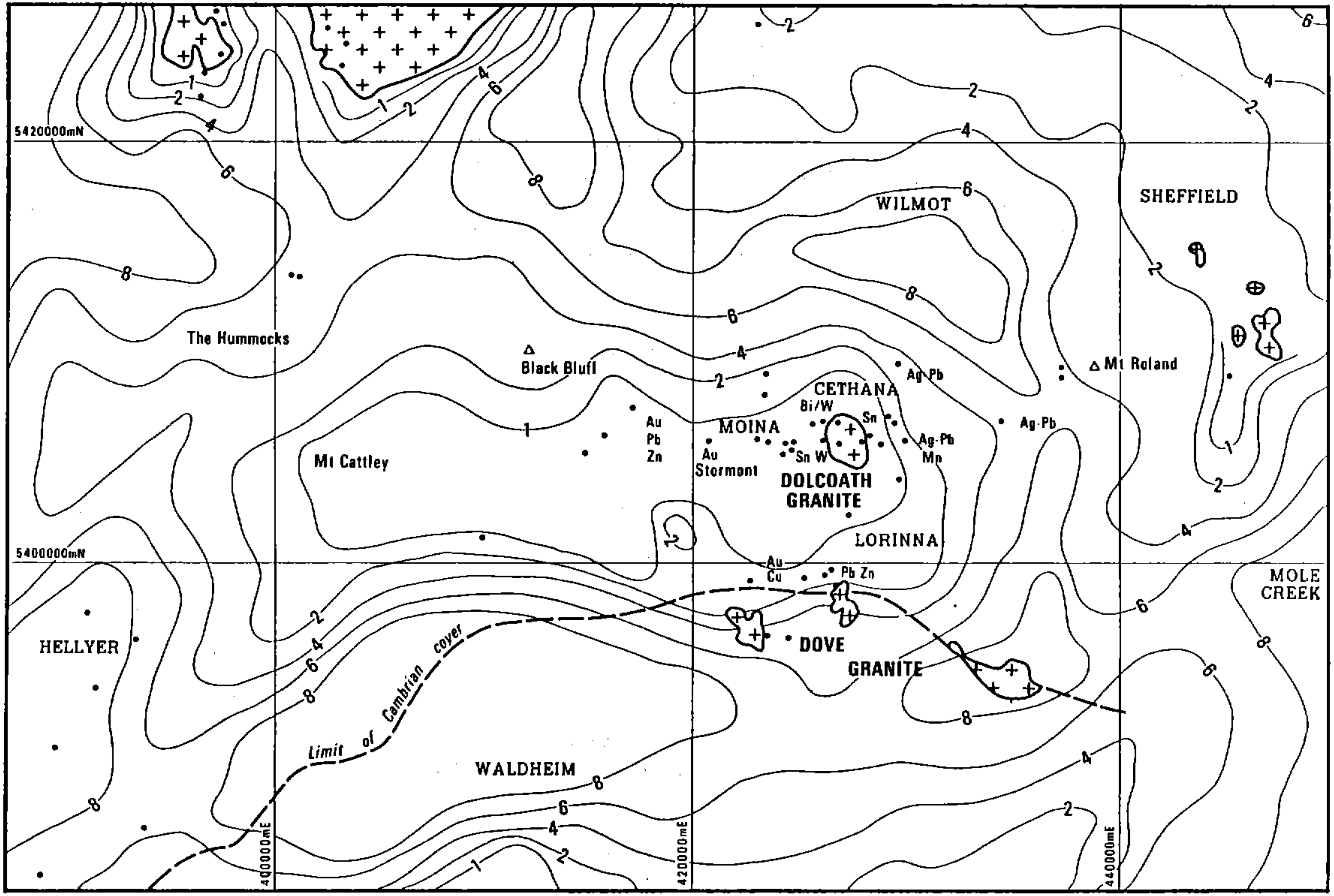

FIGURE 11: Form of the Dolcoath granite (Leaman and Richardson)

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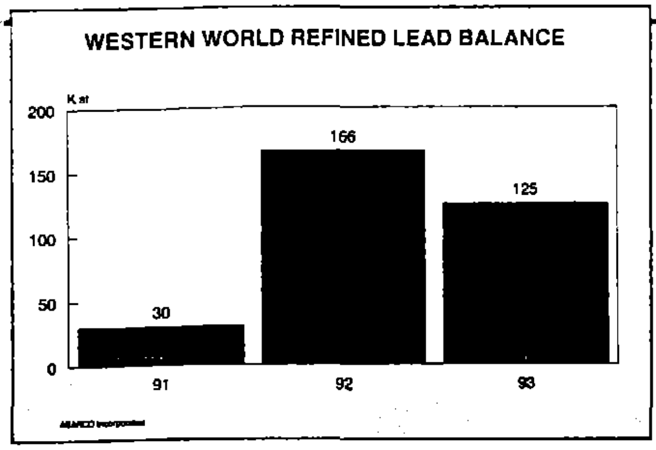
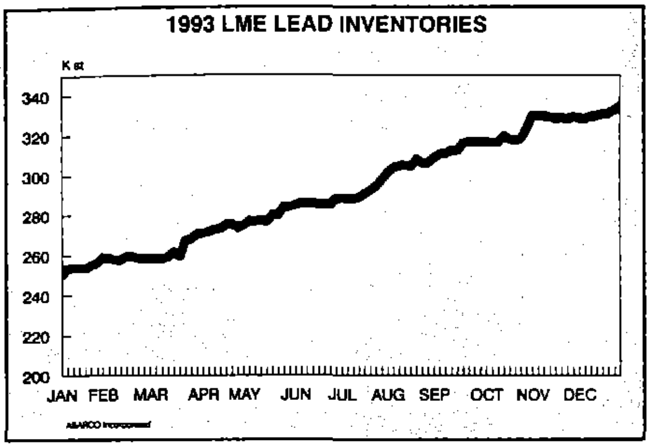
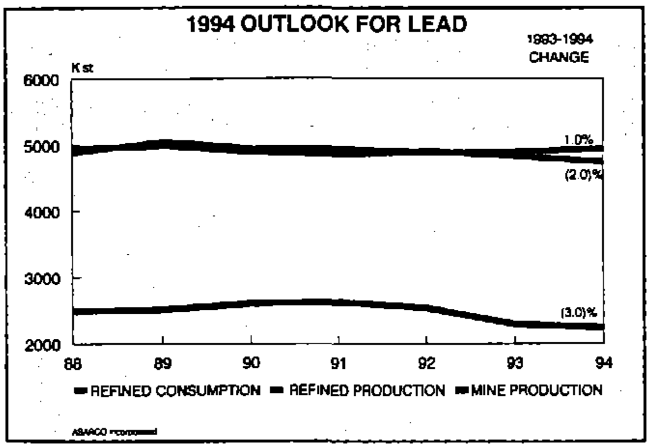
APPENDIX 1

ENGINEERING AND MINING JOURNAL ANNUAL TUNGSTEN MARKET REVIEW
MARCH 1994







and Southeast Asia are recovering and consumption is increasing in these areas.

Inventory. LME inventories were 303.65K mt at the end of 1993, an increase of over 91K mt. Continued shipments from the CIS and China contributed to the increase. Overall stocks are estimated at a seven week supply.

In the United States, primary producer stocks decreased by 30%, or 6,250 mt to end at 14.3K mt. Strong demand from the battery sector, as referenced above, was the main reason for the inventory offtake. U.S. lead exports are estimated to be about 55K mt to Asia and other Pacific Rim countries. Although a global recession affected consumption, Asia continues to be a market for long-term growth potential.

LME lead prices in 1993 averaged 18.4¢/lb with a high and low of 20.9¢/lb and 17.0¢/lb, respectively. U.S. producer prices averaged 31.7¢/lb with a high of 33.7¢/lb. In summary, preliminary lead supply and demand statistics form ILZSG indicate a 1993 statistical surplus of 56K mt.

Outlook. Looking at 1994, Western World refined-lead production is forecast at 4.5M mt, an increase of 2.9% over 1993, and U.S. production is forecast to increase by 4.6%.

Production increases and decreases in the U.S. Secondary industry will be influenced by scrap availability. GNB and RSR have announced the construction of recycling plants in the United States. Consumption is forecast slightly ahead of production. The ILZSG forecast for Western World consumption is expected to grow by 3.0%. U.S. consumption for 1994 is forecast to increase by 1.6%. ILZSG forecasts a Western World supply/demand statistical surplus of 64K mt.

TUNGSTEN

TURNAROUND IN SIGHT?

Robert M. Bunting, product director,
Strategic Minerals Corp.

After many depressing years for tungsten, 1993 emerged as the year in which conditions were the worst ever. Yet it was simultaneously the year which, towards its end, displayed some signs which indicated that the next few years will be very different from the recent past.

Tremendous oversupply for so long produced the final total price-collapse which has combined with moves to market economies in China and Russia. This has resulted in a major decline in previously subsidized production in these hitherto centrally planned economies. So worldwide production dropped so much lower than consumption that most supply in 1993 came from inventory. This practice can only be sustained as long as inventory remains, and there are signs that this might now be short-lived.

The prospect of no inventory, little production, and increasing demand—as the recession recedes—has set up the tungsten market for the possibility of a massive correction.

Production. Mine production of tungsten concentrates in market economy countries (MECs) during 1993, is estimated to have been 2,820 mt contained-tungsten. This was yet another record low for MEC mine output, with a 53% drop from 1992 output (5,960 mt). Most of this production took place in the first half of the year, before low demand and extremely low prices forced the almost complete closure of MEC tungsten mining.

The three remaining medium-to-large tungsten mines operating in MECs all closed, Mittersil (Austria) at the beginning of 1993, Regina (Peru) mid-1993, and Beralt at the end of 1993.

Peru's Regina mine, having a very high grade—and therefore low cost—is scheduled to resume operation early in 1994. Even with this re-start, however, total MEC mine production will be only 1,900-2,000 mt contained-tungsten in 1994, unless market conditions improve substantially.

Production in China has also dropped sharply, it seems to about 10.25K mt contained-tungsten (18.5K mt concentrates) in 1993. Here many mines have either halted production, or in some cases been closed permanently (e.g. Shan Hu in Guangxi Province and possibly even the biggest tungsten mine in China, Xihuashan in Jiangxi Province—although the finality of this closure has not yet been confirmed). In addition, most mines in China that are still operating are only producing at low levels.

Production in the CIS also seems to have declined sharply, to perhaps 4,500 mt contained-tungsten in 1993 (down from 8,000 mt late in the former-Soviet era).

Ending 1993, world mine-production of tungsten concentrates

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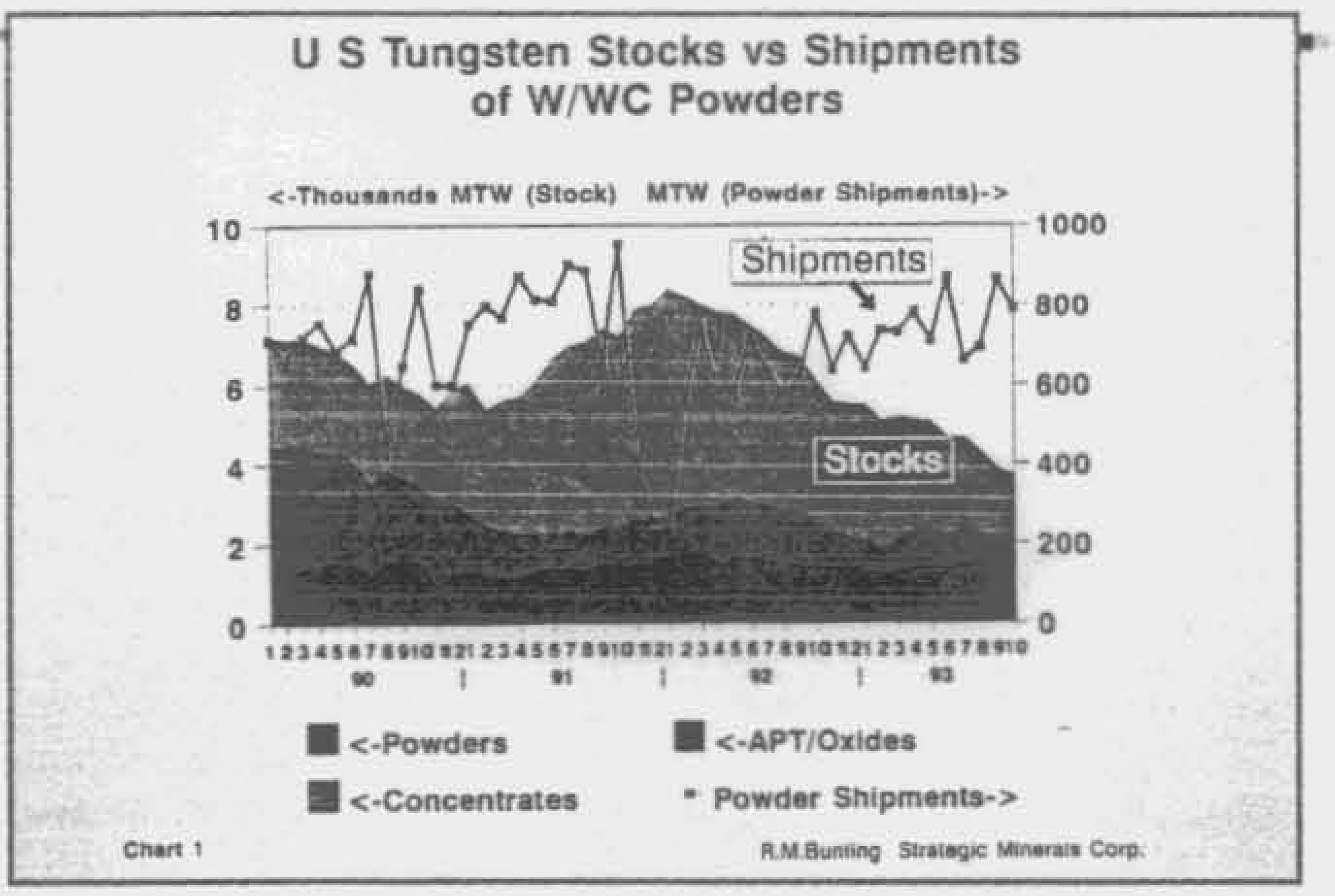
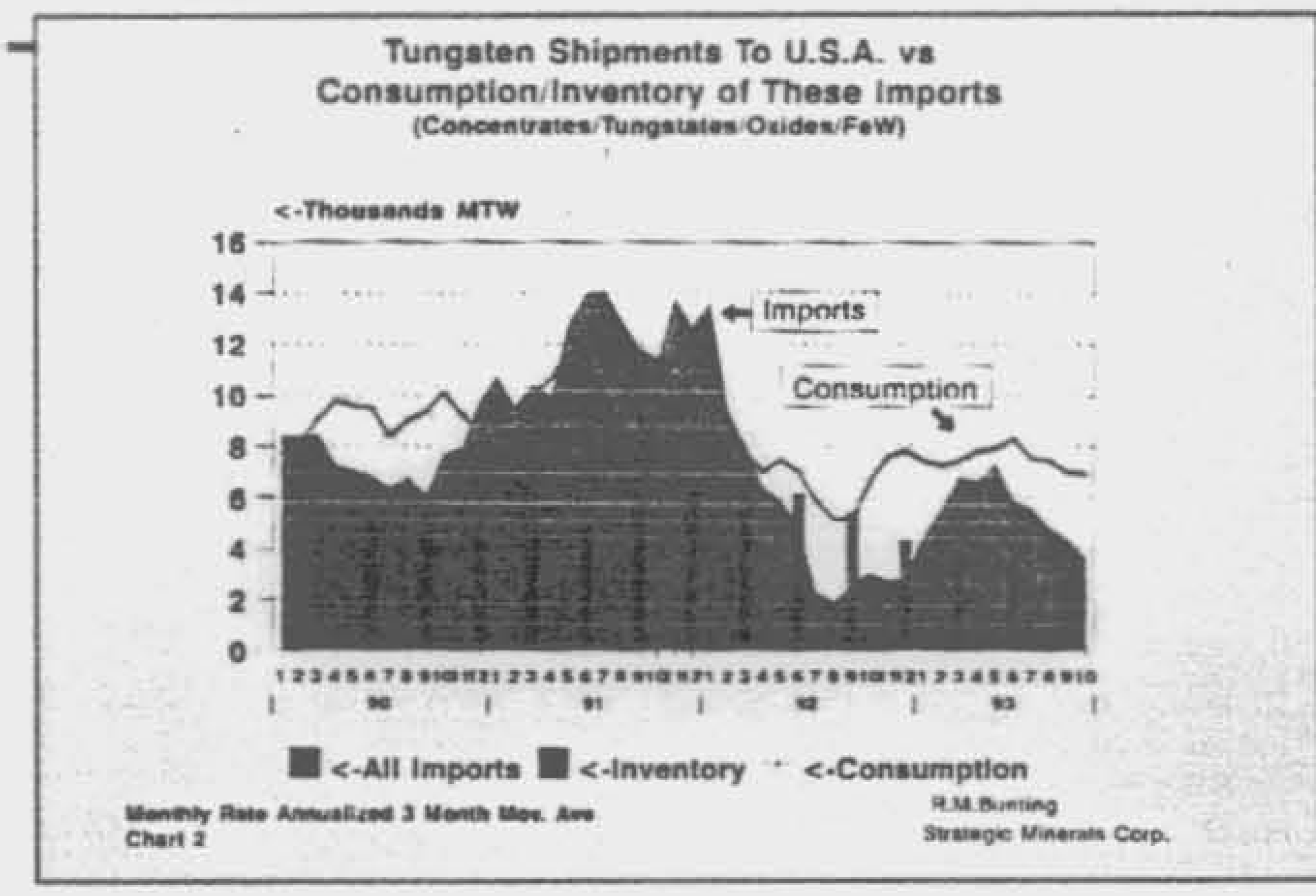
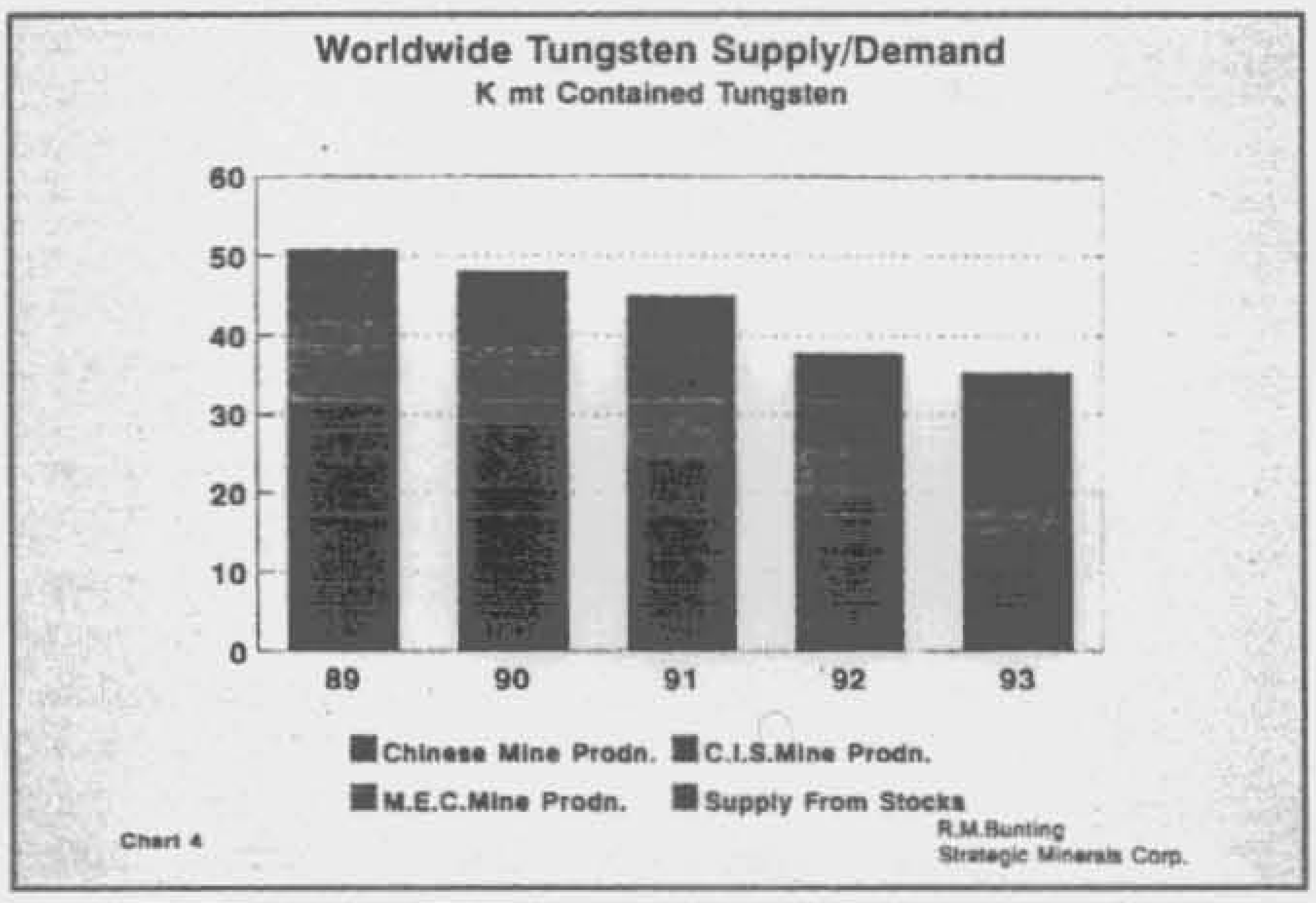
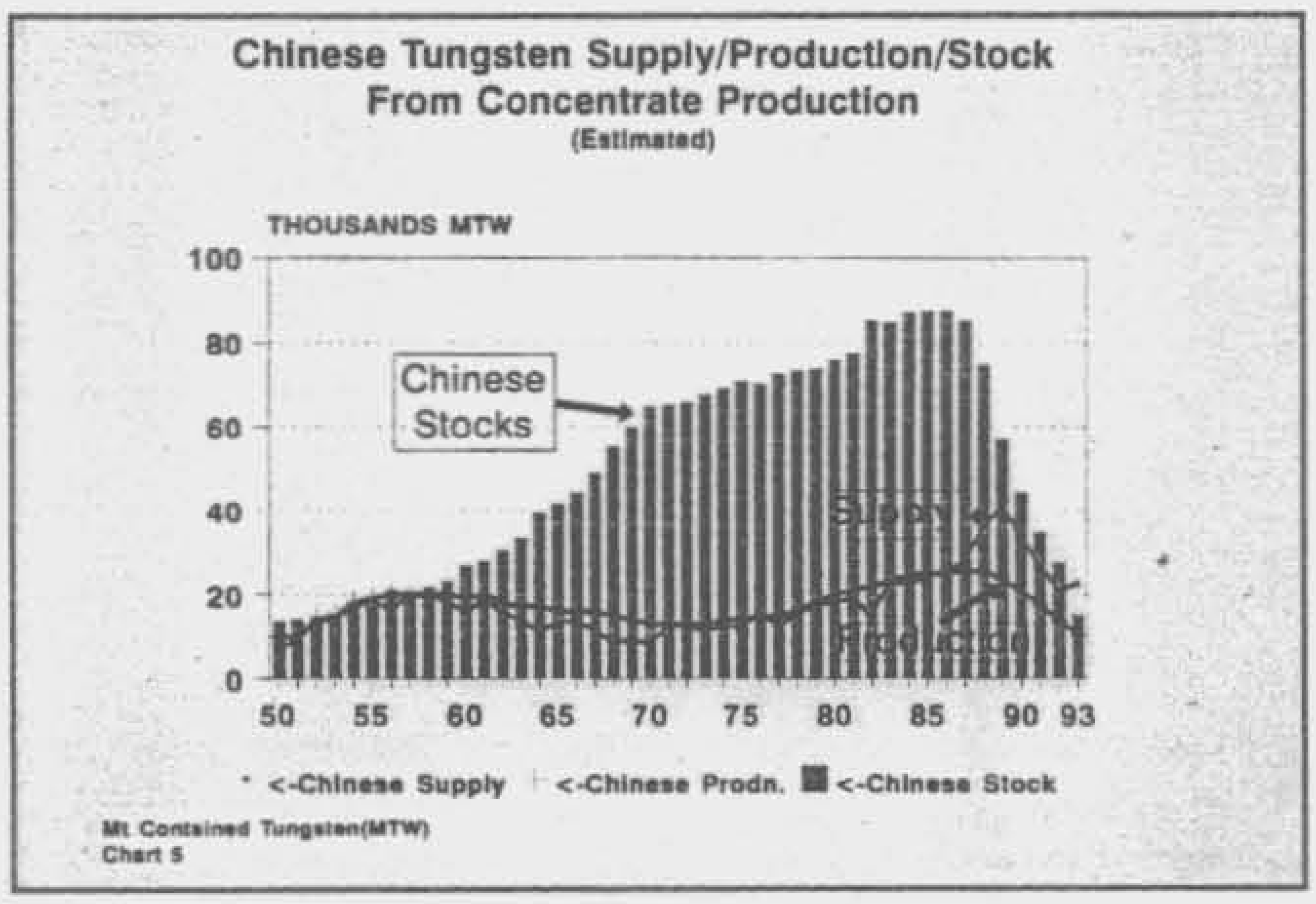
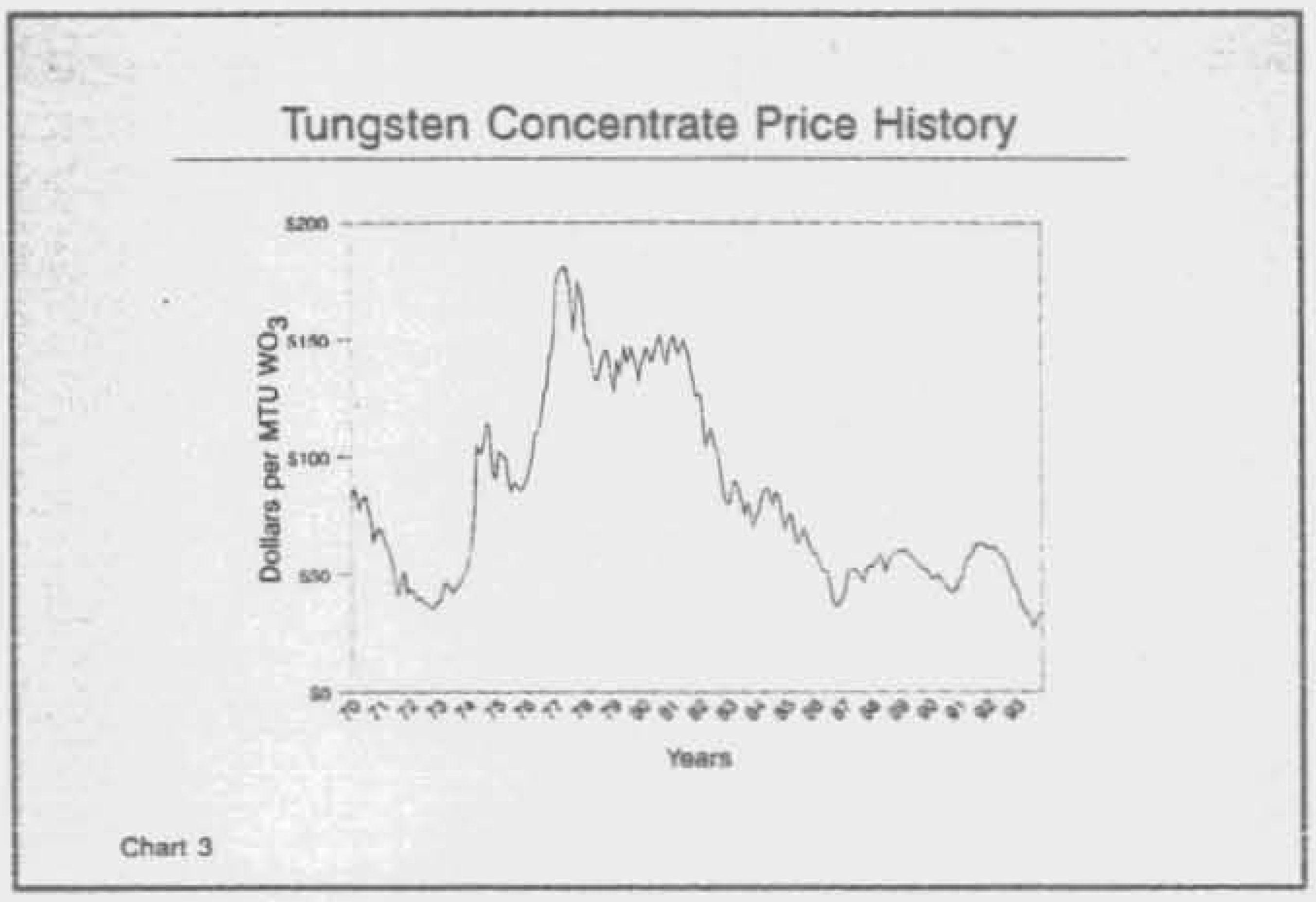










appeared to be running at 16K mt contained-tungsten. This compares to total world consumption of around 37K mt (total virgin usage, i.e. non-recycled tungsten) in 1993. The difference between consumption and production of virgin tungsten units coming from the continued worldwide inventory draw down.

Consumption. Consumption of tungsten concentrates in MECs is estimated to have been 5,330 mt contained-tungsten in 1993. This was a 39% decline from 1992. As in prior years, this reflected the continuing process of substitution of MEC ammonium-paratungstate (APT) production with imports of APT and oxides from China, together with increased production, proportionately, of APT from scrap.

A typical example of this process was seen when the Mittersil mine in Austria was closed early in 1993. When concentrate availability from the mine ceased, the supply of tungsten to downstream operations was replaced with imported APT or oxide, not with imported concentrates.

U.S. consumption of tungsten, at the tungstate level, was about 7% higher in 1993 compared to 1992 and at the tungsten/tungsten-carbide-powder level shipments were up 11% in 1993 over 1992, and were at the highest level in at least 15 years. This strength in U.S. consumption is diametrically opposed to an "apparent consumption" calculation made by the usual net-import method. For example, total U.S. imports of concentrates, tungstates and oxides in 1993 will total around 4,800 mt contained-tungsten. This is up slightly from the 3,800 mt in 1992, but only 42% of the import level (11.3K mt) in 1991. This high disparity is explained by: the continued massive inventory draw-down, which began at the outset of 1992); and by increased recycling of scrap, which peaked in 1992 (at about 35%), and was still strong in 1993 (about 28%). Charts 1 and 2 illustrate this situation. Chart 1 shows total inventory in the United States of powders, intermediates and concentrates, compared to monthly shipments of powders. Chart 2 shows all U.S. imports of virgin tungsten materials (concentrates/tungstates/oxides/FeW) compared to usage of these virgin materials, and inventory. Since U.S. production of virgin tungsten is virtually zero, these graphs provide a comprehensive view of the U.S. tungsten position.

Apart from continued strong consumption in China, demand elsewhere was low—Europe and Japan, to very low—CIS. In addition to low consumption in Europe and Japan, it is clear that there was a significant inventory draw-down in both markets, particularly in Europe. The result—imports were even lower than consumption though probably to a less extent than in the United States.

Price. The 1993 average Metal Bulletin wolframite quotation was \$37.31/metric-ton-unit (MTU). This compares with \$56.81/MTU in 1992 and is 78% below the 1977 peak average of \$170.95/MTU (See Chart 3).

In real terms, the 1993 price was, by far, the lowest in history. The price level of \$20/MTU for standard wolframite (as opposed to \$35/MTU for high-grade materials) was so low that at current exchange rates only 30-50% of the cash cost of producing these materials in CIS and China mines was being covered. This has resulted in many mine curtailments in these countries, and most concentrates sold at these levels have been the result of inventory being liquidated for cash.

Supply-Demand. It now seems clear that much of the total tungsten supply over the past five years has come from inventory.

Mine Production of Concentrates (mt W Content)

	1989	1990	1991	1992	1993
Australia	1,330	1,150	200	100	50
Austria	1,500	1,500	1,450	1,600	300
Bolivia	1,000	1,050	1,150	800	400
Brazil	600	400	250	100	100
Burma(Myanmar)	300	300	300	300	300
Japan	250	230	250	350	110
Korea Rep. of	1,540	1,250	850	200	0
Peru	925	1,000	1,050	850	350
Portugal	1,300	1,350	970	1,000	700
Sweden	250	0	0	0	0
Thailand	500	500	600	300	200
United States	400	450	200	20	40
Other	200	375	425	400	270
Total MEC	10,095	9,555	7,695	5,960	2,820
CIS (est)	8,000	8,000	6,800	5,700	4,500
China (est)	23,500	20,700	17,500	13,900	10,250
TOTAL	41,595	38,255	31,995	25,560	17,570

Consumption of Tungsten (mt W content)

	1989	1990	1991	1992	1993e
Consumption of Concentrates (MEC's)					
USA	7,800	7,330	6,200	4,310	3,340
Japan	1,570	1,710	940	740	310
W. Europe	5,050	3,200	2,550	1,990	800
Other	3,000	2,700	2,500	1,630	800
TOTAL	17,420	14,940	12,190	8,670	5,330
Imports of Intermediates (Tungstates/Oxides/Ferrotungsten) into MEC's from China.	12,950	11,720	12,450	9,260	12,600
Estimated Consumption in Non-MEC's (as Concentrate Equivalent units)					
China	9,100	8,400	8,500	8,600	8,500
CIS	15,000	12,400	10,000	8,500	7,000
Total Apparent Consumption	54,470	47,460	43,140	35,030	33,430

Worldwide Tungsten Supply-Demand (K mt contained-tungsten)

	1989	1990	1991	1992	1993
Supply from concentrate production					
MEC	10.1	9.6	7.7	6.0	2.8
Non-MEC					
China	23.5	20.7	17.5	13.9	10.3
CIS	8.0	8.0	6.8	5.7	4.5
Total	41.6	38.3	32.0	25.6	17.6
Supply from Inventory	9.2	9.7	13.0	12.1	17.7
Total Supply	50.8	48.0	45.0	37.7	35.3
Demand* (Consumption of Virgin material)					
MEC	26.7	27.2	26.5	20.6	19.8
China	9.1	8.4	8.5	8.6	8.5
CIS	15.0	12.4	10.0	8.5	7.0
Total Demand	50.8	48.0	45.0	37.7	35.3

* Demand is defined as actual consumption at tungstate/concentrate/ferrotungsten stage - not imports.

Table 3 compares demand based on annual consumption of virgin (i.e. non-recycled) tungsten, with mine production. Demand is not based on imports, but on actual consumption at the tungstate level in each region in each year.

It is clear that the collapse in CIS consumption, MEC recession, and increased recycling have reduced consumption over this period. Also apparent is the collapse of mine production. This to an even greater degree than consumption, and that a large portion of total supply has come from inventory.

Taking the five-year period in total, 40% of supply came from current Chinese mine production, 17% from MEC mine production, 15% from CIS mine production, and an extremely high 28% from inventory—from earlier production. Of the supply from inventory, 75% apparently came from Chinese inventory. The proportion supplied by inventory increased over the five-year period. For all of 1993, 50% of supply was from inventory, and by the end of 1993, 60% was from inventory (See Chart 4).

Obviously this situation can only continue until stocks are exhausted. Stocks in MEC countries are now very low indeed, but stock levels in China and CIS countries are much more difficult to assess. The rather modest offering of tungsten—compared to other commodities—from CIS countries, together with the fact that, until 1990, the Soviet Union was a major importer of tungsten might suggest that stocks there are quite low. However, strategic stockpiles hitherto untouched might still exist and be available for future supply. There are indications that Chinese stocks will be depleted by mid-1994, but these indications may not be reliable.

There is only one certainty. Once these stocks are gone, there will be a massive shortfall in supply. Most tungsten mines, worldwide will be unable to react significantly to a need for increased supply. This is due to their having been closed for so long or having limped along with no capital investment, or development of reserves. *Major capital investment would be required, which would not be forthcoming at anywhere near today's tungsten-price levels.*

China. It is now likely that China's high production of many years built large inventories of concentrates (Chart 5). China developed large production capacity for APT and ferrotungsten (FeW) around the mid-1980s. This enabled large amounts of tungsten to be constantly available in all forms through oxide for export onto world markets. Constant oversupply fueled the very extensive Chinese export system. Many trading companies both inside and outside of China attempted to profit from this constant availability. *Stockpiled inventory of concentrates was probably used to supply* APT and FeW plants to supplement current mine-production. This large increase in supply resulted in the weak pricing and constant price decline seen from 1984 onwards. As prices declined, MEC mine production declined to a low level. Within China not much change was evident until the late 1980s. By then, weak pricing was starving investment money in Chinese mines, ore grades were declining, and developed reserves were being reduced. As a result, output began to decline.

An already bad situation was suddenly greatly worsened around 1990. This when a major outlet for Chinese concentrates, the Soviet Union, stopped buying from China. On top of this, the MEC recession in 1991/1992 then brought Chinese exports to an almost dead stop.

It appears that, in the late 1980s, China began efforts to support the market by reducing production. Its hope was to firm world pricing, enabling lower subsidization of Chinese mines. While well intentioned, these modest moves proved totally inadequate compensation for the collapse in demand of the early 1990s. From 1990 onwards, China moved towards a market economy. Tremendous problems developed in the Chinese tungsten industry. Collapsing demand led to subsequent collapses in price and production. The many tungsten-mining communities within China, with several hundred thousand miners and dependents, somehow had to be supported. Simultaneously reductions or elimination of subsidies were taking place. Efforts have been made to curtail *production and, concurrently, concentrate inventories have been* sold by the mines to sustain cash flow. This will continue until stocks are exhausted. Unfortunately, the same inventory being used to sustain cash flow to the mines is, by its very existence, also holding world pricing down. Pricing will remain low until either Chinese inventory is exhausted or China deliberately restricts the flow to force prices up. So far efforts to restrict the flow have been minimal, so one can only conclude that exhaustion of stocks will force the turnaround.

Given that at the end of 1993, world mine-production is only at 40% of consumption and there are indications that Chinese stocks will be depleted at some point in 1994, a real prospect exists for a massive supply shortfall within the next 12 months.

Graph 5 is an attempted construction of Chinese production/supply and inventory. It is one of several possible scenarios. The majority of estimates of Chinese mine capacity and production, such as the estimate given by Zhao Ruihe, of the China Tungsten Industry Assoc. in the paper presented at the 1987 symposium, put Chinese production in the early to mid-1980s in the 20K-25K mt contained-tungsten range (equivalent to 40K-50K mt 65% WO_3 concentrates). Chart 5 assumes production to have been at or above this level for most of the 1980s. Chinese supply is based on official Chinese export figures. They are essentially corroborated by ITIA analysis of Chinese imports into CIS and MEC countries. Internal Chinese consumption, presented at the 1993 symposium in Guangzhou, has then been added.

For the future, Chinese authorities have indicated that Chinese mine production will be limited to 20K mt/yr. Unfortunately, it is not entirely clear whether this is intended to be 20K mt concentrates, or 20K mt contained-tungsten. Since one level is twice the other, this difference is crucial and must be clarified in the near future.

CIS. Prior to 1990, the former Soviet Union was a very large consumer of tungsten. This consumption was at least 15K mt contained-tungsten, of which approximately 7-8,000 mt/yr were produced internally, and a similar quantity imported from China. Purchases from China stopped in 1990. Since then only small sporadic quantities (possibly of special purity levels) have been imported.

Since much of the pre-1990 consumption is presumed to have gone into military applications, post-1990 consumption is clearly much reduced. However, the former Soviet Union used much tungsten in steel production (tool and alloy grades) which although much reduced is still very large. As a result, a reasonable estimate of the CIS drop in consumption might be 55%.

Mine production in the CIS is clearly down. The old Soviet system had mines producing concentrates from low-grade deposits in remote areas—northern and far eastern Siberia for example. No processing plants were built in these remote areas, so that concentrates had to be transported huge distances for consumption. The economic viability of this situation would be poor even if tungsten prices were good, so one must conclude that mine production in CIS countries under current conditions has dropped sharply and will continue to decline in the future.

Exports from the CIS have so far been limited to: small amounts of concentrates, modest amounts of yellow oxide—some of which was toll converted from Chinese concentrates, and some scrap powders. It is not known if strategic stockpiles of tungsten existed in the former Soviet Union, and if so precisely what precise might have been stocked. There have been no apparent attempts yet to move such materials—if they exist—onto world markets. It is even possible that they were consumed internally even if they did exist. However, this remains a significant uncertainty which could have future impact.

Acknowledgments: ITIA, U.S. Bureau of Mines, UNCTAD.

COBALT

AN UNPREDICTABLE MARKET

E. Kielty, president,
African Metals Corp.

The cobalt market has always been different–going against the grain if you will. The producers still influence the market but more and more the traders control the tempo of the market. This was highlighted in December when the cobalt price surged almost $3/lb across the board for reasons many participants still do not understand but can only speculate on. That speculation centers on trader manipulation but the producers also must recognize their inactions helped set the stage and increase the anxiety levels of consumers.

The inability of the African producers to announce their policy regarding the producer price ($18/lb) that expired Nov. 20, 1993 caused concern but not panic as the prices at times were more than $6 below that level. The market was not zeroing in on a number but wanted to know the thinking and direction of the African producers. No announcement in November and twice delayed announcements in December did contribute to the overall market uncertainties at the close of 1993. When we couple the above with the fact that consumers in general had significantly reduced their inventory positions, the market was susceptible to an anxiety attack.

The question now is, "Was this surge a sign of a fundamental strengthening or a fluke occurrence?" The answers will vary from one sector to another, but one should recognize that the market in general has a number of weak links in its chain and over time must address the declining production situation.

During the first half 1993 the African producers tried to maintain their producer-price philosophy but instead watched a steady erosion of the free-market prices persist throughout the year right up to early December. The overall objective in Zaire now is to stabilize production of both copper and cobalt and establish a base upon which to rebuild when the necessary funds become available. By mid-year the African producers abandoned the producer price and any discounting scheme associated with it and utilized free-market quotations as the basis of transaction prices.

March of 1993 marked the re-entry into the U.S. marketplace of cobalt stockpile sales. The stockpile had been dormant on the market since August 1976 when it last sold material. The general consensus on Defense Logistics Agency (DLA) performance was extremely positive. The disposal office was responsive and took the initiative on several occasions to meet with industry as well as utilize public forums to explain DLA's objectives and the means it would employ to achieve them. I think industry in general is appreciative to Marilyn Barnett and her staff for their unique non-governmental approach to their mission.

We trust that with a new director and staff, the DLA objectives will continue to be balanced against those of the industry, through open dialogue. The future role of the DLA stockpile sales could be pivotal in achieving overall U.S. market balance. This will be evident in 1994 when the DLA sales could approach or exceed 25% of reported U.S. consumption. This factor alone should encourage responsiveness and continued open dialogue by DLA with its present and future customer base.

Because of the varied origins for byproduct cobalt - politics will continue to overshadow this market. Politics in Africa, the CIS, and even the United States will play a part in determining the supply side of the equation.

In Africa, despite western government's efforts, President Mobutu still looms as the dominant figure in Zaire. Unless there is a major coup (either military or economic) in 1994 there is no reason to believe his role will be diminished in the near future. This means Zaire's mining industry will continue to struggle with little significant improvements forthcoming. Zambia, as well, continues to struggle with economic problems and has announced it will be forced to significantly reduce its expansion plans for 1994. This will translate into less cobalt being produced than was forecast.

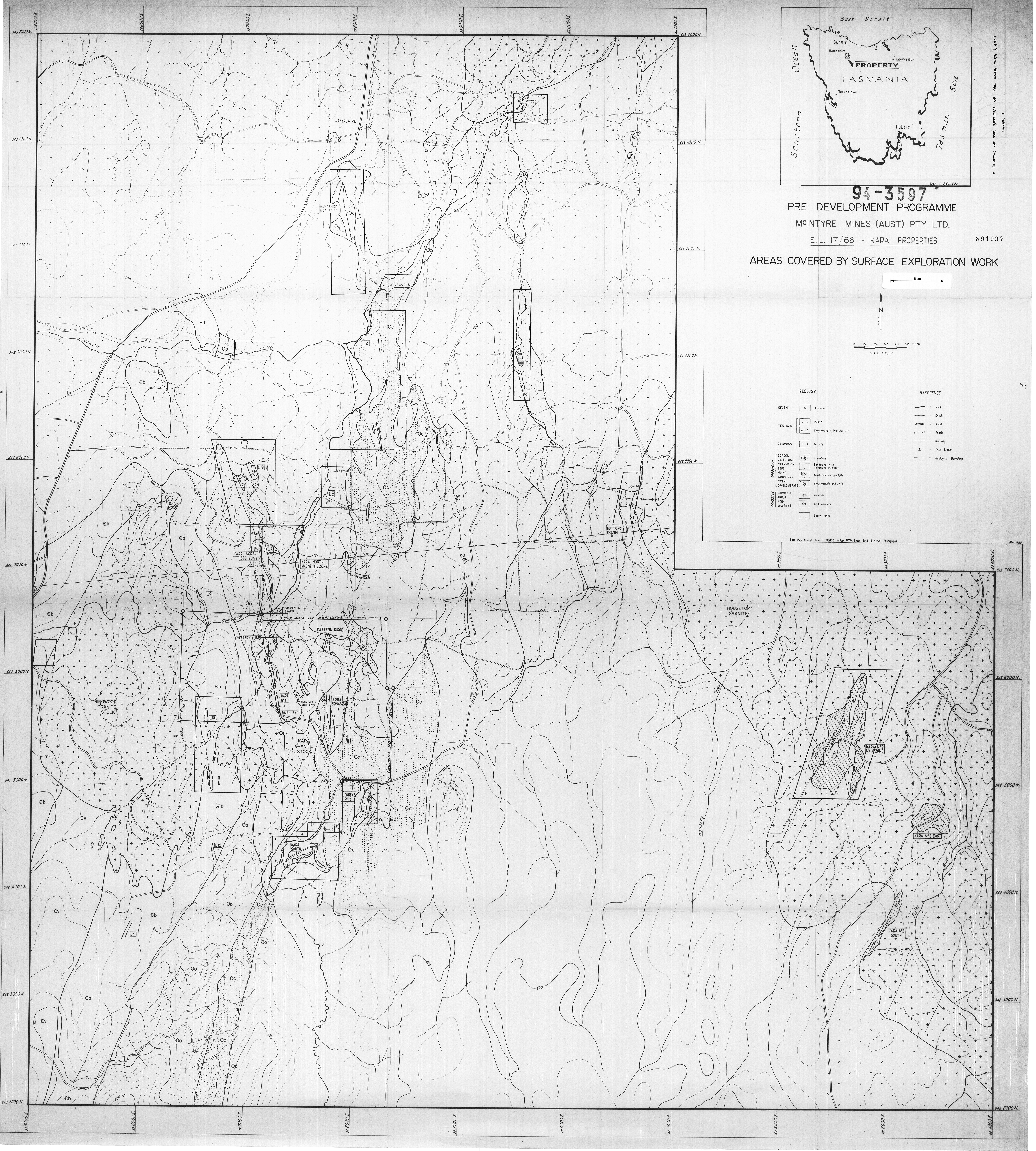
The CIS seems to finally be getting some real control over its exports but as they say the horse is already out of the barn. The CIS's role in the cobalt market over the past three years in particular has been significant. Its contribution to supply has prevented chaos from developing and at the same time forced numerous consumers to re-evaluate their product specification and actual quality needs. However, like other producers the peace dividend and the diversion of Cuban raw materials has translated into reduced CIS production and consumption. Many industry experts believe that the CIS has also exhausted a major portion of its strategic stockpiles and the West should not count on exports in 1994 exceeding 2,000 mt and that could be an optimistic forecast.

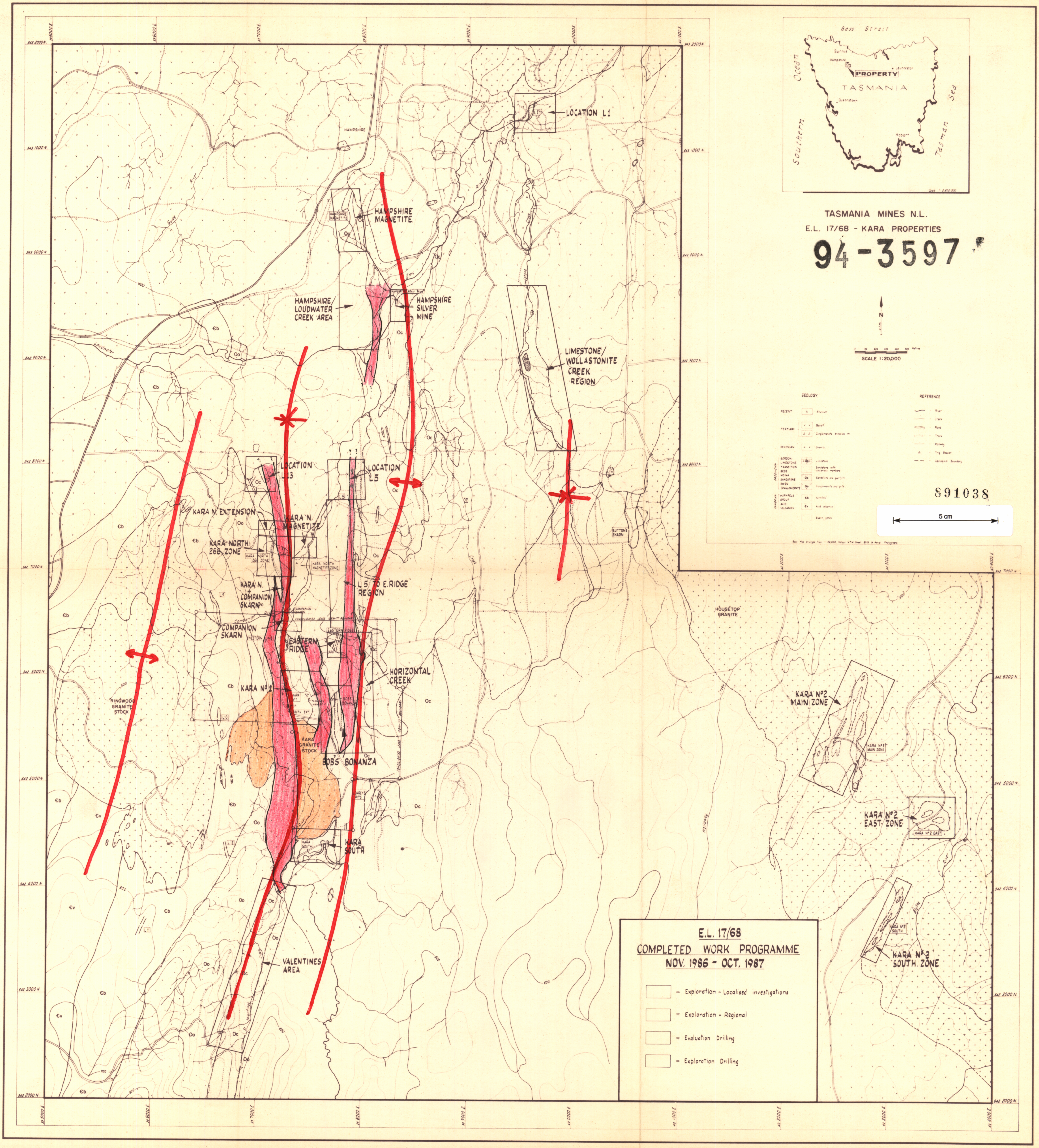
APPENDIX 2

GRANITE INTERSECTIONS AT L5

D326	7665N	7858E	363mRL	granite
D327	7673N	7840E	333mRL	granite
D328	7634N	7843E	334mRL	granite
D329	7621N	7860E	384mRL	end of hole
D330	7717N	7851E	347mRL	granite
D331	7716N	7864E	368mRL	granite
D332	7721N	7845E	337mRL	end of hole
D333	7767N	7859E	337mRL	granite
D334	7767N	7841E	320mRL	end of hole
D335	7767N	7858E	368mRL	end of hole

Note that four of the holes stopped short of the granite.


94-3597
PRE DEVELOPMENT PROGRAMME
McINTYRE MINES (AUST.) PTY. LTD.
E.L. 17/68 - KARA PROPERTIES
891037
AREAS COVERED BY SURFACE EXPLORATION WORK
5 cm
N
U.T.M.
0 100 200 300 400 500 Metres
SCALE 1:10,000
Bass Strait
Ocean
Southern
Tasman
Sea
Burnie
Hampshire
PROPERTY
Launceston
TASMANIA
Queenstown
Hobart
Scale 1:2,500,000
A REVIEW OF THE
GEOLOGY
RECENT
A Alluvium
TERTIARY
V V Basalt
Δ Δ Conglomerate, breccias etc.
DEVONIAN
+ + Granite
ORDOVICIAN
GORDON LIMESTONE
Og Limestone
TRANSITION BEDS
Sandstone with calcarious members
MOINA SANDSTONE
Oc Sandstone and quartzite
OWEN CONGLOMERATE
Oo Conglomerate and grits
CAMBRIAN
HORNFELS GROUP
€b Hornfels
ACID VOLCANICS
€v Acid volcanics
Skarn zones
REFERENCE
= River
= Creek
= Road
= Track
= Railway
= Trig. Beacon
= Geological Boundary
Base Map enlarged from 1:100,000 Hellyer N.T.M. Sheet 8015 & Aerial Photographs.
Nov. 1983
HAMPSHIRE
HAMPSHIRE MAGNETITE
KARA NORTH DGG ZONE
KARA NORTH MAGNETITE ZONE
COMPANION SKARN
CONSOLIDATED LEASE IDEM-TT BOUNDARY
EASTERN RIDGE
WESTERN
KARA No.1
SOUTH EXT.
BOBS BONANZA
KARA GRANITE STOCK
RINGWOOD GRANITE STOCK
LOWREY'S PITS
KARA SOUTH
SUTTONS SKARN
HOUSETOP GRANITE
KARA No.2 MAIN ZONE
KARA No.2 EAST
KARA No.2 SOUTH
Holloway
Creek
River
543 2000 N.
543 1000 N.
543 0000 N.
542 9000 N.
542 8000 N.
542 7000 N.
542 6000 N.
542 5000 N.
542 4000 N.
542 3000 N.
542 2000 N.
40 2000 E.
40 3000 E.
40 4000 E.



A REVIEW OF THE GEOLOGY OF THE KARA AREA (1994) FIGURE 2