K E S A T U A N   K A J I B U M I   M A L A Y S I A

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Contents

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GEOLOGIC NOTES:

Note on Gunong Kinabalu Glaciation[1]

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Recent field work on and around Gunong Kinabalu has confirmed the extent of Pleistocene glaciation first documented by Koopmans and Stauffer (1967). Additional glacial erosion features recorded during the present survey include several cirques with headwalls up to 100 feet high; there is a particularly fine example on the North Ridge. Glacial grooves and striae are preserved on the summit plateau and in Lows Gully.

Moraine

Field work has not confirmed the presence of two terminal moraines which were photo-interpreted by Koopmans and Stauffer. In Lows Gully, the vegetated hummocky area at 10,000 feet appears to be an erosion feature, with spurs sloping steeply down valley. Below Panar Laban at 11,000 feet there are exposures of subangular to sub-rounded adamellite boulders in a sandy matrix. However this could be colluvium rather than moraine.

Tilloid deposits

Tilloid deposits on the south and west sides of Gunong Kinabalu have been mapped as the Pinosuk Gravels. The Pinosuk Gravels have a maximum thickness of 400 feet and include two units. The lower unit outcrops in the southern part of the Pinosuk Plateau and is a sandy boulder gravel containing fresh angular blocks of local derivation, mainly sandstone and ultrabasic rocks. This is possibly a periglacial solifluction deposit. Stratification, some evidence of channelling, and imbrication suggest that deposition was by block streams coming from the north. Several radiocarbon determinations on wood samples from the lower unit have been beyond 40,000 years B.P. (determinations by Isotopes Inc. by courtesy of Esso Exploration, Malaysia).

Overlying this and more widespread is the upper unit which is a poorly sorted clayey to sandy boulder gravel including rounded adamellite boulders derived from Gunong Kinabalu. This material extends from the Pinosuk Plateau south east as far as Ranau, caps a ridge near Tenompok and also occurs in the Tohubang valley west of Gunong Kinabalu. One striated adamellite boulder was observed in Sungai Mesilau and this may be derived from moraine. Radiocarbon dating of a wood sample from the upper unit near Kambarangah gave a date of 34,000 years B.P. (Newton-Smith and Wilford, 1968). The upper unit may be an alpine mudflow deposit incorporating reworked moraine.

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[1] Published by permission of the Director, Geological Survey of Malaysia.

Conclusion

It seems likely that most of the glacial debris was pushed over the edge of the summit plateau by the flowing ice cap. On the south and west sides of the mountain are cliffs several thousand feet high which were probably ice-falls. From the base of the cliffs, the debris was transported by mass movement and incorporated in the tilloid deposits. On the north (inner) side of the mountain, the debris was transported by the valley glacier in Lows Gully and then eroded by running water (Sungai Penataran).

A detailed report is in preparation and will be included in Report 8 of the Geological Survey - "Geology of the Gunong Kinabalu area" to be published in 1970.

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Aspects of the mineralogy of the NE-SW trending veins at Tekka, Perak.

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University of Malaya

Recent studies of polymetallic sulphide deposits from West Malaysia (Hosking, et al., 1969, in press) revealed many interesting mineral paragenetic relations and minerals not hitherto described from Malaysia. The purpose of this communication is to record, from the polymetallic sulphide lodes at Tekka, Perak, additional new mineralogical and textural information and so to add further to the understanding of the genesis of the ore deposits of Malaysia.

General Geology

Limestone, granite, schist and clay are exposed in the main pit of the Eu Tong Seng Mines at Tekka in the state of Perak. In the northeastern side of the pit (which is a portion of the southwestern slope of Tekka Hill) a system of mineralised fractures occurs in granite. Those which strike 320^{o} range from 6 inches to one foot in width and consist mainly of cassiterite (some tantaliferous), wolframite, tourmaline and topaz in a quartz matrix. Veins of another set striking 030^{o} are generally about two inches in width but broaden locally to six inches at their intersection with the earlier mentioned ones. These latter veins, which are devoid of wolframite and contain but little cassiterite, are sulphide-rich.

Mineralogy and Texture

The mineral paragenesis of these NE-SW-trending veins is summarized in Table 1. Loellingite/arsenopyrite is clearly one of the earliest components to be formed and brecciation and fracturing of it with subsequent healing of the fractures by later sulphides are evident. One such fracture about 120 u in width displays, spectacularly, infillings of cassiterite, sphalerite, stannite, chalcopyrite, enargite and stibnite along its length. A feature which the writers believe to be perhaps more common in the Malaysian ores than hitherto realised is the association of loellingite with arsenopyrite such as is seen in the ore under review. A series of micro-indentations over a section of loellingite/arsenopyrite indicated that some of the indentations have HV values over 1,000, which is indicative of arsenopyrite (Bowie and Taylor, 1958), whilst others have HV values in the region of 840 which is respresntative of the upper limit of indentation hardness of loellingite. An etch test, conducted by immersing the polished section in a 20% aqueous solution of ferric chloride for approximately three minutes, stained loellingite brown whereas arsenopyrite remained untarnished. This etch test clearly revealed the replacement of loellingite by arsenopyrite. It is now intended to apply this technique to a number of loellingite and arsenopyrite specimens from Malaysia to ascertain whether this is, in fact, a more common feature in the Malaysian ores that has been suspected in the past.

A complex picture is presented by cassiterite in this ore. Initially primary cassiterite was deposited as single crystals which were subsequently in part replaced by stannite (fig. 1). Very small granules of cassiterite are also associated with fractures in the stannite together with covellite and, on occasion, a little chalcopyrite. This association supports Singh and Bean's (1968) observation at Serdang that local degeneration of stannite has taken place and that cassiterite and chalcopyrite (and/or covellite?) have formed from the released constituents.[1] In addition, minute (about 50 u) amoeba-like cassiterite bodies are found together with enargite and covellite in fractures in the stannite (fig. 2). A readjustment of constituents as a result of the replacement of loellingite by arsenopyrite (releasing arsenic) and the breakdown of stannite (releasing copper and tin) might well account for the formation of enargite which replaces the stannite.

Sphalerite and stannite must have been deposited more or less contemporaneously because exsolved bodies of each mineral appear in the other. However, local replacement of sphalerite by stannite (Fig. 3) indicates that the zinc species was slightly earlier. Exsolution bodies of chalcopyrite are also observed in sphalerite, and there is a strong tendency for the copper-bearing sulphide to accumulate near the crystal boundaries of the zinc sulphide.

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[1] Whilst this covellite may be hypogene in origin it is perhaps more likely that it developed from chalcopyrite as a result of later supergene processes.

Caption to Figures

Fig. 1 Primary cassiterite (centre) is partially replaced by stannite. Enargite (top right corner) is developed at the expense of stannite and, during this process, tin is released and forms another generation of cassiterite. The enargite is also in places altered to covellite. Fractures in the host stannite are indicated by solid lines.

Fig. 2 Replacement of stannite by enargite which in turn is altered to covellite. Only the larger remnants of enargite are shown; in reality, the covellite field appears to he mottled with fine relict enargite. Cassiterite is formed due to the degeneration of stannite. The stannite is also in part replaced by covellite.

Fig. 3 Alteration of stannite to varlamoffite (the solid lines in the varlamoffite indicate the crude colloform texture which can be seen at high magnification). Preferential development of covellite along fractures in stannite can be seen.

Fig. 4 Stannite healing fracture developed in loellingite/arsenopyrite. This fracture also contains small quantities of cassiterite, sphalerite, enargite and chalcopyrite (too small to be shown in the illustration).

Fig. 5 The occurrence of kobellite, sphalerite, stannite, and chalcopyrite as an 'islet' within loellingite/arsenopyrite. This illustration also shows the local replacement of sphalerite by stannite. (Erratum: in key, for 'enargite' read 'stannite).

Fig. 6 The relationship between varlamoffite and cassiterite in the 320^{o} trending fractures. Varlamoffite is seen apparently replacing cassiterite and infilling fractures of the host mineral.

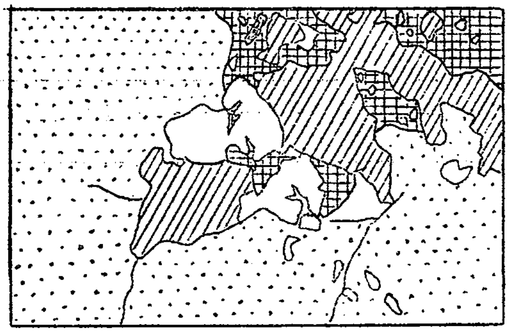


Fig. I   235 microns

Stannite · Enargite · Void · Covellite · [illegible]

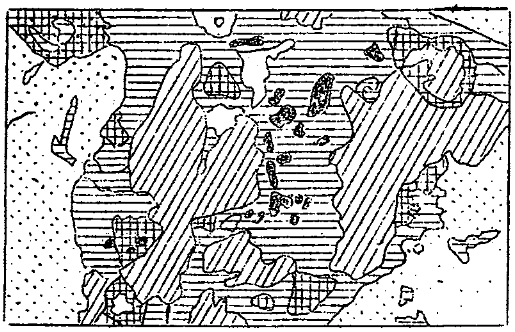


Fig. 2   164 microns

Stannite · Enargite · Covellite · Cassiterite · Void

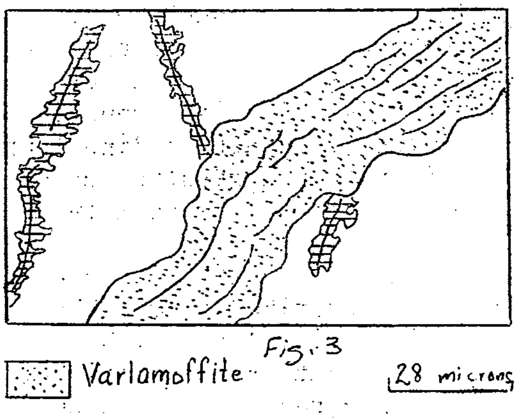


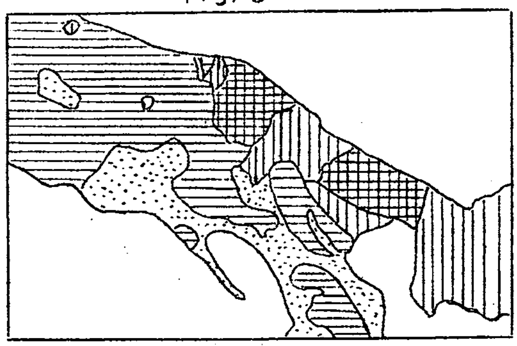
Fig. 3   28 microns

Varlamoffite · Stannite · Covellite

Fig. 4   640 microns

Loellingite/Arsenopyrite · Stannite

Fig. 5



210 microns

Loellingite/Arsenopyrite · Sphalerite · Enargite · Kobellite · Chalcopyrite

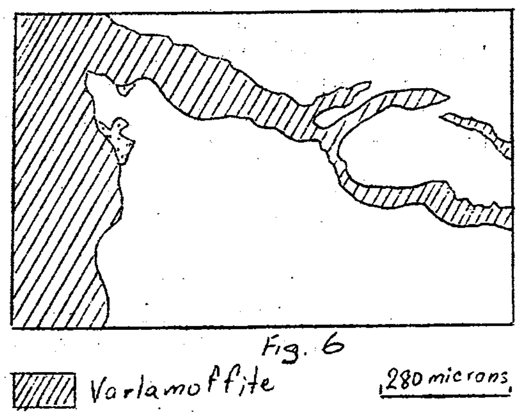
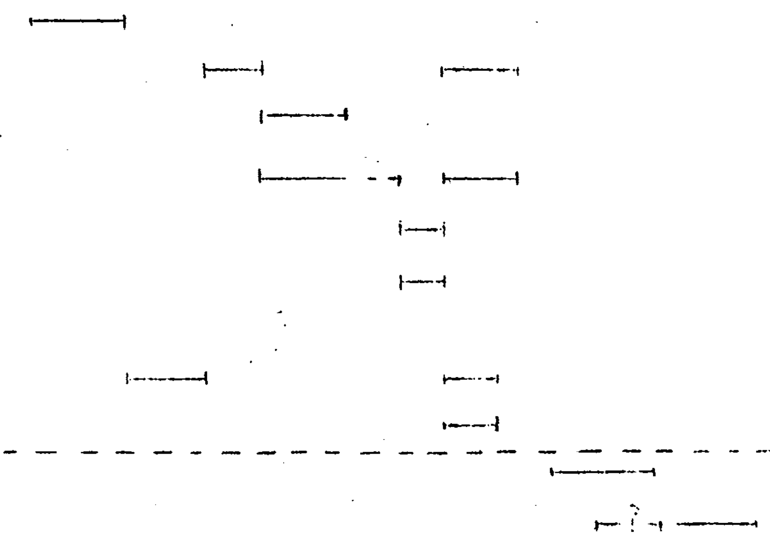


Fig. 6   280 microns

Varlamoffite · Quartz · Cassiterite

Table 1

	Mineral	Early ⟶ Late
Hypogene	Loellingite	
	Cassiterite	
	Sphalerite	
Minerals	Stannite	
	Chalcopyrite	
	Kobellite	
	Stibnite	
	Arsenopyrite	
	Enargite	
Supergene	Covellite	
Minerals	Varlamoffite	
	(Other supergene oxy-salts also occur but are not discussed in this paper)	



The position of stannite in the paragenesis of the ore is clear. This mineral heals fractures developed in loellingite/arsenopyrite (fig. 4), occurs as inclusions in sphalerite, and replaces cassiterite and sphalerite. Repeated movements must have occurred in the Tekka lodes because the stannite was also fractured giving rise to channelways for later mineralising fluids as well as being zones of weakness along which the mineral was in due course replaced by enargite. Supergene alteration of stannite to varlamoffite (fig. 5) is also observed. This stannite is light olive-grey in colour and, with a high intensity quartz iodine lamp generating 100 watts, it is clearly anisotropic with polarisation colours of grey and blue-grey and so would appear to be a tetragonal variety.

It is interesting to record here two minerals, enargite and kobellite, which the writers believe have not hitherto been described from Tekka nor, indeed, from elsewhere in Malaysia. The enargite (fig. 1 and 2) has a reflection value rather close to that of stannite, but can be distinguished from the latter mineral by its characteristic pink-grey colour, which is more pronounced when examined in oil, together with its strong anisotropism and bluish, reddish and orange polarisation colours. Although, as noted earlier, at Tekka it usually occurs as a replacement of stannite along fractures it also locally replaces chalcopyrite. The enargite was in turn replaced by covellite (under supergene conditions). As stibnite and kobellite also occur in the Tekka ore, it is likely that the enargite also contains some antimony in its lattice.

Kobellite[2] (fig. 5) appears as silvery bodies bordering and occurring as inclusions in stannite, chalcopyrite and sphalerite. It resembles galena in appearance, but can be distinguished from this species by its anisotropism, polarisation colours of grey and brown, reflection of about 41.8% in green light and HV about 150. The presence of bismuth, which is an essential constituent of kobellite, was confirmed by x-ray fluorescent analysis. Its relative time of formation is not clear, but from the textural characteristics mentioned above, and the evidence of late introduction of antimony, it is believed to be contemporaneous with the formation of enargite.

Varlamoffite (fig. 3), which in the hand specimen is a yellow-earthy mineral, is seen in polished section to replace stannite. In polished section the varlamoffite is dark-grey in plane polarised light and displays yellow-brown internal reflection when observed under crossed polars. Colloform texture can be seen under high power in air but is much more obvious when the section is observed in oil. In addition, in a thin section from the 320^{o} trending veins minute light-brown grains of varlamoffite with a birefringence much lower than cassiterite, can be seen apparently replacing cassiterite (fig. 6). The replacement of cassiterite by varlamoffite has also been reported from Chendriang (Bradford, 1957; Alexander and Flinter, 1965 in Singh and Bean, 1968). However, the interpretation of this textural relationship requires further thought, because it is well known that cassiterite is normally remarkably unreactive to supergene agents. Could the cassiterite be first replaced by another mineral, for example, stannite, before being replaced by varlamoffite? Certainly there is sufficient evidence at Tekka for the replacement of stannite by the hydrous tin oxide. The infilling of fractures in cassiterite by varlamoffite is a further indication that this problem should continue to be investigated.

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2 Recent studies (Harris, Jambor, Lachance and Thorpe, 1968) showed that this Pb-Bi-Sb sulphosalt forms a continuous solid solution series with a general formula of $5Pb.4(X)_2S_3$ where X is Bi and/or Sb. This series is arbitrarily divided at the point Bi:Sb = 1:1. Minerals from the bismuth-rich side of this division are named kobellite whilst those which are antimony-rich have been assigned the new name of tintinaite.

Conclusion

The Tekka deposit represents yet another Malaysian tin-bearing type. It is characterised by mineralisation within two sets of fractures in granite of which the earlier ones (trending 320^{o}, to be described elsewhere), carry within them tourmaline, topaz, cassiterite and wolframite. This early phase of mineralisation was followed by a later one of essentially sulphide mineralisation which was largely confined to the 030^{o} trending veins. Sulphide mineralisation at Tekka also differs from two recently described polysulphide deposits: the one at Bukit Besi is skarn-type whilst the other, at Sokor, Kelantan, is xenothermal in character (Hosking, et al. 1969, in press). The Tekka veins can best be described as hydrothermal ones which have been modified by later supergene processes. Polymetallic sulphide deposits in Malaysia have received little attention in the past but they are mineralogically and texturally variable and interesting and must be investigated if the primary mineralisation of West Malaysia is to be understood. That some of these deposits have an economic potential is beyond doubt, and their economic importance is likely to increase with time as useful stanniferous placers become increasingly difficult to find.

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Some notes on the Stong Metamorphic Complex, Kelantan.

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The purpose of this note is to record the presence of sillimanite and cordierite in a pelitic schist and diopside and phlogopite in the marble of the metamorphic complex which occupies the region of Gunong Stong in Ulu Kelantan.

The Stong metamorphic complex is unique in M-laysia. It represents a catazonal assemblage of highly migmatized amphibolite facies schist, gneiss and marble. The region has been briefly described in MacDonald (1968), but no mention was made of the occurrence of sillimanite, cordierite, pyroxene, and phlogopite. This note is intended to supplement these published descriptions.

The Sungei Kenerang is undoubtedly the most interesting river in the region; it affords excellent outcrops in rapids, but access is difficult. The rapids on the Sungei Kenerang (Malaya 1:63,360 sheet 34, grid ref.: E 980 N 567) can be reached only by a shallow draught boat, which can be hired at the railway town of Kemubu. Here are exposed some of the finest examples of venite- and agmatite-type migmatites in which the granitic veins exhibit spectacular ptygmatic folding (see Plates VIII, and IX in MacDonald, 1968). At this locality the following specimen was collected, and is worthy of note:

*Specimen 6278: Venite migmatite grading to nebulite, composed of coarse granitic veins and segregations in a sillimanite-biotite-garnet schist. The mineralogy is: biotite, very abundant and well foliated; garnet, 2 mm diameter porphyroblasts; quartz, anhedral and more abundant in the granitic segregations; andesine feldspar, strained and generally untwinned; sillimanite, acicular prismatic aggregates of 1 mm length, commonly associated with biotite and often forming euhedral crystals within the plagioclase; muscovite, of minor occurrence. The presence of cordierite is suspected in this rock.

Near the same locality, a specimen of similar rock (6358)* contains abundant sub-hedral to anhedral colourless crystals of cordierite of average grain size 1 mm. The crystals show characteristic alteration to muscovite (pinite) around the margins and along sub-parallel zones, giving them a pronounced basal lamination. Yellow pleochroic haloes surround zircon inclusions. The 2V is around 80° -ve and multiple twinning is occasionally seen, though most crystals are untwinned and no good example of cyclic twinning could be found. Inclusions of euhedral sillimanite aggregates are common. The cordierite is difficult to distinguish from the plagioclase, which is generally untwinned, but the pleochroic haloes and the alteration style serve as distinguishing features.

Farther downstream, in the Sungei Stong a little way upstream from the road bridge, which is usually annually destroyed by the monsoon floods, marble is interfoliated with garnet-biotite gneiss (same map, E. 994 N 573). The marble is of comparable metamorphic grade and is clearly interfoliated with the pelitic and psammitic metasediments.

*Specimen 5437: Crudely foliated marble, composed of a fine-grained crystalline mosaic of calcite with coarser calcite veins; abundant colourless to pale brown phlogopite with a 2V of 5°; colourless large porphyroblasts of diopside; and minor quartz and pyrite.

Access to the eastern parts of the complex can be readily gained from the unsurfaced road between Kemubu and Kampong Kuala Balah. However this road is cut off from the rest of the country because of collapsed bridges. Usually a Land Rover or car can be hired at the road end on the bank of the Sungei Galas opposite the railway town of Dabong. A regular passenger "ferry service" is available here. Numerous seasonal streams flow off the eastern slopes of the Stong Complex and cross this road, and in their courses, which are nearly dry most of the year but are torrential during the monsoon season, are usually to be found extensive cliff-like outcrops. The most interesting cliff exposure is on the unnamed stream which lies between the Sungei Seladang and the Sungei Nila about 1 mile south of Kampong Kuala Balah (same map E. 911 N 709). The rock is a nebulite-type migmatite of psammitic character, superficially resembling granite. It may be named granite gneiss. Specimens were collected from this locality by Mr John Bignell, who accompanied me on one visit, for the purpose of radiometric dating. Unfortunately the biotite extracted from this gneiss has proved to be strontium rich, and hence may not be suitable for Rubidium/strontium dating. It is of interest to record here that the Benta metamorphic complex in Pahang, which is also migmatitic in part and considered by me to be also of the catazone, is also strontium rich (Ja'afar bin Ahmad, personal communication).

In summary, the Stong metamorphic complex represents an extensive sequence of pelitic, psammitic and calcareous rocks which have been metamorphosed in the catazone of the Malayan orogen. Metamorphic temperatures in excess of $600^{\circ}C$ can be deduced because of the common occurrence of sillimanite. Cordierite indicates low pressure conditions of Abukuma or low pressure intermediate type. Syntectonic anatexis, predominantly of the psammitic rocks, which are of favourable composition, has caused the extensive development of migmatite of all types ranging from agmatite, venite, and nebulite.

The rocks and the tectonic setting of the Stong Metamorphic Complex are so radically different from the Main Range Granite, that a continuity of outcrop between these two formations as shown in Alexander (1965) must clearly be impossible. Unfortunately the geology of the region to the west of the Gunong Stong is unknown because of difficult terrain and access, but it cannot be as shown on the map - a catazonal migmatite complex with amphibolite facies pelitic, psammitic and calcareous metamorphic rocks cannot grade imperceptibly into a generally coarsely porphyritic mesozonal granitic batholith. It is recommended that the region of the Perak-Kelantan boundary around Gunong Noring and Noring East would make an interesting geological study. Let petrologists hope for the development of a tourist attraction such as a mountain resort in this region with good access roads!

Acknowledgment:

I am grateful to Mr D. Santokh Singh for valuable information regarding access to the Gunong Stong area.

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*specimen numbers quoted refer to the collection of the Department of Geology, University of Malaya, Kuala Lumpur.

VIII CONGRESS OF INQUA: ON GLACIERS, VOLCANOES, GRAVELS AND PREHISTORIC MAN

The International Union for the Study of the Quaternary (INQUA) held its eighth Congress in Paris from 30 August to 5 September this year. Several hundred geologists, geographers, and archaeologists from 58 countries attended, with good representation from France, USA and USSR.

The base of the Quaternary was defined at a previous congress as the base of the Calabrian in Italy, which has been indirectly dated as 1.8 to 2 million years before the present. Thus the Quaternary epoch represents only about 0.05 percent of the geological history of the earth, but nevertheless almost every geological discipline is involved in its study, as well as archaeology and pedology. Sections of the Congress included geology and paleohydrology: palaeobotany and palaeopedology; animal palaeontology; palaeoclimatology; stratigraphy; sedimentology; neotectonics; cartography; radiometric dating and palaeomagnetism; human palaeontology; and pre-history. I presented a paper on "The geomorphology and Quaternary deposits of the Sunda Shelf off Malaysian shores" in the section on submarine geology and geomorphology.

In high latitudes the study of the Quaternary is naturally dominated by the successions of glaciations which characterize the period, but these climatic fluctuations, and the periodic reversals in the polarity of earth's magnetic field, also left a record in deposits in the deep oceans, even in the tropics. In fact, the history of the Quaternary can be studied better in some respects in deep sea cores, where a complete succession of the sediments can be preserved in a few tens of metres of core. I was particularly impressed by several papers (in particular by J.D. Hayes and T. Saito) which presented the results of complete studies of small numbers of deep sea cores using X-ray radiography, conventional sedimentology, mineralogy, complete geochemistry, isotope studies on shells (giving estimates of paleotemperatures), determination of remanent magnetism (to give a record of reversals of the earth's magnetic field), radiometric age determinations on shells and volcanic ash beds, and palaeontological studies on foraminifers, radiolarians, pollen and spores and other microfossils, and on nanofossils. From the detailed history established in this way, correlation with the Calabrian in southern Italy (the type section of the Lower Quaternary) can be made. Certain species of Radiolaria disappear in the cores within a few tens of centimeters of magnetic reversals, and it appears likely that there is some connexion between the reversals and evolution, although this is not understood at present. These studies demonstrate, in my opinion, the clear necessity of distinguishing between different types of stratigraphic unit, in particular between time-stratigraphic and bio-stratigraphic units, and the need to define time-stratigraphic units (and by derivation time units) by reference to type sections.

From some of the discussions it is apparent that there is a good chance of general agreement on broad outlines of the stratigraphy, geochronology, and climatic variations of the Quaternary. However, there is considerable disagreement as to glacio-eustatic sea-level fluctuations. Many workers claim that the area they have studied is stable, and so the history of submergence and emergence of the coast there represents world-wide eustatic sea-level fluctuations, but evidence from different supposedly stable areas does not agree in detail, and so some other factor must be operative. Similarly, in spite of a great deal of progress in study of fossil remains (including pollen, mammalian bones, shells, and artifacts) in continental gravels and cave deposits, correlation of these deposits with each other, and with the glacial and interglacial stages established in the Alps or in North America, is often problematical and controversial.

The conference was preceeded by a number of field excursions. The writer participated in one to the massif central and the riviera coast of France. The famous "puys" of the Auvergne district of the massif central are late Pliocene to Holocene volcanoes, some of which were formed as little as 6,000 years ago, and still show their original volcanic shape with little alteration. They are being extensively studied using palaeomagnetism and radio-metric age determinations. Between the puys and south of them towards the coast, are numerous Quaternary gravels and cave deposits, many of which contain bones and teeth of mammals, including Mastodon, Rhinoceras, beavers, bears, wolves, lynx, horses and deer, and bones and tools of pre-historic man. One of the high-lights of the tour was a visit to the Lazaret Cave near Nice, which is at present being excavated. Painstaking excavation and sophisticated laboratory work has already enabled the reconstruction of the habitat and daily life of a band of Palaeolithic (Acheulean) hunters, who inhabited the cave at the end of the Riss glacial period. A short voyage was made on the oceanographic research vessel owned and operated by the University of Paris from its institute at Villeneuve, near Nice, where the University of Paris maintains permanent, well-equipped laboratories for marine geology and geophysics, including the most recent equipment for the study of palaeomagnetism.

The Quaternary of Malaysia is of great scie..cific and economic interest. Most of the tin produced comes from Quaternary deposits, yet the scientific study of these deposits, and reconstruction of the Quaternary history, is at an early stage here. There is great scope for useful studies in which geologists, botanists, geographers, soil scientists, and archaelogists can co-operate.

My attendance at the Conference was made possible by grants from the University of Malaya and Lee Foundation (States of Malaya), for which I record my appreciation here.

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JOINT IMPERIAL COLLEGE - UNIVERSITY OF MALAYA RESEARCH CRUISE (JULY 31ST - AUGUST 22ND 1969): A BRIEF REPORT

The purpose of this cruise was to collect useful data on the geology, geophysics and geochemistry of the continental shelf off the east coast of West Malaysia. Two ships, K.D. Mahamiru and K.D. Kerambit, were generously made available by the Malaysian Government for use during the research. The area of survey lies between latitudes 2°N and 4°N and longitudes 103° 30'E and 104°30'E. This area was specifically chosen for the survey because of:

(1) Its potential in tin and heavy minerals brought down by S. Kuantan, S. Kabang and S. Sedili,

(2) scattered islands close to shore providing good aid to navigation,

and (3) location of large towns (Singapore and Kuantan) where spare parts and repairs are readily available.

Two separate cruises were planned in advance. On the first cruise, Mahamiru was to be engaged in sounding and bottom sampling whilst Kerambit was to be concerned with bottom profiling and sounding. The second leg would be used for geophysical work. Conventional refraction work was to be programmed during the first part of the second leg to be followed by seismic reflection (sparker) as well as bottom profiling and sounding.

Personnel involved were Dr B.P. Dash, Dr C. Dayal, G. Summerhayes and K.O. Ahmad from the Imperial College, University of London; Professor N.S. Haile, Dharam Singh Dhillon, S.P. Sivam and Nik Mohamed from the University of Malaya. Professor Haile was the senior scientist in charge of the first cruise whilst Dr Dash was in charge of the second leg.

Some 1200 nautical miles of sounding, 600 nautical miles of strata profiler and sparker records together with over 100 nautical miles of refraction profiles were traversed for bathymetry, structural and stratigraphical studies. In addition, over 200 bottom samples were collected for palaeontological, sedimentological and geochemical work.

In echo sounding a Kelvin Hughes M26K Mk9 echo sounder was used on each ship, both echo-sounders belonging to the navy. Strata profiling was done using MS36 F/M Mk1 Strata Profiler (a modified shallow water hydrographic echo sounder). More than 100 hours of recording were done on each instrument.

Seismic reflection profiles were carried out using a 7000 Joules sparker equipment. Spark arrays and hydrophones were trailed at a distance of approximately 50 ft and 150 ft respectively. Seismic refraction profiles were shot using a two-boat/land stations technique. Kerambit was used as the shooting vessel while Mahamiru was the centr 1 boat. A reversed profile method was originally planned (land stations being P. Babi Besar - P. Tioman and P. Tioman - P. Aur), but because of communication difficulties, the method had to be abandoned. Consequently recordings were only done at P. Tioman. Signals received at P. Tioman were transmitted to and recorded on board the Mahamiru. Altogether over 40 shots were fired with charges ranging from 25 to 100 lbs per shot.

Bottom samples, primarily of olive grey, medium to coarse, muddy sands with shell fragments, corals and algal limestones, were collected using gravity corers, grab samplers and pipe dredges. Samples collected were divided into three portions for paleontological, sedimentological and geochemical studies. In addition about 20 rock and beach sand samples were collected from P. Tioman and P. Babi Besar.

It is hoped that the outcome of the survey will throw some light on the sedimentation patterns off the east coast of West Malaysia. Any discovery of features like drowned river valleys, natural levees and wave-cut channels on sounding and strata profiler records may further substantiate evidence of the postulated Pleistocene platform and drowned Sunda Shelf of Kuenen. And lastly, paleontological and geochemical analyses of the samples obtained may open new fields in mining this potentially rich (?) region of the continental shelf.

- NM

EARTHQUAKE FELT IN WEST MALAYSIA

A strong earthquake apparently centered in the Nicobar Islands was felt in West Malaysia on the morning of November 21st, 1969. According to the Straits Times, tall buildings swayed perceptibly in Penang, Ipoh, and Petaling Jaya.

This is the second time in recent years that tremors have been felt here. An earthquake off North Sumatra in April 1967 shook buildings in West Malaysian towns (see Newsletter No. 6), causing some damage in Penang and Kedah. This suggests that in spite of Malaya's aseisimic condition, "earthquake hazard" should not be disregarded in construction standards, especially for tall buildings.

— PHS

OBITUARY NOTICES

Dr Helen Marguerite Muir-Wood

Miss Muir-Wood died on the 16th January 1968 at the age of 72. She was one of the leading students of all time of the Brachiopoda. Her palaeontological research was worldwide, and included a study of the Lower Carboniferous brachiopods of Malaya:

1948: Malayan Lower Carboniferous fossils and their bearing on the Visean palaeography of Asia, 77p. 12 pl, 2 figs., London: British Museum Monograph.

Dr F.T. Ingham, former director of the Geological Survey of Malaya from April 1946 till the end of 1952, died on the 9th September 1967 at the age of 72. He joined the Geological Survey of the Federated Malay States as a Mining Geologist in 1927. He was captured by the Japanese and interned in Singapore during the 1939-45 war.

— CSH

NEWS OF THE SOCIETY

Extraordinary meeting of 17 October 1969: Films

A meeting of the Society was held in the Department of Geology, University of Malaya, on Friday 17 October. The program featured three color films.

Two of the films concerned the oil industry and were introduced by Mr H.C. Olander who had arranged to obtain them. These were "The Big Deep", a non-technical look at all aspects of the industry, especially exploration, and "The Electric Log", a clear exposition of the principles and practice of standard well logging methods. They were shown through the courtesy of Esso Exploration (Malaysia) Inc. and Schlumberger Overseas S.A. respectively.

Also shown was "Modern Methods in Archeology", which illustrates the careful methods and techniques used in detailed excavations in France. This film was shown through the courtesy of the Embassy of France, and arrangements for its presentation were made by Professor N.S. Haile.

In spite of delays caused by projector breakdown, the three films made an interesting and enjoyable program for the twenty five members and guests who attended.

\- PHS

New Members

The following were elected to membership in the GSM at a meeting of the Council on October 17th:

Full members:

Mr Gerald W. Fuller
c/o Caltex Pacific Indonesia
Kebon Sirih 52
Djakarta, Java, Indonesia

Mr Gerard Trottereau
805 AIA Building
Kuala Lumpur

Student member:

Mr K.S. Wong
c/o Department of Geology
University of Malaya
Kuala Lumpur.

Donation to the Society

The Society gratefully acknowledges a donation of $600 from the Continental Oil Company of Malaysia.

- CSH

Election of Officers and Council members

The returning officers of the ballot have so far received only 30 ballot papers. This is a disappointing number and the Council feels that more interest should be shown by members in the election of the officers and council members for the year 1970. If you have not already sent in your vote, you have until the 31st December to do so. All it requires is to put one or two crosses in the appropriate places, put the ballot paper in an addressed envelope and mail it.

- CSH

Last chance for "bargain" Life Membership

Members are reminded that on January 1st, 1970, the fee for Life Membership goes up steeply from its present low figure of M$250.00 to M$350.00. This is therefore the last chance to secure life-long membership, without any further payment of dues, at this bargain rate. Members are urged to consider this opportunity before it is too late.

NOTE TO CONTRIBUTORS

The increasing number of contributions to the Newsletter in the form of 'Geologic Notes' is very gratifying. The rapid exchange of new information or ideas is surely one of the Newsletter's most valuable functions. Two limitations need to be pointed out, however:

Brevity: Notes for the Newsletter should be brief, preferably no more than one or two pages. It is recognized that some material requires longer treatment, but short notes will be given preference. Fuller accounts are more suitably published in the Bulletin Series or elsewhere.

Illustrations: The Newsletter is printed from stencils, and the only illustrative matter which can be incorporated is that which can be put on stencils (including photo-stencil). This includes clear, dark pen-and-ink drawings, maps, and diagrams in black and white, but excludes any use of shading, color, or photographs.

Illustrations should be submitted in a form suitable for photo-stencilling, and should be of the same size as they are to appear in print.

\- PHS