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The Wang Phar tungsten deposits

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Abstract : The Wang Phar tungsten deposits are located 32 km west-southwest by road from Hatyai, Southern Thailand. The oldest rocks occurring in and around Wang Phar consist of a suite of metamorphosed sedimentaries of Palaeozoic age. These rocks have been intruded by an elongated north-south trending granite body of Cretaceous age. The emplacement of this granite body has resulted in the formation of hydrothermal vein systems which were concentrated in the granite cusps and impounded beneath the invaded rocks.

The vein systems at Wang Phar consist of a series of near-parallel, steep, westerly dipping and north-south striking quartz-muscovite veins with economic quantities of wolframite. Altogether there are five different localities within the Wang Phar area where significant vein developments are exposed on the surface. They are Kuen Mai Phai, Kuen Leng, Khog Yang, Klong Kung Lang and Klong Kung (or Ban Kam Chad).

INTRODUCTION

The Wang Phar tungsten deposits are located about 32 km west-southwest by road from Hatyai, South Thailand (Figure 1). The Wang Phar mining lease is held by the Yip-In-Tsoi Company and consists of five different localities where significant tungsten mineralisations occur. These five localities are known to the local inhabitants as Kuen Mai Phai, Kuen Leng, Khog Yang, Klong Kung Lang and Klong Kung (or Ban Kam Chad). The tungsten deposits at these five places have all been worked to varying degrees.

This paper is based largely on geological work and field mapping undertaken by the author during the early part of August, 1981. Some data were also obtained from local sources and from old plans furnished by the leaseholders.

REGIONAL SETTING

On a regional scale, the Wang Phar tungsten deposits lie within a well-known tin-tungsten province which forms part of the Southeast Asian tin-belt that extends from Northern Thailand into the western half of Peninsular Malaysia. Within the tin-tungsten province in South Thailand, various types of tungsten deposits are known to occur and are commonly of economic importance especially those of the pyrometasomatic and hydrothermal types.

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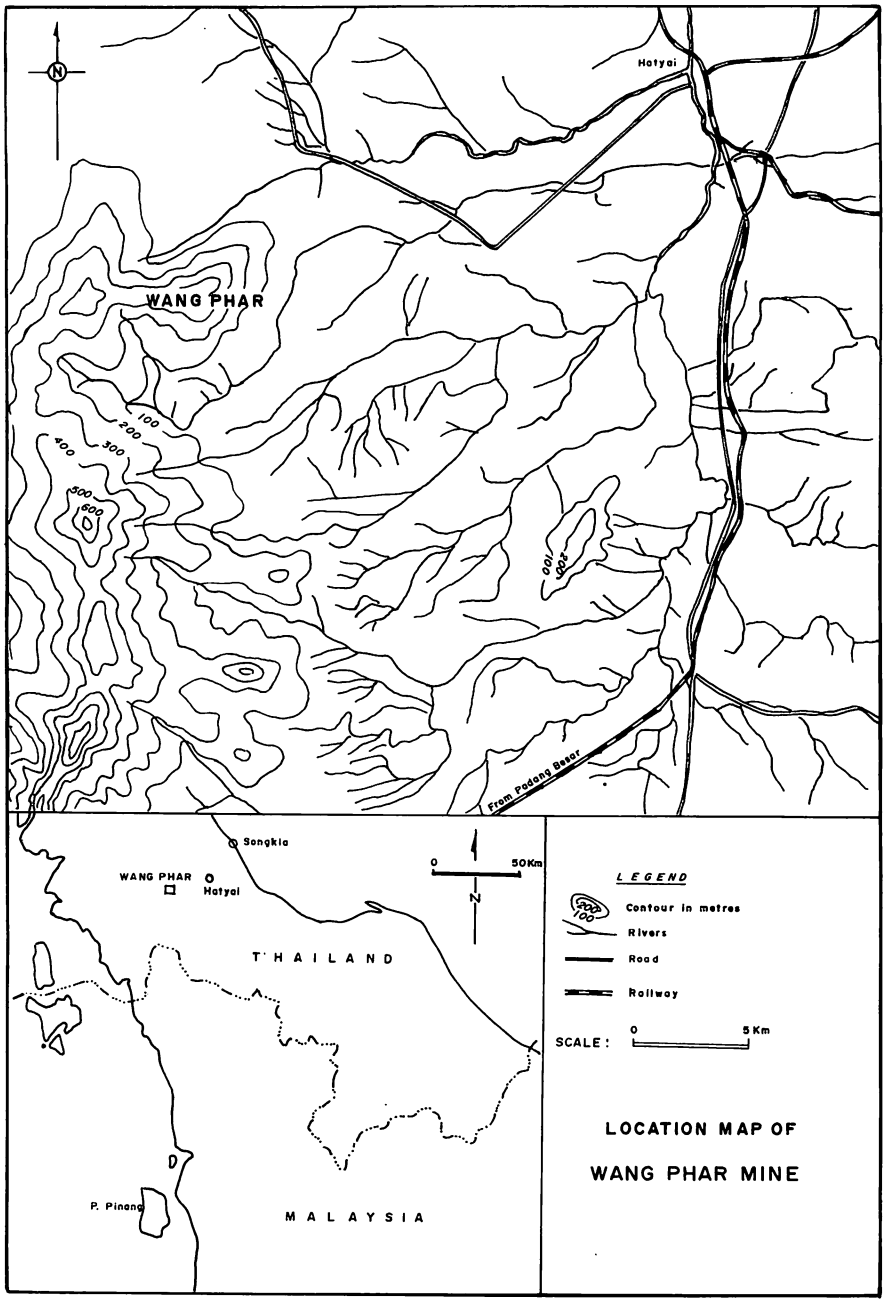

Figure 1 : Location map of Wang Phar Mine

The tungsten deposits in this province are by and large spatially, and in all probability, genetically related to granites of Cretaceous age. These granites are muscovite/biotite bearing with muscovite being more dominant. The granite bodies frequently constitute the topographical highs in this otherwise generally flat lying area.

The Wang Phar tungsten mine itself is situated on the eastern slopes of a north-south running hilly granite range overlooking a vast flat-lying alluvial plain. This granite body extends from west of Hatyai into just south of the Malaysian-Thai border. Apart from Wang Phar, other known occurrences of tungsten mineralisations are found elsewhere on this small granite range.

MINING HISTORY

The Wang Phar mine was started off initially by local participants and became a joint-venture operation later between the present leaseholder and a foreign group of companies in the 1950's. Most of the earlier planning and ground-work were carried out by the foreigners and some of the geological and survey maps produced by them still exist. However, the foreigners did not stay long and abandoned the project on mutual agreement after having stayed for only a few years. The reasons for this early withdrawal are not known for certain but could probably be due to unprofitability of the mining operations due in part to a decline in the market price for tungsten then and some other factors as well.

Sometime after the departure of the foreigners the Yip-In-Tsoi Company decided to proceed on its own. Underground workings were carried out on the easily accessible and richer parts of the ores and by 1973, a sizeable operation was underway. However, the scale of operations was greatly reduced after the later parts of 1980.

GEOLOGY

The oldest rocks occuring in and around the Wang Phar area consist of a suite of metamorphosed sedimentaries of Palaeozoic age and believed to be part of the Kanchanaburi Formation. Within the mining lease, the dominant rock-type of this suite of rocks is a weathered pale-gray phyllite which is seen to underlie the foothills and valley floors. The phyllite is observed to be substantially deformed and steeply dipping with erratic dip directions and strikes. Towards the west, the country rocks have been thermally metamorphosed by a granite intrusive into a hard and massive dark-gray jointed argillite. Bedding in the argillite has generally been destroyed. Being more resistant the argillite is seen to occupy areas which are topographically higher than the areas underlain by the phyllite.

In thin-sections, the argillite is seen to compose almost entirely of fine-grained quartz and clay minerals, with occasionally traces of chlorite and calcite existing in veinlets. The quartz grains are in lens-shaped strings which are relict textures of the original sedimentary country-rock.

The granite body which intrudes the phyllite and argillite occupies the entire western portion of the area (Figure 2). This intrusive of Cretaceous age has brought about thermal alteration to the adjacent areas resulting in the recrystallisation of the country-rocks into argillites along its eastern margins. A more important consequence of the granite emplacement is the formation of hydrothermal vein systems brought about by ore-forming agents liberated during the consolidation of the granite magma; and which were concentrated in the granite cusps immediately beneath the invaded rocks. The vein systems did not penetrate into the country-rocks because the argillite provided an effective impounding body which blocked the passage of the mineralizing solutions.

All the vein systems found in the Wang Phar area are located on the eastern face of the granite range and never far from the granite-argillite contact. Such vein developments are not seen near the crests of the present hills. The reason is probably because veins which were formed near the crests of the granite have as a result of uplift and denundation been eroded away.

In thin-sections, the granite is seen to consist typically of quartz, alkali and plagioclase feldspars, muscovite as the chief mafic mineral and trace amount of opaques. The feldspars are sometimes turbid due to alteration. The plagioclase feldspars and muscovite are also known to show signs of deformation characterised by curved lamella twins and bent cleavage traces respectively.

The contact between the granite and argillite is generally sharp and steeply dipping and is noted to be sheared in some places. Post mineralisation faults are seen cutting the vein systems but do not appear to effect any large scale displacements. Joints are often seen cutting the granite but are not as common as in the argillite.

The main structural trend of this area is north-south as indicated by the elongated granite mass and the trend of the vein systems. The individual veins on the whole have general north-south strikes with steep westerly dips and are rarely seen to depart from this attitude.

MINERALISATION

The mineralised veins occurring in the Wang Phar area vary in thickness from about 2 cm to a maximum width of about 1.2 m, frequently pinching and swelling along the way. The bigger veins may extend for about 200 m along strike, often petering out at the granite-argillite contact or disappearing beneath the argillite (Plate 1). All the veins have very steep dips and on the whole, have

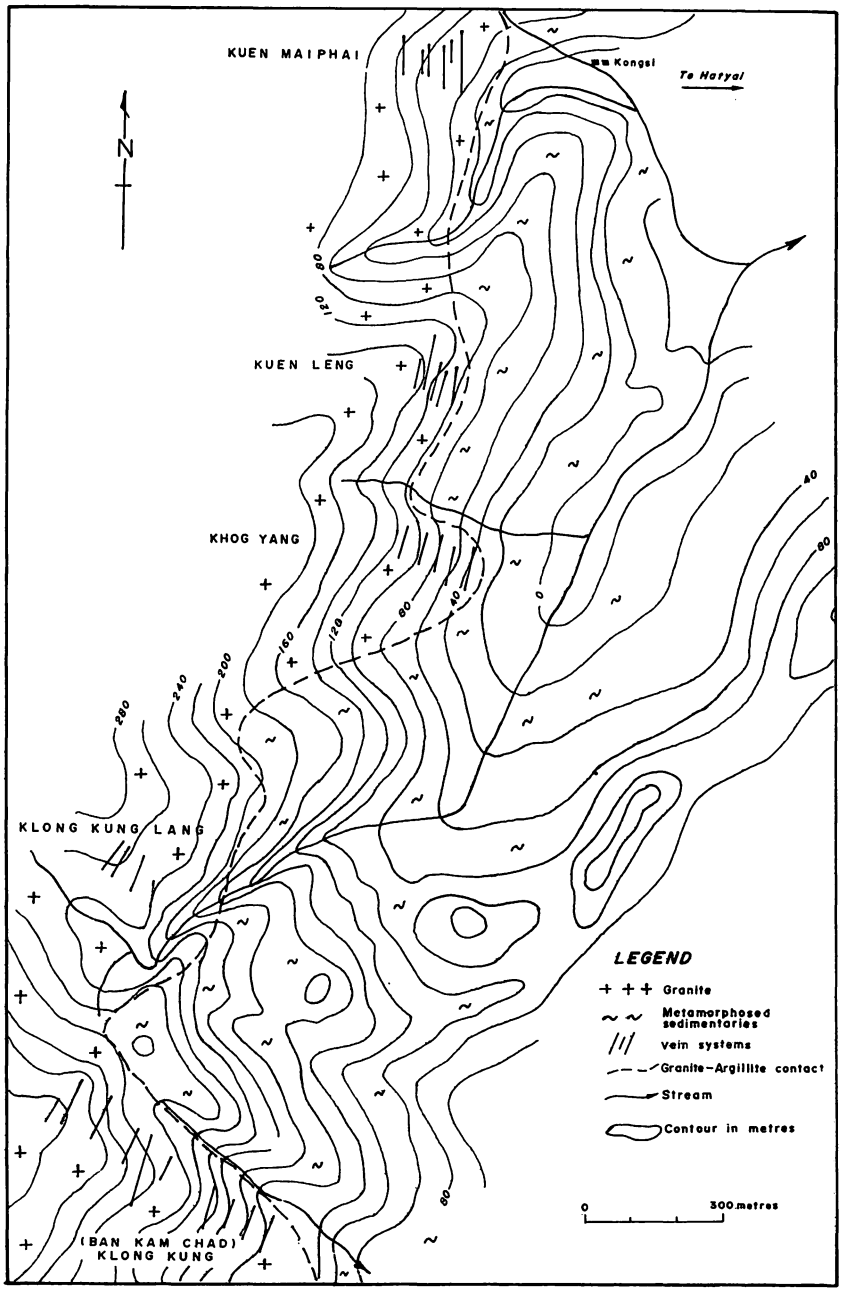

Figure 2: Geological map of Wang Phar Mine

westerly dip directions though they may bend and dip to the east at very localised spots (Plate 2). Down-dip extensions of the veins vary according to the size of the veins with some of the prominent ones extending down to at least 90 m from the surface.

The mineralised veins are quartz-muscovite veins consisting of quartz and muscovite as the main components (quartz being much more abundant) followed by lesser proportions of topaz, tourmaline and the ore-minerals wolframite, cassiterite, scheelite and sulphides. The most important ore-mineral found in the veins is wolframite which is present in significant amounts in some of the veins to be economically exploited.

The wolframite occurs commonly as grayish-black well-formed crystals and as large aggregates in the vein, often in close association with muscovite. There appears to be a general enrichment of wolframite in places along the vein where the muscovite content is increased. Veins which are very siliceous and lack muscovite seem to be of poorer grade. In many instances, the wolframite is observed to concentrate along the vein boundaries but within the vein proper.

Cassiterite and scheelite are found to make up about 1% and 0.2-0.3% of the final heavy concentrate from the treatment plant respectively. Arsenopyrite and pyrite occur quite commonly in the veins. Galena has also been noted occasionally.

The wall-rocks adjacent to the veins are sometimes altered by a process of greisenisation and to a very much lesser extent, tourmalinisation. In certain places, alteration of the granite host-rocks is indicated by the presence of abundant coarse muscovite flakes, while in other instances, the fabric of the granite appears to have been altered. The width and intensity of the alteration envelopes vary, depending frequently on the size of the veins, but are often much less than 50 cm. Presence of ore-minerals in the altered zones is uncommon and is believed to be insignificant.

DESCRIPTION OF THE MINERALISED AREAS

The Wang Phar tungsten deposits comprise of five localities where significant vein developments are exposed on the surface. Of these five places, only three, namely Kuen Leng, Khog Yang and Klong Kung (also known as Ban Kam Chad) have underground tunnel workings. The other two, Kuen Mai Phai and Klong Kung Lang, have also been worked but only on the surface.

The underground workings are usually carried out by driving an adit in a westerly direction from the side of a hill until it intersects a sizeable vein. A tunnel is then driven along the strike of the vein and the rich parts of it extracted by an overhand stope. Chutes for the passage of ores from the overhand stope are erected at 10 m intervals along the tunnel. The ores are collected by rail cars which transport the ores to a crushing and treatment plant for separation of the wolframite ores.

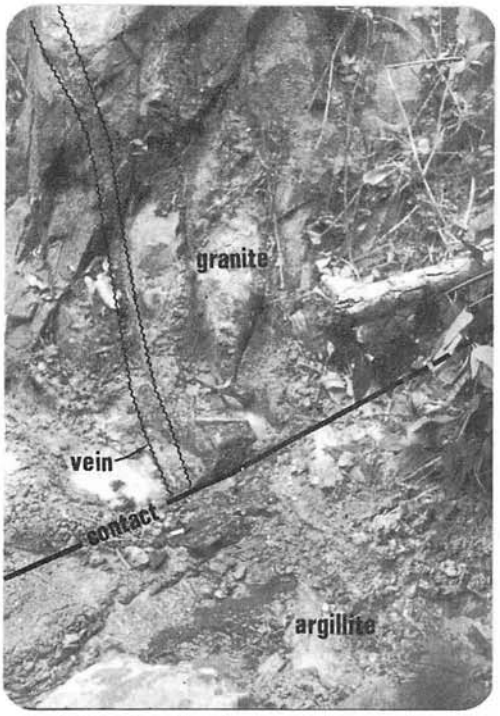

Plate 1: Quartz-muscovite vein in granite 'impounded' beneath argillite

Plate 2 : Steeply dipping wolframite bearing greisen vein.This vein is being trenched on the surface and has also been partly stoped from underground

KUEN MAI PHAI

This place is located at the northern end of the Wang Phar mining lease and is about 300 m west of, and overlooking the mine kongsi. At lease six veins occurring at about 10-20 m apart from each other are known to exist in this area. The veins have monotonous north-northeast strikes and dip steeply to the north-west. The lengths of these veins on the surface are estimated to vary between 40-130 m and have been worked to various degrees on the surface by villagers.

KUEN LENG

Kuen Leng is located on a separate hill at about 600 m south of Kuen Mai Phai. This area has the most extensive underground workings, with tunnels being driven at 50 m, 80 m and 120 m above sea levels. There are seven steeply dipping and north-northeast striking veins in this area which are significant

enough to be exploited. These significant veins vary in width from 20 cm to almost 1 m and are believed to extend as much as 200 m along strike. The down-dip extensions of these veins are in excess of 90 m as they are observed to persist down to and below the 50 m-level from surface. A large part of the broader and richer veins have been extensively worked by stoping from the 50 m-level to the surface. Apparently the average grade of ore determined from actual production is about 0.7-0.9% WO_3.

The 50 m-level consists of a total of about 700 m of tunnel. Seven veins are intersected by the main adit and cross-cut, but only four of these veins (No. 5, 3, 2B and 2A) are broad and rich enough to be mined at this level (Figure 3).

The 80 m-level has about 900 m of tunnel of which many sections are not passable as the floors have been blasted through from 50 m-level. A total of eight veins are intersected at the 80 m-level of which four (No. 4, 3, 2B and 2A) have been worked to some measurable degree (Figure 4). The granite-argillite contact is exposed on both the 50 m and 80 m-levels.

The underground workings at 120 m-level are by comparison much less well-developed, having only about 200 m of tunnel. The reason being, except for vein no. 3, the other six veins intersected by the main adit are very narrow and insignificant.

Vein No. 3 is the most prominent, richest and extensively worked vein. It characteristically pinches and swells and is seen to vary in thickness from 20-90 cm. It has been worked at all the three levels with the northern section being completely mined out from 50 m-level to the surface. The vein is observed to persist down below 50 m-level and is still considerably thick at this level. Winzes have been sunk in the richer parts of the vein at this level to extract the wolfram. The southern extension of this vein is not greatly exploited, probably due to comparatively lower grades. It appears to taper off to the south at the 80 m-level though this is not noted at the other levels.

KHOG YANG

Khog Yang is situated at about 300 m south of Kuen Leng. A dirt-track joins Kuen Leng to Khog Yang ending at the portal to vein no. 2 at Khog Yang. Six significant veins, about 100-150 m long and running generally northeast and dipping steeply to the northwest exist in this area. However, they are only about 20 cm wide and are generally not very rich.

Vein no. 2 is the only vein that has been worked below the surface. An adit is driven along the vein for a distance of 100 m. Not much of the ore have been excavated as the stopes do not appear to rise more than 10 m. This vein is about 20 cm broad at this level and is clearly seen to peter out at the portal of the adit not far away (about 10 m) from the granite-argillite contact. This vein is believed to extend at least 50 m down from the surface.

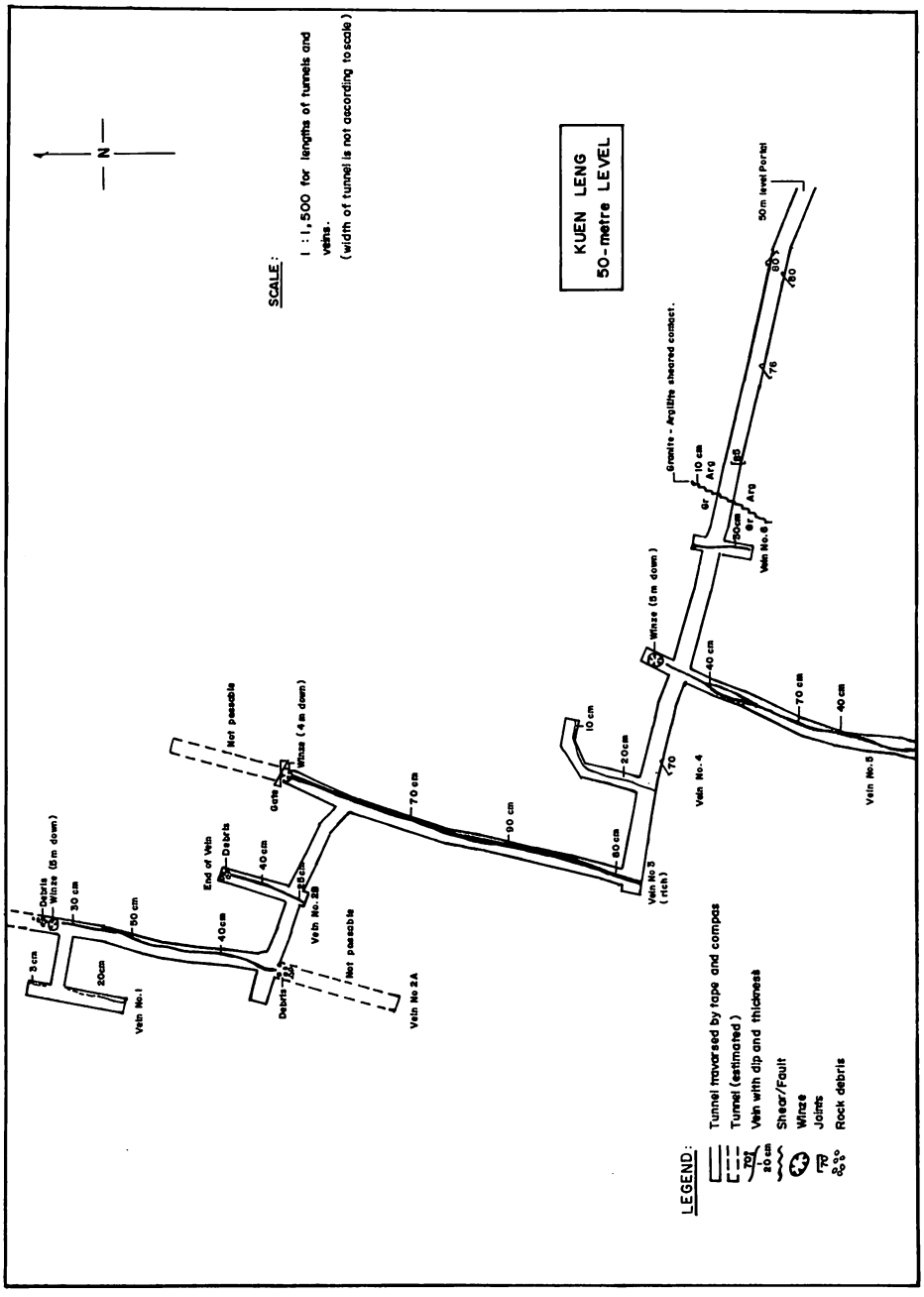

Figure 3 : 50 m-level at Kuen Leng

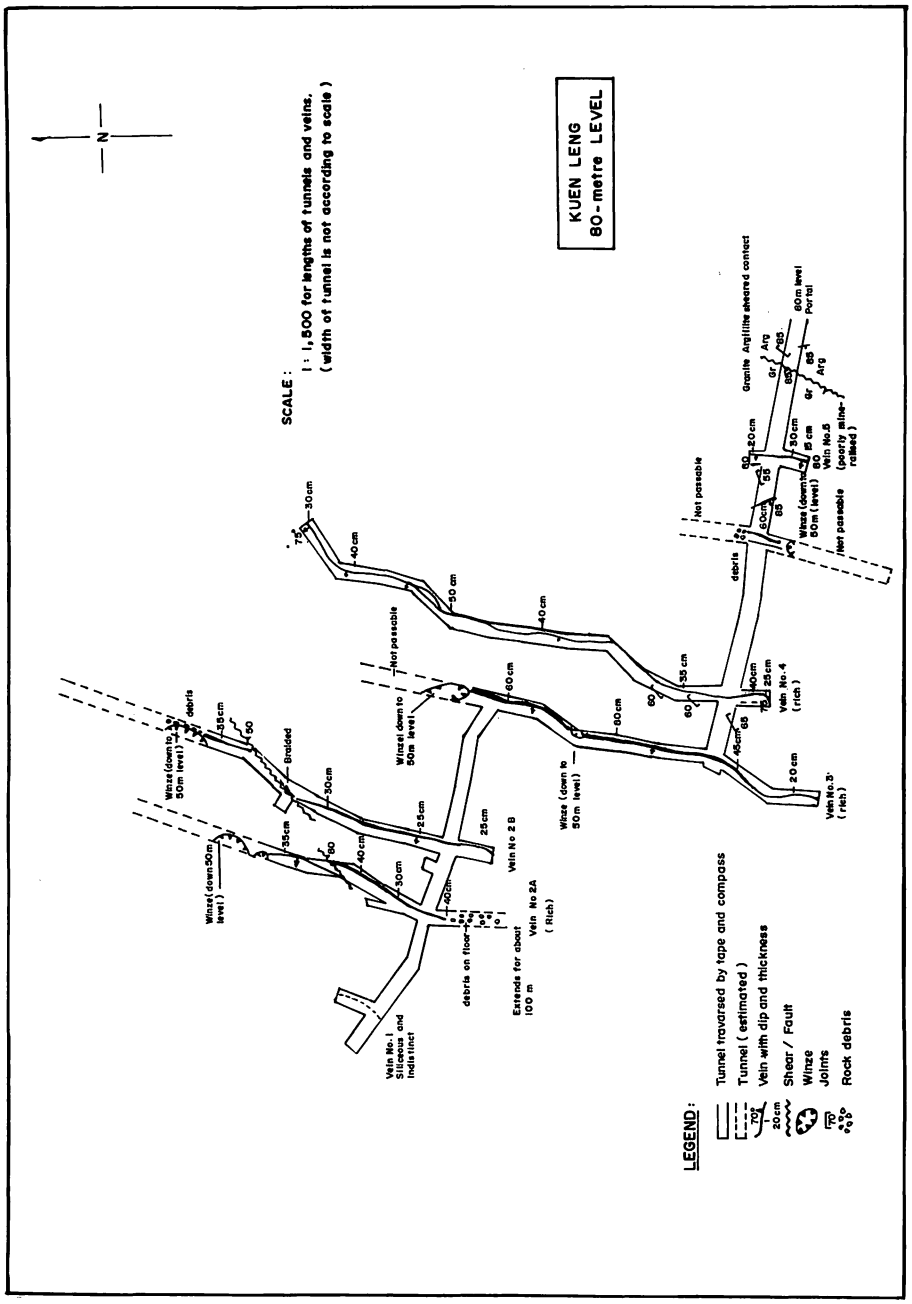

Figure 4 : 80 m-level at Kuen Leng

All the other five major veins have been worked to shallow depths along their lengths on the surface by villagers. These veins are expected to peter out or disappear beneath the argillite at the granite-argillite contact.

KLONG KUNG LANG

This locality is situated at a linear distance of 1 km southwest from Khog Yang. The core of the mineralised area is confined to a cliff face and is developed more in a form of a vein-swarm. The veins vary in size from 1 cm to about 1 m and like at the other places, are generally striking north-northeast with steep westerly dips. Some of the veins occuring closely together and exposed on the face of the cliff have been quarried in a small scale while others which are more widely separated have been scraped down to a maximum depth of 2 m along short distances of the veins. The frequency and intensity of mineralisation decrease towards the higher parts of the hill away from the cliff-face.

The three most prominent veins seen in this area are about 80-100 cm thick with quite distinct alteration zones. These veins are probably about 80-120 m long and extend for at least 30-50 m from top to foot of the cliff. One of these veins is observed to be cut by a prominent fault dipping about 50° to the south. However the displacement caused by the fault is only minimal. The three veins are generally siliceous with muscovite and wolframite occuring more commonly near the boundaries of the veins, but are on the whole not richly mineralised. A few of the very small veins are seen to contain abundant wolframite. However, the great majority of these smaller veins are barren.

KLONG KUNG (BAN KAM CHAD)

This is the southern-most mineralised area of the Wang Phar deposits and is about 700 m from Klong Kung Lang. Ban Kam Chad has the largest number of exposed veins which are observed to be 1 cm to 30 cm wide on the surface. The smaller veins are only a few metres long while the larger ones can stretch as far as 150 m. This swarm of veins occur over an estimated surface area of about 0.1 sq. km on the side of a hill with an average 20° slope.

On a broad scale, the veins are seen to be aligned north-south and arranged in parallel along a northwest axis. This vein system is cut off on the northeast by a stream which marks the granite-argillite contact. The veins exposed by surface workings show large dip angles with preferred westerly dip directions (Figure 5).

Ten prominent veins were demarcated by earlier prospectors but only veins no. 6, 7, 8, 9 and 10 are observed to be of significant importance. Three of these veins, no. 8, 9 and 10 are generally observed to be thicker in the subsurface (20-90 cm) and have been mined to some degree by underground workings. Two adits were driven at 120 m-level and 170 m-level in this area.

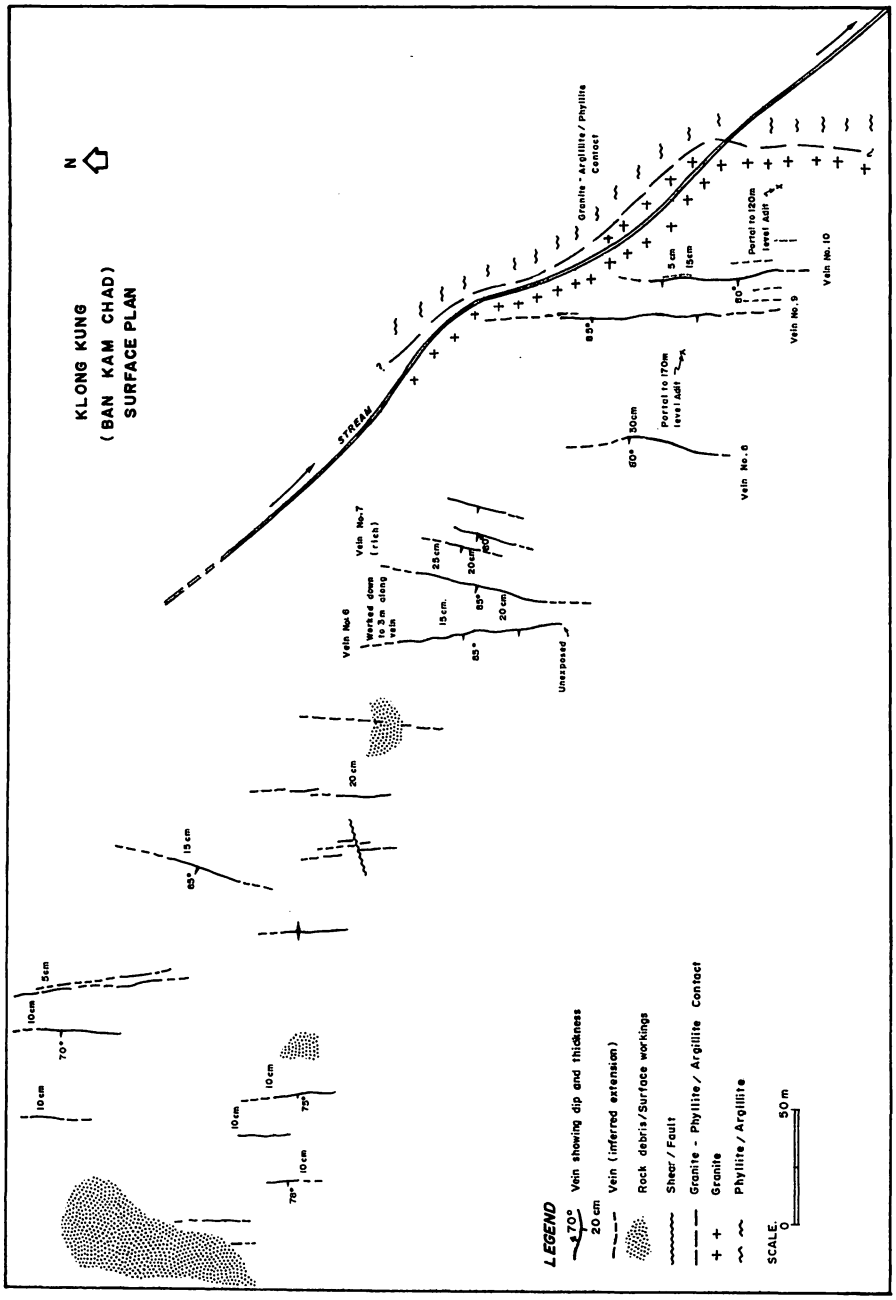

Figure 5 : Surface plan of Klong Kung

The 120 m-level adit is driven into the hill for about 160 m and intersected the three major veins no. 10, 9 and 8. The drift along vein no. 9 is longest (about 80 m) and has been stopped 30-40 m vertically up to the surface along its way. At the northern end of this drift, another vein parallel to the main vein is encountered. It thus appears that vein no. 9 consists of two veins which are unconnected but occur closely together at the ends where they overlap. Many smaller veins are also intersected by the 120 m-level adit but are too narrow or poorly mineralised to be economically mined.

The 170 m-level is observed to intersect a total of nine closely spaced veins between 5-20 cm thick. However no serious attempt has been made to mine these veins as they are too narrow and not rich enough to be mined by tunnels.

CONCLUSION

The wolframite-bearing quartz-muscovite veins at Wang Phar have sustained a small mining venture for some years. The distinctive feature of these tungsten bodies is that they are greisen deposits which have been structurally impounded and localised in the granites beneath an impervious roof of metamorphosed sediments. Because of this feature, the mineralisations observed at Wang Phar have not been fully uncovered. Downdip extensions of some of the veins are unknown and represent potential reserves in the Wang Phar mine. Finally, evidence of tungsten mineralisation outside but adjacent to the Wang Phar prospect suggest that possible significant reserves remain undiscovered in the surrounding areas of Wang Phar.

ACKNOWLEDGEMENTS

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