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Sepiolite from Kramat Pulai, Perak

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Abstract: *Meerschaum* (sepiolite), believed to be the first reported occurrence in Malaysia, is studied by chemical, DTA, optical and X-ray methods. It occurs as a white fibrous mineral in the forms of stringers, veins and films along irregular fractures in the marble host rock from an abandoned quarry. Although *meerschaum* is a high value industrial mineral, used for making smoking pipes and cigarette holders, this occurrence is too small to warrant any serious investigation. However, the quarry operators in the area should be made known of its possible economic importance for two reasons. Firstly big veins may be profitably exploited. Secondly it is a source of magnesium contamination for high-calcium limestone users. The reported *meerschaum* is believed to be formed by hydrothermal activity.

INTRODUCTION

Kramat Pulai area has a long history of tin mining since 1909 (Ingham & Bradford, 1960). The area was worked for mainly alluvial tin by Kramat Pulai Ltd., until a scheelite lode was exposed in schist by open cast mining (Willbourn & Ingham 1933). There was small scale tin mining in the area until the early 1980s. Now the area is regaining its importance as a major source of supply of limestone raw materials for marble, calcium carbonate powder, cement and lime industries.

Besides cassiterite and scheelite, the Kramat Pulai area in its heyday (1933) has yielded the following minerals: arsenopyrite, beryl, corundum, diaspore, ferberite, fluorite, galena, grossularite garnet, pyrite, pyrrhotite, sphalerite, stibnite, stolzite, tremolite asbestos, tungstite, wolframite, and yttrotungstite (Ingham & Bradford, op. cit.)

The fibrous sepiolite described here is believed to be the first reported occurrence in Malaysia. It occurs in veins in an abandoned limestone quarry. It has not been prospected to ascertain its economic potential.

LOCATION AND ACCESS

The sepiolite is found about 14 km by road to the southeast of Ipoh, in a small unnamed limestone hill just south of Gunung Terendam (Figure 1). It is accessible by road via Simpang Pulai, the road after the bridge across Sungai Raia is unpaved (Figure 2).

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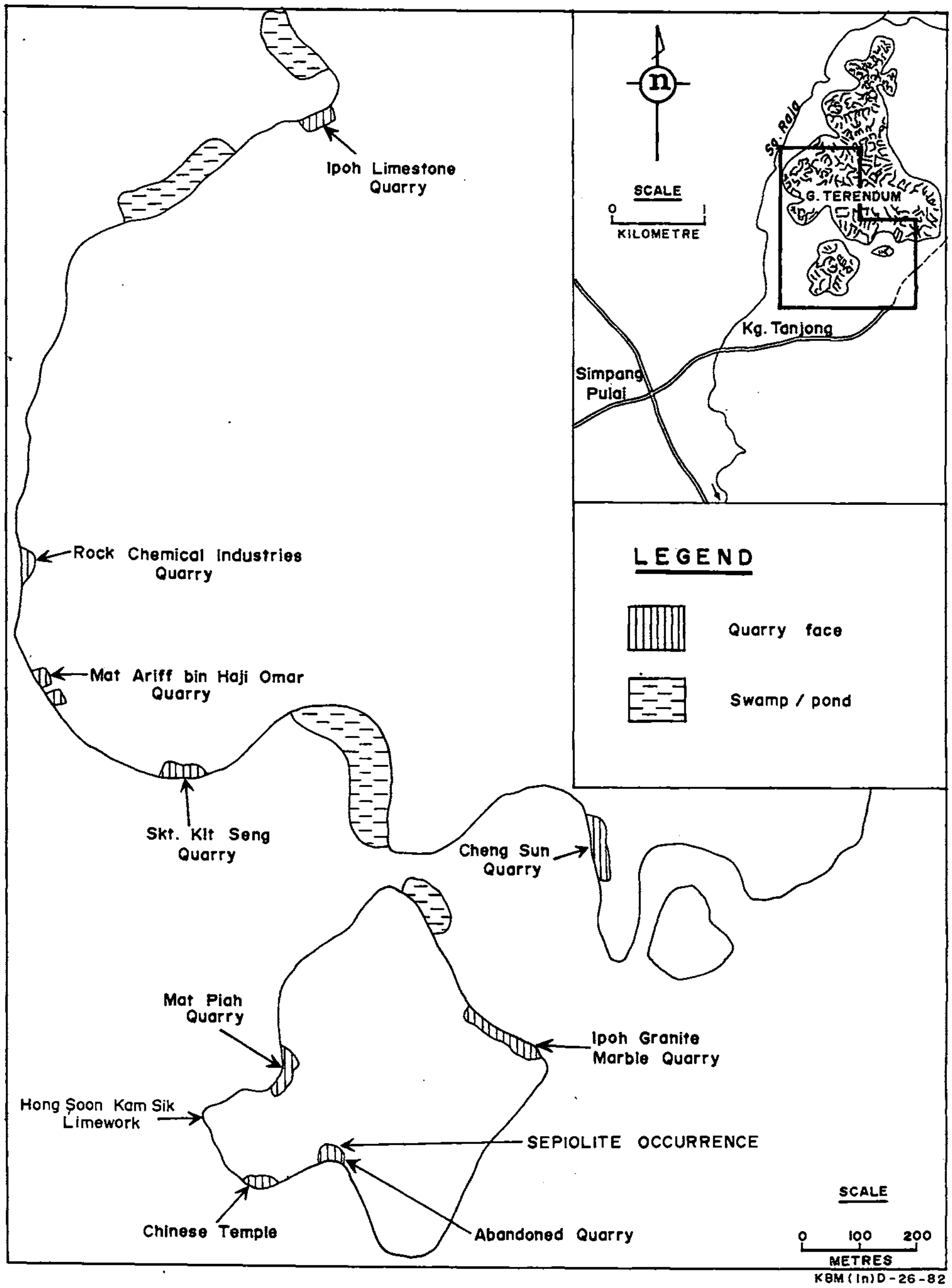

Figure 1 : Sepiolite from Kramat Pulai, Perak

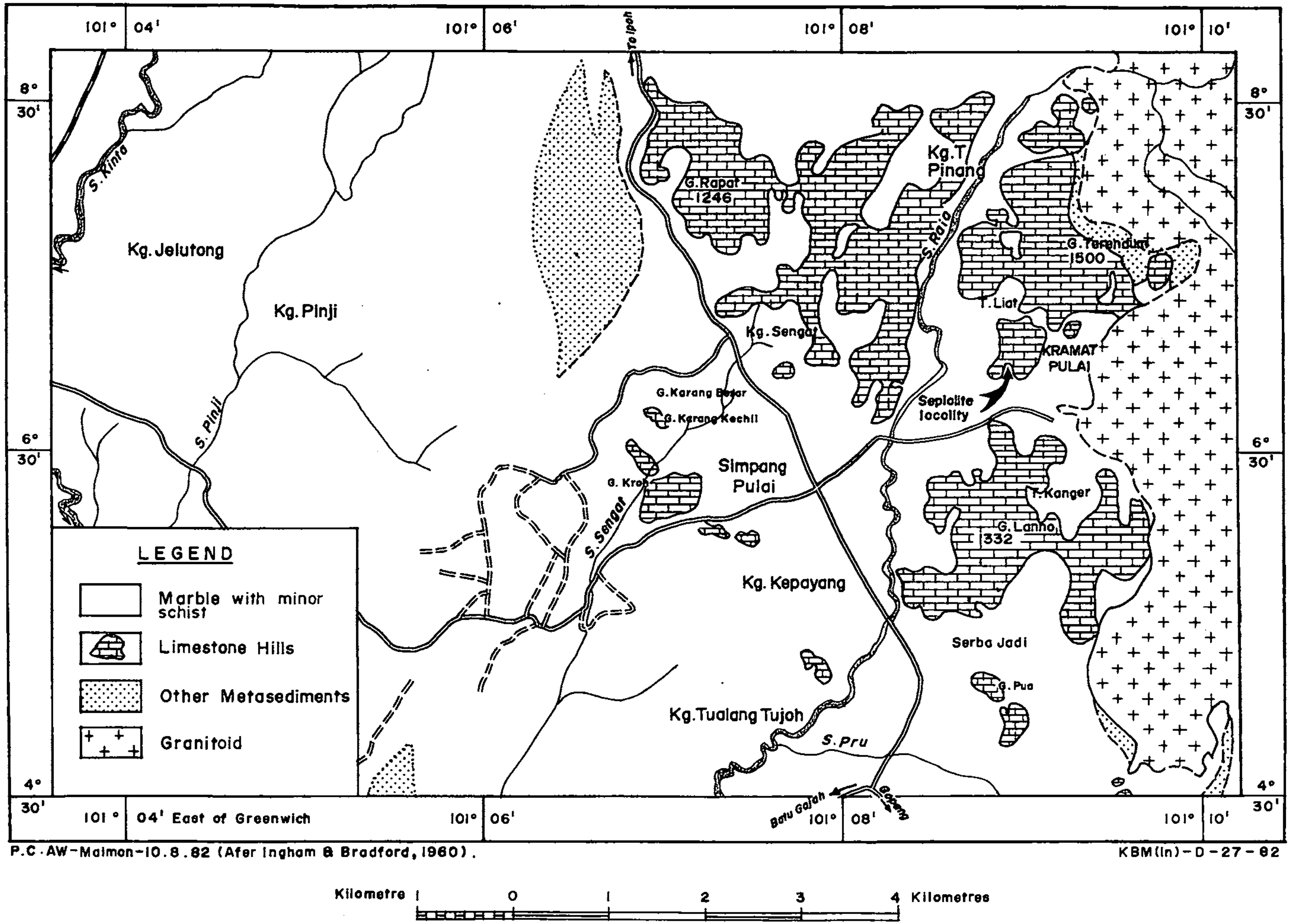

Figure 2 : General geology of Kramat Pulai area, Perak.

GEOLOGICAL SETTING

The sepiolite veins are found in the Calcareous Series which are made up mainly of marble, in places, interbedded with schist of Paleozoic age. The Calcareous Series were intruded by granite of Late Triassic age (Figure 2). At the old Kramat Pulai Scheelite mine, the main ore body was in contact with marble and schist both of which were intruded by aplite, pegmatite and granite (Willbourn & Ingham, 1933). The mine has since been covered by tin tailings, but it is believed to be located about 700 m to the northeast of the sepiolite occurrence.

OCCURRENCE

The sepiolite occurs as stringers, veins or films along irregular fractures in the marble (Figure 3). Most of the sepiolite occurs along fractures trending E-W, dipping steeply, generally in a northerly direction. The veins up to 15 mm wide can be seen in the quarry face and on broken marble blocks strewn on the floor of the quarry. The long fibres of sepiolite are arranged perpendicular to the wall of the vein (Plate 1).

DESCRIPTION OF SEPIOLITE

In a hand specimen this material is white, fibrous, like a matted cotton-wool. In thin section, with plane-polarised light, little can be seen because of the low relief and lack of colour. Under crossed nicols, however, the truly fibrous texture, like serpentine, becomes evident (Plate 2). The fibres show a wavy extinction which is nearly parallel to the length, with positive elongation. The birefringence is low and the interference figure is negative, 2V is about 40-60°.

The X-ray pattern of the sepiolite as shown in Plate 3 was obtained by the powder method using the CuK α radiation. The strongest interplanar spacing is 12.1 Å, whilst the second major line is 2.56 Å (Leong Kok Hoong, per comm). The interplanar spacing 12.1 Å compares favourably with that of 12.2 Å for the fibrous sepiolite from Arizona (Kauffman, 1943).

The DTA of the sepiolite was determined at a heating rate of 20°C/min. using Al_2O_3 as the reference material. The DTA curve shows two small endothermic reactions at about 90°C and 330° which may correspond to dehydration and a major endothermic reaction at about 835°C which denotes the decomposition temperature. There is no distinct exothermic reaction. Figure 4 shows the DTA curves of sepiolite from Kramat Pulai and others found in the literature (Grim, 1968 and Smykatz-Kloss, 1974).

CHEMICAL COMPOSITION

The host rock is high-calcium marble. Table 1 show the chemical analyses of three marble samples. Two of them show small amount of non-carbonate impurities as reflected in the acid insoluble residues. The magnesium content is low.

Table 1 : Chemical analyses of the sepiolite host rock

	KPI	KP2	KP3
CaO	55.61	51.87	50.98
MgO	0.32	0.97	1.18
Fe_2O_3	0.05	0.09	0.11
Acid Insoluble Residues	0.14	5.30	6.46

Analyst: Fan Choon Meng

The sepiolite samples were immersed in dilute acetic acid (10%) and left over night in order to remove any carbonate impurity. Three samples were analysed. The chemical analyses of the Kramat Pulai sepiolite are shown in Table 2, together with comparison with other sepiolites found in the literature. According to Surfleet and Porter (1940) as quoted in Kauffman (1943), a true magnesium trisilicate (sepiolite) should have gravimetric ratio of magnesia to silica equivalent to 1:2.24, the allowable limits being between 2.21 to 2.28. The ratios of the three above analysed samples range from 2.23 to 2.31; two out of the three samples are within the limit. Out of the 5 foreign samples given in Table 2 only 2 samples (No. 3 and 5) yield ratios within the limit.

Table 2 : Chemical analyses of sepiolite from Kramat Pulai and other countries

	1	2	3	4	5	6	7	8
SiO_2	54.9	52.88	51.89	54.83	52.51	49.42	52.15	52.50
Al_2O_3	0.40	1.72	1.43	0.28	0.87	Tr	0.12	0.60
Fe_2O_3	1.06	1.26	1.13	0.45	0.45	0.03	8.23	2.90
FeO	<0.01	–	0.08	–	0.40	0.42	1.66	0.70
TiO_2	0.01	0.06	0.11	–	0.13	–	0.05	
CaO	1.46	0.50	1.75	0.55	0.81	Tr	0.74	0.47
MgO	23.8	23.75	23.25	24.51	22.49	22.03	17.99	21.31
Na_2O	0.03	0.05	0.08	0.35	0.65		0.18	
K_2O	0.06	0.41	0.93	0.03	0.65	0.12	0.06	
P_2O_5	0.04	0.37	0.37	–	0.04	–	–	
H_2O^-	–	–	5.96	8.18	12.01	18.49	9.01	12.06
H_2O^+	17.8	–	11.54	10.74		9.99	9.08	
L.O.I.	–	–	19.24	–	9.48			9.21
Total				99.92	100.49			99.75

1. Sepiolite from Kramat Pulai, analyst Wong Yew Choong
2. Sepiolite from Kramat Pulai, analyst Lee Kim Hock
3. Sepiolite from Kramat Pulai, analyst Mohd Ariff Omar
4. Sepiolite from Arizona (Kauffman, 1943)
5. Meershaum from Tanzania (Sampson, 1966)
6. Sepiolite from Japan (Sudo & Shimoda, 1978)
7. Ferriferous sepiolite from Japan (Sudo & Shimoda, 1978)
8. Sepiolite from Madagascar (Sampson, 1966)

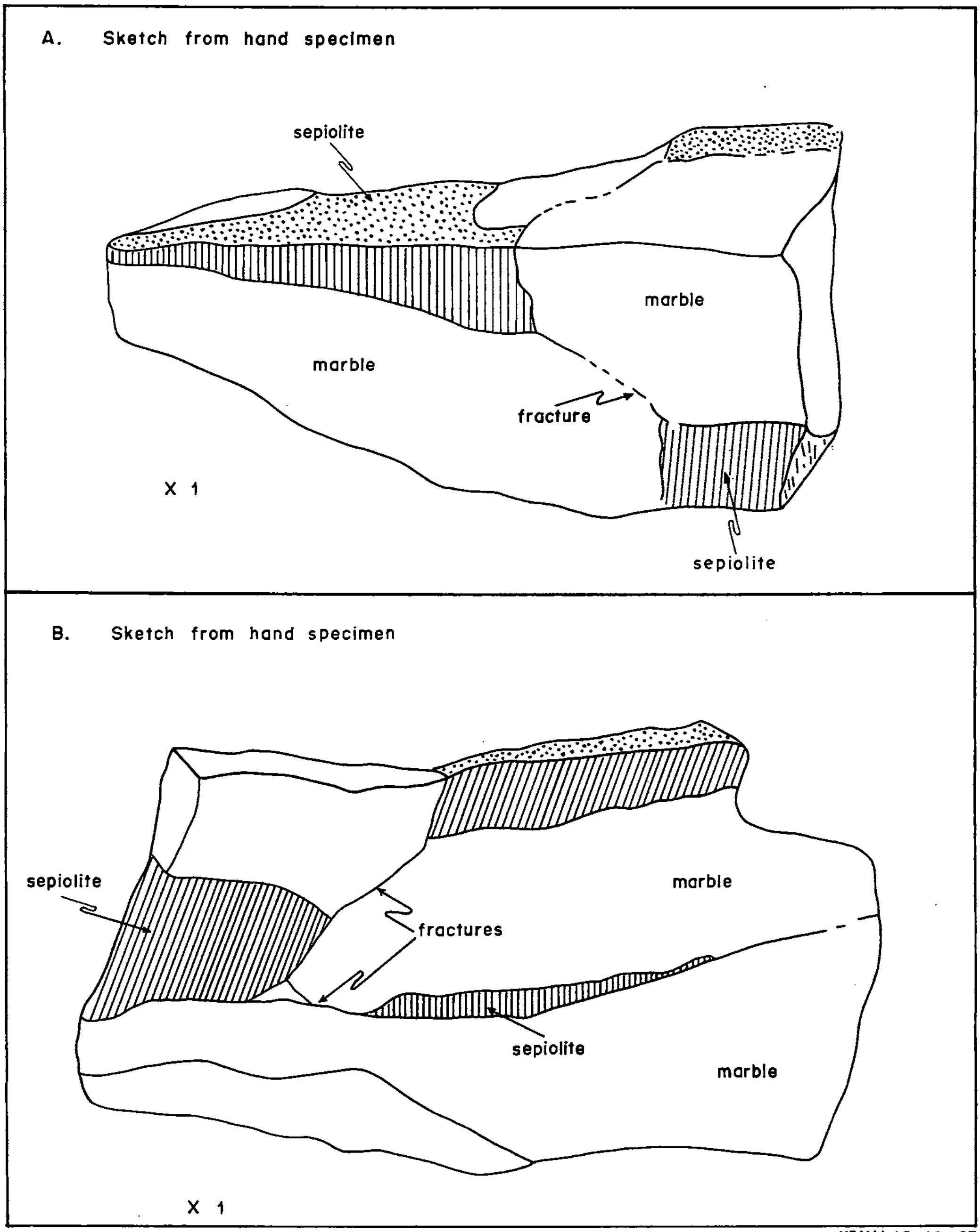

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Figure 3 : Sepiolite veins in marble, Kramat Pulai, Perak.

Plate 1 : Sepiolite vein, indicated by ball-pen, in marble host-rock.

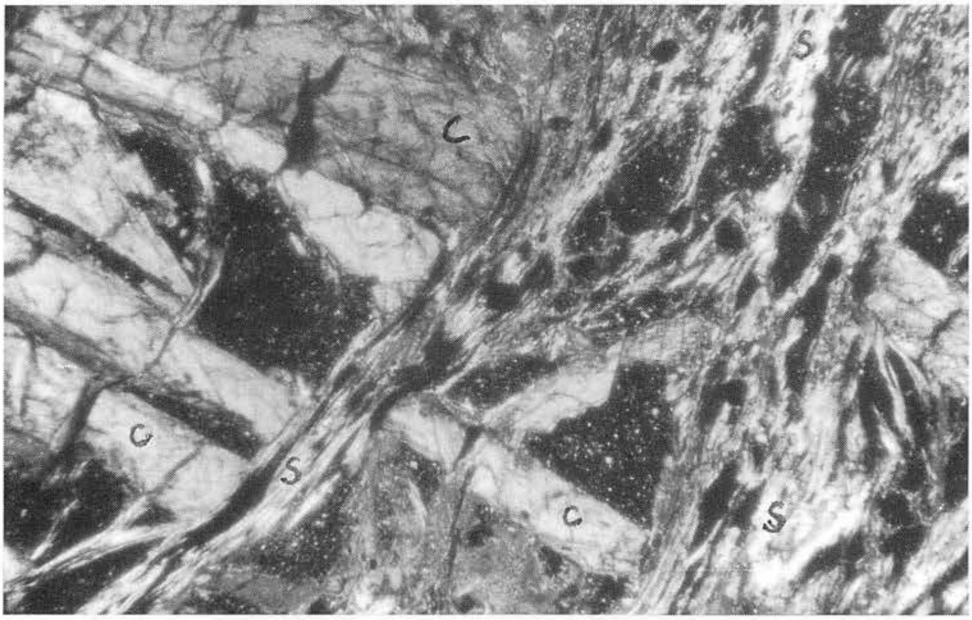

Plate 2 : Photomicrograph of sepiolite fibres(s) and calcite (c). Crossed nicols, x 30

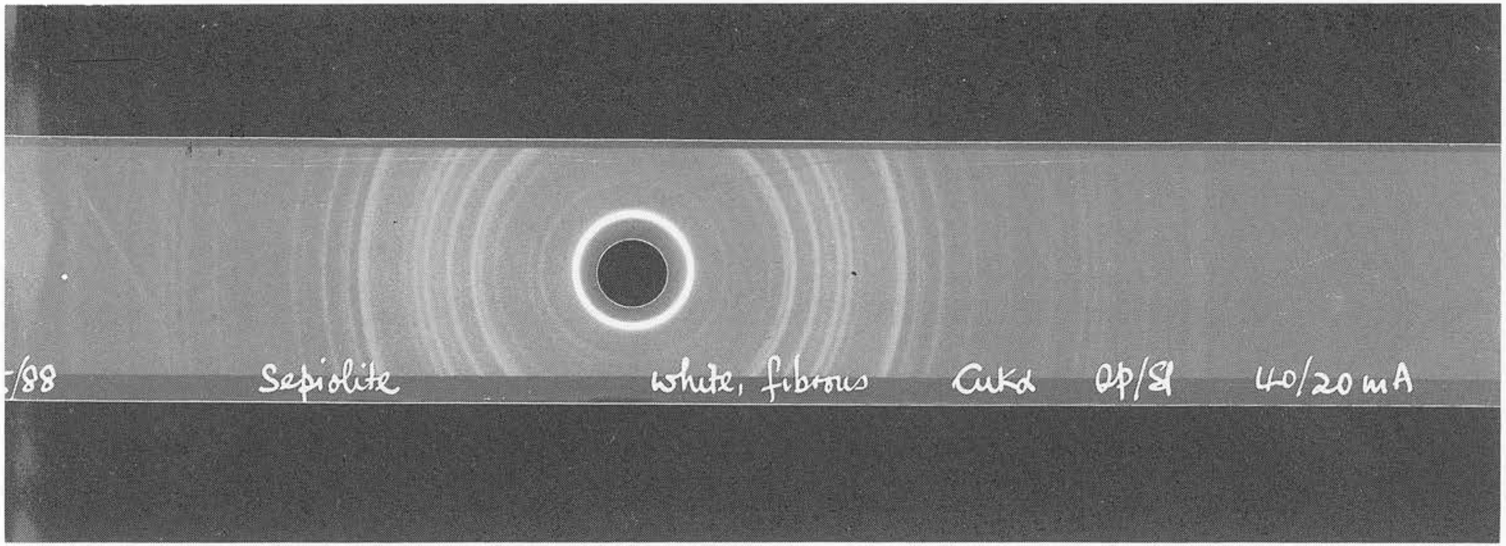

Plate 3 : X-ray pattern of sepiolite from Kramat Pulai area.

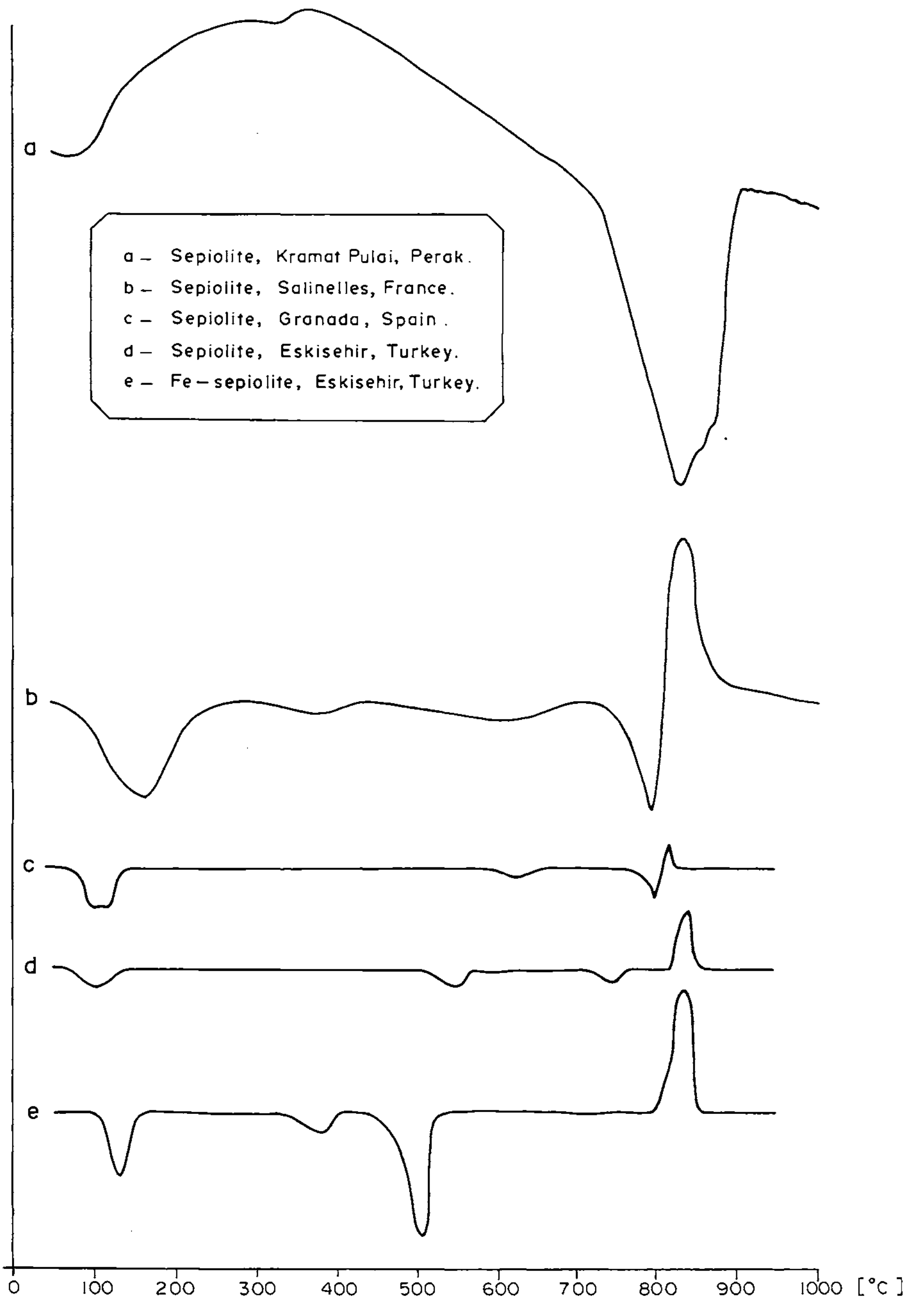

Figure 4 : DTA curves of sepiolites from Kramat Pulai, Perak and other areas.

TERMINOLOGY

Sepiolite is considered as a clay mineral, under the palygorskite group, though it is more analogous to minerals of the serpentine group (Deer *et al.*, 1969). There are two varieties of sepiolite: the compact or fibrous type and the clay-like or earthy variety. Although Kauffman (1943) suggested to continue using the term 'parasepiolite' for the fibrous variety, the name has not been popular, as it is not found in the *Glossary of Geology* (Bates & Jackson, 1980). A more popular name is *"meerschaum"* meaning "sea foam" in German, though it is more of a commerical term. Present tendency is to restrict the term *"meerschaum"* to the compact or fibrous variety, and to use the term "sepiolite" as a more general name to include both the compact and earthy varieties.

DISCUSSION

Two aspects of the sepiolite, its origin and economic importance are discussed below:

Sepiolite can be formed in two ways, either through sedimentation or hydrothermal activity. Sedimentary sepiolite is normally formed in marine or lacustrine environments of high basicity (Weaver & Pollard, 1973).

The Tanzanian *meerschaum* (sepiolite) was deposited under lacustrine environment contemporaneously with its hosts, mudstone and dolomitic limestone. The sepiolite was subsequently concentrated by tectonic activities as veins along faults/fractures/folds/joints (Simpson, 1966).

Some authors attributed the origin of sepiolite to alteration of serpentine or other magnesium minerals. In Yoshikawa, Japan, sepiolite occurring in veinlets or small masses is found in the serpentine rocks which formed the wall rocks of the chromite deposit (Sudo & Schimoda, 1978). Also elsewhere in Japan sepiolite veinlets are found cutting crystalline limestone and altered skarn minerals from a hydrothermal replacement deposit of hematite (op.cit.)

In Kramat Pulai the sepiolite veins are found in fractured marble which is calcium-rich. Tremolite asbestos has also been reported to occur in the area in small sheets forming veins in limestone near the granite (Ingham & Bradford, 1965). It was associated with fluorite and purple quartz. Although the relationship between sepiolite and tremolite is not known, the present writer believes that both are formed by hydrothermal activity associated with the end phase of the granite intrusion.

Meerschaum which is compact and of uniform colour and uniform porous texture is of commercial importance. *Meerschaum* is used for making smoking pipes, cigar and cigarette holders. It is also used in making a variety of decorative and ornamental items. This is because *meerschaum* is easily carved and given an attractive and lustreous finish by rubbing.

No current market price of *meerschaum* is available. A reference book on industrial minerals and rocks, quoted a price of about US$4/kg (Lefond, 1975). This shows that *meerschaum* is a high priced industrial mineral.

No prospecting has been carried out to ascertain the potential of *meerschaum* in Kramat Pulai area. Assessing the occurrence described herein, the writer does not believe any serious prospecting is warranted at this stage. However, he feels that the attention of the quarry operators in the area should be drawn to the existence of *meerschaum* for two reasons. One they should be on the look out for any occurrence of *meerschaum* of potential importance. Any veins of about a few cm wide are of possible interest and should be investigated. The second reason is for quarry operators exploiting calcium-rich limestone to be aware of magnesium contamination from any *meerschaum* present together with the limestone.

CONCLUSIONS

The Kramat Pulai sepiolite occurs as a white fibrous mineral in the form of stringers, veins or films along fractures in the marble host rock. In thin section, it is colourless, with low relief, nearly straight extinction, positive elongation and 2V about 40° to 60°. The strongest interplanar spacing by the X-ray powder method is 12.1 Å which is diagnostic of sepiolite. The DTA curve shows two small endothermic reactions and one major endothermic reaction at about 835°C with no distinct exothermic reaction. Chemical analyses confirmed the sepiolite is a hydrated magnesium silicate with the average gravimetric ratio of magnesia to silica equivalent to 2.26. As the Kramat Pulai sepiolite is fibrous it is more appropriate to term it as *"meerschaum"*. Although this occurrence does not warrant any serious investigation, the quarry operators in the area should be made aware of it possible economic importance.

The *meerschaum* from Kramat Pulai is believed to be formed by hydrothermal activity associated with the end phase of the granite intrusion.

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