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Cover photo: Quartz veins displaced by flexural slips along bedding planes at the hinge of a fold at Mersing, Johor. Photo by: Ng Tham Fatt

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Remnant of the Late Holocene sand beach reveals ancient settlement-related sea level change from western Thailand

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Abstract: Archaeological findings and analysis of the sand beach at the Ban Khu Bua site in western Thailand indicate substantial sea-level shifts, which relate to sea-level regression during the late Holocene. This research focused on analyzing the paleo-shoreline and determining the age of ancient sandy beach deposits. Satellite imagery (Sentinel-2A) taken in 2021 facilitated classification of the paleo-coastal landforms into four main categories: colluvium, recent floodplain, old tidal flat, and old sandy beach. The latter, running predominantly north to south, is composed of fine to very fine sand characterized by sub-angular to round shapes, high sphericity, and well sorted. The sediment's mineral composition is primarily quartz, accompanied by smaller rock fragments, organic matter, heavy minerals, and feldspars. Optically Stimulated Luminescence analysis of quartz-rich samples from the inner and outer areas suggested deposition of the old sandy beach sediments between 1,500 and 3,000 years ago in the inner part, pre-dating the establishment of the Khu Bua community in the Dvaravati period. Continuous beach sand deposition along Thao U-Thong Road aligns with the community settlement approximately 200 to 1,000 years ago.

Keywords: Old sandy beach, OSL dating, sea-level change, Khu Bua, Ratchaburi

INTRODUCTION

The evolution of the low-lying plain of Thailand is attributed to global sea-level changes over the late Quaternary. Detailed studies of low-lying coastal regions have been related and often initiated in response to natural disasters, such as coastal erosion, storm surges, flooding, and by archaeological research (Surakiatchai *et al*., 2019). The Lower Central Plain, where major cities are currently situated, stands out as a notable example of an area vulnerable to coastal-related challenges (Nutalaya & Rau, 1981; Supajanya, 1981, 1983; Chonglakmani *et al*., 1983; Sinsakul, 1992; Choowong, 2002a).

Examination of geological features and landforms (Choowong *et al*., 2002b; Nimnate *et al*., 2015; Surakiatchai *et al*., 2019; Polwichai *et al*., 2023) and paleontology studies can help identify the indicators of past sea-level changes (Choowong *et al*., 2004). Archaeological evidence, particularly artifacts discovered near ancient communities along paleo-shorelines, such as boats, anchors, masts, and tools, (Supajanya, 1983; Hutangkura, T., 2014) and the integration of archaeological findings with past aerial photo records, where available, provides a comprehensive understanding of the history of sea-level changes in the central plain of Thailand (Choowong, 2002b; 2011).

The Dvaravati period refers to a historical era in Southeast Asia, spanning the 6th to the 11th century AD, 1,000 to 1,500 years ago. Among the Dvaravati ancient towns, Khu Bua in Ratchaburi Province, western Thailand, is one of 21 ancient communities situated along the paleo-shoreline in the central plain of Thailand, at elevations ranging from about 2 to 3.5 m above mean sea level (MSL) (Supajanya, 1981). In 1961, the Department of Fine Arts of Thailand excavated the Dvaravati site of Khu Bua, located about 18 km south of Ratchaburi Province (Figure 2a). The digital elevation model showed the distribution of ancient towns near the shoreline, such as Khok Sethi (1), Khu Bua (2), Nakhon Pathom (3), Khok Panom Dee (4), and Sri Mahosot (5) (Figure 1a). The locations of these ancient communities hold significant

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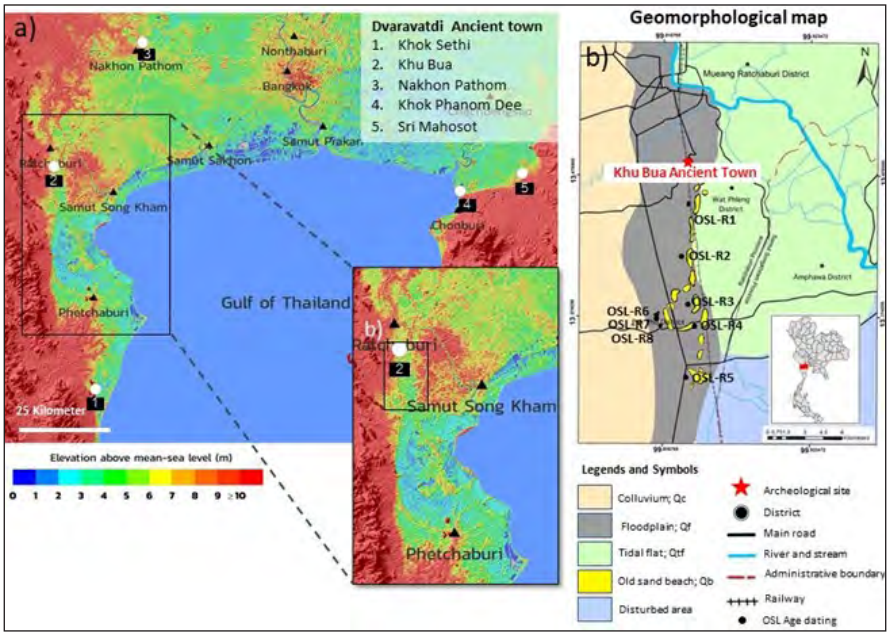

Figure 1: (a) A Digital Elevation Model along the Gulf of Thailand show the distribution of some ancient communities that are situated along the paleo-shoreline in the central plain of Thailand and (b) a geomorphological map, interpreted from Sentinel-2A imagery captured in 2021. The yellow areas on the map in (b) indicate the location of the old sandy beaches near the Khu Bua archaeological site.

clues about the sea-level changes in the lower Central Plain of Thailand.

To gain a deeper comprehension of the geological record concerning the rise and fall of the sea level, a combination of ancient landforms, sedimentological data, and radiometric dating techniques, such as radiocarbon dating, have emerged as indispensable sources of information for reconstructing the history of sea-level fluctuations (Choowong, 2011; Williams *et al*., 2016; Surakiatchai *et al*., 2019). However, Optically Stimulated Luminescence (OSL) analysis stands out as a robust method for dating Quaternary marine coastal features and landforms (Lamothe, 2016). When coupled with precise elevation measurements of each beach ridge and the provision of reliable dating outcomes, OSL analysis allows for the reliable dating of beach progradation. It also serves as a proxy for sea-level variations offering insights directly linked to sediment deposition at that time (Karpytchev, 1993).

OSL dating can determine the depositional age of quartz-rich sediments that were exposed to sunlight, covering a period ranging from several months to approximately 150,000 years ago (Murray & Wintle, 2000; Murray & Olley, 2002). Consequently, numerous studies on coastal sandy sediments have employed OSL dating. These include the dating of beach dune sequences in Australia (Banerjee *et al*., 2003), marine terrace sediments in Korea (Choi *et al*., 2003), beach ridge plains in Denmark (Nielsen *et al*., 2006), paleo shorelines in Tibet (Lee *et al*., 2009), coastal barrier spits in Germany (Reimann *et al*., 2010), and coastal dune and beach ridge deposits in Thailand (Nimnate *et al*., 2015; Surakiatchai *et al*., 2019; Miocic *et al*., 2022).

To understand how the ancient coastline in western Thailand evolved during the Dvaravati period, we undertook a chronological study of old sandy beach sediments in Ratchaburi Province to establish when they were deposited. These age determinations are crucial for estimating how regional sea levels changed when these old sandy beaches were forming. We also examined the physical characteristics of these beach sediments and shell fossils to give insights into the conditions and environments in which they were deposited, enhancing our comprehension of the paleo-shoreline and sea-level fluctuations linked to the ancient town in Ratchaburi Province.

MATERIALS AND METHODS

Study area and sampling location

Based on a detailed remote sensing interpretation (see Figure 1a) from the satellite image, a geomorphic map (Figure 1b) of this area was created to plan the sampling locations (OSL-R1 to -R8) to obtain evidence of sea-level changes, possibly delineating a single beach ridge (yellow color in Figure 1b). From the derived geomorphic map, four geomorphologic landforms were identified: colluvium, floodplain, tidal flat, and an old sand beach that was deposited along the Thao U-Thong Road.

The old sandy beach in Ratchaburi Province consists of a single discontinuous ridge (shown in yellow in Figure 1b), apart from associated tidal flat deposits (green in Figure 1b). This beach ridge is located about 20 km landwards from the present-day shoreline and in general is slightly discontinuous, curves in a north-south (N-S) direction, and is concave towards the sea (see Figure 1b). Five samples were collected along the Thao U-Thong Road, where the beach is located, and also from the rear of the paleo-beach, representing the innermost shoreline or boundary of sea-level incursion.

Sedimentological data

During field investigations, sedimentological observations encompassing parameters such as color (both sediment and mottling patterns), texture, concretions, fossil content, and contact boundaries were made. Observations were based on boreholes (Figure 2c and 2d) and sedimentary profiles (Figure 2b). Each layer of the ancient beach sand sediment from seven boreholes was subjected to grain size analysis. Physical characteristics of sand grains, including attributes such as roundness, sphericity, and sorting, were meticulously examined with the aid of a binocular microscope (Figure 2d). The percentage composition was estimated by comparison with the standard chart of sediment composition (Compton, 1962). Statistical values for grain size distribution were calculated using the graphic method of Folk & Ward (1957). Grain-size distributions are generally characterized by four principal parameters: the average grain size (mean); the spread of the sizes around the average (sorting); the symmetry or preferential spread to one side of the average (skewness); and the degree of concentration of the grains relative to the average (kurtosis).

The classification of roundness and sphericity follows Powers (1953). Through the sedimentological data, researchers have the geological data and characteristics of the ancient sandy beach in Ratchaburi Province.

Dating by OSL analysis

The period between the last sediment deposition (exposure to sunlight) and the current date can be determined through OSL dating, employing Equation (1) (Aitken, 1982):

Figure 2: Representative field investigations include (a) The Main Monument of Khu Bua Ancient Town and complete shell fragments found near the base of the monument during the excavation of this site. (b) A quarry near Ancient Monument No. 23-24, displaying biological evidence of marine regression, such as complete marine shells, a very thin oyster fragment bed (1–2 cm thick), calcrete nodules, and gypsum crystals. (c) A bird's-eye view of the old beach sand and the location of OSL-R6. (d) OSL-R2: Sedimentary texture and mineral composition observed under a microscope (left), and De (total absorbed radiation dose) age sampling taken from around 25 cm below the surface (right).

$$\text{OSL date} = \frac{\text{Equivalent dose (ED)}}{\text{Annual dose (AD)}} \quad (1)$$

where the equivalent dose (ED; measured in Gy) is derived from the luminescence emitted during the OSL analysis of the sample, while the dose rate or annual dose (AD; expressed in Gy/Ka) is based on the concentration of three prevalent natural radioisotopes [uranium (U), thorium (Th), and potassium (K)] and the water content in the surrounding environment.

In the sample collection process, each sample (denoted as OSL1–5 in Figure 1) was divided into two portions and utilized to assess (i) the ED and (ii) the AD, which also included determining the water content. For ED sampling, the uppermost soil layer was removed, and excavation was conducted until the quartz-rich sediment representing the beach ridge became exposed (typically at a depth of approximately 30–50 cm; see in Figure 2d right). After creating a light-protected environment, the surface of the sediment profile was removed to prevent current exposure to sunlight. Subsequently, the quartz-rich sediment was collected following its lamination and bedding. To prevent any leakage of the ED signal, the samples were carefully placed in plastic tubes, promptly sealed to retain moisture, and then stored in lightproof plastic bags. Additionally, sand samples were collected at a 30-cm depth surrounding the ED sampling location and were utilized for measuring AD.

Determination of ED

For each ED sample from OSL-R1 to OSL-R8, quartz enrichment was carried out following established procedures (Takashima & Honda, 1989; Surakiatchai *et al*., 2019). Initially, a wet sieve with mesh sizes ranging from 60 to 200 was utilized to recover fine to very fine-grained sands within the diameter range of 74–250 µm. Subsequently, hydrochloric acid was employed to etch the sample, removing any carbonate components. Then, hydrofluoric acid was applied to eliminate potential feldspar contamination in the sample. The sample was subsequently washed with distilled water and dried at 100 °C. Finally, ferro minerals were separated using an iso-dynamic magnetic separator.

The ED measurements were conducted using a Risø TL/OSL reader located at the Department of Geology, Faculty of Science, Chulalongkorn University, Thailand. Each measurement involved a calibrated $^{90}Sr/^{90}Y$ beta radiation source and a blue light source (470–720 nm) (Bøtter-Jensen, 1997; Bøtter-Jensen *et al*., 2000). A detection filter with a diameter of 7.5 mm (Hoya U340) was employed for the OSL measurements, and the sample was preheated to 220 °C at a rate of 5 °C/s. Prepared quartz grains were affixed to a stainless-steel disc with a diameter of 9.8 mm using silicone oil. A single aliquot regenerative technique was used to assess all equivalent doses (Readhead, 1987; Murray & Olley, 2002). A fixed test dose of 10% of the natural dose was administered to account for any sensitivity changes. The resulting OSL-R1 and OSL-R6 decay curve for the respective OSL samples are illustrated in Figure 4a, and the OSL growth curve for each aliquot was derived based on this known artificial irradiation (Figure 4b). Subsequently, the ED was calculated for each aliquot of the sample following the SAR protocol.

For analysis of the ED datasets, four different age models were applied conceptually: (i) the central or average age model, (ii) the common age model, (iii) the minimum age model, and (iv) the finite mixture model (Takashima & Honda, 1989). The ED distribution and statistical parameters for the eight samples are depicted in Figure 5. The overdispersion (OD) value for OSL-R1 to -R8 was calculated and used to select the appropriate model (Duller, 2008; Liang, 2019). Specifically, if the OD value exceeded 0.25, the minimum age model was selected, and if it was less than 0.25 the average age model was used instead. The resulting OSL ages employed in this study are highlighted in bold font in Table 1 within the columns labeled "Age min" and "Avg age (y)".

Determination of AD

A 300-g portion of the obtained grains (diameter < 90 mm) was dried and then packed in a plastic vessel for AD determination. As water aborbs part of the radiation, the water content was measured during this process. The concentrations of U (ppm), Th (ppm), and K (%) were measured by high-resolution gamma spectrometry (Table 1). Based on the measured concentrations of these three radionuclides and the water content, the AD values of each sample were calculated according to the standard table, including the calculated cosmic ray dose rate (Bell, 1979; Prescott & Hutton, 1994). The obtained AD value was corrected based on attenuation due to grain size distribution and water content (Aitken, 1982). The AD of each sample and error calculation were calculated as previously reported (Singh *et al*., 2017) and are summarized in Table 1.

Based on the obtained ED and AD of each sample, the OSL dates representing the last deposition of the sandy beach (OSL-R1 to -8 in Figures 4 and 5) were calculated and presented in Table 1.

RESULTS AND DISCUSSION

Physical characteristics of the beach sand in Ratchaburi

A comparison was made between the sediments of the straight main beach segment and the sediments of the curved segment, which lies up to 1 km to the west of the straight segment, of the old sandy beach (Figure 1b). The curved beach segment (OSL-R6 to -R8) shows

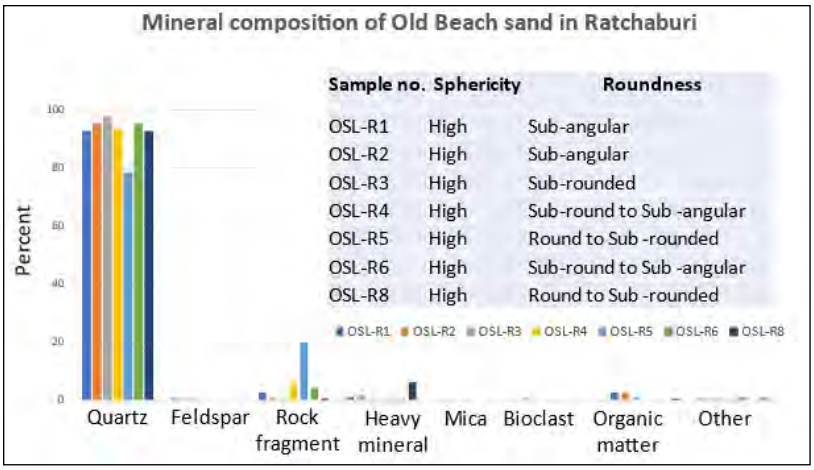

Figure 3: The mineral composition of five old sandy beach sediments revealed quartz as the major component in all samples, with minor constituents being rock fragments, organic matter, heavy minerals, and feldspar. Sand grains in these samples have high sphericity and roundness, and range between sub-angular to rounded.

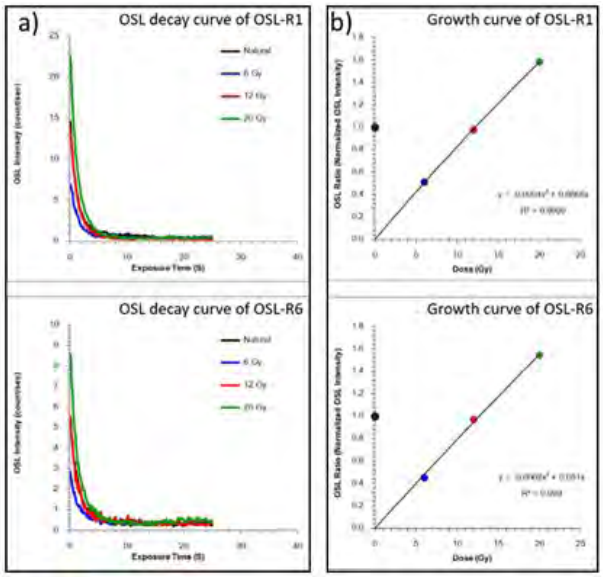

Figure 4: Representative OSL data, including: (a) decay curves and (b) growth curves of old sandy beach samples OSL-R4 and OSL-R6, where 'N' represents the natural dose (in black dots), and 'Single' (in blue dots), 'Double' (in red dots), and 'Triple' regenerative doses (in green dots), respectively.

coarse to very fine sand with a sub-round to round shape, high sphericity, and well to poorly sorted (Figure 2d left). The main part of the old sandy beach that is orientated in the N-S direction was mainly comprised of medium to fine-grained sand, moderately to poorly sorted, sub-angular to sub-rounded and high sphericity (Figure 3). The characteristics of the old sandy beach sediment is related to sea-level change from the Gulf of Thailand (GOT) shows very fine to coarse sand with a wide range of grain size depending on the source of the quartz grains: medium to coarse-grained sand from granite in Surat Thani (Polwichai *et al*., 2023), and very fine to medium-grained sand with high sphericity eroded from sedimentary rock and deposited as old beach ridges in the Chumphon area (Nimnate *et al*., 2015).

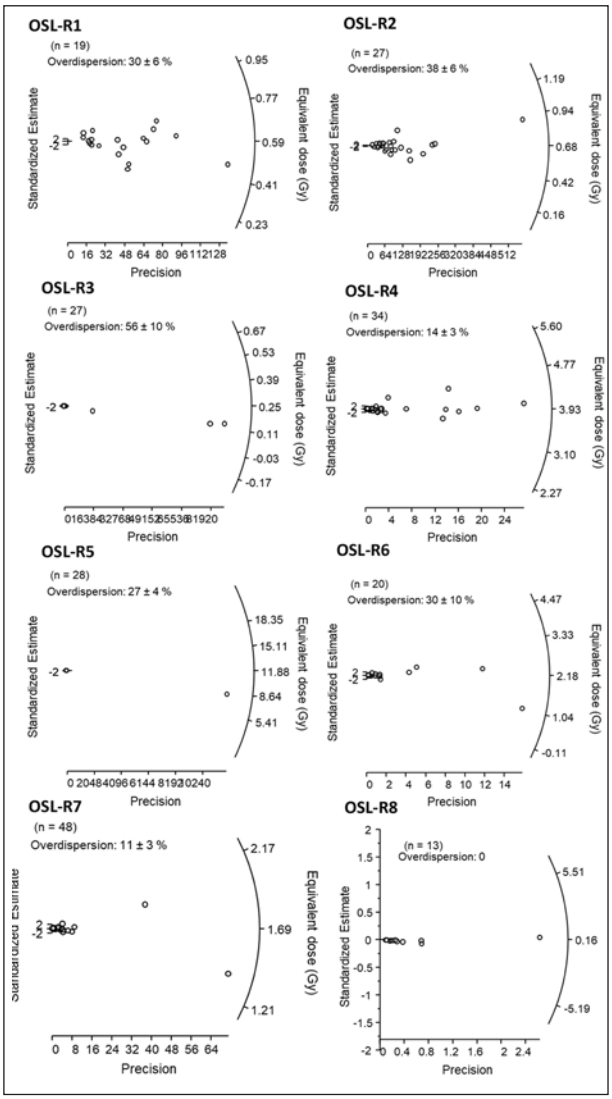

Figure 5: Radial plots illustrating the Equivalent Dose (ED) distributions for the eight old sandy beach samples, represented by white circles. Overdispersion (OD) was employed to determine the minimum or average age that best suited each sample.

Table 1: The OSL-derived ages pertain to the old sandy beach sediments collected from Bore hole no. OSL-R1 to OSL-R8.

Samples	Lat (°N)	Long (°E)	Dists (km)	Elev (m)	Depth (m)	U (ppm)	Th (ppm)	K (%)	Moist (%)	Dose rate (Gy/Ka)	De Min (Gy)	De Avg (Gy)	Age min (year)	Age avr (year)
OSL-R1	13.46	99.84	1.95	3.20	0.40	1.18± 0.01	5.88± 0.07	0.56± 0.57	6.43	4.32± 0.03	0.54± 0.04	0.40± 0.12	**410 ± 12**	590 ± 4
OSL-R2	13.42	99.83	20.38	3.40	0.25	1.09± 0.01	5.70± 0.08	0.64± 0.60	11.36	4.14± 0.03	0.62± 0.05	0.68± 0.26	**430 ± 14**	470 ± 23
OSL-R3	13.39	99.84	16.93	2.70	0.25	1.25± 0.01	6.24± 0.08	0.25± 0.25	16.66	3.56± 0.03	0.24± 0.02	0.25± 0.14	**190 ± 5**	200 ± 13
OSL-R4	13.22	99.50	15.78	2.00	0.95	1.35± 0.01	6.02± 0.05	0.72± 0.25	21.88	0.37± 0.03	0.10± 0.04	0.16± 1.25	140 ± 5	**230 ± 1.77**
OSL-R5	13.33	99.84	13.33	3.40	0.45	1.33± 0.01	7.46± 0.05	0.66± 0.003	5.80	1.43± 0.03	1.66± 0.07	1.69± 0.48	9,900 ± 4	**1,010 ± 29**
OSL-R6	13.22	99.49	18.82	3.90	0.45	0.74± 0.01	3.79± 0.06	0.08± 0.003	5.59	0.45± 0.03	1.17± 0.14	2.18± 1.14	**1,520 ±20**	2,830 ± 1,490
OSL-R7	13.37	99.83	15.25	4.00	0.70	2.40± 0.02	14.12 ± 0.12	0.95± 0.95	24.25	7.49± 0.03	6.94± 0.14	11.88± 3.24	**3,130 ± 82**	5,360 ± 200
OSL-R8	18.49	99.49	18.49	4.40	0.35	0.76± 0.01	3.36± 0.05	0.09± 0.003	15.88	0.17± 0.03	3.73± 0.11	3.93± 0.83	2,600 ± 9	**2,740 ± 38**

Lat : Latitude. Long : Longitude. Dists : distance to the shore. De : total absorbed radiation dose.

The mineral composition of the old sandy beach sediments was predominantly quartz (more than 95%), with smaller proportions of rock fragments (4.8%), heavy minerals (1.5%), and feldspars (0.1%) (Figure 3). The old sandy beach was found at a depth of approximately 25–40 cm. The provenance of sediment originates from sandstones of the Carboniferous age in the northwestern part of the study area around 3 km away.

Age of the sandy beach deposits related to the Khu Bua archeological site

According to the derived OSL dates, the age of samples OSL-R1 to -R9 show a diverse distribution of OD values (Figure 5), which were used to determine the minimum or average age of each sample (Table 1). The old beach sands (samples OSL-R1 to -R5) suggest that the inner sandy beach sediments were deposited between approximately 3,130 ± 82 years ago for OSL-R7 to 1,520 ± 20 years ago for OSL-R6 and formed a curved beach (Figure 6 at OSL-R6 to -R8). Subsequently, the outer sandy beach sediments were deposited within a range of approximately 190 ± 5 years ago for sample OSL-R3 to 1,010 ± 29 years ago for OSL-R5 and formed a straight beach along the Thao U-Thong Road in a N-S direction, as indicated on the geomorphological map (Figure 6). The innermost inner beach ridge also suggests a high sea-level stand during the Dvaravati period (1,000–1,500 years ago), characterized by a curved beach. The deposition transitioned to a narrow, elongated beach southwards from the Ban Khu Bua Archaeological site.

Evidence for a period of regression is derived from archaeological findings at the base of the main monument, where shell fragments were discovered (Figure 2a). This could indicate that sea levels fell significantly after reached far inland during mid-Holocene, although no direct evidence of a beach was found for that time period. Two main beach deposition phases were evident: one occurring between 3,100 and 1,500 years ago for the curved beach and the other between 190 and 1,000 years ago for the straight beach in a N-S trend (Figure 6). Deposition of beach sands ceased during this time, transitioning to clay-rich sediments influenced by tides in the vicinity of Ancient remains No. 24 and 25, where a very thin shell bed (1–2 cm thick) was discovered (white dash-line in Figure 2b). Moreover, complete marine shells, such as gastropods and bivalves, were found (Figure 2b). Furthermore, the presence of gypsum crystals (Selenite) and calcrete nodules in a zone approximately 5 m thick along the shell bed, provides evidence of past seawater incursion and the subsequent crystallization of evaporite minerals in high evaporative conditions along coastal tidal flat depositional environment and very shallow strand-line lagoonal accumulation (the early stages of many ancient marine evaporite deposits) (Hardie & Eugster, 2006). This type of mineral deposit is commonly also found in coastal salt works (evaporative Salinas) and some natural coastal lakes where gypsum has either precipitated recently or in the past (Babel, 1986). In Ratchaburi Province, a narrow beach deposit is evident, situated along the main rural road (Thao U-Thong Road) and dating back to approximately 1,000 years ago, coinciding with the establishment of the ancient community. The maximum age of the beach ridges (paleo-shoreline) was determined to be 3,130 ± 82 years ago at an elevation of 4 m above MSL from the location where sample OSL-7 was collected, approximately 15.25 km perpendicular to the present shoreline (Figure 6).

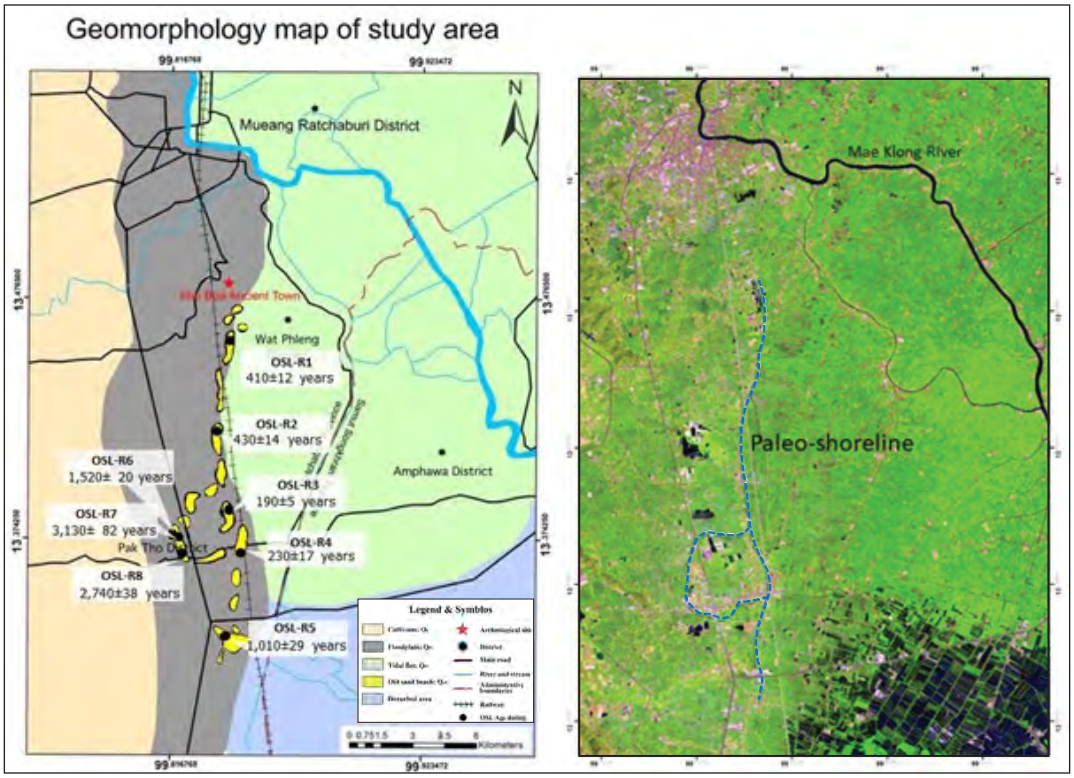

Figure 6: The age of the old beach sand deposit resulting from sea-level regression ranges from approximately 1,500 to 3,000 years ago in the inner part (3.9–4.4 m above MSL in OSL-R6 to OSL-R8) to about 200 to 1,000 years ago along Tow U-Thong Road (2.0–3.4 m above MSL), as observed at locations OSL-R1 to OSL-R4. Satellite images (infrared) reveal a paleo-shoreline (indicated by blue dashed lines) in Ratchaburi Province.

Sea-level evolution in Ratchaburi Province, western Thailand

During the Holocene Epoch, the lower central plain of Thailand experienced inundation by seawater, resulting in the deposition of old tidal flat sediments in this region (green color in Figure 6). Various types of beach deposits, including inner curved beaches and long, narrow beach formations along the Thao U-Thong Road (yellow color in Figure 6), were formed during regression periods. The sedimentation of tidal flat sediments near Ancient remains No. 24 and 25 in Ratchaburi Province is supported from the evidence of a shell bed in the clay layer. Beach sediment deposition occurred in a N-S direction, extending from the west of the present shoreline. These paleo beach ridges are characterized by slightly curved formations and continue into adjacent provinces, such as Bangkok, Samut Sakorn, Samut Prakan, and Samut Songkram (Hutangkura, 2014).

Furthermore, the age determination of beach deposits along the west coast of the GOT predominantly revealed the historical record of Dvaravati ancient communities that once existed along the coastline in the lower central plain. These communities include the Nakhon Pathom Ancient Town in Nakhon Prathom Province, U-Thong Ancient Town in Suphanburi Province, Lopburi Ancient town in Lopburi Province, Kid Kin Ancient Town in Saraburi Province, and Sri Mahosot Ancient town in Prachinburi Province. These ancient settlements share a similar age range, dating back to approximately 2,000 to 3,000 years ago (Hutangkura, 2014).

CONCLUSIONS

This study provides new findings in the history of sea level change using chronological (OSL dating) and archaeological evidence from the western part of the Central Plain of Thailand where the ancient shoreline is likely located far inland. The application of OSL dating to determine the ages of young Holocene beach sediments that relate the regression of sea level in the late Holocene Epoch within the coastal region of Ratchaburi Province. Eight samples were collected from Muang to Pak Tho Districts, covering the transition from older small curved beaches to the development of an extensive long beach sand system. The OSL dating technique, following the Single Aliquot Regenerative protocol, was applied to coarse-grained quartz.

In summary, the OSL dating results of the old beach sands provide valuable insights into the historical sea-level changes in the western part of the Central Plain of Thailand. The findings from OSL dating confirm the sea-

level regression or stillstand during this period as suggested by Surakiatchai *et al*. (2018), followed by a subsequent regression towards the east, coinciding with the deposition of long beach sediments around 1,000 years ago. Subsequently, tidal flat sediments began forming 200 years ago towards the east, following the settlement of ancient communities in the area. Eventually, the environment transitioned into the present-day floodplain of the Mae Klong River due to sea-level regression to its current position. During the Dvaravati period, the paleo-shoreline related to the Khu Bua archaeological site was situated in an almost north-south orientation, at an elevation of approximately 2–3.4 m above MSL. This evidence is primarily derived from the presence of old beach sands, with a significant concentration along the Tow U-Thong Road. In other areas, such as the pit near Ancient remains No. 24 and 25 on the eastern side, the deposits primarily consist of tidal flat and mangrove sediments. This aligns with previous research that has suggested the paleo-shoreline throughout the Holocene period was characterized by a strip of mangrove ecology near the Khu Bua Archeological site (Hutangkura, 2014).

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AUTHORS CONTRIBUTION

PN, SS, SW – conceptualization, experiment design, collecting sample and laboratory analysis; PN – writing, review and editing manuscript.

CONFLICT OF INTEREST

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the effort reported in this paper.

REFERENCES

Aitken, M.J., 1982. Thermoluminescence dating: Past progress and future trends. Nuclear Tracks and Radiation Measurements, 10, 3-6.

Babel, M., 1986. Growth of crystals and sedimentary structures in the sabre-like gypsum (Miocene, southern Poland). Przeglad Geulogiczny, 34, 204–208.

Banerjee, D., Hildebrand, A. N., Murray-Wallace, C. V., Bourman, R. P., Brooke, B. P., & Blair, M., 2003. New quartz SAR-OSL ages from the stranded beach dune sequence in south-east South Australia. Quaternary Science Reviews, 22, 1019-1025.

Bell, W. T., 1979. Attenuation factors for the absorbed radiation dose in quartz inclusions for Thermo-luminescence dating. Ancient TL, 8, 2-13.

BØtter-Jensen, L., 1997. Luminescence techniques: Instrumentation and methods. Radiation Measurements, 27, 749-768.

Bøtter-Jensen, L., Bulur, E., Duller, G. A. T., & Murray, A. S., 2000. Advances in luminescence instrument systems. Radiation Measurements, 32, 523-528.

Choi, J. H., Murray, A. S., Jain, M., Cheong, C. S., & Chang, H. mW., 2003. Luminescence dating of well-sorted marine terrace sediments on the southeastern coast of Korea. Quaternary Science Reviews, 22, 407-421.

Chonglakmani, C., Ingavat, R., Piccoli, G., & Robba, E., 1983. The last marine submersion of the Bangkok area in Thailand. Memorie Di Scienze Geologiche. Padova, 35, 35352.

Choowong, M., 2002a. Isostatic models and Holocene relative changes in sea level from the coastal lowland area in the Gulf of Thailand. Journal of Scientific Research Chulalongkorn University, 27, 83-92.

Choowong, M., 2002b. The geomorphology and assessment of indicators of sea-level changes to study coastal evolution from the Gulf of Thailand. Proceedings of International Symposium on "Geology of Thailand", 207-220.

Choowong, M., 2011. Quaternary. In: M.F. Ridd, A.J. Barber & M.J. Crow (Eds.), The Geology of Thailand. Geological Society of London, London.

Choowong, M., Ugai, H., Charoentitirat, T., Charusiri, P., Daorerk, V., Songmuang, R., & Ladachart, R., 2004. Holocene Biostratigraphical Records in Coastal Deposits from Sam Roi Yod National Park, Prachuap Khiri Khan, Western Thailand. Tropical Natural History, 4, 1-18.

Compton, R.R., 1962. Manual of Field Geology. John Wiley and Sons Inc., New York. 378 p.

Duller, G. A. T., 2008. Single-grain optical dating of Quaternary sediments: Why aliquot size matters in luminescence dating. Boreas, 37, 589-612.

Folk, R.L. & Ward, W.C., 1957. A study in the significance of grain-size parameters. Journal of Sedimentary Petrology, 27, 3-26. https://doi.org/10.1306/74D70646-2B21-11D7-8648000102C1865D.

Hardie, L., & Eugster, H. P., 2006. The depositional environment of marine evaporites: A case for shallow, clastic accumulation. Sedimentology, 16, 187 - 220. https://doi.org/10.1111/j.1365-3091.1971.tb00228.x.

Hutangkura, T., 2014. A New Interpretation of the Boundary of Dvaravati Shoreline on the Lower Central Plain. Damrong Journal ,13, 12-14.

Karpytchev, Y. A., 1993. Reconstruction of Caspian Sea level fluctuations: Radiocarbon dating coastal and bottom deposits. Radiocarbon, 35, 409-420.

Lamothe, M., 2016. Luminescence dating of interglacial coastal depositional systems: Recent developments and future

avenues of research. Quaternary Science Reviews, 146, 1-27.
Lee, J., Li, S., & Aitchison, J., 2009. OSL dating of paleoshorelines at Lagkor Tso, western Tibet. Quaternary Geochronology, 4, 335-343.
Liang, P., 2019. LDAC: An Excel-based program for luminescence equivalent dose and burial age calculations. Ancient TL, 37, 21-40.
Miocic, J., Sah, R., Chawchai, S., Surakiatchai, P., Choowong, M., & Preusser, F., 2022. High resolution luminescence chronology of coastal dune deposits near Chumphon, Western Gulf of Thailand. Aeolian Research, 56, 100797.
Murray, A., & Olley, J., 2002. Precision and accuracy in the optically stimulated luminescence dating of sedimentary quartz: A status review. Geochronometria, 21.
Murray, A. S., & Wintle, A. G., 2000. Luminescence dating of quartz using an improved single-aliquot regenerative-dose protocol. Radiation Measurements, 32, 57-73.
Nielsen, A., Murray, A.S., Pejrup, M., & Elberling, B., 2006. Optically stimulated luminescence dating of a Holocene beach ridge plain in Northern Jutland, Denmark. Quaternary Geochronology, 1, 305-312.
Nimnate, P., Chutakositkanona, V., Choowong, M., Pailoplee, S., & Phantuwongraja, S., 2015. Evidence of Holocene sea level regression from Chumphon coast of the Gulf of Thailand. ScienceAsia, 41, 55-63.
Nutalaya, P., & Rau, J. J., 1981. Bangkok: The Sinking Metropolis. Episodes, Journal of International Geoscience, 4, 3-8.
Polwichai, S., Phantuwongraj, S. & Choowong, M., 2023. Beach ridge evolution in response to the Holocene sea-level change from Surat Thani, Thai-Malay Peninsula. ScienceAsia, 49, 232-360.
Powers, M.C., 1953. A new roundness scale for sedimentary particles. Journal of Sedimentary Research, 23, 117-119.
Prescott, J. R., & Hutton, J. T., 1994. Cosmic ray contributions to dose rates for luminescence and ESR dating: Large depths and long-term time variations. Radiation Measurements, 23(2-3), 497-500.
Readhead, M. L., 1987. Thermoluminescence dose rate data and dating equations for the case of disequilibrium in the decay series. International Journal of Radiation Applications and Instrumentation, Part D, Nuclear Tracks and Radiation Measurements, 13(4), 197-207.
Reimann, T., Naumann, M., Tsukamoto, S., & Frechen, M., 2010. Luminescence dating of coastal sediments from the Baltic Sea coastal barrier-spit Darss–Zingst, NE Germany. Geomorphology, 122, 264-273.
Singh, A. K., Pattanaik, J. K., Gagan, & Jaiswal, M. K., 2017. Late Quaternary evolution of Tista River terraces in Darjeeling-Sikkim-Tibet wedge: Implications to climate and tectonics. Quaternary International, 443, 132-142.
Sinsakul, S., 1992. Evidence of Quaternary Sea Level Changes in the Coastal Areas of Thailand: a review. Journal of Southeast Asian Earth Sciences, 7, 23-37.
Supajanya, T., 1981. Delineation of the regression shorelines in the lower Chao Phraya Plain. Proceedings of the Seventeenth Session, Committee for Coordination of Joint Prospecting for Mineral Resources, 232-237.
Supajanya, T., 1983. Tentative correlation of old shorelines around the Gulf of Thailand. First Symposium on Geomorphology and Quaternary Geology kof Thailand, Bangkok, 96-105.
Surakiatchai, P., Choowong, M., Charusiri, P., Charoentitirat, T., Chawchai, S., Pailoplee, S., & Bissen, R., 2018. Paleogeographic reconstruction and history of the sea level change at Sam Roi Yot National Park, Gulf of Thailand. Tropical Natural History, 18, 112- 134.
Surakiatchai, P., Songsangworn, E., Pailoplee, S., Choowong, M., Phantuwongraj, S., Jirapinyakul, A., & Charusiri, P., 2019. Optically stimulated luminescence dating reveals rate of beach ridge and sand spit depositions from the upper Gulf of Thailand. Songklanakarin Journal of Science and Technology, 41, 1136-1145.
Takashima, I., & Honda, S., 1989. Comparison between K-Ar and TL dating results of pyroclastic flow deposits in the Aizutajima area, Northeast Japan. Journal of the Geological Society of Japan, 95, 807-816.
Williams, H., Choowong, M., Phantuwongraj, S., Surakietchai, P., Thongkhao, T., Kongsen, S., & Simon, E., 2016. Geologic records of Holocene typhoon strikes on the Gulf of Thailand coast. Marine Geology, 372, 66-78.

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Grain size distribution and heavy minerals in the sediments of Sungai Dungun, Terengganu

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Abstract: Twenty-one samples of sediments were collected from the center of the river channel and 13 sediment samples collected from the riverbank were analysed for their textural parameters (mean, standard deviation, skewness, and kurtosis) to determine the mineral size. The results indicate that sediments from both the center of the channel and the riverbank were dominated by very coarse sand and very fine gravel. Heavy minerals in the sediment were separated using bromoform for density separation, as well as magnetic separation. Ilmenite, magnetite and cassiterite were abundant in the middle of the channel whereas rutile and zircon were found to be dominant at the riverbank.

Keywords: Grain size, heavy minerals, river, estuary, riverbank

INTRODUCTION

Heavy minerals refer to the minerals that are of higher density (at 2.65 g/) than quartz. Some of these heavy minerals have economic value (Mustafa Ergin *et al.,* 2007; Ali Mohammad *et al.,* 2020; M. Julleh Jalalur Rahman *et al.,* 2022; Omran E. Frihy *et al.,* 2022; Uddin *et al.,* 2022) due to their properties and prevalence and are useful materials for industries such as paints and pigments, ceramics, and sandblasting.

Heavy minerals can be found in mineable concentrations in various type of placer deposits. The heavy minerals accumulated in the placers due to physical processes beginning with weathering, erosion, transportation and finally deposition. Placer deposits can be divided into seven categories, i.e., alluvial placers, colluvial placers, fluvial placers, glacial placers, littoral placers, aeolian placers and marine placers (MacDonald, 1983).

Malaysia has been producing heavy minerals for the past few decades; most coming from amang (heavy mineral separates) and sand derived from tin mining activities. The trend of heavy mineral production in Malaysia has been rapidly declining since 2013 (Department of Mineral and Geoscience Malaysia, 2022) which can be attributed to the declining tin mining activity which in turn reduced the production of amang. In view of the situation, river sand can be evaluated as an alternative source for heavy minerals. Currently, river sand is mainly used in the mixing of concrete in the construction industry. At present, there is no exploration work on river sand for heavy minerals. However, studies have shown that river sand does contain heavy minerals together with other sediments. Therefore, this study is carried out to determine the heavy mineral content and as well as the grain size distribution of sediments from Sungai Dungun, Terengganu. Sungai Dungun is selected based on the geology in the upper reaches area of the river which suggest the presence of heavy minerals in the river sediments.

Grain size plays an important role in determining the energy of deposition as well as the transportation and sorting of sediments. The most common method used for grain size analysis is the Folk & Ward (1957) method which characterizes grain sizes based on mean, standard deviation, skewness, and kurtosis (Folk & Ward, 1957; Wan Hanna Melini *et al.,* 2015, 2017; Oladipo *et al.,* 2018). The mean value reflects the dominant grain size which is influenced by the source supply and environment of deposition. The standard deviation or sorting measures the uniformity of the particle size distribution whereby well sorted particles would have a narrower range of grain size when compared to poorly sorted particles. Skewness reflects the asymmetry of the particle distribution whereby

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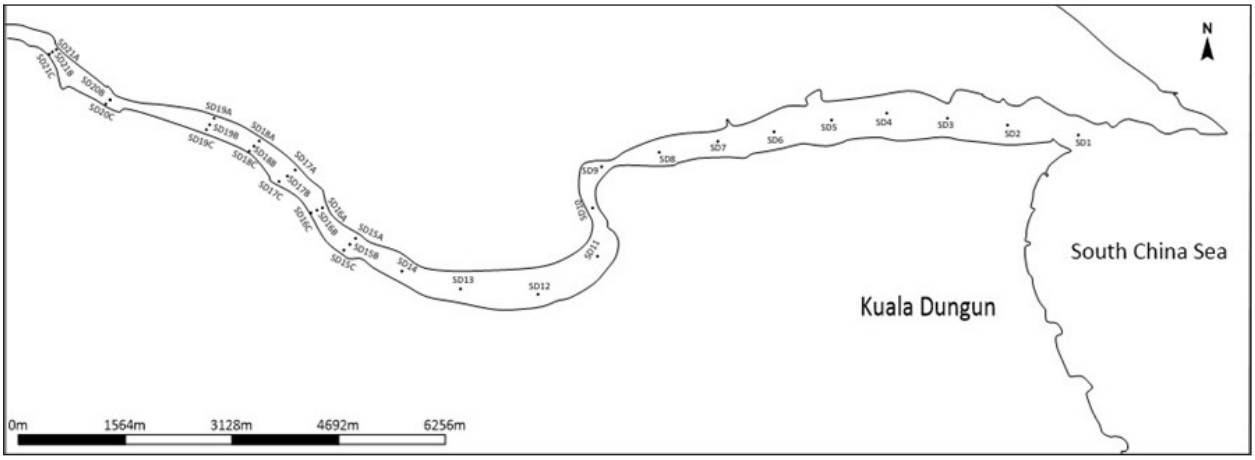

Figure 1: Map of study area.

positive skewness indicates abundance of larger grains that corresponds to low energy environment whereas negative skewness indicates otherwise. Kurtosis describes the peakedness of the grain size distribution such that positive kurtosis indicates coarser grain size whereas negative kurtosis indicates finer grain size.

STUDY AREA

The study area (Figure 1), Sungai Dungun is located in the southeastern part of Terengganu state within the latitudes 4°46'49.07"N and 4°47'18.94"N and longitudes 103°25'45.92"E and 103°20'45.46"E. Sungai Dungun is in the Dungun district of Terengganu which is located about 67 km to the south of Kuala Terengganu and 3 km to the north of Kuala Dungun town. The river, Sungai Dungun, is a meandering river with a sinuosity index of 1.66.

Geologically, the area is underlain by a meta-sedimentary rock sequence known as the Sungai Perlis Beds of Lower Carboniferous age (Chand, 1978). The Sungai Perlis Bed is made up of a rock sequence dominated by shale, slate, phyllite as well as schist with some quartzite, metaconglomerate and hornfels.

The study area covers a distance of approximately 11.5 km along Sungai Dungun, starting from the upper reaches of the river and ending with the estuary.

METHODOLOGY

The study integrates statistical and qualitative analyses (Figure 2) to characterize the distribution of grain size and heavy mineral content in the sediments of Sungai Dungun.

SEDIMENT SAMPLING

Sediment sampling was conducted along the river to collect sediment samples along the middle of the river and at the riverbank. A total of 34 sediment samples were collected. The interval between each sampling point is about 500 metres with additional sampling points added

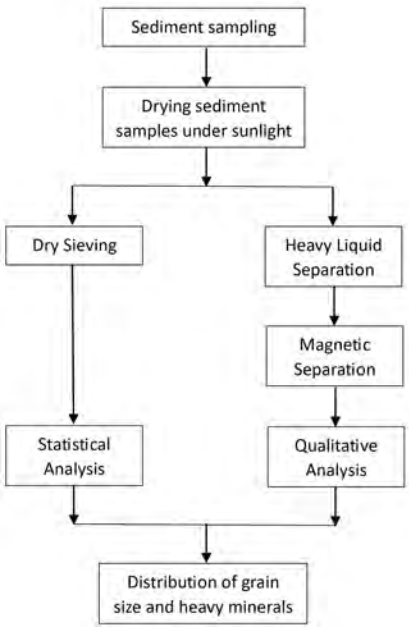

Figure 2: Workflow of study.

within similar transect line if river width is too wide. Sediment samples were not collected at the banks of the estuary due to the extensive development which deems as unsuitable for sampling. The samples were collected using grab sampling method at depths ranging between 1 metre to 7 metres. The sampling process was carried out using a Ponar grab sampler and the sediment samples were placed in airtight plastic bottles with labels.

STATISTICAL ANALYSIS

Statistical analysis (Figure 3) was carried out to identify the grain size of the sediments. The samples were air dried during the day for 4 days to remove moisture from the sediment samples. The dried samples were then sieved using mesh sizes of 32 mm, 16 mm, 8 mm, 4 mm, 2 mm, 1 mm, 0.5 mm, 0.25 mm, 0.125 mm, 0.0625 mm,

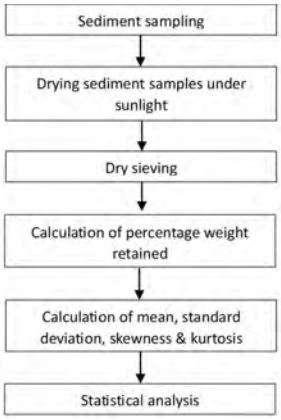

Figure 3: Statistical analysis procedure.

0.031 mm, 0.0156 mm, 0.0078 mm, 0.0039 mm, and 0.00006 mm. The stacked sieves of various sizes were placed in a mechanical shaker for ten minutes to ensure the accuracy and consistency of the sample distribution in the sieves. The percentage of sample retained in each sieve was calculated according to equation 1 (Table 1). From the data obtained, the mean, standard deviation, skewness, and kurtosis for each sample is calculated according to equations 2 to 5 (Table 1).

QUALITATIVE ANALYSIS

Qualitative analysis (Figure 4) was carried out to distinguish heavy minerals present in the sediments. The dried samples were panned to concentrate the heavy minerals. The heavy mineral concentrate was then mixed with bromoform (2.89 g/cm^3) in a separatory funnel and left for an hour to allow the separation of heavy and light minerals. The heavy minerals will settle to the bottom of the separatory funnel due to its higher density. The heavy mineral concentrate was then separated from the bromoform using filter paper. The heavy mineral concentrate was dried on a hot plate to remove residual bromoform. The dried heavy mineral concentrate was loaded onto the Frantz Magnetic Separator and separated according to the heavy mineral's magnetic susceptibility i.e. hand magnet, 0.4 A, 0.7 A, 1 A and non-magnetic. The segregated heavy minerals were identified using a binocular microscope.

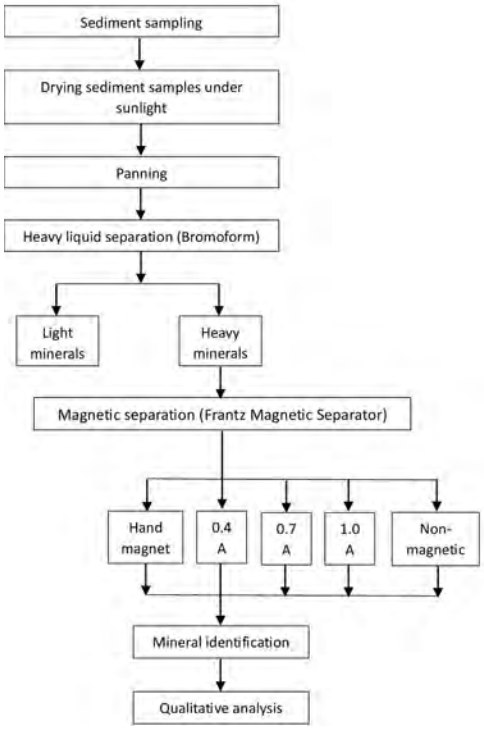

Figure 4: Qualitative analysis procedure.

RESULTS AND DISCUSSION

Mid-channel sediments

Grain size analysis

Grain size parameters (mean, sorting, skewness, and kurtosis) were generated on the 21 sediment samples taken from the middle of the river channel using the method from Folk & Ward (1957). Based on the mean (Table 2), the distribution of grain size of mid-channel sediments (Figure 5) is dominated by very coarse sand (71%), followed by very fine gravel (19%) and coarse sand (10%). The sediments are poorly sorted, except for sampling point SD13, where they are moderately sorted. Skewness is variable, with most samples being symmetrically skewed, with other samples ranging between coarse skewed and very fine skewed. Kurtosis is also variable, with samples ranging between leptokurtic and platykurtic, with most samples being mesokurtic.

Table 1: Equations of statistical analysis.

No.	Parameter	Equation
(1)	Percentage weight retained	% retained = (weight retained (g))/(total weight retained (g)) × 100
(2)	Mean, M_Z	$M_Z = (\varphi_{16} + \varphi_{50} + \varphi_{84})/3$
(3)	Standard deviation/Sorting, σ_1	$\sigma_1 = (\varphi_{84} - \varphi_{16})/4 + (\varphi_{95} - \varphi_5)/6.6$
(4)	Skewness, S_k	$S_k = (\varphi_{16} + \varphi_{84} - 2\varphi_{50})/(2(\varphi_{84} - \varphi_{16})) + (\varphi_5 + \varphi_{95} - 2\varphi_{50})/(2(\varphi_{95} - \varphi_5))$
(5)	Kurtosis, K_G	$K_G = (\varphi_{95} - \varphi_5)/(2.44(\varphi_{75} - \varphi_{25}))$

Table 2: Textural interpretation of samples of middle of the river.

Sampling Point	Mean, M_Z	Sorting, σ_1	Skewness, S_k	Kurtosis, K_G
SD 1	Very Coarse Sand	Poorly Sorted	Symmetrical	Mesokurtic
SD 2	Very Coarse Sand	Poorly Sorted	Coarse skewed	Mesokurtic
SD 3	Very Fine Gravel	Poorly Sorted	Very Fine Skewed	Mesokurtic
SD 4	Very Coarse Sand	Poorly Sorted	Symmetrical	Mesokurtic
SD 5	Coarse Sand	Poorly Sorted	Coarse skewed	Mesokurtic
SD 6	Very Coarse Sand	Poorly Sorted	Very Coarse Skewed	Mesokurtic
SD 7	Very Fine Gravel	Poorly Sorted	Very Fine Skewed	Leptokurtic
SD 8	Very Coarse Sand	Poorly Sorted	Coarse skewed	Mesokurtic
SD 9	Very Coarse Sand	Poorly Sorted	Coarse skewed	Leptokurtic
SD 10	Very Coarse Sand	Poorly Sorted	Symmetrical	Mesokurtic
SD 11	Very Coarse Sand	Poorly Sorted	Symmetrical	Mesokurtic
SD 12	Coarse Sand	Poorly Sorted	Symmetrical	Mesokurtic
SD 13	Very Coarse Sand	Moderately Sorted	Symmetrical	Platykurtic
SD 14	Very Coarse Sand	Poorly Sorted	Very Fine Skewed	Platykurtic
SD 15B	Very Coarse Sand	Poorly Sorted	Symmetrical	Platykurtic
SD 16B	Very Coarse Sand	Poorly Sorted	Fine Skewed	Platykurtic
SD 17B	Very Coarse Sand	Poorly Sorted	Symmetrical	Leptokurtic
SD 18B	Very Fine Gravel	Poorly Sorted	Fine Skewed	Leptokurtic
SD 19B	Very Coarse Sand	Poorly Sorted	Symmetrical	Platykurtic
SD 20B	Very Coarse Sand	Poorly Sorted	Symmetrical	Mesokurtic
SD 21B	Very Fine Gravel	Poorly Sorted	Very Fine Skewed	Mesokurtic

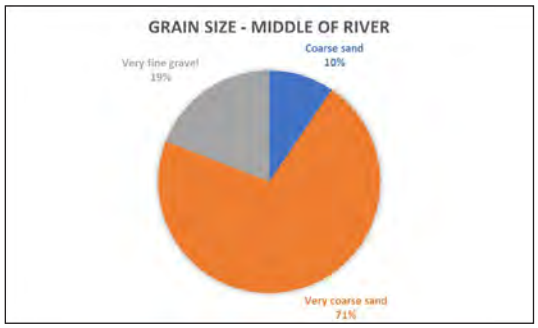

Figure 5: Distribution of grain size in mid-channel sediments.

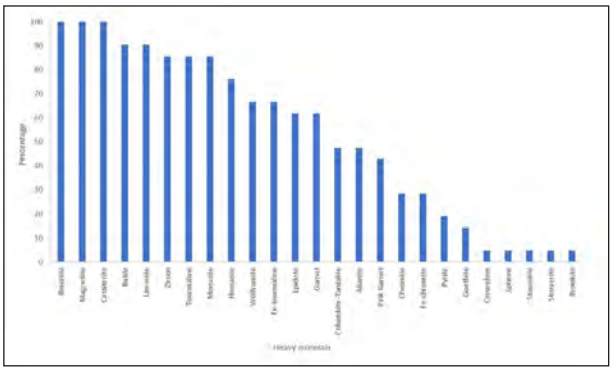

Figure 6: Distribution of heavy minerals in mid-channel sediments.

Heavy mineral distribution

All mid-channel sediment samples contain ilmenite, magnetite and cassiterite. Other heavy minerals found in abundance were rutile, limonite, zircon, tourmaline, and monazite. Heavy minerals present in minor amounts (<10%) were corundum, sphene, staurolite, struverite, and brookite (Figure 6).

Distribution of heavy minerals in grain size fractions

Mid-channel sediments were mainly made up of very coarse sand, followed by very fine gravel and coarse sand. Heavy minerals were mainly associated with very coarse sand (Figure 7). The presence of heavy minerals in

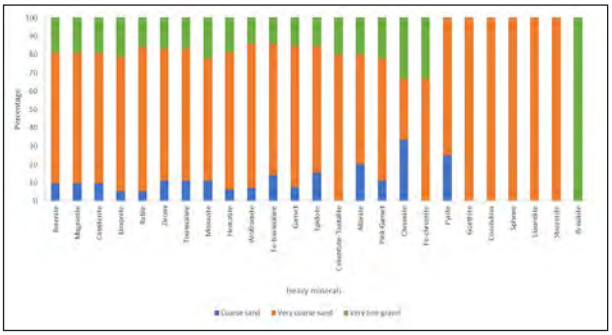

Figure 7: Distribution of heavy minerals and grain size of middle of river.

very coarse sand is between 33% and 100%, whereby the least mineral found is chromite (33%). Common heavy minerals found in very coarse sand include columbite-tantalite, rutile, wolframite, and garnet. Five types of heavy minerals, such as goethite, corundum, sphene, staurolite, and struverite, are exclusively present in the very coarse sand situated along the middle of the river channel. The sole heavy mineral absent in very coarse sand is brookite.

Heavy minerals present in very fine gravel in mid-channel sediments range between 14% to 100%. The heavy minerals least commonly present are wolframite and Fe-tourmaline (14%) followed by garnet and epidote (15%). The most common heavy minerals present include chromite and Fe-chromite (33%) as well as monazite and pink garnet (22%). Brookite is only found in very fine gravel along the middle of the river. The six (6) types of heavy minerals which are not present include pyrite, goethite, corundum, sphene, staurolite and struverite.

Heavy minerals in mid-channel sediments are found in small amounts in coarse sand i.e. 5% to 33%. The most common heavy mineral present is chromite (33%) followed by pyrite (25%). Heavy minerals present in minor amounts (<10%) include limonite, rutile, hematite, wolframite, and garnet. Apart from that, eight (8) types of heavy minerals, namely columbite-tantalite, Fe-chromite, goethite, corundum, sphene, staurolite, struverite and brookite, are absent in coarse sand in mid-channel.

Riverbank

Grain size analysis

13 samples taken from both the left and right banks of the river were analysed for grain size distribution (Table 3 and Figure 8). The samples were dominated by very fine gravel, followed by very coarse sand, medium sand, and fine sand. 69% of the samples were poorly sorted with the remaining being moderately sorted. Skewness was found to be highly variable, with samples ranging through symmetrically skewed, coarse skewed, fine skewed, very fine skewed and very coarse skewed. Kurtosis ranged from mesokurtic, platykurtic, leptokurtic to very leptokurtic.

Heavy mineral distribution

All 13 samples taken from the riverbank contain rutile, while zircon was found in 92% of the samples (Figure 9). Ilmenite, magnetite, cassiterite, tourmaline and monazite were found in 85% of the samples. Chromite and anatase were the least common minerals found along the riverbank, occurring in less than 10% of the samples.

Distribution of heavy minerals in grain size fractions

Riverbank sediments were found to contain very fine gravel, very coarse sand, medium sand, and fine sand. The various heavy minerals make up 20% to 100% of the

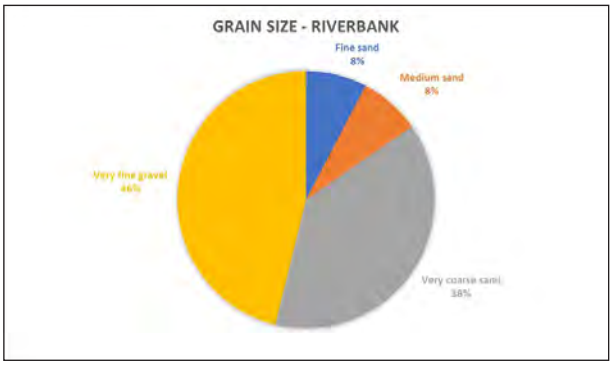

Figure 8: Distribution of grain size in riverbank sediments.

Table 3: Textural interpretation of samples of riverbank.

Sampling Point	Mean, M_Z	Sorting, σ_1	Skewness, S_k	Kurtosis, K_G
SD 15A	Fine Sand	Poorly Sorted	Very Coarse Skewed	Mesokurtic
SD 15C	Very Fine Gravel	Poorly Sorted	Very Fine Skewed	Very Leptokurtic
SD 16A	Very Fine Gravel	Poorly Sorted	Coarse Skewed	Very Leptokurtic
SD 16C	Very Fine Gravel	Moderately Sorted	Symmetrical	Very Leptokurtic
SD 17A	Very Coarse Sand	Poorly Sorted	Fine Skewed	Platykurtic
SD 17C	Medium Sand	Poorly Sorted	Symmetrical	Platykurtic
SD 18A	Very Coarse Sand	Poorly Sorted	Symmetrical	Platykurtic
SD 18C	Very Fine Gravel	Moderately Sorted	Fine Skewed	Mesokurtic
SD 19A	Very Coarse Sand	Moderately Sorted	Symmetrical	Mesokurtic
SD 19C	Very Fine Gravel	Poorly Sorted	Fine Skewed	Leptokurtic
SD 20C	Very Fine Gravel	Poorly Sorted	Very Fine Skewed	Leptokurtic
SD 21A	Very Coarse Sand	Poorly Sorted	Coarse Skewed	Leptokurtic
SD 21C	Very Coarse Sand	Moderately Sorted	Coarse Skewed	Mesokurtic

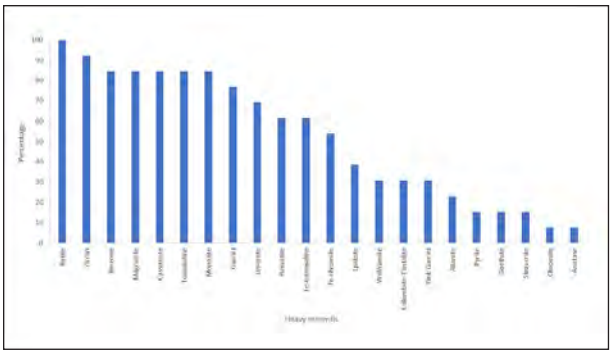

Figure 9: Distribution of heavy minerals at riverbank.

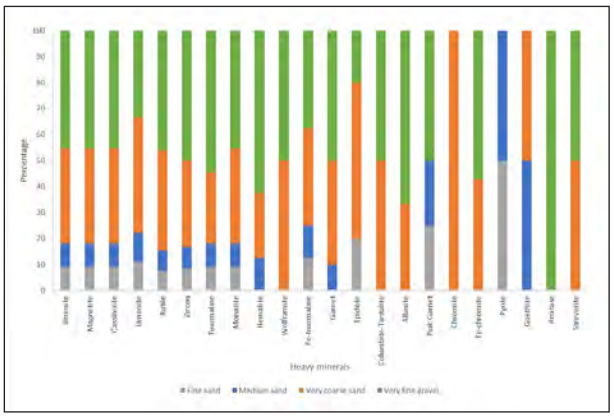

Figure 10: Distribution of heavy minerals and grain size of riverbank.

very fine gravel fraction (Figure 10), with epidote being the heavy mineral that makes up the smallest fraction of this grain size fraction. Common heavy minerals found include allanite, hematite, and Fe-chromite. Equal parts of wolframite, columbite-tantalite and struverite are found in very fine gravel and very coarse sand. Anatase is exclusively found in very fine gravel of the riverbank. Heavy minerals such as chromite, pyrite and goethite are absent in the very fine gravel.

Heavy minerals make up between 25% to 100% in very coarse sand fraction. Some common heavy minerals include epidote, goethite, columbite-tantalite, and wolframite. Hematite and tourmaline are the two least heavy minerals found. Anatase, pyrite and pink garnet are not present in very coarse sand. However, chromite is exclusively found in very coarse sand.

Heavy minerals make up between 8% to 50% in both fine sand and medium sand fractions, with the majority of the heavy minerals making up between eight and nine percent of the fine and medium sand fractions. Pyrite makes up 50% of both medium sand and fine sand. The least common heavy minerals present are rutile and zircon. Hematite, garnet, and goethite are absent in fine sand, whereas epidote is not present in medium sand.

INTERRELATIONSHIP BETWEEN GRAIN SIZE, HEAVY MINERALS AND ENVIRONMENT OF DEPOSITION

Correlation between grain size and environment of deposition demonstrates that very coarse sand is observed in the middle of the river channel whereas very fine gravel is observed at the riverbank. The correlation between grain size and heavy minerals expresses that heavy minerals are mostly found in very coarse sand and very fine gravel. In short, heavy minerals are concentrated in very coarse sand of middle of river and very fine gravel of riverbank.

CONCLUSION

The study area is divided into two parts, namely middle of river channel and the riverbank. The sediments found in mid-channel is primarily very coarse sand, very fine gravel, and coarse sand. The most abundant heavy minerals found in mid-channel sediments are ilmenite, magnetite, and cassiterite. Majority of the heavy minerals are found in samples of very coarse sand in mid-channel. Goethite, corundum, sphene, staurolite, and struverite, are exclusive to samples of very coarse sand whereas brookite is exclusive to samples of very fine gravel.

The riverbank is dominated by very fine gravel, very coarse sand, medium sand, and fine sand. Most of the heavy minerals are present in samples of very fine gravel and very coarse sand. The most dominant heavy minerals here are rutile and zircon. Chromite is exclusive to very coarse sand whereas anatase is exclusive to very fine gravel. Concisely, the distribution of grain size and heavy minerals for both, middle of river and riverbank exhibit a chaotic trend.

It is essential to consider potential impacts and implement measures to minimize adverse effects towards the environment which could affect the distribution of sediments in the river. Some countermeasures which could be implemented is monitoring sediment transport to track sediment transport dynamics within the river. Apart from that, erosion control measures should be executed in areas where sediment disturbances are likely to occur during sampling activities. Long-term monitoring could be carried out to assess the sedimentation rates, erosion patterns and changes in sediment composition over time in the river. In short, these countermeasures could be implemented to minimize the impacts of sampling activities towards the sediment distribution in the river.

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AUTHORS CONTRIBUTION

INDAA contributed to the data analysis, data interpretation and writing of the manuscript. MSI contributed to the conceptualization of the study, writing, and reviewing of the manuscript. MSS helped with the data collection and fieldwork. SNFJ helped with the illustrations, figures and reviewing of the manuscript.

CONFLICT OF INTEREST

The authors have no conflict of interest to declare regarding the content of this paper.

REFERENCES

Ali Mohammad, Parvathaneni Bhanu Murthy, Edupuganti Naga Dhanamjaya Rao & Hari Prasad, 2020. A study on textural characteristics, heavy mineral distribution and grain-microtextures of recent sediment in the coastal area between the Sarada and Gosthani rivers, east coast of India. International Journal of Sediment Research, 35(5), 484 – 503.

Chand, F., 1978. Geological Survey District Memoir 16. Geological Survey Headquarters, Malaysia.

Department of Mineral and Geoscience Malaysia, 2022. Malaysian Minerals Yearbook 2021. Department of Mineral and Geoscience, Malaysia.

Folk, R.L. & Ward, W.C., 1957. Brazos River Bar: A study in the significance of grain size parameters. Journal of Sedimentary Petrology, 27(1), 3 – 26.

MacDonald, E.H., 1983. Alluvial Mining: The Geology, Technology and Economics of Placers. Springer, Netherlands. 508 p.

M. Julleh Jalalur Rahman, M.I. Pownceby & Md. Sohel Rana, 2022. Distribution and characterization of heavy minerals in Meghna River sand deposits, Bangladesh. Ore Geology Reviews, 143, Article 104773.

Mustafa Ergin, Şeref Keskin, A. Umran Doğan, Yusuf Kaan Kadıoğlu & Zehra Karakaş, 2007. Grain size and heavy mineral distribution as related to hinterland and environmental conditions for modern beach sediments from the Gulfs of Antalya and Finike, eastern Mediterranean. Marine Geology, 240, 185 – 196.

Oladipo, V.O., Adedoyin, A.D. & Atat, J.G., 2018. Geostatistical investigation of grain size and heavy minerals of stream sediments from Agunjin area, Kwara State. World Journal of Applied Science and Technology, 10(1B), 249 – 257.

Omran E. Frihy, Essam A. Deabes, Abdelaleem A. Abudia, & Ahamed Adawi, 2022. Heavy mineral composition and texture of the recently formed fluvial delta sediment of Lake Nasser/Nubia, Egypt and Sudan. International Journal of Sediment Research, 37(1), 70 -82.

Uddin, Md. R., Khandaker, M. U., Akter, N., Ahmed, Md. F., Hossain, S. Md. M., Gafur, A., Abedin, Md. J., Rahman, Md. A. & Idris, A. M., 2022. Identification and economic potentiality of mineral sands resources of Hatiya Island, Bangladesh. Minerals, 12(11), 1436.

Wan Hanna Melini, W.M., Siti Aminah Bassa Nawang & Mojtaba Porhemat, 2015. Statistical characterisation of grain-size distribution in fluvial sediment of Kelantan Rivers. Jurnal Teknologi, 74(3), 103 – 109.

Wan Hanna Melini, W.M., Siti Aminah Bassa & Mojtaba Porhemat, 2017. Grain size analysis of surface fluvial sediments in rivers in Kelantan, Malaysia. Sains Malaysiana, 46(5), 685 – 693.

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A New Approach of Adjustment Factor 2023 ($NAAF_{23}$) for Modified Slope Mass Rating (M-SMR)

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Abstract: The Modified Slope Mass Rating (M-SMR) system is a SMR-based geomechanical classification system utilized for rock slope characterization in the Crocker Formation. The M-SMR rating is derived from the sum of the basic Rock Mass Rating (RMRb) and an adjustment factor. However, it has been observed that the parallelism correction parameter, F1, within both the M-SMR and SMR systems, can sometimes be overestimated, especially for toppling failures when the discontinuity dip direction (αj) is less than the slope dip direction (αs). This study was conducted on six rock-cut slopes to not only evaluate the production of a convincing F1 value but also to introduce a simplified New Approach of Adjustment Factor 2023 ($NAAF_{23}$) diagram for the M-SMR. This adjustment factor (F) includes four correction parameters (F1, F2, F3, and F4), similar to those used in SMR, but modifies the calculation approach for F1. The calculation now involves subtracting the higher value from the lower value among the discontinuity dip, slope dip, or intersection line orientations. The symbols A, B, C, and D represent the subtracted values, with A and B used when the discontinuity dip direction is higher than the slope dip direction and vice versa, and C and D used when the intersection line is higher than the slope dip direction and vice versa. For plane failures, A or B becomes the value, while for wedge failures, C and D are used. For toppling failures, the formula is 180 − A or B if A or B is less than 180, and A or B − 180 if A or B is greater than 180, eliminating the need for absolute symbols. A comparison F1 calculation using SMR is also conducted. The results show that F1 values become more convincing when using $NAAF_{23}$.

Keywords: $NAAF_{23}$, M-SMR, SMR, correction parameter, Crocker Formation

INTRODUCTION

Rock mass classification systems are widely used in evaluating slope stability and providing empirical support for feasibility studies. These systems aid in characterizing, classifying, and understanding rock mass properties. Notable rock mass classifications include the Rock Mass Rating (RMR, Bieniawski, 1973), Slope Mass Rating (SMR, Romana, 1985), Rock Mass Strength (RMS, Selby, 1980), Slope Rock Mass Rating (SRMR, Robertson, 1988), Mining Rock Mass Rating (MRMR, Laubscher, 1990), Modified Mining Rock Mass Rating (MRMR modified, Haines & Terbrugge, 1991), Chinese Slope Mass Rating (CSMR, Chen, 1995), Modified Rock Mass Rating (M-RMR, Ünal, 1996), Slope Stability Probability Classification (SSPC, Hack, 1998), and Modified Slope Mass Rating (M-SMR, Rahim, 2011, 2015).

From the list mentioned earlier, the Slope Mass Rating (SMR) is widely utilized in slope stability evaluations, particularly to refine the orientation parameter (R6) within the Rock Mass Rating (RMR) system. SMR transforms the discontinuity orientation parameter into adjustment factors, labeled as "F." These adjustment factors are further defined by four correction factors (F1 to F4). The determination of these factors is influenced by the relationships among the slope orientation, the characteristics of discontinuities, the orientation of the intersection lines between discontinuities (which is a critical factor affecting rock slope stability), and the excavation method employed to construct the slope.

Since the SMR system's introduction over thirty years ago (Romana *et al*., 2015), numerous methodologies have been proposed to refine the SMR and SMR-based systems, particularly concerning the adjustment factor (F). These

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refinements address various aspects, including the mode of failure, calculation methodologies, and the generation of more positive and convincing values. Specifically, for the SMR and Modified Slope Mass Rating (M-SMR), the parallelism value, represented by the F1 correction parameter, is overestimated when the slope's dip direction exceeds that of the discontinuity ($\alpha s > \alpha j$). This discrepancy suggests a need for revision in the calculation of F1.

This study aimed to calculate the F1 adjustment factor for both the Slope Mass Rating (SMR) and Modified Slope Mass Rating (M-SMR) systems on six rock-cut slopes within the Crocker Formation in Kota Kinabalu, Sabah, Malaysia, as shown in Figure 1. Additionally, the study incorporated the use of fictitious data to complement the analysis.

M-SMR AND ADJUSTMENT FACTOR

The Modified Slope Mass Rating (M-SMR) value is derived from the sum of the basic Rock Mass Rating (RMRb) and the adjustment factor (F) values. The concept of F originates from the discontinuity orientation parameter in the RMR, which is then adapted into the orientation factor in the Slope Mass Rating (SMR), and subsequently transformed into the adjustment factor in M-SMR (Rahim, 2011). Within the M-SMR framework, F is referred to as the New Adjustment Factor (NAF), which follows the principles of SMR but incorporates several modifications in parameter calculation. The NAF was later evolved into the New Approach of Adjustment Factor (NAAF) (Rahim *et al*., 2012), introducing a more comprehensive methodology for parameter calculations.

In the NAAF, the adjustment factor F is determined by four correction parameters. These parameters encompass the geometrical relationship between the slope face and the effect of discontinuities on the slope face (parameters F1, F2, and F3), as well as the excavation method used to create the slope (F4). The calculation of F involves the subtraction of the higher value from the lower value, emphasizing the difference in orientations or positions. Symbols K, L, M, and N are utilized to denote the subtracted values, which represent the differences between the discontinuity dip or the intersection line orientation and the slope direction, or vice versa. This approach underlies the calculation and conceptual framework of the Modified Slope Mass Rating (M-SMR).

F1 is a correction parameter that reflects the degree of parallelism between the intersection line or the dip direction of discontinuities and the dip direction of the slope. It is determined by subtracting the higher value of either the discontinuity dip direction (αj) or the intersection line direction (αi) from/ or, depending on the failure mode, adding it to the lower value of the slope dip direction (αs). This calculation is applicable for plane (P), toppling (T), and wedge (W) failure modes. Each of these failure modes (P, T, and W) is marked and calculated according to their specific characteristics and the relationship between the discontinuity orientations and the slope orientation.

For the calculation of the adjustment factor F1 in the context of plane and toppling failures, the symbols K or L are employed. K is used when the discontinuity dip direction (αj) is greater than the slope dip direction (αs), and L is used for the opposite scenario. For wedge failures, M or N symbols are used following the same principle, with M being used when the intersection line direction (αi) exceeds the slope dip direction, and N for the reverse.

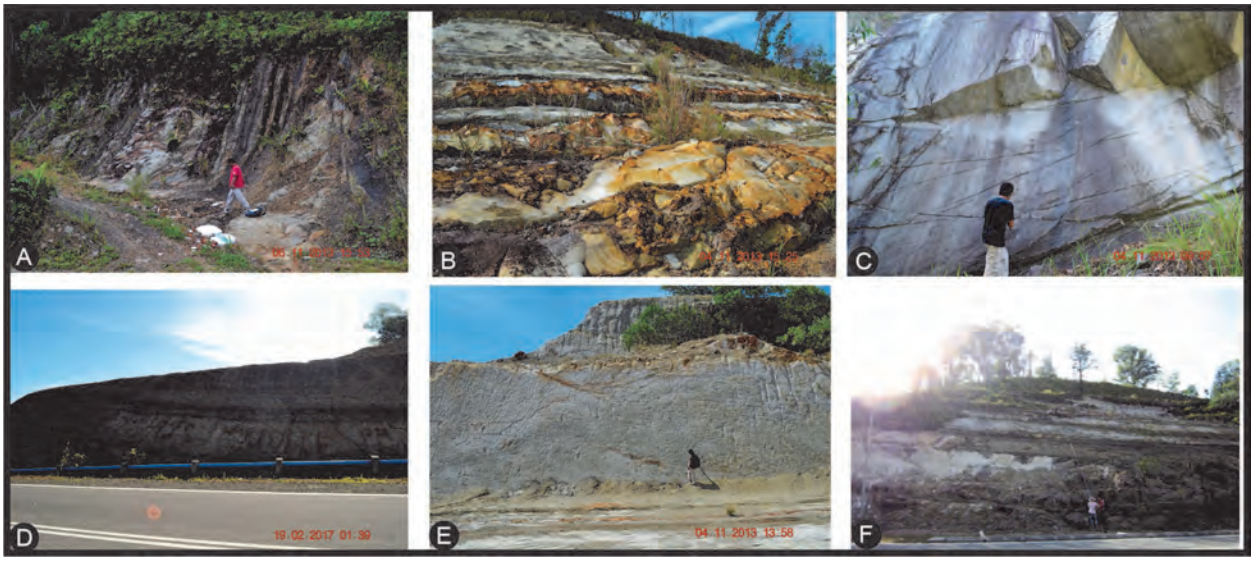

Figure 1: Selected rock cut slopes (outcrops). View to the east. A – Slope BU (Bundung); B – Slope MD (Mardi); C – Slope BS (Bandar Sierra); D – Slope KB (Kibagu); E – Slope BG (Bukit Gayang); F – Slope SU (Sulaman).

For both plane and wedge failures, if K, L, M, and N fall within the ranges of 270° to 360°, 180° to 270°, and 90° to 180°, then 360°, 270°, and 180° are subtracted from these values, respectively. If K or L fall within the range of 0° to 90°, then K or L remains unchanged. In the case of toppling failures, if K or L are within 90° to 180°, 180° is subtracted from K or L, and if within 180° to 270°, K or L is subtracted from 180°.

F2 addresses the dip angles of discontinuities or the plunge of the intersection line for plane or wedge failures, respectively. It represents the probability of discontinuity shear strength. For toppling failures, this value remains constant at 1.00. The dip or plunge angles of discontinuities and intersection lines are always considered positive.

F3 captures the relationship between the angle of discontinuity dips and the slope angle, focusing on the probability of discontinuities emerging or "daylighting" on the slope face in the context of plane, toppling, and wedge failures. This relationship is quantified by subtracting the higher angle from the lower among the discontinuity dip angle, the intersection line, and the slope dip angle, ensuring the result is a positive value.

F4 serves as a correction parameter that relates to the methods of blasting and excavation utilized. It accounts for the impact these methods have on the stability and classification of the slope, adjusting the overall assessment to reflect the effects of the chosen excavation techniques.

METHODOLOGY

This study compiled a comprehensive review of published works on the Slope Mass Rating (SMR) and SMR-based classification systems, with a particular focus on the adjustment factor, serving as a foundational study. The field component of the research entailed geological mapping, a slope survey, and a scanline discontinuity survey, adhering to the guidelines set forth by the International Society for Rock Mechanics (ISRM, 2015). The slope survey was divided into two main activities: a survey of slope failures and measurements of slope geometry. Laboratory experiments included tilt tests, which were conducted in accordance with the procedures described by Alejano *et al*. (2018).

The potential modes of failure were assessed using the Markland test (Markland, 1972), an integral part of the data analysis phase focused on calculating the F value. According to this analysis, for plane and wedge failures, if the parallelism between the discontinuity or intersection line and the slope dip directions is less than 20°, the failure is considered potential; if the parallelism exceeds 20°, the failure is deemed possible. Conversely, for toppling failures, parallelism of less than 10 degrees indicates potential failure. Additionally, the analysis utilized an average basic friction angle (ϕb) value of 28° for the Crocker Formation's fine sandstone, as reported by Rahim *et al*. (2017) in their study (Table 1).

Table 1: The value of basic friction angle, ϕ_b, of fine sandstone of the Crocker Formation by tilt testing (taken from Rahim *et al*., 2017).

Lithology	Basic friction angle, ϕ_b (degree)
Fine sandstone	Minimum = 26
	Average = 28
	Maximim = 29

The F value was determined using the proposed $NAAF_{23}$, as detailed in Table 2. $NAAF_{23}$ closely mirrors the calculations of the original NAAF but simplifies the correction parameter F1 for plane, wedge, and toppling failures. Moreover, the symbols used for calculation, previously K, L, M, and N, were changed to A, B, C, and D.

The calculation involves subtracting the higher value from the lower one among the discontinuity dip or intersection line directions and the slope dip directions, or the reverse. The resulting subtracted values are labelled as A and B for plane and toppling failures, and C and D for wedge failures. Specifically, in the case of toppling failures, the value of A or B is determined to be either more or less than 180°. If it exceeds 180°, then 180° is subtracted from it, and vice versa. The calculation does not employ the absolute value symbol, which is a departure from previous methodologies.

RESULTS

Table 3 presents the F1 values for toppling failures using the NAAF, $NAAF_{23}$, and SMR methods, based on hypothetical data. It compares cases where the discontinuity dip direction (α_j = 30°) is less than the slope dip direction (α_s = 220°), and vice versa. The F1 value appears reasonable (indicating parallelism) across all methods, except when $\alpha_s > \alpha_j$ in the SMR calculation, where F1 is notably overestimated at 370°.

The results from the Markland test for six selected slopes are detailed in Figure 2 and Table 4. The data identify potential and possible wedge, plane, and toppling failures. Specifically, wedge failure is identified as possible in slopes BU (Bundung), KB (Kibagu), and BG (Bukit Gayang) with intersection line directions of 68°, 329°, and 299°, respectively. Slope SU (Sulaman) shows potential for wedge failure at intersection line directions of 326° and 299°, and it is deemed possible at 339° and 292°. Plane failure is only potentially identified in slope KB, with a dip direction of 343°.

For toppling failures, slope BU's risk is linked to joint 3 (J3) with a 244° dip direction, slope MD (Mardi) to bedding (B) at 312°, slope BS (Bandar Sierra) to joint 2 at 134°, and slopes KB, BG, and SU to bedding (B) at dip directions of 60°, 134°, and 135°, respectively. The opposite slope dip directions for these slopes are 56°, 130°, 354°, 235°, 326°, and 317°.

Table 2: $NAAF_{23}$ for Modified Slope Mass Rating (M-SMR) system.

Case		VF	F	Fr	UF	VUF
P	A or B	> 30°	30-20°	20-10°	10-5°	5°
W	C or D					
T	180° - A or B (A or B < 180°) A or B - 180° (A or B > 180°)					
F_1		*0.15*	*0.40*	*0.70*	*0.85*	*1.00*
Relationship		$F_1 = (1 - \text{Sin}[\alpha_j - \alpha_s])^2$ or $(1 - \text{Sin}[\alpha_i - \alpha_s])^2$				
P	$\lvert\beta_i\rvert$	< 20°	20°-30°	30°-35°	35°-45°	45°
W	$\lvert\beta_i\rvert$					
F_2	**P/W**	*0.15*	*0.40*	*0.70*	*0.85*	*1.00*
	T	*1*	*1*	*1*	*1*	*1*
Relationship		$F_2 = \text{Tan}^2 \beta_j$ or $\text{Tan}^2 \beta_i$				
P	$\beta_j - \beta_s$	> 10°	10°-0°	0°	0-(-10°)	< -10°
W	$\beta_i - \beta_s$					
T	$\beta_{j\,+}\,\beta_s$	< 110°	110°-120°	120°-140°	140°-170°	170°-180°
F_3		*0*	*-6*	*-25*	*-50*	*-60*
F_4		Natural slope	Presplit-ting	Smooth blasting	Blasting & mechanical	Deficient blasting
		+15	*+10*	*+8*	*0*	*−8*

Note: P- planar; T- toppling; W-wedge; α_j - discontinuity dip direction; α_s- slope dip direction; α_i – plunge direction of intersection line; β_j - discontinuity dip angle; β_s - slope dip angle; β_i – plunge of intersection line; VF - Very Favourable; F - Favourable; Fr - Fair; UF - Unfavourable; VUF - Very Unfavourable; $A = (\alpha_j - \alpha_s)$ if $(\alpha_j > \alpha_s)$, $B = \alpha_s - \alpha_j$ if $(\alpha_s > \alpha_j)$; $C = \beta_j - \beta_s$ if $(\beta_j - \beta_s)$; $D = \beta_s - \beta_j$ if $(\beta_s > \beta_j)$; joint (j) will be change into intersection (i) for wedge failure; Z = parallelism in degree and depends on mode of failure.

Table 3: Example of the issues of toppling failure in SMR and M-SMR using fictitious data where $\alpha_s > \alpha_j$ and $\alpha_j > \alpha_s$.

System	DC	Operation			F1	Issue
M-SMR (NAAF)	$\alpha_s = 220°$ $\alpha_j = 30°$	$\alpha_s > \alpha_j$ (90°<K<180°)	$(\alpha_s - \alpha_j) = 190°$ (180°<K<270°)	K − 180°	190° − 180° = 10°	Parallel
	$\alpha_j = 220°$ $\alpha_s = 30°$	$\alpha_j > \alpha_s$ (90°<K<180°)	$(\alpha_s - \alpha_j) = 190°$ (180°<L<270°)	L − 180°	190° − 180° = 10°	Parallel
M-SMR ($NAAF_{23}$)	$\alpha_s = 220°$ $\alpha_j = 30°$	$\alpha_s > \alpha_j$	$(\alpha_s - \alpha_j) = 190°$ (A>180°)	A − 180°	190° − 180° = 10°	Parallel
	$\alpha_j = 220°$ $\alpha_s = 30°$	$\alpha_s > \alpha_j$ (90°<K<180°)	$(\alpha_s - \alpha_j) = 190°$ (B>180°)	B − 180°	190° − 180° = 10°	Parallel
SMR	$\alpha_s = 220°$ $\alpha_j = 30°$	$\alpha_s > \alpha_j$	$(\alpha_j - \alpha_s) =$ 30° − 220° = −190°	$\lvert(\alpha_j - \alpha_s) - 180°\rvert$	[−190° − 180°] = [−370°] = 370°	Overestimated
	$\alpha_j = 220°$ $\alpha_s = 30°$	$\alpha_j > \alpha_s$	$(\alpha_j - \alpha_s) =$ 220° − 30° = 190°		[190° − 180°] = [10°] = 10°	Parallel

Note: DC - discontinuity

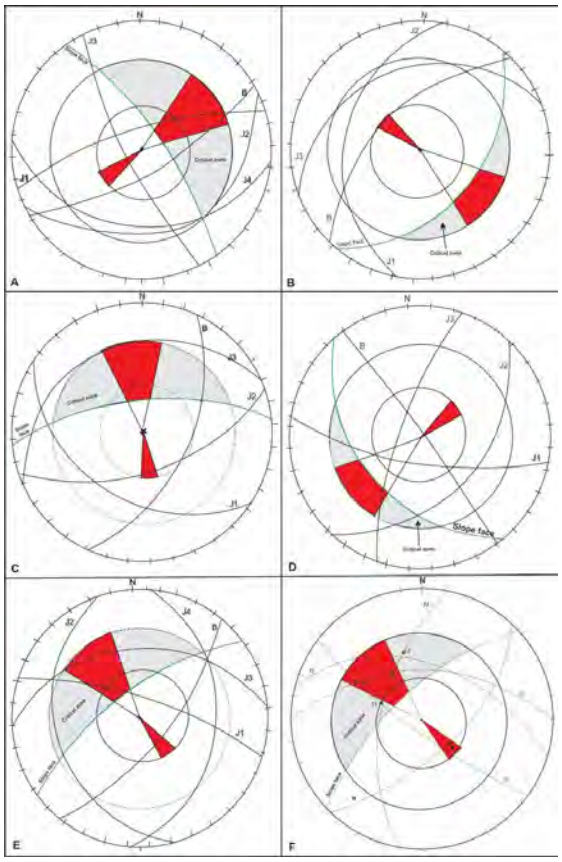

Figure 2: Markland test. A – Slope BU; B – Slope MD; C – Slope BS; D – Slope KB; E – Slope – BG; F – Slope SU.

Using the $NAAF_{23}$ method, the F1 values for potential toppling failures exceed 180° for slopes BU, MD, BS, and BG but are less than 180° for KB and SU. Slopes BU, MD, and SU are categorized under group A, while BS, KB, and BG under group B. The A and B values were then subtracted from or added to 180° to determine the F1 values. The calculated F1 values for slopes BS, BG, KB, and BG are 9, 5, 12, and 1, respectively, indicating convincing levels of parallelism.

However, the F1 values for toppling failure according to the SMR method for slopes BS, KB, BG, and SU are 369, 355, 372, and 359, respectively, which suggests an overestimation of parallelism (Figure 3). In contrast, the F1 values for slopes BU and MD are considered reasonable at 8 and 2, respectively.

DISCUSSIONS

The correction parameter for parallelism, F1, within the discontinuity adjustment factor F in the SMR system, involves subtracting the discontinuity dip direction or the intersection line directions from the slope dip direction for plane and wedge failures. For toppling failures, this value is further reduced by 180°. To ensure values remain positive, the 'absolute' symbol is applied. However, this methodology can result in negative values when the discontinuity dip or intersection line directions are less than the slope dip directions in both plane and wedge failures, as well as in toppling failures. In cases of toppling failure, subtracting an additional 180° from an

Table 4: Summary of the discontinuity plane and intersection line, mode of failures, probability to fail and F1 values for toppling failure by SMR and M-SMR systems. Red- potential zone; Grey- possible zone.

Slope	Slope dip direction	Mode of failure	Discontinuity dip direction or intersection line direction	Failure level	F1 (For toppling)	
BU (BUNDUNG)	56	Toppling	244	Potential	SMR	8
		Wedge	68	Possible	M-SMR	8
MD (MARDI)	130	Toppling	312	Potential	SMR	2
					M-SMR	2
BS (B. SIERRA)	354	Toppling	165	Potential	SMR	369
					M-SMR	9
KB (KIBAGU)	235	Toppling	60	Potential	SMR	355
		Planar	343	Potential	M-SMR	5
		Wedge	329	Possible		
BG (BT. GAYANG)	326	Toppling	134	Potential	SMR	372
		Wedge	299	Possible	M-SMR	12
SU (SULAMAN)	317	Toppling	138	Potential	SMR	359
		Wedge	326	Potential	M-SMR	1
		Wedge	299	Potential		
		Wedge	339	Possible		
		Wedge	292	Possible		

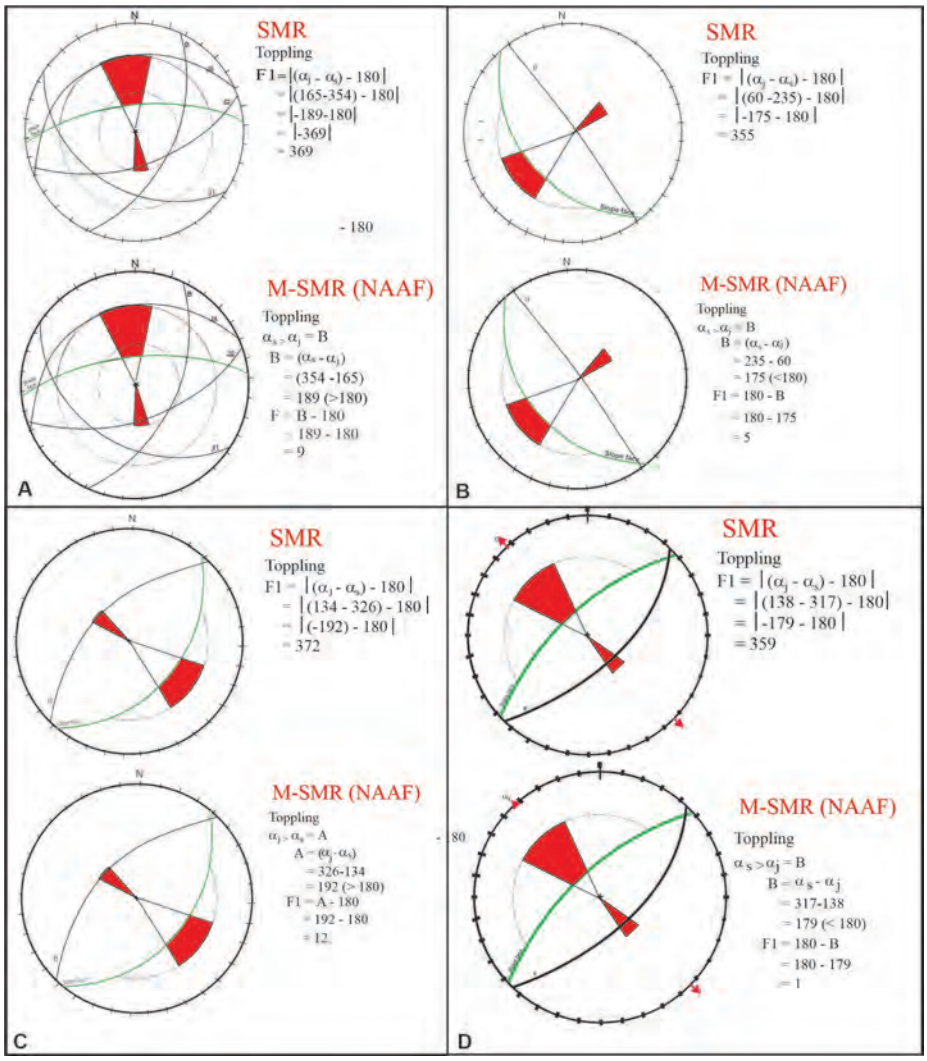

Figure 3: Result of F1 calculation for SMR and M-SMR ($NAAF_{23}$). Note: A – slope BS; B – slope KB; C – slope BG; D – slope SU.

already negative value results in an even more negative outcome, since subtracting a negative from a negative yield a larger negative number.

The first issue concerns the overestimation or representation of parallelism by larger numbers. For instance, it is debatable whether 355° or 5° better represents parallelism. Although both angles could theoretically imply similar levels of parallelism, smaller values (like 5°) are intuitively easier to understand as indicating closer alignment than larger ones (like 355°). This concept is illustrated in Table 4 and Figures 3A, 3B, 3C, and 3D. Secondly, for the F1 value to truly reflect parallelism, the discontinuity dip direction (αj) must always exceed the slope dip direction, as highlighted in Tables 3 and 4.

To address the issues mentioned earlier, the Modified Slope Mass Rating (M-SMR) updated the New Adjustment Factor (NAF) (Rahim, 2011) to the New Approach of Adjustment Factor (NAAF) (Rahim *et al.*, 2012). Essentially, NAAF follows the original framework established by Romana (1985) and Anbalagan *et al.* (1992) but modifies the approach by subtracting the higher value from the lower value among the discontinuity dip or intersection line direction and the slope dip direction, without applying the absolute value operation.

The operations are categorized based on whether the discontinuity or intersection line direction is greater or less than the slope dip direction. K is used for a higher discontinuity dip direction, while L is used when it is lower, applicable in plane and toppling failures. For a higher intersection line direction in wedge failures, M is used, and N for the lower. This ensures that results are always positive, eliminating the need for the absolute value symbol. For toppling failures, K or L is subtracted from or added to 180° depending on its value relative to 180°, followed by a subtraction from 180°, guaranteeing positive, smaller, or more convincing values.

While NAAF is effective under most conditions, it was considered complex. It has been re-evaluated and

redesigned to be simpler and more user-friendly, leading to the development of $NAAF_{23}$ for M-SMR. $NAAF_{23}$ retains the core concept of NAAF but changes the symbols back to A, B, C, and D for clarity. $NAAF_{23}$ has been simplified, and its operation is detailed in the methodology section.

The overestimation of the F1 adjustment parameter in SMR, as compared to $NAAF_{23}$, is illustrated in Tables 3 and 4, and Figure 3. For example, in Figure 3D, the discontinuity dip direction of 138° and a slope dip direction of 317° result in an F1 value of 359° for SMR, which, before applying the absolute value, is negative and overestimated in terms of parallelism. Using the $NAAF_{23}$ approach for the same data results in an F1 value of 1°, accurately reflecting parallelism and providing a more convincing representation.

The findings from this study indicate that the updated $NAAF_{23}$ is highly effective in calculating the parallelism of the F1 correction parameter, offering a solution that is both more convincing and user-friendly.

CONCLUSIONS

The M-SMR system has been successfully applied to calculate the value of the adjustment factor, specifically the parallelism correction parameter (F1), for toppling failures using $NAAF_{23}$. $NAAF_{23}$ ensures that the F1 value is never overestimated. Additionally, it provides F1 values that are more convincing and user-friendly.

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AUTHORS CONTRIBUTION

IAR: Conceptualization, investigation, writing original draft, validation, formal analysis writing and editing. MFA: writing and editing.

CONFLICT OF INTEREST

The authors have no conflicts of interest to declare that are relevant to the content of this article.

REFERENCES

Alejano, L. R., Li, C., Muralha, J. & Perez-Ray, I., 2018. ISRM Suggested Method for Determining the Basic Friction Angle of Plane Rock Surfaces by Means of Tilt Tests. Rock Mech & Rock Engineering, 51(12), 3853-3859.

Anbalagan, R., Sharma, S. & Tarun, R., 1992. Rock mass stability evaluation using modified SMR approach. Proceeding of the Sixth National Symposium on Rock Mechanics, Bangalore, India, 258-268.

Bieniawski, Z.T., 1973. Engineering classification of jointed rock masses. Transactions of the South African Institution of Civil Engineers, 15, 335-344.

Chen, Z., 1995. Recent developments in slope stability analysis. Keynote lecture. In: Proceedings of the 8th International Congress on Rock Mechanics, Tokyo, 1995. p. 1041-1048.

Hack, R., 1998. Slope stability probability classification; SSPC. PhD thesis, University of Technology Delft. Delft, Enschede, The Netherlands.

Haines, A., & Terbrugge, P. J., 1991. Preliminary estimation of rock slope stability using rock mass classification system. In: Proceedings of the 7th Congress on Rock Mechanics, ISRM. p. 887-892.

International Society of Rock Mechanics (ISRM), 2015. In: Ulusay, R. (Ed.), The ISRM Suggested Methods for Rock Characterization, Testing and Monitoring: 2007-2014. Springer, Cham, Switzerland. 293 p.

Laubscher, D. H., 1990. A geomechanical classification system for the rating of rock mass in mine design. Journal of the South African Institute of Mining and Metallurgy, 90, 257-273.

Markland, J. T., 1972. A useful technique for estimating the stability of rock slopes when the rigid wedge slide type of failure is expected. Imperial College of Science and Technology, London. 9 p.

Rahim, I. A., 2011. Rock mass classification of the Crocker Formation in Kota Kinabalu for rock slope engineering purpose, Sabah, Malaysia. PhD Thesis, Universiti Malaysia Sabah, Kota Kinabalu, Sabah.

Rahim, I. A., 2015. Geomechanical classification scheme for heterogeneous Crocker Formation in Kota Kinabalu, Sabah: An update. Bulletin of the Geological Society of Malaysia, 61, 85-89.

Rahim, I. A., Junaide Asis & Mohamed Ali Yusuf Mohd Husein, 2017. Sample type of tilt testing and basic friction angle value for the Crocker Formation's fine sandstone of Sabah, Malaysia. Proceeding of Southeast Asia and Natural Resources Management 2017 (SANREM 2017) Conference, Kota Kinabalu, Sabah.

Rahim, I. A., Sanudin Tahir, Baba Musta, & Shariff A. K. Omang, 2012. Adjustment factor for Slope Mass Rating (SMR) system: Revisited. Proceeding of National Geoscience Conference 2012 (NGC2012), 22-23 June 2012, Pullman Hotel, Kuching, Sarawak.

Robertson, A. M., 1988. Estimating weak rock strength. In: Proceedings of the SME Annual Meeting, Phoenix, Arizona. Society of Mining Engineers, Preprint No. 88-145, 1-5.

Romana, M., 1985. New adjustment rating for application of Bieniawski classification for slopes. Proceeding of International Symposium on the Role of Rock Mechanics, Zacatecas, Mexico, pp 49-53.

Romana, M., Tomás, R., & Serón, J.B., 2015. Slope Mass Rating (SMR) geomechanics classification: Thirty years review. ISRM Congress 2015 Proceedings, International Symposium on Rock Mechanics, Quebec, Canada, May 10 - 13, 2015. 10 pp.

Selby, M. J., 1980. A rock mass strength classification for geomorphic purposes: with tests from Antarctica and New Zealand. Zeitschrifts für Geomorphologie, 24, 31-51.

Ünal, E., 1996. Modified rock mass classification: M-RMR system. Milestones in rock engineering. The Bieniawski Jubilee Collection, Balkema, Rotterdam. pp. 203-223.

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58th ANNUAL GENERAL MEETING & ANNUAL REPORT 2023

PERSATUAN GEOLOGI MALAYSIA
GEOLOGICAL SOCIETY OF MALAYSIA

58th ANNUAL GENERAL MEETING & ANNUAL REPORT 2023

23rd April 2024
PAUM Clubhouse, University of Malaya, Kuala Lumpur

Agenda

The Agenda for the Annual General Meeting is as follows:

1. Welcome Address by the President for Session 2023/2024
2. Confirmation of Minutes of the 57th AGM held on the 28th April 2023
3. Matters Arising
4. Annual Report for Session 2023/2024
   a. President's Report
   b. Secretary's Report
   c. Editor's Report
   d. Treasurer's and Honorary Auditor's reports
   e. GSM Endowment Fund Report
5. Election of Honorary Auditor
6. Other Matters
7. Announcement of New Council for 2024/2025
8. Presidential Address

Confirmation of Minutes of the 57th AGM

PERSATUAN GEOLOGI MALAYSIA
GEOLOGICAL SOCIETY OF MALAYSIA (GSM)

MINUTES OF 57th ANNUAL GENERAL MEETING

Date: 28th April 2023
Time: 4.30 p.m.
Venue/Platform: Sheraton PJ / ZOOM Online Meeting

Member Attendance:

Sheraton Hotel PJ

1. Abd Rasid Jaapar
2. Ahmad Nizam Hasan
3. Arnout J.W Everts
4. Choong Chee Meng
5. Farah Fazulah Abdullah
6. Lee Chai Peng
7. Lim Choun Sian
8. Mohd Hariri Arifin
9. Mohd Shafiq Firdauz Abdul Razak
10. Mohd. Rozi Umor
11. Muhammad Yasir Yusoff
12. Norazianti Asmari
13. Nur Iskandar Taib
14. P Loganathan
15. Ros Fatihah Hj. Muhammad
16. Tan Boon Kong
17. Yunus Abd Razak

Online

18. Abd Hanan Ahmad Nadzeri
19. Abdul Aziz Bin Muhamad
20. Abu Bakar Bin Zainal
21. Ahmad Ridhwan Bin Mohammad
22. Ahmad Tariq Ahmad Ziyad
23. Amir Ariff Najmuddin Bin Abd Manan
24. Arindam Chakraborty
25. Azhar bin Ahmad Nazri
26. Azimah Ali
27. Azman Abdullah
28. Azyan Syahira binti Azmi
29. Bakhtiar Azam Md Khalid
30. Ban Zhuan
31. Calvin Cheah Gim Hoe
32. Chan Chin Sin
33. Chan Yin-Hoe
34. Charles P Molujin
35. Cindy Simba Ngumbang
36. Devendran Arumugan
37. Dorani bin Johari
38. Hamdan Mohamad
39. Hamka bin Istamar
40. Harwant Singh
41. Hasbi Husein Bin Sulkifli
42. How Yi Eng
43. Ibrahim bin Lah
44. Immas Janggok
45. Irving Tan Zhi Mian
46. Jeremy Ong Pau Chiang
47. Jong E Cheng
48. Khoong Tai Wai
49. Kim Yik Lee
50. Kong Wai Loon
51. Lakam Anak Mejus
52. Lee Kim Yik
53. Mabelyn, Tay Yen Choo
54. Meor Hakif Amir Hassan
55. Mohd Badzran Bin Mat Taib
56. Mohd Idham bin Mansor
57. Mohd Khairudin bin Muhamed
58. Mohd Zulfaiz Abdul Latif
59. Muhamad Ibrahim Abd Majid
60. Muhammad Anasrullah Abd Rahim
61. Muhammad Hatta Roselee
62. Muhammad Mustadza bin Mazni
63. Muhammad Sofi b. Mohammed Nasir
64. Muhammad Taqiuddin bin Zakaria
65. Muhd Nur Ismail Bin Abdul Rahman
66. Nan Ley Ling
67. Nicholas Jacob T Jacob
68. Nor Dalila binti Desa
69. Norhayati binti Mohd Rawi
70. Nur Chitra Dewi Binti Mohamad Noor
71. Nur Dhuha bt Dzulkifli
72. Nurfarisha Athirah binti Shahru Hasimin
73. Nurul Nadia Binti Abd. Malek
74. Patrick Gou
75. Rasydan Rais
76. Raymond Ng Huat Hoe
77. Robin Leow
78. Rusli bin Abdullah
79. Safarudin Mat Tahir
80. Siti Maisarah bt Mohd
81. Siti Nur Fathiyah Jamaluddin
82. Siti Sarah binti Yahya
83. Syed Hadi bin Syed Abu Bakar
84. Wan Hasiah Abdullah
85. Wan Zawawie bin Wan Akil
86. Wendy Teoh Hoon Ping
87. Woo Chaw Hong
88. Zuhar Zahir Harith
89. Zulqarnain Ibrahim

1. Welcome Address by the President for Session 2022/2023

Mr. Ahmad Nizam Hasan the President of Geological Society of Malaysia acted as the Chairperson of the AGM and called the meeting to order at 5.08 pm.

Adoption of Agenda

The Chairperson tabled the following agenda to the AGM for acceptance:

1. Welcome Address by the President for Session 2022/2023
2. Confirmation of Minutes of the 56th AGM
3. Matters Arising
4. Annual Report for Session 2022/2023
    a. President's Report
    b. Secretary's Report (including Assistant Secretary's Report)
    c. Editor's Report
    d. Treasurer's Report
    e. Honorary Auditor's Report
    f. GSM Endowment Fund Report
5. Election of Honorary Auditor & Board of Trustees
6. Other Matters
7. Announcement of New Council for 2023/2024
8. Presidential Address

The agenda was proposed to be accepted by Abdul Hanan and seconded by Dato' Yunus Abd Razak.

2. Confirmation of Minutes of the 56th AGM

The Minutes of the 56th AGM was tabled for confirmation.

Dr. Hariri proposed that the minutes be confirmed, seconded by Tan Bon Kong.

The minutes were unanimously confirmed without any amendment.

3. Matters Arising (56th AGM Minutes)

There were no matters arising from the previous AGM, except for typos which has been corrected at the final report and Dato' Sia and was presented at Endowment Fund report section in 57th AGM.

All other sections were presented and accepted. Action: Information

4. Annual Report for Session 2022/2023

a. President's Report

Ahmad Nizam Hasan tabled the President's Report, website update and GEOSEA video. He also thanked council members and secretary/secretariat for the support, followed conveying well wishes to the next President.

The AGM discussed the following matters:

- The society commanded the GEOSEA was a successful event and applauded the organizing team.

Action: Incoming Council

Arnout Everts proposed that the President's Report to be accepted, seconded by Dr. Hariri Ariffin.

b. Secretary's Report

Farah Fazulah Abdullah tabled the Secretary's Report and also the Assistant Secretary's Report on behalf of Norazianti Asmari. She expressed her gratitude to have served the GSM since 2018 and wanted to convey well wishes to the future council member.

The AGM discussed the following matters:

- Mr. Loganathan proposed the current international book/journal/publication to be inventorised and/or digitized. This enables a better housekeeping of available copies.

- Mr. Arnout suggested the formation of a new working group called 'Environmental Geology & Climate Change. Mr. Tan mentioned that this has historically recognised as part of the Engineering Geology subgroup
- The Society wishes to recruit more Full members in the future upon seeing a reduction in the current term's membership.

Action: Incoming Council

Abd Hanan B Ahmad Nadzeri proposed that the Secretary Report to be accepted, seconded by Azman Abdullah.

c. Editor's Report
Farah Fazulah Abdullah tabled the Editor's Report on behalf of Wan Hasiah Abdullah.

The AGM discussed the following matters:

- No further comments were made. Action: Incoming Council

Dr. Lim Choun Sian proposed that the Editor's Report to be accepted, seconded by Mr. Loganathan.

d. Treasurer's Report
Dr. Lim Choun Sian reported the Treasurer's report.

The AGM discussed the following matters:
- No further comments were made.

e. Honorary Auditor's Report
The AGM discussed the following matters:
- Treasurer requested S.F. Lee to be reappointed as auditor, and was supported by Dato' Yunus Abd Razak.

Action: Incoming Council

Dr. Rozi proposed Treasurer's report and Honorary Auditor's report to be accepted, seconded by Mr. Tan Boon Kong.

f. GSM Endowment Fund Report
Dato Yunus Abd Razak, Chairman in Board of Trustees of the GSM Endowment Fund, recommended the society to transfer the inactive funds in the operating account to Endowment Fund in order to increase interest gains. He also proposed the Council to manage the interest accrued from Dato Sia's donation Endowment Fund.

The following recommendations were accepted by the 57th AGM of the GSM:

(i) Approval of the sum of RM 40,000 that is requested by the GSM Council for publications for the year 2023.
(ii) Transfer of RM 100,000 from the UOBM Current Account to the UOBM Fixed Deposit account to increase the principal amount of the GSM Endowment Fund by the In-Coming Council.
(iii) Implementation of the modality proposed for using accumulated interest earned (RM 13,633.90) from the donation of RM 50,000.00 by YBhg. Dato' Sia Hok Kiang to the GSM Endowment Fund in 2014, with progress to be reported to Board of Trustees of the GSM Endowment Fund.
(iv) The "Board of Trustees of the GSM Endowment Fund", whose members shall comprise the GSM President, Immediate Past President, Secretary, Treasurer, Editor and at least three independent Full Members "in good standing" has to be appointed at the AGM in 2023. The AGM is requested to appoint the Chair and at least three independent Full Members in good-standing until 2026.

Mr. Loganathan proposed that report and recommendations from the Board of Trustees to be accepted by AGM, seconded by Dato' Zakaria Mohammad.

Action: Incoming Council

5. Election of Honorary Auditor & Board of Trustees Report

The AGM discussed the following matters:

- Treasurer requested S.F. Lee to be reappointed as auditor
- Dato' Yunus as Chair of Trustee
- Three (3) independent Full Members were elected as members of the Board of Trustee ;

- o Dr. Wan Hasiah
- o Dr. Lee Chai Peng
- o Azimah Ali

6. Other Matters

The AGM discussed the following matters:

- There were none being submitted prior to the AGM deadline (20th April 2023), as such none was discussed in the AGM.

7. Announcement of New Council for 2023/2024

Farah Fazulah Abdullah presented the findings from GSM Council Election term 2023/2024 result on behalf of Amie Amir.

At the end of the nomination period on 30 September 2022, single nominations were received for all the positions except for the four (4) two-year term Councillor posts, for which six (6) nominations were received. The Council decided to conduct email balloting for the four (4) Councillor posts.

With the closing of balloting on 15 December 2022, the votes were counted and verified by Elections Officer Amie Amir and two Scrutineers, Prof Dr. Azman A. Ghani and Dr. Ng Tham Fatt.

Candidates with the 4 highest votes shall be elected as Councillors for a two-year term (2023/2024 – 2024/2025) at the forthcoming the 57th AGM in April 2023.

The following results were presented to the AGM

The Council for 2023/2024:

President	:	Dr. Mohd Hariri Arifin (UKM)
Vice-President	:	Dr. Meor Amir Hassan (UM)
Immediate Past President	:	Mr. Ahmad Nizam Hasan (GeoSolution Resources)
Secretary	:	Mr. Ling Nan Ley
Assistant Secretary	:	Ms. Norazianti Asmari (GDS Sdn Bhd)
Treasurer	:	Dr. Lim Choun Sian (UKM)
Editor	:	Prof. Joy Jacqueline Pereira

Councillors 2023/2024:

i. Abdull Halim bin Abdul
ii. Ahmad Zulqurnain bin Ghazali
iii. Nor Shahidah bt. Mohd. Nazer
iv. Tan Boon Kong

Councillors 2023/2024 - 2024/2025:

i. Cindy Simba Ngumbang
ii. Mohd Shafiq Firdaus Abdul Razak
iii. Muhammad Hatta Roselee
iv. Siti Nur Fathiyah Jamaludin

First-time councillors were asked to self-introduce to the AGM audience.

Information

8. Presidential Address

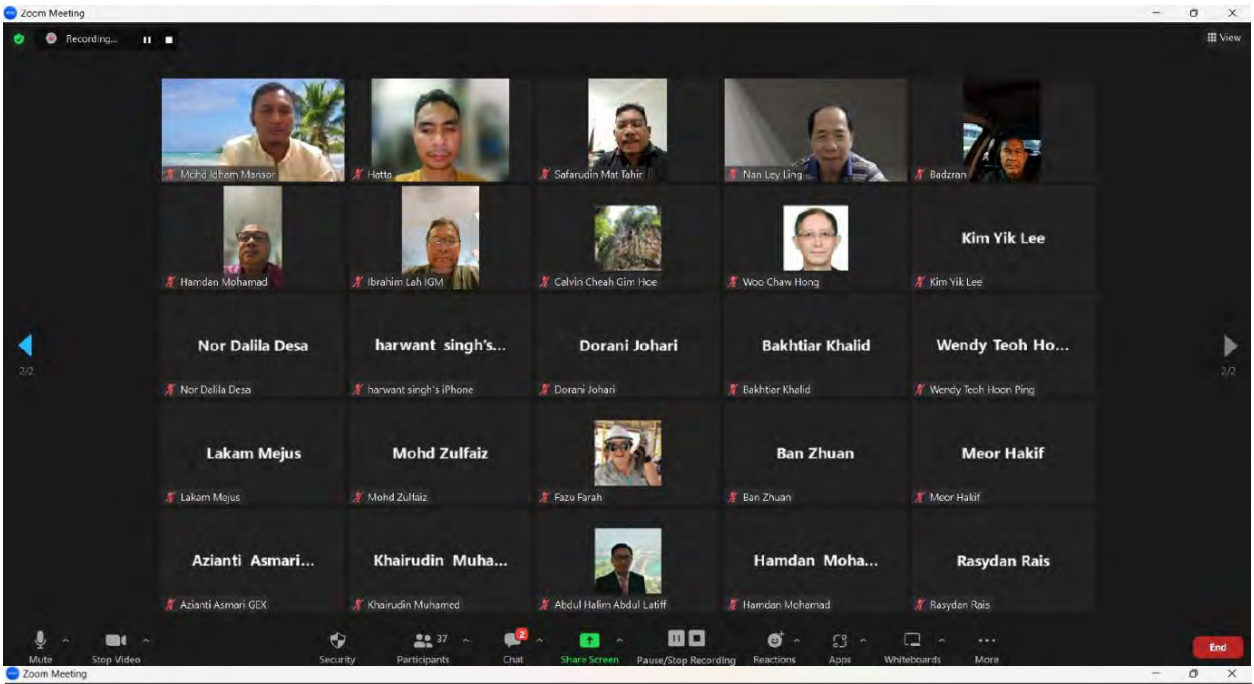
The newly elected President, Dr. Mohd Hariri Arifin expressed his gratitude to GSM members in supporting his presidency. He is grateful for the AGM's attendance as there were close to a total of 100 participants attending physically at Sheraton Hotel and via online.

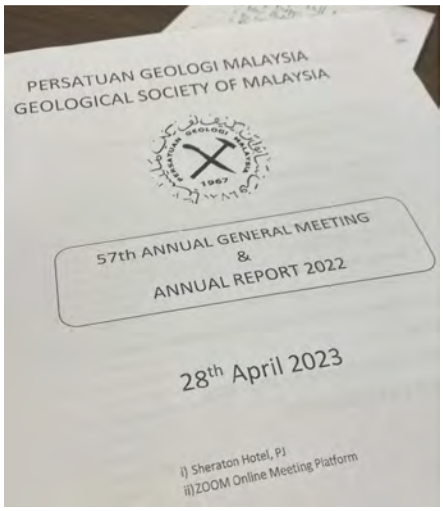
He also thanked the outgoing past president for the guidance and also having set the bar for future organisation of GEOSEA. He also vowed to keep the momentum going in organising virtual program. He promised to organise activities to benefit all the members.

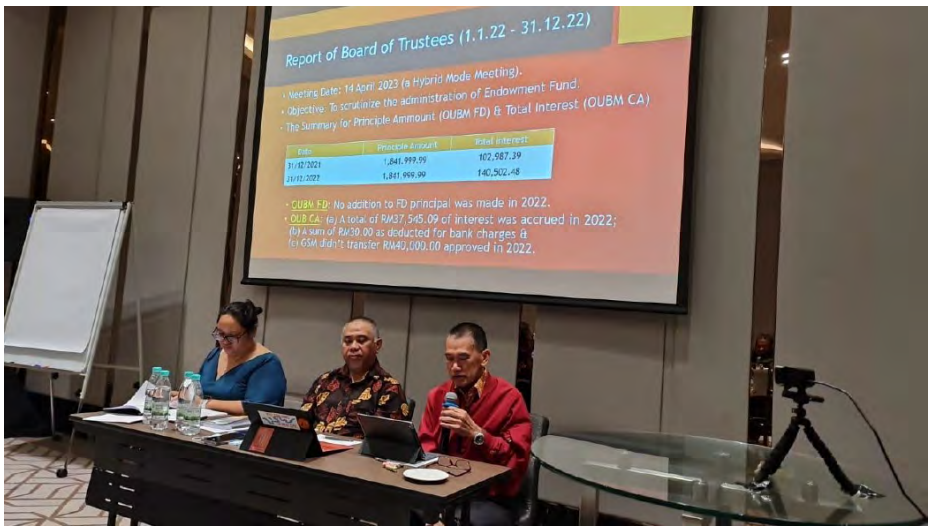
In the upcoming term, GSM will be having more robust demographic of council from different generations and a fair mix of various industry and academics, and welcoming the new secretariat. The president is hopeful to have external support for the chair working group, and promising a fruitful year ahead. Since the councillors for the new term are from both the industry and academics, and also are from different generations, The President is hopeful of a fruitful term ahead.

The AGM adjourned at 7:30 pm.

FARAH FAZULAH ABDULLAH
Secretary 2022/2023
Geological Society of Malaysia




PERSATUAN GEOLOGI MALAYSIA
GEOLOGICAL SOCIETY OF MALAYSIA
1967
57th ANNUAL GENERAL MEETING
&
ANNUAL REPORT 2022
28th April 2023
i) Sheraton Hotel, PJ
ii)ZOOM Online Meeting Platform


Report of Board of Trustees (1.1.22 - 31.12.22)
• Meeting Date: 14 April 2023 (a Hybrid Mode Meeting).
• Objective: To scrutinize the administration of Endowment Fund.
• The Summary for Principle Ammount (OUBM FD) & Total Interest (OUBM CA)
Date
Principle Amount
Total Interest
31/12/2021
1,841,999.99
102,987.39
31/12/2022
1,841,999.99
140,502.48
• OUBM FD: No addition to FD principal was made in 2022.
• OUB CA: (a) A total of RM37,545.09 of interest was accrued in 2022;
(b) A sum of RM30.00 as deducted for bank charges &
(c) GSM didn't transfer RM40,000.00 approved in 2022.

Annual Report for Session 2023/2024

President's Report

Introduction

I would like to thank all Council members and the Secretariat for the support, and all GSM members that attended the AGM for current session 2023/2024.

Programmes and collaborations

A total of 54 activities were conducted between 28 April 2023 and 23 April 2024. This is a 1-year period under the current Council. 32 activities were organised by GSM while the rest were in collaboration with other bodies, including Institute of Geology Malaysia (IGM), Board of Geologists Malaysia (BoG), Department of Mineral and Geoscience Malaysia (JMG), University of Malaya (UM), Universiti Kebangsaan Malaysia (UKM), Universiti Malaysia Terengganu (UMT), Universiti Teknologi PETRONAS (UTP), Universiti Sains Malaysia (USM) and Universiti Malaysia Kelantan (UMK). Programmes were also organized by GSM student chapters, led by the Universiti Malaysia Sabah Student Chapter (GSM-UMS SC), and student chapters in other universities. Special thanks to all the parties that were involved, including those not specifically listed here. The Chairs of the GSM Working Groups also must be credited.

GEOSEA 2024; NGC 2023-NGC 2024; the way forward to NGC 2025

The Regional Congress on Geology, Minerals and Energy Resources of Southeast Asia (GEOSEA) 2024 was held at Khon Kaen, Thailand from 20 – 23 February 2024, led by the Geological Society of Thailand (GST). GSM was represented by the President and Treasurer. Also attending the event were representatives of IGM (Mr. Abd Rasid Jaapar and Mr. Ahmad Nizam Hassan). The next GEOSEA (19th) will be chaired by Indonesia, to be led by Ikatan Ahli Geologi Indonesia (IAGI) and the event will be held in 2026. GEOSEA was initiated in 1972 by the four co-founding institutions: IAGI, GSM, GST and Geological Society of the Philippines (GSP). Since then, member institutions, including those from Myanmar and Vietnam, took turns to host GEOSEA on a rotating basis. The GEOSEA Secretariat was established in 2009. An MoU was later signed to form a joint federation of geoscience organizations, known as the AFGEO - ASEAN Federation of Geoscience Organisations (AFGEO). The Myanmar Geosciences Society (MGS) later joined AFGEO in 2022. GSM is one of the AFGEO Executive Board members.

The National Geoscience Conference (NGC) 2023 was held from 7–8 November 2023 at the Everly Putrajaya, Kuala Lumpur that was attended by 233 participants. This was the 36th edition of the annual conference with total of 48 oral and 19 poster presentations. The conference was officially declared open by Datuk P. Geol. Zamri bin Ramli, Director-General of JMG Malaysia. During the opening, Datuk P. Geol. Zamri bin Ramli launched the MyBahaya Platform, a product of the IDRC Project led by Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), with GSM as a collaborator. A total of 65 participants joined the post-conference fieldwork, which covered the area of KL-Selangor. The upcoming NGC 2024, led by Vice President (Assoc. Prof. Dr. Meor Hakif Amir Hassan), will be held at the Wyndham Grand Bangsar, Kuala Lumpur from 1-3 October 2024. I would like to propose that we solicit bids for holding the upcoming NGC 2025.

Publication: Book 'CEO GEO' and Kamus Istilah Geologi + bergambar (last published by Dewan Bahasa & Pustaka 1988)

Finally the book 'Topi Bulat dalam Geologi' was published and printed, and is available for purchase. Special thanks to the GSM editorial team and all the contributors. I wish to propose a new GSM book project - 'CEO GEO' with the objective of sharing the experiences and knowledge from leaders in the geoscience industries to inspire young geos on their profession. I also urge the GSM members to support the initiative to produce an updated Kamus Istilah Geologi (Dictionary of Geological Terms) with illustrations or graphics. I propose a meeting to form a committee for this project with stakeholders to be called after this AGM.

Closing remarks

For many years to come, I hope that GSM will become more established and receive massive recognition through the society members contributions and support. GSM is also a platform to nurture for both young and experienced professionals, presenting a unique opportunity by creating a vibrant community and support network within the geological field. We enthusiastically welcome the new joiners of various of background such as fresh graduates and young graduates to professional experience. Come and join us as part of the Council and learn the effective processes from the seniors to deliver the GSM tasks in a timely manner.

Thank you.

MOHD HARIRI ARIFIN
President
Geological Society of Malaysia

Secretary's Report

1.0 Introduction

On behalf of the members of the Council of the Geological Society of Malaysia (GSM), it is my pleasure to present the Secretary's Report for the session 2023/2024.

2.0 Society structure

The Society's stakeholders are the members of the Society. The Society is led by an elected Council whose main functions are to set directions to promote the advancement of geosciences, endorse activities and provide guidance for the execution of the activities of the Society.

The Council is supported by 11 Geoscience Working Groups and 5 Promotion/Supporting Working Groups. The Geoscience Working Groups' main function is to promote the advancement and exchange of knowledge in specific geoscience areas whereas the role of the Promotion/Supporting Working Groups is to promote the publicity of the society and to support the running of the Council.

The Council is assisted by the Secretariat. The Secretariat assisted the Society in the administration of day-to-day activities of the Council and the Working Groups.

3.0 Membership

As on 31st December 2023, the total number of registered members in the Society was 1115. There was an overall membership increase of 73 when compared to 2022. The increases were in Life Membership and Student Membership, largely from Malaysia. The table below presents the details of membership categories and their geographical breakdown (based on the members' mailing addresses).

Breakdown of Membership

COUNTRY	Hon	Life	Full	Assoc.	Student	Total 2023	Total 2022	Variance (2023-2022)
Malaysia	11	463	93	9	448	**1024**	**948**	**+76**
Australia	1	20	-	-	-	**21**	**21**	**0**
Bangladesh	-	2	-	-	-	**2**	**2**	**0**
Brunei	-	2	-	-	-	**2**	**2**	**0**
Canada	-	3	-	-	-	**3**	**4**	**-1**
China	-	1	-	-	-	**1**	**1**	**0**
Europe	-	15	1	-	-	**16**	**16**	**0**
Hong Kong	-	1	-	-	-	**1**	**1**	**0**
India	-	3	-	-	-	**3**	**1**	**+2**
Indonesia	-	9	-	-	-	**9**	**11**	**-2**
Japan	-	3	-	-	-	**3**	**4**	**-1**
Libya	-	3	-	-	-	**3**	**3**	**0**
New Zealand	-	2	-	-	-	**2**	**1**	**+1**
Philliphines	-	2	-	-	-	**2**	**4**	**-2**
Qatar	-	1	-	-	-	**1**	**1**	**0**
Singapore	-	9	-	-	-	**9**	**10**	**-1**
Thailand	-	2	-	-	-	**2**	**2**	**0**
USA	-	11	-	-	-	**11**	**11**	**0**
Total 2023	**12**	**552**	**94**	**9**	**448**	**1115**		
Total 2022	**13**	**534**	**119**	**10**	**366**		**1042**	
Variance (2023-2022)	**-1**	**+18**	**-25**	**-1**	**+82**			

4.0 The Council

The Council for the Geological Society of Malaysia (GSM) for 2023/2024 session resumed their office after the 57th AGM on the 28th April 2023.

4.1 Council Members

The Council Members for 2023/2024 are as follows:

President:	Dr. Mohd Hariri Arifin
Vice President:	Dr. Meor Hakif Amir Hassan
Immediate Past President:	Mr. Ahmad Nizam Hasan
Secretary:	Mr. Ling Nan Ley
Assistant Secretary:	Ms. Norazianti Asmari
Treasurer:	Dr. Lim Choun Sian
Editor:	Prof. Dr. Joy Jacqueline Pereira
Councillors:	
(2023/2024)	Dr. Abdull Halim Abdul
	Mr. Ahmad Zulqurnain Ghazali
	Dr. Nor Shahidah Mohd. Nazer
	Mr. Tan Boon Kong
(2023/2024 - 2024/2025)	Ms. Cindy Simba Ngumbang
	Mr. Mohd Shafiq Firdaus Abdul Razak
	Dr. Muhammad Hatta Roselee
	Dr. Siti Nur Fathiyah Jamaludin

4.2 Council Meetings

During the 2023/2024 session, the Council met 6 times. The attendance of the council members to the meetings is presented in the table below. All the meetings were conducted online except once at the meeting room of the Department of Geology, University of Malaya, Kuala Lumpur.

Attendance of Council Members to the Council Meetings

NAME	10/5/23	26/6/23	25/8/23 (UM)	19/12/23	23/1/24	26/3/24	Total
Mohd Hariri Arifin	/	/	/	/	/	/	6/6
Meor Hakif Amir Hassan	/	/	0	/	/	/	5/6
Ling Nan Ley	/	/	/	/	/	/	6/6
Norazianti Asmari	/	/	/	/	/	0	5/6
Lim Choun Sian	/	/	/	/	0	/	5/6
Joy Jacqueline Pereira	/	/	0	/	/	/	5/6
Ahmad Nizam Hassan - IPP	0	0	0	0	0	0	0/6
Abdull Halim Abdul	/	/	/	/	/	/	6/6
Ahmad Zulqurnain Ghazali	/	/	/	0	/	0	4/6
Nor Shahidah Mohd Nazer	/	/	/	0	0	0	3/6
Tan Boon Kong	/	/	/	/	/	/	6/6
Cindy Simba Ngumbang	/	/	0	0	0	/	3/6
M. Shafiq Firdauz Abdul Razak	/	/	/	/	/	/	6/6
Muhammad Hatta Roselee	/	/	/	/	/	/	6/6
Siti Nur Fathiyah Jamaludin	/	/	/	0	/	/	5/6

Note: / = present 0 = absent with apology

5.0 Working Groups

The Working Groups and the Chairs for Session 2023/2024 are as follows:

	A. GEOSCIENCE WORKING GROUP	CHAIRMAN
1	Engineering Geology	Mr. Tan Boon Kong
2	Hydrogeology	Mr. Adam Hashim
3	Economic Geology & Mineral Resources	Dr. Zakaria Endut (USM)
4	Regional Geology & Stratigraphy	Dr. Meor Hakif Amir Hassan
5	Geophysics	Dr. Siti Nur Fathiyah
6	Petroleum Geoscience	Ms. Cindy Simba Ngumbang & Mr. Mohd Shafiq Firdauz
7	Offshore Hazards and HSE	Dr. Abdull Halim Abdul
8	Quaternary & Marine Geology	Dr. Khaira Ismail
9	GSM-IGM Flagship on Geoscience to Action for Disaster Risk Reduction (G2A4DRR)	Prof Dr. Joy Jacqueline Pereira
10	Geo Heritage	Dr. Nursufiah Sulaiman
11	Karst & Caves	Dr. Ros Fatihah

	B. PROMOTION/SUPPORTING WORKING GROUP	CHAIRMAN
1	Membership Database	Dr. Muhammad Hatta Roselee
2	Promotion of Geoscience, Social Media & Digital Content	Ms. Norazianti Asmari Mr. Ahmad Zulqarnain
3	Young Geologist & Student Outreach	Dr. Nor Shahidah Dr. Muhammad Hatta Roselee
4	IT & Website	Dr Lim Choun Sian, Ms. Norazianti Asmari Mr. Ahmad Zulqarnain
5	CPD - Liason with BoG	Ms. Norazianti Asmari

6.0 Activities

The Society had successfully organised activities such as technical talks, field visit and short courses.

6.1 Technical Talks organised by GSM

During the session, the Council with the cooperation of Working Groups, were able to organise a total of 32 technical talk sessions.

Summary of Technical Talks organized by GSM

NO	DATE	TITLE	SPEAKER	COLLABORATORS
1	28.4.2023	Pre-Annual General Meeting (AGM) Talk- Classification of Geothermal Systems from Geology and Resource-Assessment Perspective	Dr. Arnout JW Everts	IGM
2	24.5.2023	Sea Bed Mapping	P. Geol. Dr. Abdull Halim bin Abdul	IGM, UM
3	14.6.2023	Technical Talk: Modified-Slope Mass Rating (M-SMR) System: application on Ultramafic Rock in Telupid, Sabah, Malaysia	P. Geol. Dr. Ismail Bin Abdul Rahim	IGM, UM

4	16.6.2023	Technical Talk: Neogene palaeoceanography of northern Indian Ocean: Evidence from the microfossils	Dr. Arindam Chakraborty	IGM, UM
5	22.6.2023	Technical Talk: Deep Marine, Channel-to-Lobe Transition Deposits of the Oligocene – Miocene Tajau Sandstone Member, Kudat Formation, Sabah	Dr. Hafzan Eva Mansor	IGM, UM
6	4.7.2023	Technical Talk: Introduction to Petroleum System Modelling	Eduardo de Mio	UM
7	5.7.2023	Sharing Session: Experiences and Journey Becoming the Digital Leader for Geospatial and Geotechnical for the O&G in Malaysia	Mr. Tengku Faiz (TnF Energy)	UKM
8	12.7.2023	Technical Talk: The Sabah Melange and Mass Movement	P. Geol. Prof. Dr. Baba Musta (UMS)	IGM, UM
9	10.8.2023	Technical Talk: Over-The-Horizon Shallow Geophysical Surveying from Home - An Experience Sharing	Sr Safaruddin Kamaruddin	IGM
10	16.8.2023	Technical Talk: Debris Flow and Mud Flood Disaster in Sugud-Maang, Penampang, Sabah: Its Impact and Possible Cause	P. Geol. Prof. Dr. Felix Tongkul (UMS)	IGM, UM
11	18.8.2023	Technical Talk: Crustal structure and tectonics of Borneo and Sulawesi	Dr. Harry Telajan Linang (UM)	
12	21.8.2023	Sharing session on internship placements for geoscience students: Do's and Don'ts	Ms. Amirah Wardah, Mr. Rashdan Marzuki, Ms. Aini Tasnim	UTP
13	23.8.2023	Technical Talk: Workflow for Geophysical Interpretation and Modeling	Mr. Mukhriz Mubin	Rock Flow Dynamics, UTP
14	13.9.2023	Technical Talk: Field Identification Of Clay Minerals Based On Desiccated Crack Morphological Pattern	Dr. Nor Shahidah Mohd Nazer (UKM)	IGM, UM
15	11.10.2023	Technical Talk- Foundation Challenges at Geological Interface Zone	Ir. Chow Chee Meng	IGM, UM
16	25.10.2023	Technical Talk: Crossgradient Multiphysics Imaging Technology for Accurate Geothermal Resource Investigations	Dr. Max A. Meju	IGM, UKM
17	7-9.11.2023	National Geoscience Conference (NGC) 2023		JMG, IGM
18	15.11.2023	Technical Talk: Geotechnical Challenges in Geologically Complex Urban Underground Construction	Ir. Khoo Chee Min (MRTC)	IGM, UM
19	23.11.2023	GSM Webinar: How effective are the peer reviews of groundwater models?	Mr. Ehsan Kamali Maskooni Moderator : P.Geol Adam Hashim	IGM

20	13.12.2023	Technical Talk: Geotechnical behaviour and interpretation of reconstituted geomaterials for soil-structure applications	Ir. Dr. Dominic E.L. Ong (Griffith University, Queensland)	IGM, UM
21	23.12.2023	Technical Talk: Introduction to fractured basement exploration	Muchamad Rahadian Anwar	IGM, UM
22	24.1.2024	Technical Talk: Innovative Approach in Risk and Stability Assessment of An Engineered Rock Slope	P. Geol. Koay Leong Thye	IGM, UM
23	31.1.2024	GSM Webinar: Appraisal of the Geology of Boya Quarry, WA	Mr. Ramli Mohd Osman	IGM, UKM
24	5.2.2024	Technical Talk: What do you need to do when performing seismic interpretation?	Mr. Mukhriz Mubin	UTP, Rock Flow Dynamics
25	7.2.2024	Technical Talk: Improving Seismic Facies Classification through Attribute Selection and Sample Size Analysis: Examples from Malay and Sabah Basins, Offshore Malaysia	Dr. Ismailalwali Babikir (UTP)	UTP
26	21.2.2024	Technical Talk: Problematic Behaviour of Dispersive Soil: Evidence from Landslide Events in Malaysia	Dr. Nor Shahidah Mohd Nazer (UKM)	IGM, UM
27	6.3.2024	Mapping Kuala Lumpur's Resilience: Urban Geology for Sustainable Development	Dr. Elanni Md Affandi	IGM, UM
28	6.3.2024	Modern foraminifera and their application	Dr. Fatin Izzati Minhat	UMT
29	19.3.2024	A multi-hazards coastal vulnerability index of the east coast of Peninsular Malaysia	Assoc. Prof. Dr. Effi Helmy Ariffin	UMT
30	19.3.2024	Seismic Geomorphology: From the Earth's Ocean Depths to Beyond Earth. A Revolution in Reconstructing Landscape Form and Process	Dr. Lesli J. Wood	UM
31	17.4.2024	Kejadian Tanah Runtuh Di Batang Kali, Hulu Selangor, Selangor	Ir. Dr. Mohamad Nizar Bin Abdurahman	IGM, UM
32	22.4.2024	Ground water Webinar- Jordan Water Resources: Groundwater critical role	Ms. Ala'a Atieh Moderator : P.Geol Adam Hashim	IGM

6.2 Activities collaborated with other institutions

GSM, collaborated in 22 other activities organized by various other institutions.

Summary of collaboration in other activities organized by the other institutions

NO	DATE	TITLE	SPEAKER	ORGANISER	COLLABORATORS
1	3.5.2023	Conodont Biostratigraphy in Dating Limestone of Northwest Peninsular Malaysia	Cik Atilia binti Bashardin	UKM	GSM, IGM
2	6.5.2023	UM-GSM SC: Geoshare Series 03 2023 : Introduction to the Geothermal Resources in Malaysia	Assoc. Prof. Ts. Dr. Mohd Hariri Arifin	UM	GSM
3	10.5.2023	Bencana Tsunami dan Kesiapsiagaan Negara	Dr. Chai Mui Fatt	NDRC, UMS	GSM
4	13-14.5.2023	UM-GSM SC: Geoscience Industrial Week 2023		UM-GSM SC	GSM
5	13-14.5.2023	Bengkel Pemantapan Pelan Strategik Lembaga Ahli Geologi Malaysia		BOG	GSM
6	24.5.2023	A GPS-Based Strain Rate in Groundwater Extraction-Induced Land Subsidence Study in Kelantan, Malaysia	Dr. Yong Chien Zheng	UKM	GSM, IGM
7	7-9.6.2023	Geoscience Week 2023, Sarawak		BOG	JMG, GSM, MyGeo
8	14.6.2023	Driving Sustainability: Managing Geothermal Power Plants to Expedite Energy Transition	Mr. Ilen Kardani	UKM	GSM, IGM
9	21.6.2023	Geologi dan Pelantar Benua dalam Undang-undang Laut	Dr. Mazlan Bin Hj Madon	UKM	GSM, IGM
10	1.7.2023	GSM-UMS Geology Club: GeoRun: Costume Fun Run		GSM-UMS SC	GSM
11	8.7.2023	GEOTALK 12.0: Geohazard - Don't underestimate Earth's power, landslides may devour!		GSM-UMS SC	GSM
12	10.7.2023	Lawatan ke ECRL	Dr. Nor Shahidah Mohd Nazer (UKM)	UKM	GSM WG Young Geologist and Student Outreach
13	16.8.2023	Surface Settlement Prediction using 2D SSPT Geo Modelling System	P. Geol. Dr. Abdull Halim bin Abdul	UKM	IGM, UKM
14	21-24.8.2023	7th Asia Pacific Coastal Aquifer Management Meeting		APCAMM	GSM, JMG, NAHRIM, UKM, UMT
15	17.10.2023	Reversal in Structural Transport Direction in the NW Borneo Deep Water Fold and Thrust Belt	Dr. Sudirman Dawing	UKM	GSM, IGM

16	16.11.2023	*Conference on the Development of Primary Tin Deposits in Malaysia			MCOM, JMG-SUPPORTED BY GSM, IGM, BOG, MTPMA, INST. KEJURUTERAAN GALIAN MALAYSIA
17	16-17.11.2023	International Conference on Geophysics 2023 (ICOG 2023)		USM	Co-organised by UM, UMP, UMK, ITU, UTHM, UKM, UTM, UTP, ISM, Approved by BOG, BEM, GSM. IGM, HRDCorp
18	21.11.2023	Bridging Geology and Engineering for Sustainable Solution: Addressing Global Challenges	P. Geol. Mohamad Faruq Syahmi bin Md Aripin	UKM	GSM, IGM
19	24-25.11.2023	3rd International Undergraduate Geological Mapping Symposium	UMK	UMK	GSM
20	21.2.2024	Ceramah Teknik Geologi Siri 1/2024: Memudahkan Proses Rekabentuk (Geoteknik) Pada Tanah Lembut: Model Resistiviti Elektrik Untuk Meramal Nilai- N dan Sifat-Sifat Tanah	Puan Ir. Ts. Zakiah Binti Razak	UKM	GSM, IGM
21	6.3.2024	Geology Technical Talk Series 2/2024: Groundwater and Surface Water Interaction Revealed by Multi-Tracer Method in Klang River Watershed, Malaysia	Dr. Saito Maruko	UKM	GSM, IGM
22	27.3.2024	A Special Ramadhan Talk Series: The Geological Concept of Mountains in the Quran	Mr. Askury Abdul Kadir		

7.0 National Geoscience Conference

7.1 The National Geoscience Conference 2023 (NGC 2023)

With Mineral and Geoscience Department Malaysia and IGM as co-organisers, the NGC 2023 was successfully held from 7th to 9th November 2023 at The Everly Putrajaya, Kuala Lumpur. A total of 48 orals and 19 posters were presented. A total of 233 geoscientists from academia as well as the public and private sectors attended the conference. The conference was officially declared open by Datuk P. Geol. Zamri bin Ramli, Director-General of JMG Malaysia.

During the opening, the MyBahaya Platform - a product of the IDRC Project led by Universiti Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), with GSM as a collaborator was launched.

A total of 65 participants joined the post-conference fieldwork, which covered the area of KL-Selangor.

7.2 The National Geosience Conference 2024 (NGC 2024)

The National Geoscience Conference 2024 (NGC 2024) will be held in collaboration with the Department of Geology, Universiti Malaya from the 1 - 3 October 2024 at the Wyndham Grand Bangsar, Kuala Lumpur. The theme of NGC 2024 is "*Geoscience for a sustainable future*".

8.0 GSM Awards

GSM awarded the GSM Best Student Award 2023 during NGC 2023.

Each of the awards was RM 1000.

1- UMS - WARDAH IDAYU BINTI MARZUKI
2- UM - WAN ZARA ANNATI BINTI WAN MOHD ROZI
3- UMK - HEERALENA A/P ARUL PATRICK
4- USM - DANITES JOEL ANYI
5- UMT - SITI NUR HANANI BT ZAINUDDIN
6- UKM - UMIE ASSIRA BT JAMALI (RM500) & AFIQAH IZZATI ABDULLAH (RM500)

9.0 Linkages and Collaborations

GSM maintained linkages with national and international institutions such as:

- Board of Geologists
  GSM is in close collaboration with BoG and endeavours to streamline its activities in pursuing to achieve the aspiration of BoG Strategic Plan 2040.
  In an effort to promote and advance geoscience knowledge, GSM also organises programmes that award the participants with CPD points.
- Institute of Geology Malaysia
  The GSM-IGM Joint Committee, co-chaired by the respective Presidents was established under the agreement signed on 5th April 2013 by GSM and Institute of Geology Malaysia (IGM).
  During the session, only one Joint Committee meeting was held on 13 February 2024. The Vice Presidents of GSM and IGM were tasked to identify and propose new initiatives / more joint programmes for implementation and to develop them into flagship/signature programmes of the Joint Committee.
- Confederation of Scientific and Technological Association of Malaysia (COSTAM)
  – GSM is paying subscription to COSTAM
- Formation Evaluation Society Malaysia (FESM)
  - FESM had successfully registered with ROS and hence GSM would refund all their money parked with us.
- American Association of Petroleum Geology (AAPG)
- AAPG Student Chapter of University of Malaya
- GEOSEA
  - GSM is the present host of the permanent Secretariat
- Universities
  GSM had signed MoU with the following universities:
  - University of Malaya
  - Universiti Kebangsaan Malaysia
  - Universiti Sains Malaysia
  - Universiti Malaysia Kelantan
  - Universiti Malaysia Terengganu
  - Universiti Malaysia Sabah

10.0 Acknowledgement

The Society would like to record its utmost appreciation to all the individuals and organisations in organising the Society's numerous activities during the session. Special mention must be made of the tremendous support by the Head and staff of the Geology Department, University of Malaya especially in the use of its premises for the Society's meetings and activities. The continued co-operation and support extended by BoG, JMG, IGM, UKM, UTP and UMT is recorded with gratitude. The unwavering support of Ms. Anna Lee and Puan Nazatul Athirah Abdul Khalil – the GSM Secretariat in the administration of GSM is also very much appreciated. Last but not least, the Council also wishes to record its appreciation to all GSM members for their advice, guidance and support throughout the session.

LING NAN LEY
Secretary
Geological Society of Malaysia

Assistant Secretary's Report

The sales of the Society publications and the list of organizations and institutions that were exchanging publications with GSM are presented in the following tables.

Sales and stock of publications for 2023 (Bulletin only)

Publications	Sales 2023	Stock remaining by end of 2023	Remarks
Bulletin 1	**Out of Stock**		
Bulletin 2	0	59	
Bulletin 3	3	82	
Bulletin 4	1	68	
Bulletin 5	**Out of Stock**		
Bulletin 6	3	309	
Bulletin 7	1	215	
Bulletin 8	**Out of Stock**		
Bulletin 9	**Out of Stock**		
Bulletin 10	**Out of Stock**		
Bulletin 11	**Out of Stock**		
Bulletin 12	**Out of Stock**		
Bulletin 13	**2**	**5**	
Bulletin 14	**Out of Stock**		
Bulletin 15	**Out of Stock**		
Bulletin 16	**Out of Stock**		
Bulletin 17	**Out of Stock**		
Bulletin 18	**Out of Stock**		
Bulletin 19	1	313	
Bulletin 20	1	283	
Bulletin 21	2	72	
Bulletin 22	2	151	
Bulletin 23	2	152	
Bulletin 24	2	322	
Bulletin 25	2	109	
Bulletin 26	2	135	
Bulletin 27	2	-	
Bulletin 28	2	88	
Bulletin 29	2	63	
Bulletin 30	2	357	
Bulletin 31	2	52	
Bulletin 32	2	36	
Bulletin 33	1	91	
Bulletin 34	2	18	
Bulletin 35	**Out of Stock**		

Bulletin 36	1	48	
Bulletin 37	2	186	
Bulletin 38	1	308	
Bulletin 39	**Out of Stock**		
Bulletin 40	2	25	
Bulletin 41	**Out of Stock**		
Bulletin 42	**Out of Stock**		
Bulletin 43	1	52	
Bulletin 44	2	-	
Bulletin 45	**Out of Stock**		
Bulletin 46	**Out of Stock**		
Bulletin 47	**Out of Stock**		
Bulletin 48	2	13	
Bulletin 49	2	200	
Bulletin 50	2	315	
Bulletin 51	1	155	
Bulletin 52	2	178	
Bulletin 53	2	211	
Bulletin 54	1	290	
Bulletin 55	2	407	
Bulletin 56	2	136	
Bulletin 57	2	193	
Bulletin 58	**Out of Stock**		
Bulletin 59	2	14	
Bulletin 60	6	13	
Bulletin 61	2	109	
Bulletin 62	**Out of Stock**		
Bulletin 63	**Out of Stock**		
Bulletin 64	**Out of Stock**		
Bulletin 65	2	93	
Bulletin 66	1	345	
E-Bulletin 67	1	19	
E-Bulletin 68	2	30	
E-Bulletin 69	1	15	
E-Bulletin 70	5	27	
E-Bulletin 71	1	31	
E-Bulletin 72	1	30	
E-Bulletin 73	11	9	Ministry and library
E-Bulletin 74	11	25	
E-Bulletin 75	14	36	
E-Bulletin 76	14	36	

There was a consensus decision made to digitize the Bulletin as of 2019, E-Bulletin 67 onwards, hence only 50 hard printed copies with limited distribution to standing order subscribers.

Sales and stock of publications for 2023 (All other GSM publication)

Other Publications	Sales 2023	Stock remaining by end of 2023
Proceeding AGC 2000	**Out of Stock**	
Proceeding AGC 2001	2	75
Malaysian Stratigraphic guide	**Out of Stock**	
Lexicon of stratigraphy	**Out of Stock**	
Stratigraphic correlation	**Out of Stock**	
Rocks poster	**Out of Stock**	
Geology of Borneo (CD)	**Out of Stock**	
Geology of Borneo (Map)	5	672
Geol. Evolution of SEA	7	300
Geology of P. Malaysia	45	1188

List of organizations and institutions that are exchanging publications with GSM

Item	Organization	Country
	Senckenberg Research Institute and Natural History Museum Frankfurt	Germany

NORAZIANTI ASMARI
Assistant Secretary
Geological Society of Malaysia

Editor's Report

The Geological Society of Malaysia (GSM) has two scientific journals, *Bulletin of the Geological Society of Malaysia* and *Warta Geologi*. Two volumes of the *Bulletin* were published in 2023, Volume 75 (May 2023) and Volume 76 (November 2023). Three issues of *Warta Geologi* were also published in the same year, Vol. 49, No. 1 (April 2023), Vol. 49, No. 2, (August 2023), and Vol. 49, No. 3 (December 2023). Both publications are available on the GSM website (https://gsm.org.my/). Remedial work to ensure that every article is correctly linked in the new GSM website has been completed but constant monitoring is required to maintain this status.

Under the leadership of the previous Editor, both the publications have been indexed by Scopus and the Malaysian Citation Index / MyCite. Scopus has updated the CiteScore methodology to reflect research impact. The updated methodology has been retroactively applied for all previous CiteScore years, with previous results being removed. The performance of GSM journals using this new methodology indicates that the CiteScore of the *Bulletin* has improved to 1.6 in 2023, from 1.3 in the previous year, with a rank of #102/141. The CiteScore of *Warta Geologi* was 0.1 in 2023.

An application will be made for both the scientific journals of GSM to be indexed by the Web of Science after resolving technical issues related to the e-ISSN status of the journals, and registration of *Warta Geologi* to the Directory of Open Access Journals (DOAJ), following the previous successful listing of the *Bulletin* to the DOAJ. Online manuscript submission via the Open Journal System (OJS), which has been temporarily suspended during transfer to the new GSM website will also commence to support this effort.

In 2023, the GSM also published "Topi Bulat Dalam Geologi", edited by Mohd Hariri Arifin and Lim Choun-Sian, which documents the experience of 18 geologists in obtaining their doctoral degrees. The GSM will seek to publish more substantial publications and explore the possibility of indexing books with Scopus and the Web of Science.

The GSM is grateful to all the authors for their contributions, reviewers for their time and effort to improve the quality of the scientific papers, and members of the Editorial Board for their support. The list of all reviewers for *Bulletin* and *Warta Geologi* in 2023 will be listed in the upcoming issue of *Warta Geologi*. Upon request, reviewers are also provided with a certificate regardless of whether the manuscripts they reviewed were eventually accepted or declined.

I would like to acknowledge the immediate past Editor Dr. Wan Hasiah Abdullah for her tremendous service to GSM. I also thank the Editorial Board, Assistant Editors, Editorial Management Committee, Council Members and GSM Secretariat for their unwavering assistance, especially Dr. Iskandar Taib, Ms. Wan Aida Wan Zahari, Ms. Nazatul Athirah Abdul Khalil, Ms. Anna Lee and Associate Prof. Dr. Ng Tham Fatt. Last but not least, I express my deepest gratitude to all the authors, reviewers and report contributors for their support. I look forward to all your continuous help in my tenure as the Editor.

JOY JACQUELINE PEREIRA
Editor
Geological Society of Malaysia

Treasurer's Report

For the Financial Year 2023, the society posted a net surplus of RM 36,884 compared to small deficit of RM (175) in 2022 in its General Fund. While surplus of income over expenditure before tax increased to RM 93,477 from RM 44,950 in 2022.

Total income increased from RM 118,699 in 2022, to RM 157,425 in 2023. Total operating expenses also increased from RM 120,359 in 2022, to RM131,128 in year 2023.

The income was contributed from several main sources: (i) Sales of publication in the form of royalty from AAPG; (ii) National Geoscience Conference in 2023; (iii) GEOSEA Congress/National Geoscience Conference in October 2022; and (iv) Membership fee. The expenses increased due to a new commitment: (i) New salaried personnel for an Administrative Executive.

There is an increase in the interest rates in fixed deposits, from RM 46,610 (year 2022) to RM 67,093 (year 2023), inclusive of the ~74% interest earned in the Endowment Fund account. Further saving in printing cost of Warta Geologi and Bulletin after being published in digital copies compared to a minimum total of RM 40,000 in year 2020 and earlier, decreases from RM18,772 in 2022 to RM 16,464 in 2023.

Compared to the year 2022, sales of publication in the form of royalty shows a slight decrease from RM 72,165 to RM 67,093 in 2023; and membership subscription significantly decreases from RM 20,449 to RM 14,318 in 2023.

A projection into future expenditures and mandate for budget proposal/approval for each budget line at the early of year:

a. The publication arm of GSM relies on the financial support of Endowment Fund and projects (e.g. Joint project with SEADPRI) in funding the operation and temporary staffs. There will be a need to look into committed funding and permanent human resource in the very near future. Currently this section operates from the contribution from Endowment Fund annually and funds from joint projects. It is anticipated the need to hire permanent staffs, and changes in financial and human support from project that finished in year 2023.
b. After the COVID-19 recovery, there are increasing requests from universities especially the GSM student chapters for monetary contribution in their activities. It creates vetting-approval problems, there is a need for a SOP and committee without every request going to the Council in facilitating the activities for students in universities.

The Treasurer would like to express a great appreciation to the donors, sponsors and all parties on their contributions and supports throughout the year. Credits to GSM Endowment Fund and shared resources from projects jointly carried out with SEADPRI-UKM for the funding of allowances for human resource and electronic journal publishing including its websites for publication and submission. Last but not least to Ms Anna Lee on her contribution managing the accounts and many miscellaneous throughout the year.

LIM CHOUN SIAN
Treasurer
Geological Society of Malaysia

Honorary Auditor's Report

PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)
(Society no : PPM-001-14-10011967)
(Registered under the Societies Act, 1966)

FINANCIAL STATEMENTS
31 DECEMBER 2023

PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)
(Society No: PPM-001-14-10011967)
(Registered under the Societies Act, 1966)

THE CORPORATE INFORMATION FOR 2023 / 2024

President	:	Mohd Hariri Arifin
Vice President	:	Meor Hakif Amir Hassan
Immediate Past President	:	Ahmad Nizam Hasan
Secretary	:	Ling Nan Ley
Assistant Secretary	:	Norazianti Asmari
Treasurer	:	Lim Choun Sian
Editor	:	Joy Jacqueline Pereira
Councillors	:	Abdull Halim Bin Abdul
	:	Ahmad Zulqurnain Ghazali
	:	Cindy Simba Ngumbang Ak Kadir
	:	Mohd Shafiq Firdauz Abdul Razak
	:	Muhammad Hatta Roselee
	:	Nor Shahidah Mohd Nazer
	:	Siti Nur Fathiyah Jamaludin
	:	Tan Boon Kong
Auditors	:	S.F. Lee & Co. (AF : 0670) No.5-3, Udarama Complex, Jalan 1/64A, Off Jalan Ipoh, 50350 Kuala Lumpur. Tel: 03-40410540 Fax: 03-40410586
Registered Office	:	c/o Department of Geology, University of Malaya, 50603 Kuala Lumpur.
Bankers	:	United Overseas Bank (Malaysia) Berhad
	:	Standard Chartered Bank

PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)
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PERSATUAN GEOLOGI MALAYSIA
(GEOLOGICAL SOCIETY OF MALAYSIA)
(Society No: PPM-001-14-10011967)
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STATEMENT BY THE COUNCIL

We, Mohd Hariri Arifin and Lim Choun Sian, being the President and Treasurer of the Council of Persatuan Geologi Malaysia (Geological Society Of Malaysia), do hereby state that, in our opinion, the accompanying financial statements set out pages 5 to 16 are drawn up in accordance with Malaysian Private Entities Reporting Standard and the requirements of the Societies Act, 1966 in Malaysia so as to give a true and fair view of the financial position of the Persatuan Geologi Malaysia (Geological Society Of Malaysia), as at 31 December 2023, and of the financial performance and cash flows of the Society for the year then ended.

Signed on behalf of the Council

21 FEB 2024

Mohd Hariri Arifin
President

Lim Choun Sian
Treasurer

Dated:

Kuala Lumpur

STATUTORY DECLARATION

I, Lim Choun Sian, being the Treasurer primarily responsible for the financial management of Persatuan Geologi Malaysia (Geological Society Of Malaysia), do solemnly and sincerely declare that the accompanying financial statements set out on pages 5 to 16 are in my opinion correct, and I make this solemn declaration conscientiously believing the same to be by virtue of the provisions of the Statutory Declarations Act, 1960.

Subscribed and solemnly declared by abovenamed Lim Choun Sian at Kuala Lumpur in Wilayah Persekutuan on 21 FEB 2024

Lim Choun Sian

PESURUHJAYA SUMPAH
W 465
KAPT (B) JASNI BIN YUSOFF
01 JAN 2023 - 31 DIS 2024
MALAYSIA

Before me:

Kuala Lumpur

Lot 1.08, Tingkat 1,
Bangunan KWSP, Jln Raja [illegible]
50350 Kuala Lumpur.
Tel: 019-6680745

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S.F. LEE & CO (AF : 0670)
CHARTERED ACCOUNTANTS

No. 5-3, Jalan 1/64A,
Kompleks Udarama, Off Jalan Ipoh,
50350 Kuala Lumpur.
Tel : 03 - 4041 0540 / 546
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INDEPENDENT AUDITORS' REPORT
TO THE MEMBERS OF PERSATUAN GEOLOGI MALAYSIA (GEOLOGICAL SOCIETY OF MALAYSIA)

Report on the Financial Statements

Opinion

We have audited the financial statements of **Persatuan Geologi Malaysia (Geological Society Of Malaysia)**, which comprise the statement of financial position of the Society as at 31 December 2023, the statement of comprehensive income and statement of cash flows of the Society for the year then ended, and a summary of significant accounting policies and other explanatory notes, as set out on pages 5 to 16.

In our opinion, the accompanying financial statements give a true and fair view of the financial position of the Society as at 31 December 2023, and of its financial performance and its cash flows for the year then ended in accordance with Malaysian Private Entities Reporting Standard and the requirements of the Societies Act, 1966 in Malaysia.

Basis for opinion

We conducted our audit in accordance with approved standards on auditing in Malaysia and International Standards on Auditing. Our responsibilities under those standards are further described in the *Auditor's Responsibilities for the Audit of the Financial Statements* section of our report. We believe that the audit evidence we have obtained is sufficient and appropriate to provide a basis for our opinion.

Independence and Other Ethical Responsibilities

We are independent of the Society in accordance with the By-Laws (*on Professional Ethics, Conduct and Practice*) of the Malaysian Institute of Accountants ("By-Laws') and the International Ethics Standards Board for Accountants' *International Code of Ethics for Professional Accountants (including International Independence Standards)* ("IESBA Code"), and we have fulfilled our other ethical responsibilities in accordance with the By-Laws and the IESBA Code.

Responsibilities of the Council for the Financial Statements

The council of the Society are responsible for the preparation of financial statements of the Society that give a true and fair view in accordance with Malaysian Private Entities Reporting Standard and the requirement of the Societies Act, 1966 in Malaysia. The council are also responsible for such internal control as council determine is necessary to enable the preparation of financial statements of the Society that are free from material misstatements, whether due to fraud or error.

In preparing the financial statements of the Society, the council are responsible for assessing the Society's ability to continue as a going concern, disclosing, as applicable, matters related to going concern and using the going concern basis of accounting unless the council either intend to liquidate the Society or to cease operations, or have no realistic alternative but to do so.

Branch add : G - 23A, Jalan SP 5/5, Seksyen 5,
Taman Serdang Perdana, 43300 Seri Kembangan,
Selangor Darul Ehsan.

S.F. LEE & CO (AF : 0670)

PERSATUAN GEOLOGI MALAYSIA
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Auditor's Responsibilities for the Audit of the Financial Statements

Our objectives are to obtain reasonable assurance about whether the financial statements of the Society as a whole are free from material misstatement, whether due to fraud or error, and to issue an auditors' report that includes our opinion. Reasonable assurance is a high level of assurance, but is not a guarantee that an audit conducted in accordance with approved standards on auditing in Malaysia and International Standards on Auditing will always detect a material misstatement when it exists. Misstatements can arise from fraud or error and are considered material if, individually or in the aggregate, they could reasonably be expected to influence the economic decisions of users taken on the basis of these financial statements.

As part of an audit in accordance with approved standards on auditing in Malaysia and International Standards on Auditing, we exercise professional judgment and maintain professional skepticism throughout the audit. We also:

- Identify and assess the risks of material misstatement of the financial statements of the Society, whether due to fraud or error, design and perform audit procedures responsive to those risks, and obtain audit evidence that is sufficient and appropriate to provide a basis for our opinion. The risk of not detecting a material misstatement resulting from fraud is higher than for one resulting from error, as fraud may involve collusion, forgery, intentional omissions, misrepresentations, or the override of internal control.

- Obtain an understanding of internal control relevant to the audit in order to design audit procedures that are appropriate in the circumstances, but not for the purpose of expressing an opinion on the effectiveness of the Society's internal control.

- Evaluate the appropriateness of accounting policies used and the reasonableness of accounting estimates and related disclosures made by the council.

- Conclude on the appropriateness of the council's use of the going concern basis of accounting and, based on the audit evidence obtained, whether a material uncertainty exists related to events or conditions that may cast significant doubt on the Society's ability to continue as a going concern. If we conclude that a material uncertainty exists, we are required to draw attention in our auditors' report to the related disclosures in the financial statements of the Society or, if such disclosures are inadequate, to modify our opinion. Our conclusions are based on the audit evidence obtained up to the date of our auditors' report. However, future events or conditions may cause the Society to cease to continue as a going concern.

- Evaluate the overall presentation, structure and content of the financial statements of the Society, including the disclosures, and whether the financial statements represent the underlying transactions and events in a manner that achieves fair presentation.

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We communicate with the council regarding, among other matters, the planned scope and timing of the audit and significant audit findings, including any significant deficiencies in internal control that we identify during our audit.

Report on Other Legal and Regulatory Requirements

In accordance with the requirements of the Societies Act, 1966 in Malaysia, we also report that in our opinion the accounting and other records and the registers required by the Act to be kept by the Society have been properly kept in accordance with the provisions of the Act.

Other Matter

This report is made solely to the members of the Society, as a body, in accordance with the Societies Act, 1966 in Malaysia. and for no other purpose. We do not assume responsibility to any other person for the content of this report.

S.F. LEE & CO.
AF 0670
CHARTERED ACCOUNTANTS

LEE SIEW FATT
01179/09/2024 (J)
CHARTERED ACCOUNTANT

Kuala Lumpur
Dated: 21 FEB 2024

PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF FINANCIAL POSITION
As at 31 December 2023

	Note	2023 RM	2022 RM
FUND ACCOUNTS			
GENERAL FUND	4	896,174	859,290
ENDOWMENT FUND	5	2,035,705	1,982,502
STUDENT LOAN FUND		2,055	1,755
YOUNG GEOSCIENTIST AWARD FUND		3,143	3,143
		2,937,077	2,846,690
Represented by:			
NON-CURRENT ASSETS			
PROPERTY, PLANT AND EQUIPMENT	6	9,277	8,611
CURRENT ASSETS			
Time deposits with licensed bank	7	2,479,701	2,379,701
Cash and bank balances		528,528	701,696
		3,008,229	3,081,397
CURRENT LIABILITIES			
Other payables and accrued expenses	8	78,379	241,789
Current tax liabilities		2,050	1,529
		80,429	243,318
NET CURRENT ASSETS		2,927,800	2,838,079
		2,937,077	2,846,690

The annexed notes form an integral part of the financial statements.

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STATEMENT OF COMPREHENSIVE INCOME
For the year ended 31 December 2023

	Note	2023	2022
		RM	RM
INCOME			
Sundry income	9	157,425	118,699
Time deposits interest		67,180	46,610
		224,605	165,309
EXPENDITURE			
Administrative and operating expenses	10	(131,128)	(120,359)
Surplus before taxation		93,477	44,950
Tax expense	11	(3,390)	(7,610)
Surplus for the financial year		90,087	37,340
Represented By:			
General fund		36,884	(175)
Endowment fund		53,203	37,515
		90,087	37,340

The annexed notes form an integral part of the financial statements.

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PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF CHANGES IN FUND
For the year ended 31 December 2023

	Endowment Fund RM	General Fund RM	Total RM
At 1 January 2022	1,944,987	859,465	2,804,452
Surplus of income over expenditure for the year	37,515	(175)	37,340
At 31 December 2022	1,982,502	859,290	2,841,792
Surplus of income over expenditure for the year	53,203	36,884	90,087
At 31 December 2023	2,035,705	896,174	2,931,879

The accompanying notes are an integral part of the financial statements
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PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF CASH FLOWS
For the year ended 31 December 2023

	2023 RM	2022 RM
Cash flows from operating activities		
Surplus of income over expenditure for the year	93,477	44,950
Adjustments for:-		
Depreciation on property, plant & equipment	1,633	1,710
Interest income	(67,180)	(46,610)
Surplus before working capital changes	27,930	50
Decrease in receivables	-	600
Decrease in other payables	(163,410)	(101,936)
Cash used in operations	(135,480)	(101,286)
Increase of studend loan fund	300	-
Tax paid	(2,869)	(8,110)
Interest income	67,180	46,610
Net cash used in operating activities	(70,869)	(62,786)
Cash flows from investing activities		
Purchase of property, plant and equipment	(2,299)	(3,499)
Net cash used in investing activities	(2,299)	(3,499)
Net decrease in cash and cash equivalents	(73,168)	(66,285)
Cash and cash equivalents at beginning of the year	3,081,397	3,147,682
Cash and cash equivalents at end of the year	3,008,229	3,081,397

	2023 RM	2022 RM
Cash and cash equivalents comprised of:		
Deposits with licensed banks	2,479,701	2,379,701
Cash at bank	527,793	701,696
Cash in hand	735	-
	3,008,229	3,081,397

The accompanying notes are an integral part of the financial statements

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PERSATUAN GEOLOGI MALAYSIA
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NOTES TO THE FINANCIAL STATEMENTS –31 DECEMBER 2023

1. GENERAL INFORMATION

The principal activity of the Society is to promote the advancement of the geological sciences in Malaysia. The Persatuan Geologi Malaysia (Geological Society Of Malaysia) is a registered Society under Societies Act, 1966.

The registered office of the Society is located at c/o Department of Geologi, University of Malaya, 50603 Kuala Lumpur.

The financial statements were authorised for issue in accordance with a resolution by the council on 21 FEB 2024

2. BASIS OF PREPARATION

(a) Statement of compliance

The financial statements of the Society have been prepared in accordance with Malaysian Private Entities Reporting Standard ("MPERS") and the requirements of Societies Act, 1966 in Malaysia.

(b) Basis of measurement

The financial statements have been prepared on the historical cost basis except as otherwise stated in the financial statements.

(c) Functional and presentation currency

These financial statements are presented in Ringgit Malaysia ("RM"), which is the Society's functional currency.

(d) Use of estimates and judgements

The preparation of the financial statements in conformity with MPERS requires the use of certain accounting estimates and exercise of judgements. Estimates and judgements are continuously evaluated and are based on past experience, reasonable expectations of future events and other factors.

The council are the opinion that there are no key assumptions concerning the future and other key sources of estimation uncertainty at the reporting date, that have a significant risk of causing material adjustment to the carrying amounts of assets and liabilities within next financial year.

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3. SUMMARY OF ACCOUNTING POLICIES

(a) Plant and equipment and depreciation

All items of plant and equipment are initially recorded at cost. The cost of an item of plant and equipment is recognised an asset if, and only if, it is probable that future economic benefits associated with the item will flow to the Society and the cost of the item can be measured reliably.

Subsequent to recognition, plant and equipment are measured at cost less accumulated depreciation and accumulated impairment losses. Repair and maintenance costs are recognised in statement of income and expenditure as incurred.

Depreciation on plant and equipment is computed on a reducing balance basis to write-off the cost to its residual value over the estimated useful lives of the assets at following annual rate:-

Information of technology equipments	20%
Office equipment	10%

The carrying values of property, plant and equipment are reviewed for impairment when events or changes in circumstances indicate that the carrying value may not be recoverable.

The residual value, useful life and depreciation method are reviewed at each year-end, and adjusted prospectively, if appropriate.

An item of property, plant and equipment is derecognised upon disposal or when no future economic benefits are expected from its use or disposal. Any gain or loss on derecognition of the asset is included in profit or loss in the year the asset is derecognised.

(b) Impairment of non-financial assets

The carrying amounts of non-financial assets are reviewed at the end of each reporting period to determine whether there is any indication of impairment. If any such indication exists, then the asset's recoverable amount is estimated.

For the purpose of impairment testing, assets are grouped together into the smallest group of assets that generated cash inflows from continuing use that are largely independent of the cash inflows from other assets or cash-generating units.

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The recoverable amount of an asset or cash-generating unit is the higher of its fair value less costs to sell and its value in use. In assessing value in use, the estimated future cash flows are discounted to their present value using a pre-tax discount rate that reflects current market assessments of the time value of money and the risks specific to the asset or cash-generating unit

An impairment loss is recognised if the carrying amount of an asset or its related cash-generating unit exceeds its estimated recoverable amount. Impairment losses are recognised in the income statement. Impairment losses recognised in respect of cash-generating units are allocated to reduce the carrying amounts of cash generating unit on a pro rata basis.

Impairment losses recognised in prior periods are assessed at the end of each reporting period for any indications that the loss has decreased or no longer exists. An impairment loss is reversed if there has been a change in the estimates used to determine the recoverable amount since the last impairment loss was recognised. An impairment loss is reversed only to the extent that the assets's carrying amount does not exceed the carrying amount that would have been determined, net of depreciation or amortisation, if no impairment loss had been recognised. Reversals of impairment losses are credited to income statement in the financial year in which the reversals are recognised.

(c) Financial instruments

(i) Initial recognition and measurement

A financial asset or financial liability is recognised in the statement of financial position when, and only when, the Society becomes a party to the contractual provisions of the instrument.

A financial instrument is recognised initially at the transaction price (including transaction costs except in the initial measurement of a financial asset or financial liability that is measured at fair value through income statement) unless the arrangement constitutes, in effect, a financing transaction. If the arrangement constitutes a financing transaction, the financial asset or financial liability is measured at the present value of the future payments discounted at a market rate of interest for a similar debt instrument.

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(ii) Subsequent measurement

Debt instruments that meet the following conditions are measured at amortised cost using the effective interest method:

(a) returns to the holder are determinable, e.g. a fixed amount and/or variable rate of return benchmark against a quoted or observable interest rate;

(b) there is no contractual provision that could result in the holder losing the principal amount or any interest attributable to the current or prior periods;

(c) prepayment option, if any, is not contingent on future events.

Debt instruments that are classified as current assets or current liabilities are measured at the undiscounted amount of the cash or other consideration expected to be paid or received unless the arrangement constitutes, in effect, a financing transaction.

Financial assets or financial liabilities not measured at amortised at cost or cost less impairment are measured at fair value changes recognised in the income statement.

All financial assets are assessed at each reporting date whether there is any objective evidence of impairment. An impairment loss is measured as follows:

(i) For an instrument measured at amortised cost, the impairment loss is the difference between the asset's carrying amount and the present value of estimated cash flows discounted at the asset's original effective interest rate.

(ii) For an instrument measured at cost less impairment, the impairment loss is the difference between the asset's carrying amount and the best estimate of the amount that would be received for the asset if it were to be sold at the reporting date.

(iii) Derecognition

A financial asset or part of it is derecognised when, and only when, the contractual rights to the cash flows from the financial asset expired or are settled, or control of the asset is not retained or substantially all of the risks and rewards of ownership of the financial asset are transferred to another party. On derecognition of a financial asset, the difference between the carrying amount of the financial asset derecognised and the consideration received, including any newly created rights and obligations, is recognised in the income statement.

A financial liability or part of it is derecognised when, and only when, the obligation specified in the contract is discharged, cancelled or expires. On derecognition of a financial liability, the difference between carrying amount of the financial liability extinguished or transferred to another party and the consideration paid, including any non-cash assets transferred or liabilities assumed, is recognised in the income statement.

(d) Revenue Recognition

(i) Membership subscription is payable annually at the beginning of the financial year and is recognised on receipt basis.

(ii) Interest earned from time deposit placements are recognized on time proportionate basis.

(iii) Sale of publications is recognised upon delivery of goods sold.

(iv) Seminar income is recognised upon the conduct of the respective seminars.

(e) Taxation

Current tax expense is determined according to the Malaysia tax laws substantially enacted by the reporting date and includes all taxes based upon the taxable profits.

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4. GENERAL FUND

	2023 RM	2022 RM
At 1 January	859,290	859,465
Surplus / (deficit) for the year	36,884	(175)
At 31 December	896,174	859,290

The General Fund can be utilised at the discretion of the council members.

5. ENDOWMENT FUND

	2023 RM	2022 RM
At 1 January	1,982,502	1,944,987
Surplus for the year	53,203	37,515
At 31 December	2,035,705	1,982,502

The Endowment Fund can only be utilised with the approval of the members at the Annual General Meeting.

6. PLANT AND EQUIPMENT

	Information technology equipment	Office equipment	Total
	RM	RM	RM
Cost			
At 1 January 2023	11,724	18,826	30,550
Additions	-	2,299	2,299
Disposal and deletion	-	-	-
At 31 December 2023	11,724	21,125	32,849
Accumulated depreciation and impairment losses			
At 1 January 2023	6,297	15,642	21,939
Charge for the year	1,085	548	1,633
Disposal and deletion	-	-	-
At 31 December 2023	7,382	16,190	23,572
Carrying amounts at 1 January 2023	5,427	3,184	8,611
Carrying amounts at 1 December 2023	4,342	4,935	9,277

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7. TIME DEPOSITS WITH LICENSED BANKS

	2023 RM	2022 RM
General fund	537,701	537,701
Endowment fund	1,942,000	1,842,000
	2,479,701	2,379,701

The time deposits with licensed banks have an average maturity of between 3 to 15 months (2023: 3 to 15 months). Interest rates for the deposits ranged from 1.60% to 3.20% (2022: 1.6% to 2%) per annum.

8. OTHER PAYABLES AND ACCRUED EXPENSES

	2023 RM	2022 RM
Other payables	76,379	239,789
Accrued expenses	2,000	2,000
	78,379	241,789

9. SUNDRY INCOME

	2023 RM	2022 RM
Atosice donation	-	1,967
Advanced Seminar On Economic Geology	-	9,033
Entrance fee	920	960
Membership fee	14,318	20,449
Sales of publications	1,743	1,595
Geology of Peninsular Malaysia	6,860	10,300
National Geoscience Conference	45,475	-
AAPG royalties	67,093	72,165
Geological Evolution of Southeast Asia	1,125	2,230
Souvenirs	2,850	-
Geosea	17,041	-
	157,425	118,699

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10. ADMINISTRATIVE AND OPERATING EXPENSES

	2023 RM	2022 RM
Audit fee	2,000	2,000
Best student award	5,000	2,000
Depreciation on property, plant and equipment	1,633	1,710
Department of geology	24,000	12,000
Donation	1,358	-
Geosea	635	27,860
Honorarium	24,080	24,040
Printing and stationary	16,464	18,772
Professional fee	800	800
Subscription	1,416	2,545
Website maintenance	8,224	19,190
Other expenses	45,518	9,442
	131,128	120,359

11. TAX EXPENSE

Income tax is provided for investment income and on surplus arising from transactions with non-members.

	2023 RM	2022 RM
Current tax:		
On result for the year	3,390	1,529
Underprovision in prior year	-	6,081
	3,390	7,610

12. FINANCIAL INSTRUMENTS

The financial instruments of the Society are categorised into the following classes:

	2023 RM	2022 RM
Financial assets measured at amortised cost less impairment		
Time deposits with licensed bank	2,479,701	2,379,701
Cash at bank	528,074	701,696
	3,007,775	3,081,397
Financial liabilities carried at amortised cost		
Other payables and accrued expenses	77,924	241,789

PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF INCOME AND EXPENDITURE
For the year ended 31 December 2023

INCOME	2023 RM	2022 RM
Atosice donation	-	1,967
Advanced Seminar On Economic Geology	-	9,033
Entrance fee	920	960
Time deposits interest income	67,180	46,610
Membership fee	14,318	20,449
Sales of publications	1,743	1,595
Geology of Peninsular Malaysia	6,860	10,300
National Geoscience Conference	45,475	-
AAPG royalties	67,093	72,165
Geological Evolution of Southeast Asia	1,125	2,230
Souvenirs	2,850	-
Geosea	17,041	-
	224,605	165,309
EXPENDITURE		
Annual dinner	3,401	1,536
Audit fee	2,000	2,000
Staff EPF and Socso	6,064	-
Bank charges	188	64
Best Student's award (UKM and UM)	5,000	2,000
Board of geologist fee	1,300	600
Depreciation on property, plant and equipment	1,633	1,710
Department of Geology	24,000	12,000
Departmental club activity	-	699
Donation	1,358	-
Event attendance	1,601	1,274
Geosea	635	27,860
Geology of peninsular Malaysia	3,727	-
Geological Evaluation of southeast Asia	275	-
Honorarium	24,080	24,040
Miscellaneous expenses	3,629	1,246
Penalty	-	914
Postages	845	1,617
Printing and Stationery		
- Warta Geologi	6,650	7,150
- Bulletin	8,125	10,000
- Stationery	1,689	1,622
Professional fee	800	800
Refreshment	504	77
Service tax	120	120
Souvenirs	-	400
Subscription fee	1,416	2,545
Salary	20,536	-
Studend events	1,506	-
Speakers expenses	402	-
Telephone and fax	1,420	895
Website maintenance	8,224	19,190
	131,128	120,359
Surplus before tax	93,477	44,950

GSM Endowment Fund Report

GSM ENDOWMENT FUND: BOARD OF TRUSTEES REPORT FOR THE 58th ANNUAL GENERAL MEETING OF THE GEOLOGICAL SOCIETY OF MALAYSIA
23 April 2024

Background

1. The 47th AGM in 2013 confirmed the establishment of the GSM Endowment Fund and endorsed the Terms of Reference prepared by Advocates and Solicitors, Messrs Yeap, Yong and Amy.
2. The 48th AGM in 2014 approved an amendment to the Terms of Reference to provide for the establishment of the "Board of Trustees of the GSM Endowment Fund", whose members shall comprise the GSM President, Immediate Past President, Secretary, Treasurer, Editor and at least three independent Full Members "in good standing", to be appointed at the AGM in 2017, 2020, 2023, 2026, 2029, 2032 etc.
3. The 53rd AGM in 2019 was informed that the GSM Council undertook a search on the website of "Lembaga Hasil Dalam Negeri" (LHDN) and found that GSM is listed as an organisation that is approved to collect donations under Subsection 44(6) since the year 1967. The GSM has "tax deductible" status that allows individuals and organizations to obtain tax exemption for their donations.
4. The 55th AGM in 2021 was informed that the GSM Council has developed a procedure for issuance of receipts for tax exemption and to inform LHDN for donations of RM 5,000 and above.
5. The 57th AGM in 2023 also appointed YBhg. Dato' Yunus Abd Razak as Chair of the Board of Trustees of the GSM Endowment Fund, with Dr. Lee Chai Peng, Dr. Wan Hasiah Abdullah and Puan Azimah Ali as independent Full Members to serve until the AGM in 2026.
6. Items pending from the 57th AGM held on 28 April 2023 are as follows:
   (i) Approval of the sum of RM 40,000.00 that was requested by the GSM Council for publications for the year 2023.
   (ii) Transfer of RM 100,000.00 from the UOB Current Account to the UOB Fixed Deposit account to increase the principal amount of the GSM Endowment Fund by the In-Coming Council
   (iii) Implementation of the modality proposed for using accumulated interest earned (RM 13,633.90) from the donation of RM 50,000.00 by YBhg. Dato' Sia Hok Kiang to the GSM Endowment Fund in 2014, with progress to be reported to the Board of Trustees of the GSM Endowment Fund.

Report of the Board of Trustees

1. This report covers the period from 1 January 2023 to 31 December 2023. The Board of Trustees met on 16 April 2024 (Tuesday) on a hybrid mode, physically at Department of Geology, Universiti Malaya and on Zoom, to scrutinise the administration of the GSM Endowment Fund. The meeting was moderated by the Chair, YBhg. Dato' Yunus Abd Razak. Members in attendance were GSM President, Dr. Mohd Hariri Arifin; Immediate Past President, Mr. Ahmad Nizam Hasan (online); Secretary, Mr. Ling Nan Ley; Treasurer, Dr. Lim Choun Sian; and GSM Members Dr. Lee Chai Peng, Dr. Wan Hasiah Abdullah and Puan Azimah Ali. Observers included Puan Anna Lee and Puan Nazatul Athirah Abdul Khalil. Editor, Prof. Joy Jacqueline Pereira was absent with apologies.
2. The principal amount, in the form of fixed deposits with the United Overseas Bank Malaysia (UOB) as reflected in the bank statement is currently RM 1,941,999.99.
3. A special Current Account is also maintained with UOB to receive the interest accrued from the principal amount. The interest is kept in this GSM Current Account at UOB (which is separate from the operational account of GSM at the Standard Chartered Bank Bhd.). The annual interest accrued from the fixed deposits in 2023 is RM 53,202.72. The balance in the Current Account of the Endowment Fund as of 31 December 2023 is RM 53,674.70. The balance in the Current Account of the Endowment Fund in the previous year (as of 31 December 2022) was RM 140,502.48.
4. The GSM Council did not transfer any funds from the GSM operating account at the Standard Chartered Bank Bhd. to the Endowment Fund to increase the principal amount.
5. The GSM Council on 18 October 2023, transferred a sum of RM 40,000.00 from UOB Current Account to the operational account of GSM at the Standard Chartered Bank Bhd. as approved by the AGM in 2023 to be used for publication purposes in 2023.

6. The GSM Council transferred a total sum of RM 100,000.00 (RM 50,000.00 on 25 July 2023 and RM 50,000.00 on 21 December 2023) from the UOB Current Account to the UOB Fixed Deposit account to increase the principal amount of the GSM Endowment Fund.
7. The accumulated interest earned from the donation of RM 50,000.00 by YBhg. Dato' Sia Hok Kiang to the GSM Endowment Fund in 2014 for research on economic geology is RM 14,946.16 as of 31 December 2023. The GSM Council has discussed the modality for disbursement of the research grant. The GSM Council will advertise periodically for research proposals on economic geology from graduate and postgraduate students, with a requirement for publication in an indexed journal.
8. Recommendations of the Board of Trustees to the 58th AGM of the GSM on 23 April 2024 are as follows:
   (i) The GSM Council is requested to report progress to the Board of Trustees of the GSM Endowment Fund regarding implementation of the proposed modality for using accumulated interest earned (RM 14,946.16 as of 31 December 2023) from the donation of RM 50,000.00 by YBhg. Dato' Sia Hok Kiang to the GSM Endowment Fund in 2014.
   (ii) The AGM is recommended to approve the sum of RM 40,000.00 that is requested by the GSM Council for the publications for the year 2024. The GSM Council is requested to report the usage of the fund to the Board of Trustees of the GSM Endowment Fund.
   (iii) The AGM is recommended to approve the maximum sum of RM 24,000.00 that is requested by the NGC 2024 Organizing Committee to subsidize the registration fees of GSM student members only.

On behalf of the Board of Trustees, I declare that I am satisfied that the GSM Endowment Fund is being administered in a satisfactory manner and that the terms of reference are adhered to. I hereby approve the report prepared for the 58th AGM of the GSM.

Dato' Yunus Abd Razak
Chairman
Board of Trustees of the GSM Endowment Fund
Geological Society of Malaysia
16 April 2024

Announcement of New Council for 2024/2025

PERSATUAN GEOLOGI MALAYSIA
GEOLOGICAL SOCIETY OF MALAYSIA
c/o Department of Geology, University of Malaya, 50603 Kuala Lumpur, Malaysia
Tel: 603 – 7957 7036 Fax: 603 – 7956 3900 email: geologicalsociety@gmail.com

GSM Council Elections for 2024/2025: Reports by Nominations Committee

As required by the Constitution, the Council sent out the call for nominations through email to all the GSM members on 12th of August 2023.

Nominations Committee Chair, Dr Muhammad Hatta Roselee was appointed by the Council at the council meeting on 26th of June 2023

Subsequently, the Chair recruited Associate Prof Dr Ng Tham Fatt and Prof Azman Abd Ghani as members of the Nominations Committee.

By 30th September 2023, the following nominations were received by Nominations Committee for all the office-bearers and councilor posts that are up for election for the term of 2024/2025.

The **nominations** received are as follows:

President – Associate Prof. Ts Dr Mohd Hariri Bin Arifin, P.Geol. (Universiti Kebangsaan Malaysia)

Vice-President – Associate Prof. Dr Meor Hakif Bin Amir Hassan, P.Geol. (Universiti Malaya)

Secretary – Ling Nan Ley, P.Geol. (Freelance Consultant)

Assistant Secretary – Norazianti Binti Asmari, P.Geol (GeoExpert)

Treasurer – Dr. Lim Choun Sian, P.Geol. (Universiti Kebangsaan Malaysia)

Editor – Prof. Dr Joy Jacqueline Pereira, P.Geol. (Universiti Kebangsaan Malaysia)

Councilors (for 2-years term) [*arranged in alphabetical order*]

- **Dr. Allagu Balaguru (Freelance Consultant)**
- **P.Geol. Muhammad Ashahadi Bin Dzulkafli (Universiti Kebangsaan Malaysia)**
- **Muhammad Azri Ismail (Department of Mineral and Geosains Malaysia)**
- **Tan Boon Kong (Freelance Consultant)**

The posts of President, Vice President, Treasurer, Secretary, Assistant Secretary and Editor received only one nomination for each post. Hence, the nominees to those posts shall be elected without contest.

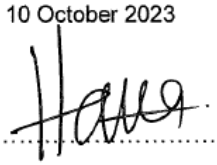
Four councillors posts are still being held by current council members serving the remaining part of their 2-years term (2022/2023 - 2024/2025). The incumbent council members, namely:

- Dr. Muhammad Hatta Roselee, P.Geol. (Universiti Malaya)
- Cindy Simba Ngumbang, P.Geol. (Petronas)
- Mohd Shafiq Firdaus Abdul Razak (Beicip-Franlab Asia)
- Ts. Dr Siti Nur Fathiyah Jamaludin, P.Geol. (Universiti Teknologi Petronas)

will serve the remainder of their term (and none have stated their intention otherwise), these posts are not up for elections

For the incoming 2-years councillor posts, there are 4 nominations for 4 free councillor posts. Hence **there will be no election** by balloting and all the nominees will be automatically elected as the 2024/2025 councillor post.

Report prepared by Nominations Committee
Date: 10 October 2023



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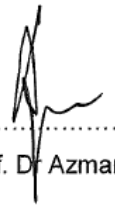
Chair – Dr Muhammad Hatta Roselee, P.Geol



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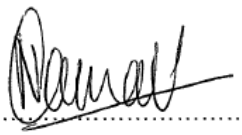
Member – Prof. Dr Azman Abdul Ghani. P.Geol.



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Member – Associate Prof. Dr Ng Tham Fatt, P.Gel.

Attachments: Nomination form received

CERAMAH TEKNIK TECHNICAL TALK

A Special Ramadan Talk Series: The geological concept of mountains in the Quran

Askury bin Abdul Kadir
Geomag Engineering Sdn Bhd
Date: 27 March 2024
Platform: Zoom and Facebook

Academy GEX, in collaboration with the Geological Society of Malaysia (GSM), launched a Special Ramadan Talk Series featuring a session titled "The Geological Concept of Mountains in the Quran." This session explored the correlation between geological mountain formations and Quranic verses. The distinguished guest speaker, P. Geol. Askury bin Abdul Kadir, delivered the talk, moderated by P. Geol. Mohd Shaufi Bin Sokiman. The event took place on March 27, 2024, from 10:00 am to 12:00 pm, was broadcasted live on GSM's Facebook and Zoom platforms, drawing nearly 70 participants. This collaboration marks a significant achievement for Academy GEX, supported by GEOMAG Engineering and Geoxpert Sdn. Bhd.

The talk discussed how mountains were created from a scientific perspective, and how this could be related to verses in the Quran. It began with an overview of the significance of mountains in Islamic teachings, emphasizing their portrayal as signs of Allah's creation and wisdom.

The speaker began with an introduction to the geological perspective of mountain building, beginning with types of mountains (e.g., fold mountains, volcanic mountains), and their functions in Earth's geological processes.

The speaker then talked about how verses from the Quran correlated with what we know of orogenic geological process, such as plate tectonics, volcanic activity, erosion, and other relevant fields.

This program also highlighted specific geological features mentioned in the Quran (e.g., the roots of mountains and their stabilizing role), correlating them with scientific findings.

The Quran frequently refers to the mountains as part of the natural world that reflects the greatness and wisdom of Allah. For example, in Surah An-Naba (78:6-7), it says, "Have We not made the earth a resting place? And the mountains as stakes?" and mountains are described as pegs or stakes that anchor the Earth, providing stability and balance to the land. This is highlighted in Surah An-Naba (78:6-7) and Surah An-Naziat (79:32).

In essence, by integrating scientific knowledge with Quranic teachings, believers can enrich their understanding of the natural world, including the geological formation of mountains, and strengthen their spiritual connection to Allah's creation. This reflection fosters a holistic appreciation for both scientific inquiry and religious devotion within the Islamic framework.

Thank you GSM for this opportunity.

Prepared by,
Nur Fatin Julia Binti Maznan
Penyelaras Academy GEX
18th July 2024

CERAMAH TEKNIK TECHNICAL TALK

Kejadian tanah runtuh di Batang Kali, Hulu Selangor, Selangor

Mohamad Niizar bin Abdurahman
Cawangan Kejuruteraan Cerun, Jabatan Kerja Raya (JKR)
Date: 17 April 2024
Platform: Zoom

The above talk was delivered by Ir. Dr. Mohamad Niizar Bin Abdurahman (Cawangan Kejuruteraan Cerun, JKR) on 17th April, 2024 via Zoom. Some 130 members participated, the highest number to-date. An abstract of the talk is given below:

Abstrak: Kejadian tanah runtuh di Jalan B66, Batang Kali-Genting Highlands, Hulu Selangor, Selangor, telah melibatkan sejumlah 92 mangsa. Daripada jumlah tersebut, 61 orang telah berjaya diselamatkan, manakala 31 orang lain terkorban. Ini merupakan insiden kedua terburuk melibatkan kejadian tanah runtuh selepas insiden Highland Tower. Satu jawatankuasa khas yang dikenali sebagai Jawatankuasa Kumpulan Kerja Tanah Runtuh (JKKTR) telah ditubuhkan bagi menjalankan kerja-kerja penyiasatan tanah runtuh ini. JKKTR tersebut diketuai oleh Cawangan Kejuruteraan Cerun, Jabatan Kerja Raya (JKR) Malaysia, dan melibatkan agensi-agensi teknikal lain seperti Jabatan Mineral dan Geosains Malaysia (JMG), Jabatan Ukur dan Pemetaan Malaysia (JUPEM), Jabatan Pengairan dan Saliran (JPS), Jabatan Meteorologi Malaysia (METMalaysia), Universiti Teknologi Malaysia (UTM), dan badan-badan professional yang dilantik. Hasil siasatan menunjukkan bahawa tanah runtuh pertama berlaku kira-kira pada jam 2.00 pagi, dengan ukuran kegagalan cerun sepanjang 120 m dan kedalaman maksimum 14 m. Mod kegagalan ini adalah kombinasi runtuhan jenis putaran dan aliran puing / tanah (toe rotational slide and debris / earth flow). Hasil analisis forensik mendapati bahawa faktor pencetus utama insiden tersebut adalah kejadian hujan (rainfall event) iaitu kombinasi jumlah hujan major (major rainfall) dan hujan anteseden (antecedent rainfall). Selain itu, faktor muka bumi dan geologi turut mempengaruhi kejadian tersebut. Tiada bukti kukuh yang menunjukkan faktor guna tanah oleh aktiviti manusia telah menyumbang kepada kegagalan cerun berkenaan. Rekod penyenggaraan jalan dan sistem perparitan bagi laluan B66 menunjukkan pelaksanaan kerja-kerja mengikut jadual dan tiada tanda-tanda awalan kegagalan cerun dilaporkan.

We thank Sdr Niizar for his support and contribution to the Society's activities.

Prepared by,
Tan Boon Kong
Chairman, Working Group on Engineering Geology
18th April 2024

CERAMAH TEKNIK TECHNICAL TALK

Jordan water resources: Groundwater critical role

Ala'a Atieh
Ministry of Water & Irrigation, Jordan
Date: 22 April 2024
Platform: Zoom

Introduction of the Speaker:

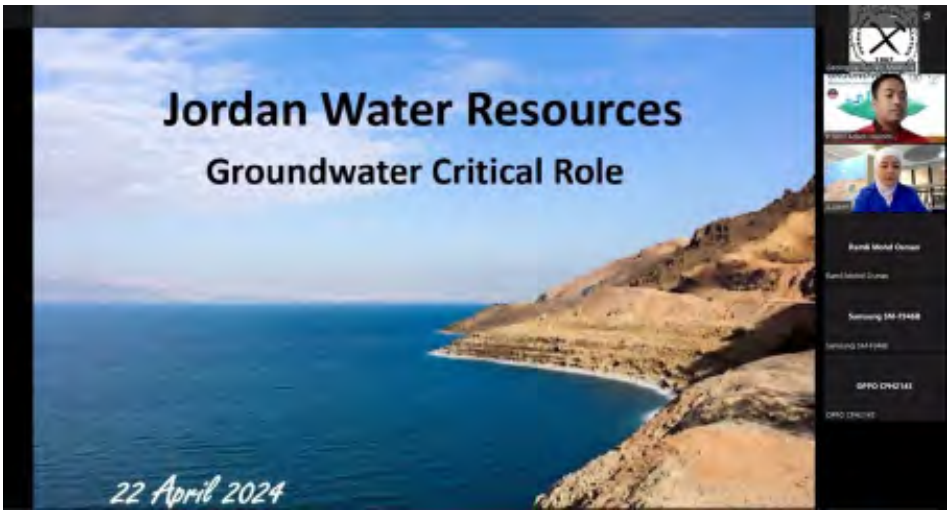
Ms. Ala'a Atieh is a Geologist at the Ministry of Water & Irrigation, Jordan. She is also the Head of Groundwater Monitoring Department.
Ms. Ala'a graduated from Jordan Univeristy, in Amman, Jordan, in 2002. She started working in the Jordan Water Authority from 2014 and then continues working for the Ministry of Water & Irrigation from 2017, until today.

Summary of the Webinar:

The talk is aimed to learn how other countries, like Jordan, manage their groundwater sources, and how it contributed heavily to the country water supply.
Jordan is considered one of the most water scarce countries in the world. Groundwater is the most important source for the water supply of Jordan. Population growth, rising use of groundwater for irrigation purposes and illegal abstractions have increased the stress on existing groundwater resources.
In local context, the talk is aimed to spur the local knowledge especially in acknowledging the importance of groundwater supply during drought season, like the current el-Niño we are facing in the 2024.
With the effect of climate change, local authorities in Malaysia can adopt the same measures as Jordan in utilising Groundwater as part of the main water supply in the country.

A total of 135 on-line participants were recorded.

Below are the photos of the webinar.



Prepared by,
P. Geol. Adam Hashim
Chairman, Working Group on Hydrogeology
14th May 2024

CERAMAH TEKNIK TECHNICAL TALK

The role of groundwater monitoring network in coastal groundwater management and optimization strategy

Dewandra Bagus Eka Putra
Seoul National University, Korea
Date: 24 April 2024
Platform: Zoom and Facebook Live FST, UKM

The above talk was delivered by Mr. Dewandra Bagus Eka Putra on 24th April 2024 via Zoom and Facebook Live of Faculty Science and Technology UKM. The total attendees were 96 persons.

Below is the synopsis of the presentation:

Seawater intrusion is becoming a significant issue in coastal areas, triggered by natural and anthropogenic activities causing groundwater quality degradation. Climate change, sea-level rise, and the constant removal of massive amounts of water from aquifers are substantial factors that cause coastal areas to be susceptible to saltwater intrusion. Indonesia and Malaysia have long coastlines, which play an important role in these countries, where several major cities are located. Seawater intrusion can lead to a significant risk to the sustainability of coastal communities, agricultural practices, and various economic sectors that rely heavily on freshwater availability, and this phenomenon can happen if there is no proper groundwater management in the area. Groundwater resource management facilities in coastal areas are critical for several reasons. First, they allow for early detection and accurate assessment of seawater intrusion events, enabling prompt and targeted response measures. Second, long-term monitoring data facilitates the identification of trends and patterns, aiding in the formulation of sustainable strategies to mitigate the impacts of seawater intrusion on coastal aquifers. Furthermore, proper monitoring facilities would enhance understanding of the intricate hydrogeological processes governing the interactions between fresh and saline water in coastal aquifers. This knowledge is vital for developing accurate numerical models to predict future seawater intrusion scenarios, assisting in proactive management practices to protect freshwater resources. Reliable data would enable stakeholders, such as policymakers, academics, local communities, and industries, to decide on water resource allocation, land-use planning, and adaptation strategies to secure water availability in coastal regions. Through a comprehensive groundwater monitoring system, protecting coastal freshwater resources can promote the resilience and prosperity of communities and ecosystems in the face of ongoing environmental challenges.

The invited speaker with the moderator and some of the participants that attended the session.

Prepared by,
Dr. Norsyafina Roslan
Moderator, Geology Technical Talk Series 2024 (UKM)
22nd May 2024

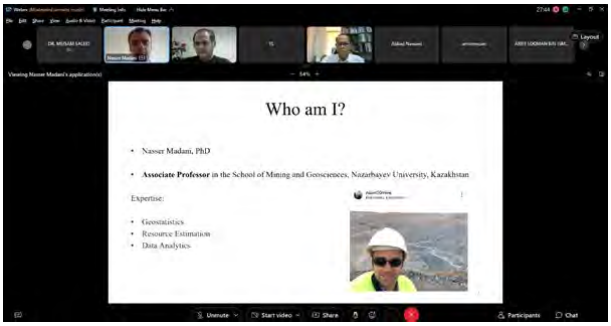
CERAMAH TEKNIK TECHNICAL TALK

Cutting-edge techniques in advanced resource estimation: Innovations, challenges, and future prospects

Nasser Madani
Nazarbayev University
Date: 2 May 2024
Platform: Webex

The above webinar was delivered by Dr. Nasser Madani (Nazarbayev University, Kazakhstan) on 2nd May, 2024 via Webex. The total attendees were 64 persons. The summary for this webinar is given below:

Summary: Innovations, Challenges, and Future Prospects in Cutting-Edge Techniques for Advanced Resource Estimation were the subject of the seminar. It examined the most recent developments in resource estimation methodologies. The objective of this seminar was to examine the most recent developments in machine learning algorithms, data-driven modeling, and geostatistical methods that are fundamentally transforming the processes of natural resource estimation and quantification. By examining innovative methods to incorporate diverse data sources and tackling uncertainties and biases in estimations, participants acquired a deeper understanding of the intricacies and subtleties that characterize contemporary resource estimation practices. In addition, the seminar addressed the obstacles that arise during the implementation of these sophisticated methodologies, encompassing concerns such as regulatory compliance, data accessibility, and computational resources. Challenges and limitations in resource estimation were addressed, including missing data and logical domaining, and a methodology for deterministic imputation and a more comprehensive approach to geological domaining was proposed. The use of clustering machine learning algorithms for geological domaining and interpretation, and the potential of implicit geological modeling techniques to address wireframing challenges were also discussed. Finally, the integration of machine learning and optimization techniques in geological modeling was explored, with a software program presented that incorporates AI and machine learning techniques to improve resource estimation accuracy. The seminar concluded with a discussion of emerging trends and future orientations in resource estimation, with an emphasis on potential opportunities for collaboration and innovation in this ever-evolving field.



Prepared by,
Dr. Zakaria Endut
Chairman, Economic Geology & Mineral Resources Working Group
Geological Society of Malaysia
29th May 2024

CERAMAH TEKNIK TECHNICAL TALK

The Quaternary geology of Peninsular Malaysia and the Straits of Malacca
&
Geological character of Sumatera (Indonesia) and Malaysia: Its impact on both nations

Prof. Madya Dr. Habibah binti Hj. Jamil
Jabatan Sains Bumi dan Alam Sekitar, FST UKM
Prof. Dr. Yahdi Zaim
IPU (Department of Geology ITERA, Indonesia)
Tarikh: 15 Mei 2024
Platform: Zoom dan Facebook Live FST, UKM

Kedua-dua ceramah teknik ini julung kali diadakan sebagai usaha sama awal di antara UKM dan ITERA. Ceramah teknik ini diadakan secara atas talian di platform Zoom/Facebook Live Fakulti Sains dan Teknologi, UKM pada 15 Mei 2024. Jumlah peserta adalah seramai 202 orang.

Berikut merupakan abstrak pembentangan:

The Quaternary geology of Peninsular Malaysia is indicated by the deposition of marine and continental sediments, particularly along the coastal plain and inland valleys. Fine-grained marine sediments are found along the western coast of Peninsular Malaysia, while sandy sediments dominate the eastern coast due to higher energy levels. The east coast of Sumatera consists of an alluvial plain, separated by the Straits of Malacca, not far from Johor. During the Pleistocene, Sumatera and Peninsular Malaysia were part of the exposed continental platform of Sundaland, separated by a major river. Subsequent transgressions throughout the Holocene led to the intrusion of seawater, separating the two regions. The sedimentation in the Straits of Malacca is a lateral continuation of the sedimentation along the coasts of Sumatera and Peninsular Malaysia. Implications of Quaternary deposits include insights into paleoclimate and paleoenvironment. Records of sea-level fluctuations from Sumatera can be correlated with those from Peninsular Malaysia. Economically, paleochannels could be focused on for placer deposits and sand resources. The depositional environment can serve as an analogue for submerged estuarine environments, beneficial for hydrocarbon exploration.

Development of geology of Sumatra during Paleozoic - Mesozoic was indicated by the existence of basement rocks of the Tertiary basin showing similar characteristics to the geology in Malaysia, which mainly consists of metamorphic, plutonic granitic and other igneous as well as sedimentary rocks known as Pre-Tertiary basement rocks. The similarities of Pre-Tertiary rocks can be described from the basement rocks exposed in both Sumatera and Malaysia.In Sumatera, the Pre-Tertiary basement rocks are well exposed around the North Sumatra basins consist of metamorphic rocks of schist, gneiss, and black slate belong to Kluet Formation, and the diamict till deposits of compacted clay contains sparse polymictic clasts in various sizes belongs to the Bahorok Formation, which were formed during the Permo-Carbonifeous. The Pre-Tertiary of Carboniferous – Cretaceous basement rocks have also been exposed around the West, Central and South Sumatera Basins, consist of meta-sediment such as slate, marble, phyllite, quartzite, and metamorphic rocks such as schist and gneiss, and marine sediments consist of limestone, shales, silici- and volcani-clastics, while the igneous rocks represented by gabbroic as well as granitic rocks.Peninsular Malaysia was an integral part of the Southeast Asian continental core of Sundaland. Paleozoic - Mesozoic rocks have also been exposed in the Peninsular Malaysia, such as igneous, granitic and metamorphic as well as marine and non-marine sedimentary rocks which were very similar to those Pre-Tertiary rocks found in Sumatra. The parallel geological development during Paleozoic-Mesozoic of Sumatra and Malaysia apparently did not continue into the Tertiary and Quaternary. During the Pre-Tertiary, Sumatra was still part of the Asian continental system, however, it had a divergent tectonic evolution in the Tertiary. The Indonesian region, including Sumatra, in the early Tertiary, was a very active tectonic region, in the area where the Indian-Australian oceanic crust was moving northward facing the Asian continental

crust, which was a relatively stable continental area. This tectonic evolution formed the sedimentary basins in the Indonesian region, including Sumatra, both fore-arc and back-arc basins, as well as the formation of volcanic arcs throughout the Indonesian region, including Sumatra, which did not occur on the Malaysian Peninsula. The presence of Pre-tertiary rocks in both Sumatra and the Malaysian Peninsula provides an important framework for the presence of mineral resources, and the formation of basins and volcanic arcs in Sumatra, and almost in all Indonesia provides a very important meaning for the exploration of energy and mineral resources.

Setinggi-tinggi ucapan terima kasih diucapkan kepada kedua-dua pembentang atas sokongan dan sumbangan kepada UKM dan aktiviti persatuan.

Prof. Dr Yahdi, Prof. Madya Dr Habibah bersama moderator dan sebahagian para hadirin.

Disediakan oleh,
Dr Norsyafina Roslan
Moderator Slot Ceramah Teknik (UKM)

CERAMAH TEKNIK TECHNICAL TALK

Caves and karst of Australia

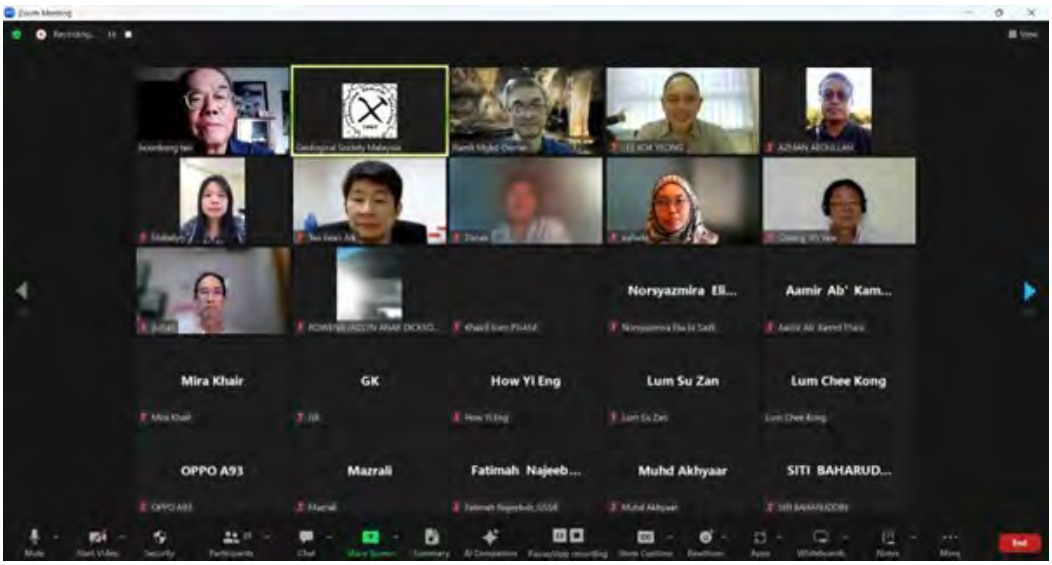
Ramli Mohd Osman
Former Geoscientist (JMG)
Date: 15 May 2024
Platform: Zoom

The above talk was delivered by Sdr Ramli Mohd Osman (former Geoscientist, JMG Malaysia) on 15th May, 2024 via Zoom. Some 70 members participated. An abstract of the talk is given below:

Abstract: There is so much diversity of the formation of Australian caves and karst in term of variety in carbonate rock types and tectonics, and geological history from Quaternary to Paleozoic:

1. Quaternary Limestones (Western Australia, South Australia, Victorian Coast, Tasmanian Islands) are basically dune systems.
2. Tertiary and Quaternary Limestones (Nullarbor & Mount Gambier) are pretty much flat lying.
3. Eastern Palaeozoic Limestones (Tasmanian Caves, Buchan Caves, Jenolan Cave, Chillagoe Cave) are mostly quite heavily deformed.
4. Northwest Palaeozoic Limestones (Mimbi Caves & Cutta Cutta Caves) are more or less flat lying therefore different karst development than the Eastern Palaeozoic Limestones.

We thank Sdr Ramli for his support and contribution to the Society's activities.



Prepared by,
Tan Boon Kong
Chairman, Working Group on Engineering Geology
16th May 2024

CERAMAH TEKNIK TECHNICAL TALK

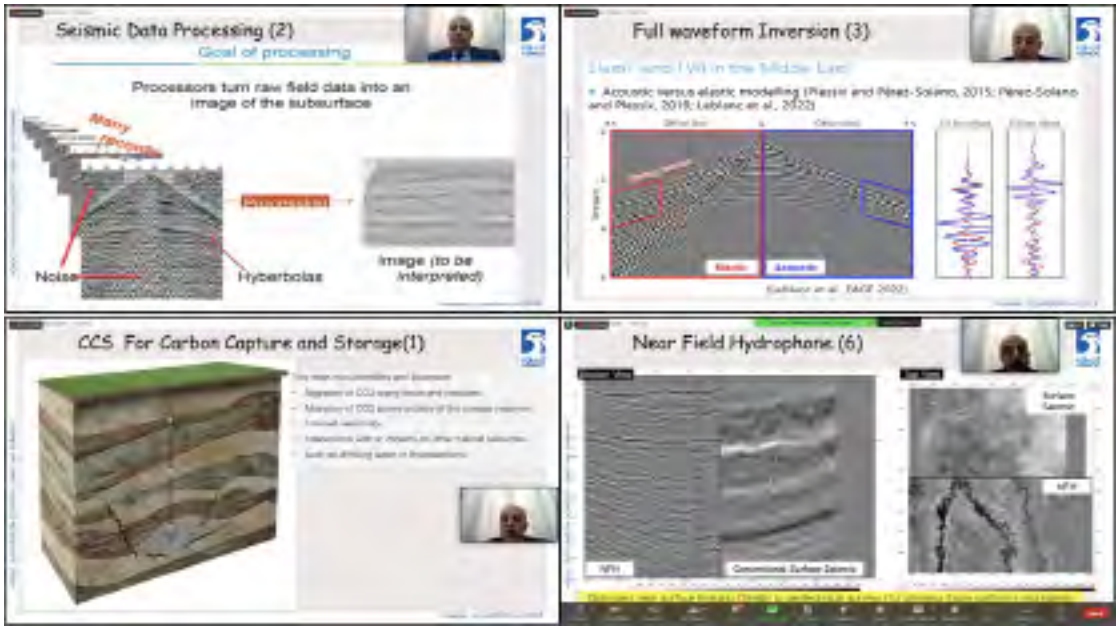
Seismic applications in industry and sustainability

Mohamed Abdelghany Mahgoub
Geophysics Specialist in ADNOC, Abu Dhabi, UAE
Date: 15 May 2024
Platform: Zoom

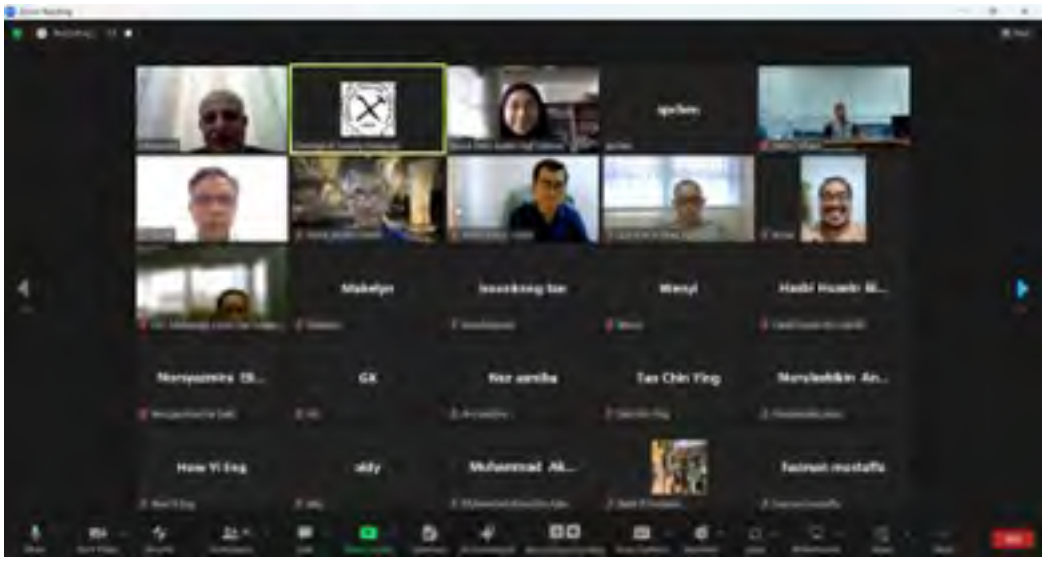
On May 15th 2024, the Geological Society of Malaysia (GSM), in collaboration with the Centre for Subsurface Imaging (CSI) from University Technology PETRONAS (UTP) organized a virtual technical talk on "Seismic Applications in Industry and Sustainability" via Zoom platform that was participated by 100 attendees. This program was managed by the Geophysics Working Group within the GSM. The talk was presented by Dr. Mohamed Abdelghany Mahgoub, a Geophysics Specialist in ADNOC, Abu Dhabi, UAE whereby the presentation highlighted the significance and uses of seismic in the fields of geosciences and geophysics. The talk outlined some of the important workflows and elements involved in seismic data acquisition and processing. The speaker shared several forms of the essential processes that are required to produce high-quality interpretable seismic data. He also showcased the effects and differences before and after certain seismic data was processed for removing noises and multiples.

Apart from that, Dr Mohamed Abdelghany presented a profound sharing regarding some of the useful techniques for interpreting the seismic data of carbonate reservoirs as this form of field is very complex and heterogeneous in nature hence, geoscientists often find the interpretation processes are quite challenging when compared to sedimentary basin. The talk also included the knowledge of the current advancing research particularly on the applications of seismic in Carbon Capture and Storage (CCS) as well as the risks and challenges involved.

At the end of the session, the audience asked the speaker several questions regarding the processing and applications of the seismic. Dr. Mohamed delivered comprehensive solutions and answers to the inquiries. He also added some motivations upon the importance of understanding this knowledge and the role of geoscientists and geophysicists. The participants engaged and interacted actively throughout the sharing. The knowledge of seismic application is very vast and holds vital roles and numerous benefits to the industry and research world in the current times and future. Geoscientists and geophysicists are highly encouraged to explore more about it for the betterment of this field.



Screenshots of the technical talk by Dr. Mohamed Abdelghany Mahgoub.



The participants of GSM technical talk with Dr. Mohamed Abdelghany (top left).

Prepared by,
Nurul Fatin Izzatie binti Salman
Moderator
12th June 2024

CERAMAH TEKNIK TECHNICAL TALK

Application of hydrochemical tracers, as a tool in hydrogeology

Konstantina Katsanou
Water Quality Assessment and Monitoring, IHE Delft
Date: 4 June 2024
Platform: Zoom

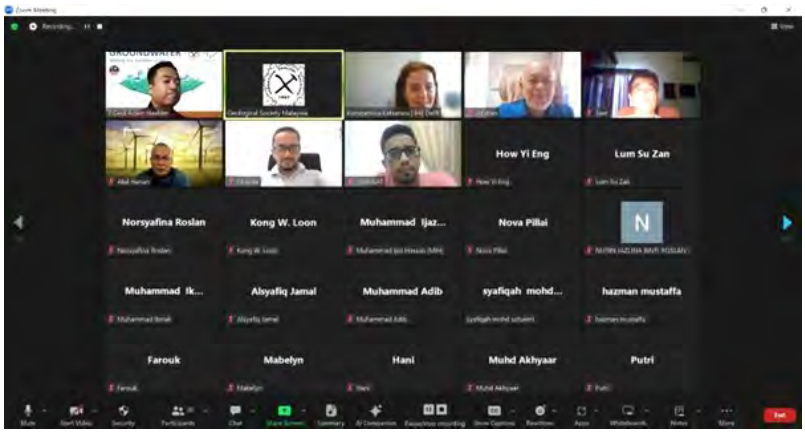
Introduction of the Speaker:
Ms. Konstantina Katsanou is currently a Senior Lecturer/Researcher in Water Quality Assessment and Monitoring at IHE Delft (Netherlands), holds a Bachelor's degree in Geology and a Master's degree in Environmental Sciences. Konstantina received her Ph.D. from the University of Patras, Greece where she also carried out her postdoctoral research.
She has extensive experience in Water Policy at the European level. She worked for the Greek Water Directorate on the implementation of the European environmental regulations, while she contributed to the revision and implementation of the River Basin Management Plans (RBMPs) and Flood Risk Management Plans (FRMPs). Over the course of 15+ years, she has offered key contributions to this field through environmental studies, scientific publications, and government programs.
Konstantina is teaching parts of the IHE MSc Programme on surface and groundwater quality monitoring, and is involved in the supervision of MSc students. She is also involved in a number of interdisciplinary research and capacity-building projects in Europe, North and Central America, and East Africa.

Summary of the Webinar:

The talk is aimed to learn how other countries, like Jordan, manage their groundwater sources, and how it contributed heavily to the country water supply.
Jordan is considered one of the most water scarce countries in the world. Groundwater is the most important source for the water supply of Jordan. Population growth, rising use of groundwater for irrigation purposes and illegal abstractions have increased the stress on existing groundwater resources.
In local context, the talk is aimed to spur the local knowledge especially in acknowledging the importance of groundwater supply during drought season, like the current el-Niño we are facing in the 2024.

A total of 49 on-line participants were recorded.

Below is a photo of the webinar.



Prepared by,
P. Geol. Adam Hashim
Chairman, Working Group on Hydrogeology
7th June 2024

CERAMAH TEKNIK TECHNICAL TALK

Sustainable groundwater development

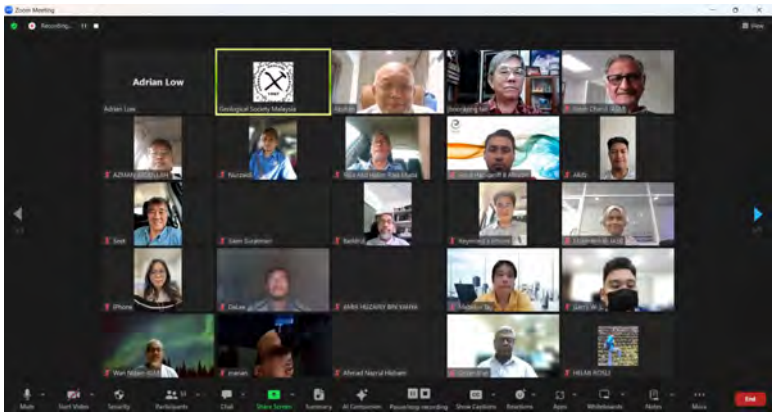
Azuhan Mohamed
Consultant
Date: 12 June 2024
Platform: Zoom

The above talk was delivered by Datuk Ir. P.Geol. Dr. Azuhan Mohamed (consultant) on 12th June, 2024 via Zoom. Some 100 members (maximum limit) participated. An abstract of the talk is given below:

Abstract: Sustainable groundwater development could only be realized by adopting best practices in all facets of groundwater activities that include but not limited to the followings:
- Groundwater exploration;
- Groundwater well construction;
- Groundwater well yield testing;
- Groundwater well field management;
- Groundwater treatment processes;
- Groundwater supplies operation and maintenance;
- Groundwater well rehabilitation and reconstruction; and
- Groundwater well abandonment.

Best practices in sustainable groundwater development could only be achieved through competent professionals with integrity such as consultants and contractors as well as pump suppliers and installers. These groundwater activities need to comply with the conditions set by the Department of Environment. Monitoring of groundwater activities are vital to realise sustainable groundwater development in order to ensure no negative impacts to the environment besides sustaining the targeted groundwater yields and without any degradation in groundwater quality. The latter could lead to the failure of the installed groundwater treatment plant to produce treated water that comply with the standards set by Ministry of Health and massive costs may be required to improve the groundwater treatment processes. Groundwater well will experience reduction in efficiency with time, that is reduction in the well's yield and this need to be addressed by ageing prevention. Knowing the technical and scientific background helps to select useful methods for well rehabilitation and reconstruction.

We thank Sdr Azuhan for his support and contribution to the Society's activities.



Prepared by,
Tan Boon Kong
Chairman, Working Group on Engineering Geology
13th June 2024

CERAMAH TEKNIK TECHNICAL TALK

Silicate weathering versus reverse weathering across geological time

Santanu Banerjee
Department of Earth Sciences, Indian Institute of Technology (IIT), Bombay (India)
Date: 12 July 2024
Venue: Department of Geology, Universiti Malaya and Zoom

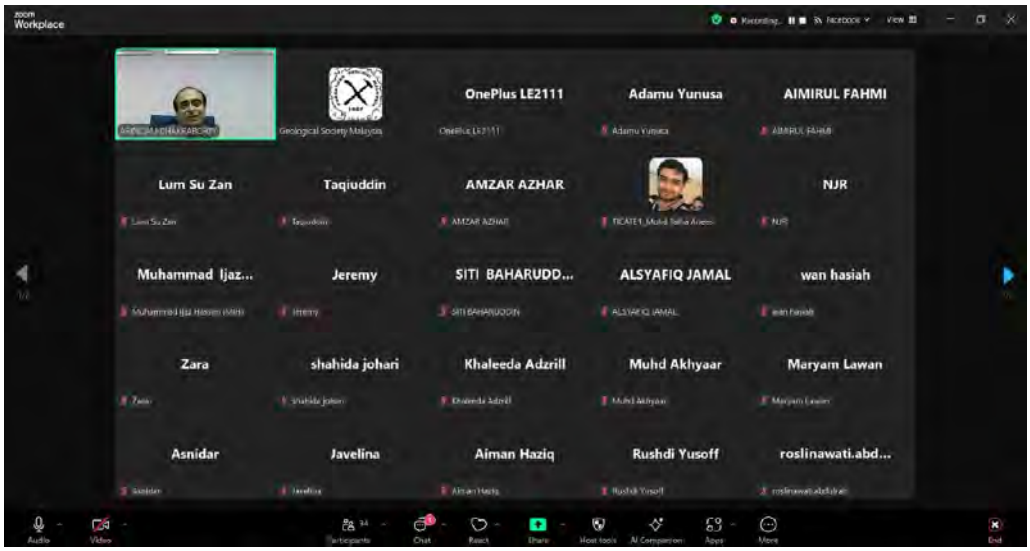
Moderator: Dr. Arindam Chakraborty

On 12th July, 2024, Department of Geology, Universiti Malaya in partnership with Geological Society of Malaysia hosted a technical talk titled "Silicate weathering versus reverse weathering across geological time". The talk was delivered by Professor Santanu Banerjee (IIT Bombay) in hybrid mode from the meeting room of Department of Geology, Universiti Malaya, Kuala Lumpur. Around 40 members participated online through zoom and others viewed through GSM Facebook live (https://fb.watch/toocvvjygH/). There were 10 participants present at the venue to listen to the talk and interact with him.

Abstract of the talk: Reverse weathering, which is a near-surface clay mineral authigenic process, is one of the first-order controls on regulating seawater pH through the generation of acidity, and thus controls the carbon mass balance fluxes between the marine sediments, the ocean and the atmosphere over geological timescales. This process is mainly triggered by the rates of silicate and carbonate weathering on the continents and the reactivity of detritus supplied to the oceans, which both provide essential dissolved components (e.g., K^+, Mg^{2+}, Ca^{2+}) to the marine pore water inventory that cause authigenic clay minerals, such as glauconite, celadonite and greenalite, to form close to the sediment-seawater interface. Fast retrograde clay mineral reactions impact the benthic cycling vs sequestration of chemical elements, importantly Si, Fe, Mg and K, and subsequently contribute to the fluctuations in climate and seawater geochemistry recorded in marine archives over geological time. Earth's greenhouse climatic periods clearly influenced the rates of reverse weathering and the associated distribution and abundance of authigenic clay minerals in marine sediments across geological time. Such periods were characterized by elevated temperature and pH conditions, higher Si $(OH)_4$ concentrations in seawater and enhanced microbial activity that all catalyzed reverse weathering reactions.

Synopsis of the talk: During the geological past it was observed that the amount of authigenic Fe-rich silicates e.g. Glauconite increases and mark different orders of flooding surfaces/global sea level rise so their study is crucial for high resolution sequence stratigraphic correlation and reservoir correlation. This can be an additional tool with the biostratigraphic information.

We thank Professor Banerjee for his support and contribution to the Society's activity.



Online participants.

Offline participants.

Felicitating the speaker by Assoc. Prof. Dr. Meor Hakif Bin Amir Hassan.

Prepared by,
Dr. Arindam Chakraborty
Life Member, GSM
Senior Lecturer and Supervisor, Geology Museum
Department of Geology, Universiti Malaya
18th July 2024

CERAMAH TEKNIK TECHNICAL TALK

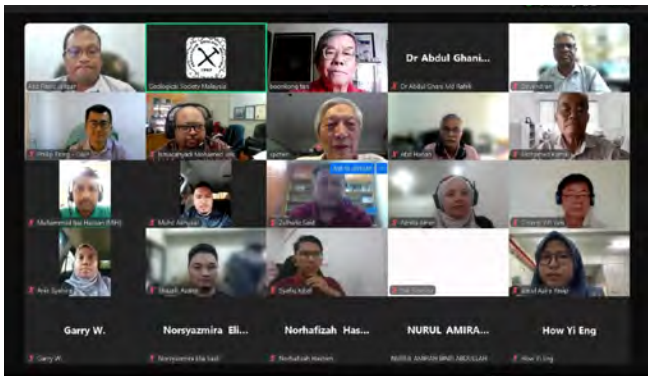
Landslide forensic investigation: Approach, practice and case studies in Malaysia

Abd Rasid Jaapar
GMT Group (GMT)
Date: 17 July 2024
Platform: Zoom

The above talk was delivered by P.Geol. Abd Rasid Jaapar (GMT) on 17th July, 2024 via Zoom. Some 100 members (maximum limit) participated. An abstract of the talk is given below:

Abstract: Leonardo da Vinci introduced the concept of visual literacy, which he referred to as "sapere vedere," meaning "knowing how to see." In addition to his renowned painting skills, Da Vinci was a master of drawing and sketching. He believed that visualization had two components: first, knowing something well enough to visualize or draw it from memory; and second, developing a deep understanding of something to reveal its essence through drawings, thereby creating new ideas. Similarly, the infamous fictional character, Sherlock Holmes' unique approach to solving crimes has revolutionized investigative methods, influencing how investigators handle complex cases. Holmes' keen observation skills and sharp deductive reasoning set him apart, establishing the groundwork for modern investigative techniques. His attention to detail, often noting the minutest aspects that others overlook, forms the foundation of his deductions. Both Da Vinci and Holmes created approaches that can be replicated by engineering geologists, particularly in landslide forensic investigation. This technical talk will explore the methodologies of Da Vinci and Holmes, along with insights from experts worldwide. It will cover how to collect information and make observations in the field to support effective landslide forensic investigations. Understanding the importance of a desk study and utilizing desk study information for well-informed field assessments is crucial. The talk will discuss local and international practices for developing effective field techniques for mapping and observing landslides, recognizing various landslide types, and identifying landslide hazards. Engineering geologists need to observe and understand the geological and geomorphological features associated with landslides, record them on maps, and develop different types of geological models, especially for areas with landslide issues. Comprehending landslide mechanisms, processes, and rates, and estimating the probability and consequences of landslide processes through mathematical models and simulations should be part of the engineering geologists' work before making effective remediation and mitigation recommendations. The presentation will include local case studies on landslide forensic investigation of man-made slopes. Results and reports provided by engineering geologists should contain sufficient information for accurate and optimized mitigation design by geotechnical engineers. Engineering geologists must deliver well-informed findings with facts and evidence and communicate effectively with other professionals involved in landslide engineering and risk management.

We thank Sdr Rasid for his support and contribution to the Society's activities.



Prepared by,
Tan Boon Kong
Chairman, Working Group on Engineering Geology & Environmental Geology
18th July 2024

IN MEMORIAM

Ahmad Said bin Fazal Mohammed (1952-2024)

Ahmad Said bin Fazal Mohammed, or Ahmad Said, was born in Taiping on 27 January 1952. When he was little, his family moved to Penang (George Town) to build a thriving family business on Chulia Street. In George Town, Said went to Hutchings primary school. There, he became a school prefect who often came up top of his class. He then attended Penang Free School (PFS), where he was active in sports and played cricket and hockey.

After completing Form Six, Said was offered a scholarship to study dentistry but a chance encounter at the Penang Botanic Gardens changed his calling. He had met with an American geology student searching for rock samples and soon got hooked on rocks. After a few exchanges with the American, Said decided to study geology at the University of Malaya (UM). In his application, Said did not ask for scholarship as his father had insisted on paying for it.

Said's geology classmate and PETRONAS colleague, Hoh Swee Chee, remembers him as very relaxed and laid-back but smart and intelligent. He was active in sports and, with his easy-going style, made many friends. A student once borrowed his motorcycle and kept it for more than a week. Always avoiding confrontations, Said just went up to him and said "Can I borrow my bike that you borrowed?".

During field work in Sabah for his BSc. thesis project, Said stayed in a room above a coffee shop in Kota Kinabalu. Every morning, after breakfast, he would pack food and water and hitch a ride with JKR[1] workers to get to the outcrops along a federal road that was being built across the Crocker Range. Said was not one to do the ordinary. To ensure that he would complete his thesis on time, he would walk for miles along the highway to collect data and samples, even alone on Sundays. Said completed his thesis, entitled "Geology of the Crocker Formation along the Kota Kinabalu-Tambunan road, Sabah, East Malaysia"[2] . He graduated in 1976 with a BSc. (Hons.) in geology and joined PETRONAS soon after.

Said had a long and illustrious career with PETRONAS that spanned four decades (1976-2016). He and a few of other UM geology graduates were pioneers at the PETRONAS Exploration Department who laid the foundation for the exploration business in Malaysia. During those early years, Said's work mainly involved developing the terms for Malaysia's production-sharing contracts (PSC) with foreign oil companies, monitoring the PSC work programs, and promoting and licensing new blocks. With his good friend Andrew (Effendy) Cheng, who passed away in 2023, Said was instrumental in drafting and executing the PSC, which became the cornerstone of the E&P business in Malaysia that has been emulated by other countries.

From 1987 to 1992, as the Exploration Manager, Said negotiated over thirty PSCs with foreign oil companies. He oversaw the introduction of the deepwater PSC terms and the first deepwater seismic surveys. He also coordinated with Malaysia's neighbours in the Gulf of Thailand for joint development agreements, namely the Commercial Arrangement Area with Vietnam (PM3 area) and the Malaysia-Thai Joint Development Area (MTJDA).

By the early 1990s, Said was a well-respected figure in the industry who had forged close partnerships and cooperation between PETRONAS and foreign oil companies by assisting them in business development. To some, he was known as the "Beethoven" of PETRONAS, not only for his unique hairstyle but also for his friendly personality and unique voice tone.

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[1] Jabatan Kerja Raya (Public Works Department)

[2] Warta Geologi Volume 2 No 2, Mar – Apr 1976

In 1993-1994, Said became PETRONAS Carigali's Deputy General Manager for Exploration responsible for domestic exploration and PSC negotiations. From 1994 to 1998, as General Manager, Said oversaw Carigali's rapid expansion overseas. He negotiated with the Sudanese for the export of oil via the >1500 km pipeline to Port Sudan on the Red Sea. Said was also involved in asset acquisition in Turkmenistan (Caspian Sea), Pakistan, Algeria, China, and Iraq. During his trips to Iraq, Said showed what a kind-hearted and caring person he was. Due to economic sanction before the Gulf War (1990-91), he would bring food and medicine for the Iraqi ministers he was meeting and for the hotel staff where he stayed. He initially did it quietly, out of his own pocket, but when his boss Dato' Mohamad Idris Mansor found out about it, he was allowed to use PETRONAS funds for it. In 1995, Said led the negotiations for field development projects which were ultimately awarded to PETRONAS in 2010.

Despite his wide business network, Said was a patriot who was deeply loyal to PETRONAS and country. He turned down a lucrative job offer from another company and chose to serve the organisation he loved, with dedication, until his retirement in 2016. He was truly an asset to PETRONAS, which has become a great company because of his dedication and contribution. Said went on to hold key positions in PETRONAS – general manager of strategy and business development (1998-2001), non-executive director of Energy Africa (1999-2001), senior general manager for crude oil marketing and trading (2001-2003), head of upstream business for PETRONAS Carigali in Sudan and Chad and for exploration in North and West Africa (2003-2004), senior general manager of business development (2005-2012), and advisor, strategy and new ventures (2012-2016).

Besides his remarkably successful career in the oil industry, Said was an active member of the Geological Society of Malaysia. (GSM). As a geology graduate of UM, Said maintained a close link with GSM and contributed significantly to the activities of the Society. He was the organising chairman of the Petroleum Geology Seminar[3] in 1980 and 1986. He started to serve as council member in 1981 and later went on to become President for three consecutive terms, from April 1990 to April 1993. During his tenure, GSM held its Annual General Meeting and Dinner at the posh Petroleum Club located at the PETRONAS headquarters at the time in Kompleks Dayabumi, downtown Kuala Lumpur. It was a pleasant treat for members despite having to rush through the afternoon traffic and thunderstorm to reach the venue in the city centre!

While at PETRONAS, Said encouraged his staff to be active in GSM and maintain the close link. When his term as president ended in April 1993, several of his senior staff, all UM geology graduates, took turns to get elected to the council, starting with Michael Leong (elected in 1982), Tay Say Ann (1987), Hila Ludin Abu Hazim (1988), Ali Mohd Sharif (1993) and Effendy Cheng (1993). Some stayed for a few terms but some last for only one. The late Effendy Cheng Abdullah served until 1996, but unfortunately he was the last from Said's cadre of senior geologists who served the GSM council.

Said was a major driver behind the Petroleum Geology Seminar series during its first decade of operation (1980s) Every year, after having chaired the organising committee in 1980, he personally handpicked the organising chairman from among his trusted lieutenants in Exploration Department, starting with Michael Leong, Nordin Ramli, and Hila Ludin Abu Hazim. That set an unwritten practice during the many years that followed[4], which undoubtedly helped transform the seminar to become the hugely successful Petroleum Geoscience Conference and Exhibition (PGCE).

Said became a life member of GSM in 1999 and continued to support GSM behind the scenes. He was appointed to the Board of Trustees for the GSM Endowment Fund when it was established in 2014. Besides GSM, he also served in the first council of the Institute Geology Malaysia in 1991[5].

Said was a loving family man. He married Izmashumi Ishak in 1988 and became a doting father at age 38 with the birth of their daughter and, later, two sons. He was a hands-on dad and loved to change diapers, wash and bottle-feed the kids whenever he could, even taking the midnight shifts. He tried to pass on his love for geology to his daughter, who at age two was able to recognise some rock types. Family trips were always to places where the kids could learn something, like museums or short geological field trips. A passionate geologist, Said would stop by the roadside to look at outcrops, despite protests from the kids.

He was also a great science student who loved astronomy, an interest he developed with the first telescope that his father got him. He was an avid reader with a collection of a few thousand books, which are mostly technical. He kept a massive collection of National Geographic and maps in his home library. His museum of rock includes prob-

[3] Petroleum Geology Seminar was the precursor to the Petroleum Geoscience Conference and Exhibition (PGCE) which ran until 2013.

[4] Details in Warta Geologi, Vol. 47, No. 3, December 2021, p. 246-254.

[5] Warta Geologi Volume 17, No 5, Sep-Oct 1991.

ably the largest collection of tektites in Malaysia. Said used to go to Petaling Street with the wife to look for sellers of rare Nepali tektites that came from the Mt Everest region.

Said's love of cricket since school days stayed with him; his favourite teams were South Africa and Pakistan. He often watched cricket games with his wife, who inadvertently learned the game even though she never played it. The couple also loved Chinese sopranos and were a big fan of Tan Soo Suan, the award-winning vocalist and resident singer of the Dama Asia theatre company in Kuala Lumpur.

Said was also fond of carpentry and had made for his beloved mother a number of wooden items for the kitchen. He was a loving son. When his mom was still alive, Said never failed to call his mom in Penang three times a week. After his retirement, Said spent his days at the mosque near his home and helped out with the neighbourhood security scheme as much as he could.

Ahmad Said passed away peacefully on 22 April 2024 in Kuala Lumpur. He is survived by his wife, daughter and two sons. The geoscience community has lost a well-respected titan in geology who had made a significant contribution to the petroleum exploration business in Malaysia. Said had such a great impact on the lives of many, especially his closest friends at PETRONAS, several of whom have kindly shared their personal tributes below.

Hoh Swee Chee

Ahmad Said was a very private individual, but to his peers he was warm, approachable and cooperative. As a dear friend, I would remember him as 'Mr. Cool' - always calm and cool when faced with challenges. He was also kind-hearted and compassionate; when visiting poor countries, he would bring with him medical aid for the needy. He was a well-liked and respected figure in the oil and gas community, always promoting the PETRONAS image and supporting its policies and upholding its values.

As the head of exploration in PETRONAS, he helped establish and promoted the annual petroleum seminar (which later became the PGCE) for the oil and gas fraternity. With his support, a portion of the proceeds from the conference was allocated as scholarships and training aids (computers) for geology students. Throughout his career, Said used his influence to help many students and aspiring professionals to get employment in the oil and gas industry

Said was a very supportive and caring boss. He may be critical but only with the work, never with the person. He would send his people for training or assignment, even overseas, for exposure and to improve their skills. He is an avid reader and very well informed of world affairs. He had fantastic memory and was able to recollect 80% of what he read. His warm and unassuming personality and wide knowledge of world affairs made him the ideal person for business development and to attract foreign investors to Malaysia. He was resourceful and had a wide network of friends and professionals to whom he can turn for information and assistance.

Mohd Idrus Ismail

En. Ahmad Said was the very first person I interacted with when I joined PETRONAS in September 1981. He played a significant role in shaping my career as a geologist at the PETRONAS Exploration Department. Many other geologists also benefited from his mentorship. En Ahmad Said became part of the team in 1978 and alongside other pioneers, including the late Effendy Cheng, Ho Wang Kin, Hila Ludin Abu Hazim, and Michael Leong, helped establish the Exploration Department at Wisma Peladang and Kompleks Dayabumi.

The department evolved into a highly respected entity which manages the nation's hydrocarbon resources and successfully attracts independent oil/gas companies to explore in Malaysia. The various production sharing contracts (PSCs) including Shallow Water PSCs, Deepwater PSCs, Risk Service PSCs, and Gas PSCs were the result of the efforts led by En Ahmad Said and his team. PETRONAS's strong sense of national identity and agenda can also be credited to these pioneers, particularly En Ahmad Said who had a wide network of friends within and outside the organization, both locally and internationally. He embodied the essence of being a PETRONAS employee and was highly respected by his colleagues within the company and external partners.

Personally, I have never seen a moment where he was not dedicated to the success of PETRONAS. His commitment was unwavering, as he ate, slept, and lived for the company. His guidance, positive attitude, sense of humour, and friendship will be greatly missed by all who had the privilege of knowing him.

Barney Mahendran

It was great to work with Said. He was efficient, dedicated and serious when it came to tackling tasks and meeting deadlines. However, once the work day was over, Said could transform into a fantastic friend to have fun with and unwind. Another thing, he wrote excellently in English too, so our technical reports had to be grammatically correct!!

Ho Wang Kin
Ahmad Said was a great man to work with. He was under appreciated by PETRONAS. He should have been a Vice President or Executive Vice President of the E&P sector but, unfortunately, his contemporary and an outsider made it to the finishing line instead.

Prepared by,
Mazlan Madon
21st June 2024

Acknowledgement: I am deeply grateful to Pn. Izmashumi Ishak for kindly sharing information and anecdotes about Ahmad Said, for whom I have great respect but did not have the privilege to know well personally.

Tributes from other close acquintences:

My deepest condolences.
Rest in peace, Said. Will miss your "cool" presence!
Anna

Sad to hear the demise of Ahmad Said. A good and dear old friend. He had contributed a lot to GSM, as President, and the geological community.
Our deepest condolences to his family. May his soul rest in peace.
Choo Mun Keong

Our heartfelt condolences to the family on the demise of Ahmad Said. He was a jovial person who got along very well with the geological fraternity. He has contributed a great deal to GSM.
May his soul rest in peace.
Fateh Chand

" Word has its limitation in expressing the exact feeling toward a friend, a professional associate, a brother, and a dear kind person. All that combined and more was my dear friend Ahmed Said".
We met the first time when he applied for a job with a company I used to work with. His application was rejected due to "lack of experience", His comment was "How the hell I get experience if you do not hire me". With that smart answer, we never used that excuse again in rejecting any applicant. At that time, I thought this applicant was too smart for the job he applied for.
And that is how our relationship started. He kept moving up the ladder in Petronas and I was moving up the ladder with the company I was working with.
Our destinies met when we were working on the Iraq Project. Despite the political difficulties, progress was made and Petronas was awarded the project. It was hard work but his drive and determination were the main contributors.
We kept our friendly relationship and he was there whenever I visited Kuala Lumpur. We continued to enjoy our simple meal at the Indian Club despite his high position in Petronas. Mr. Said, as I used to call him, was a person that I will never forget and will treasure every moment we spent together.
Rest in Peace and BASA "Inna Lillahi Wa Inna Ileyhi Rajioon" SAA.
Khalid Ameen

Deepest condolences to Ahmad Said's family. He did a lot for GSM as President and will be dearly missed.
Lee Chai Peng

It is with a heavy heart to hear that Ahmad Said is no longer with us. My sincere condolences to his family, may Ahmad rest-in-peace.
Just before MCO, Ahmad gifted me with a piece of tektite from his vast collection, attached photo shows the teardrop shape piece that I chose. That was the last time I met him having known him since he tutored us when I was in my Year 1 geology class.
Low Keng Lok

NEW MEMBERSHIP

Student Membership

1. Abdul Hakim Abdullah Sani
2. Abdulrahman Isa Danlami
3. Abdulrahman Muhammad
4. Abdulrasheed Adamu Hassan
5. Adamu Kamaliddeen Salisu
6. Ahmad Kamil Ahmad Nadzri
7. Ain Nabilah Zamri
8. 'Aisyah Hamizah Azeman
9. Albert Bruce
10. Alia Umairah Abd Wahab
11. Alyaa Natasha Aidi Rafizul
12. Ammar Musouvi Basir
13. Anis Madihah Nazirie
14. Arif Hakimi Halim
15. Bashir S Mustafa Agha-Musa
16. Baskaran Venkateshwaran
17. Belinda Clare Bonny
18. Bello Abdulsalam
19. Elijah Nanang Richard Tini
20. Fahad Abubakar
21. Faiz Muhammad Hafiz
22. Fakhrul Radzi Mohd Rezal
23. Fatin Suraiya Abdul Rahim
24. Fong Yuen Sie
25. Hasya Syazwani Hasri
26. Hazwany Hazren
27. Karthigesan Subramaniam
28. Koh Ye Shyn
29. Kueh Siu Cheng, Maybelline
30. Lim Xin Rou, Christabelle
31. Lim Yi Zheng, Nicholas
32. Lo Lin Lin, Winnie
33. Luqman Mohd Zaki
34. Mahaashini Ramachanthiran
35. Maina Muhammad Badamasi
36. Maisarah Alaudin
37. Maryam Sofia Mohd Rasdi
38. Md Yeasin Arafath
39. Mirrah Maisarah Ab Aziz
40. Mohamad Adam Daniel Mohd Rusok
41. Mohamad Danish Wafiq Hamarudin
42. Mohamad Fatihi Abdul Patah
43. Mohammed Hassan
44. Muhamad Zaidi Zainudin
45. Muhammad Amri Mahadir
46. Muhammad Asyraf Isfahan Abu Samah
47. Muhammad Asyraf Wajdi Che Azuhari
48. Muhammad Zarif Amdan
49. Ng Yun Rou, Zoe
50. Noerman Haleef Norhizam
51. Noor Amirah Syahirah Noor Aizam
52. Nur Aida Nadhirah Ahmad
53. Nur Alya Afiqah Mohd Rodzi
54. Nur Alya Sabrina Mohd Saharom
55. Nur Alyatul Aisya Dihanan
56. Nur Amanina Adriana Hishamri
57. Nur Hazreen Syafiqa Md Nazri
58. Nur Husniena Izzaty Adnan
59. Nur Ivana Balqis Ishak
60. Nur Mujeera Chaudhry
61. Nur Najwa Alia Muhamad Azlan
62. Nur Sabrina Amrul Hazli
63. Nur Sahira Mohamad Sazli
64. Nureen Faqihah Zulkifli
65. Nuriffa Syahira Mohd Najib
66. Nurnajmina Imanni Hasrul Fredawadi
67. Nurul Afiqah Mohammad Zahir
68. Nurul Fatin Hanani Azmi
69. Nurul Iman Syuhada Mohd Razi
70. Nurul Suzana Safia'ai
71. Pang Jie Hui
72. Pavenya Balasandran
73. Shanti Shanmugam
74. Shereen Farisha Azlan Shah
75. Sirajo Abubakar
76. Siti Aisyah Fuwazil
77. Sohag Ali
78. Soong Zhi Yi, Karyn
79. Tan Yee Ching, Winnie
80. Tengku Amalin Tengku Zainal Abidin
81. Ummul Masitah A Rahim
82. Victor Darkwah-Owusu
83. Vun Jin Ying, Ivy
84. Wan Anis Suraya Wan Ahmad Khiri
85. Yanuska Sarawanan
86. Zainab Oyinda Adedeji
87. Zakiyah Ainul Kamal

Full Membership

1. Abdul Hakim Fadzil
2. Ahmad Fauzan Yusoff
3. Ahmad Hussaini Hassan
4. Anis Syahira Mohd Mozli
5. Chan Jair Luen
6. Harry Telajan Linang
7. Hijaz Kamal Hasnan
8. Javelina Jitai
9. Khairunnisa Abdul Rahman Siddik
10. Lin Hou En
11. Mohd Faiz Abd Aziz
12. Muhamad Zubir Mohd Tarmizi
13. Muhammad Akhyaar Kok Mohd Firdaus Kok
14. Muhammad Ijaz Hassan
15. Nurul Iffah Ismail
16. Prasanna Mohan Viswanathan
17. Stanley Forbes Rae
18. Syaukat Salim

From Student To Full Membership

1. Najwa Zawani Dhamirah Mohamad Bahtiar

From Full To Life Membership

1. Aisyah Azhar
2. Fong Yi Ning
3. Shi Joyce Sim

Associate

1. Nur Fadzlina Aini Mohmad Lehan

GEOSEA 18th activities

GEOSEA and dinosaurs
Report On GEOSEA 18th activities in Khon Kaen, Thailand

Khon Kaen is a city in the northeast of Thailand, located in the west side of the Khorat Plateau (Figure 1). From Krung Thep Maha Nakhon (Bangkok), the capital city, it takes about an hour's flight to get there. With the traditional train, however, it would take eight hours. There are several geoparks around Khon Kaen, with the famous discoveries of dinosaur fossils, petrified wood fossils, and many others. But what led to these geological parks in the first place was the GEOSEA 2024 Conference.

The 18th GEOSEA conference was held in Khon Kaen on 20-23 February 2024, hosted by the Geological Society of Thailand (Figure 2). GEOSEA, the regional congress on geology, minerals, and energy resources of Southeast Asia, is every other year event, usually run in conjunction with the annual conference of the host organization. GEOSEA program is managed by the ASEAN Federation of Geoscience Organization (AFGEO). This year's theme is "Geoscience for Society." The conference's purpose is to inspire people with the importance of geology. The event was sponsored by several companies such as PTT Exploration and Production based in Thailand (PTTEP), Schlumberger Limited, Halliburton, and many others. In 2022 GEOSEA was held in Langkawi, Malaysia, and in 2026 it will be in Banyuwangi, Indonesia. The conference has a special meaning for the geoscience community as it fosters collaboration, and shares ideas relevant to the knowledge and organizations.

More than 100 participants came to GEOSEA 2024. Most participants are geoscientists from many countries, especially from Southeast Asia, including Malaysia, Thailand, Myanmar, Cambodia, Philippines, and Indonesia. Others were from Canada, Poland, France, Germany, Japan, the UK, and USA. Several members, unintentionally, met each other upon arrival at the Khon Kaen Airport. They all showed great enthusiasm and were filled with excitement in attending the conference. One of the organizers mentioned that there would be many participants who came from Thailand because the coordinator of the event is a team leader of a company, therefore he encouraged his subordinates to join the event.

The GEOSEA meeting in Khon Kaen also boosted the local economy, especially tourism. The participants who were coming from abroad needed accommodation and food. Therefore, it would increase the sales in hotels and restaurants nearby, creating a positive domino effect on the economy. The geopark promotion and creative local industries that make souvenirs help raise the locals' income. Several booths were set up during the conference to support the event. These went along with the conference theme, which is "Geoscience for Society".

Participants were expected to join two field trip programs, the Petrified Wood Pit and Sirindhorn Museum. All participants enjoyed this regional event, especially the dinosaur excavation site visit, next to the Sirindhorn Museum. The participants were very impressed with the program as they were allowed to visit the laboratory where scientists worked on the fossils.

Figure 1: Location map of Khon Kaen and Khorat Plateau, Thailand.

Khon Kaen, Mesozoic vertebrate

In 1978, Varavudh Suteethorn and a group of geologists from the Department of Mineral Resources investigated a newly discovered locality of vertebrate bones at Non Buri, Sahatsakhan, in Khon Kaen province. Phrakhru Witchit Sahatsakhun found fossils in the temple's compound, the Abbot of Wat Sakawan in 1970. Later in 1980, a team of Thai-French Geological Survey took the bone fossils and examined them further. They found out that they were fossils of *Sauropod*, a type of dinosaur that has a long neck, a long tail, and a small head. Then in 1994, a major excavation was carried out and they successfully unearthed about 700 fossilized bones. The *Sauropod* fossils were possibly of the early Cretaceous period, or around 130 million years ago. From this significant discovery, the government built a roofed structure to cover the excavation site and set it as a learning center for paleontology in Thailand (Tourism Authority of Thailand).

Furthermore, several types of herbivorous dinosaurs were identified at the excavation site, and amongst the fossil specimens, the most complete structure was the skeletons of the herbivorous *Phuwiangosaurus Sirindhornae*. It was in a lying position with its spine erected, ribs on both sides of the body, hip bones in the original position, and tail bones arranged in a circle towards the middle of its back until the end of the tail. However, the hind leg, right front leg, neck, and head were scattered. This type of sauropod became the focus of every participant and an iconic feature of the location.

The first major discovery of dinosaur fossils in Khon Kaen province occurred in 1994. One can see the location in the map as part of Khorat Plateau (Figure 1). Their age was of Late Triassic to the mid Cretacious. Moreover, experts reported that the region was to be the most significant dinosaur's site in Southeast Asia. One decade after this big discovery, many visitors began to visit the museum. People come to prove the history of the earth by the presence of the fossils and to learn its significance in their life.

During the trip to the dinosaur excavation site, Dr. Phornphen Chanthasit (the trip leader) explained about the fossils, especially *Phuwiangosaurus Sirindhornae* (Figure 3). She highlighted that the sandstone where the fossils lay was very hard, therefore the paleontologists who recovered the fossils needed to work with great care as not to ruin the fragile bones. Moreover, during the rainy season, the site faced threats of flood. Efforts to protect the site included digging shallow trenches so that the water would not cover the base of the fossils. When GEOSEA participants arrived at the site, another big group of school children came as well. They wanted to witness and celebrate the discovery of the big dinosaurs that roamed the earth million years ago. This also shows how important "Geoscience for Society", referring back to the topic of the conference.

Sirindhorn Museum

From the excavation site, the conference participants were led to another building nearby which is called Sirindhorn Museum. The royal princess Maha Chakri Sirindhorn had granted her name to be used as the name for the museum. Before proceeding to the exhibition hall which is in level two, the trip leader brought the group to another room in level one. In this room several activities were taking place, including a laboratory hall and a storage facility. Plenty of vertebrate fauna fossils were displayed in the hall, such as small turtles which were stacked on top of each other, fish, and crocodiles. Some fossils were set on the tables, but many others were laid on the floor. One most photographed fossil was a piece of bone which was nearly two meters high. It was said to be from one of the dinosaur's legs.

At Sirindhorn, the GEOSEA group was also given the privilege to witness the original and clean fossils. They were kept safe in a closed and guarded room and covered shelf. The way these ancient materials were preserved was by putting them on shelves with aluminum foil as the base. Each piece of fossil was given a tag that had its taxonomy written down, the year it was found, and other important information. The leader explained that the fossils keeping was important for comparative research. The staff treasured all materials so well for they were valuable for learning and academic resources.

The 2nd level of the museum was where the fossils were elegantly displayed. The exhibition is famous for being the largest paleontological learning center and vertebrate collection in Southeast Asia. Many herbivore-type dinosaurs were displayed, although some of them were replicas. Moreover, sedimentary rocks were available in different types. In addition, one should not miss the fossil-like living fish which was swimming in an aquarium by the corner of the museum.

The Sirindhorn museum has been designed for the purpose of being a learning center for the public. Training for teachers and students in paleontology and geology programs are conducted at the site. Thus, the place makes geology for everyone. People are coming to gain information which is good for their knowledge. In addition, the museum is of great benefit for local tourism. To complete the visitor's experience, a souvenir shop was provided at the end of the trip. Lots of ideas and creativity are shown by the things for sale which made the journey fun and entertaining.

Khon Kaen, Cenozoic petrified wood

Mesozoic to Cenozoic petrified woods are very rich in Northeast Thailand, in particular in the Khorat plateau. Several scientists have reported it in the 1920s (Wang *et al.*, 2006). Since then, many surveys and work of investigation have been carried out to analyze them.

The field trip to the Cenozoic wood fossil took less than an hour from the hotel. It is located in Bon Non Khon, Khon Kaen province. When the group arrived, the leader, Prof. Rungroj Arjwech, explained the geology of the area and the wood fossils (Figure 4). And, it was not long before the people began to notice that there were plenty of wood fossils trapped in sedimentary rocks. The fossils were scattered on the ground and there were fossils which were partially exposed.

The wood fossil log sizes ranged up to 14.8 m long (Figure 5). They provided good evidence of what environment they were growing in. The logs were probably deposited in a moist forest environment which was cooler than the present day. It was concluded that the fossil wood in Khon Kaen is from the Plio-Pleistocene age, about 5 Ma BP to 10 Ka BP. And, the plants and climate during the deposition resembled those of the present day because the ecosystem was a semi-evergreen forest (Arjwech, R., 2024 in Benyasuta, 2003).

During the trip, the leader explained that the depositional environments of the fossils range from fluvial to alluvial settings. The participants strongly argued, however, that the deposition in the site was in a fluvial environment, which was shown by the presence of the gravels. The channels made it possible for the gravel to be transported and deposited. Further discussion amongst the participants in the site was whether the petrified woods were originally in situ or transported, and what kind of tree they originated from. Scientists (Boonchai *et al.*, 2009) recognized the fossils from the Miocene to Pleistocene, and their kinds were very diverse, such as from families of Leguminosae, Dipterocarpaceae, and Combretaceae.

For the benefit of the GEOSEA participants, the leader provided a concise summary of the field trip in a printed book. He divided the sediment deposits into four units (Figure 6). Unit 1: Conglomeratic sand. This is the lowermost unit, unconformably overlying the Khok Kruat Formation. It was 3-5 m thick, and composed of clays, sands, and gravel. This unit can be divided into a conglomeratic sand facies and a channeled-filled sand facies.

The first facies is the conglomeratic sand, which was a 3-4 m thick sand unit, containing red coarse-grained sand with a yellowish-brown weathered color. The gravel diameters range between 0.5-5 cm. The gravels contained white quartz fragments, were subrounded to subangular, had low sphericity, and were poorly sorted. The upper section has eroded, forming channels. The sandstone in this facies is fining upward with cross-bedding. The second facies is a channel-filled sand facies. This facies is 0.5-1.5 m thick, containing fine- to medium-grained sands with a few yellow clays that have a brownish-orange weathered color and were moderately sorted. The gravels were 0.3-0.7 cm in diameter.

Unit 2: Lenticular gravel with sand. This unit was 1-4 m thick, conformably overlies unit 1, and comprises interbedded layers of gravels and sand. Moreover, it can be divided into two facies. The first facies was clast-supported gravel, 0.2-1 m thick. This consists of white quartz clasts with diameters ranging from 0.5-6 cm. The majority of the clasts were quartz (70%). The remainder were sandstone (15%) and other minerals and rocks such as flint, chert, silicified shale, and shale (15%). The sediments were consolidated, forming lenticular beds. The facies is coarsening-upward and contain pieces and complete logs of petrified wood.

The second facies of lenticular gravel with sand unit was sand facies. They consisted of red, coarse-grained sands which were well-rounded to subangular, with high sphericity and moderate to poor sorting. This facies of 0.5-2.5 m thick, was consolidated and contains muscovite and feldspar. The cross bedding orientation indicates a paleocurrent direction from northwest to southeast.

Unit 3: Massive gravel. This is with dark reddish-brown weathered color, 2-5 m thick, and conforms to the overlying Unit 2. It is clasts supported and poorly sorted, primarily composed of white quartz clasts. A minor amount of fragments within the sandstones are flint, chert, silicified shale, and shale clasts. The gravels have diameters ranging from 0.5-7 cm. This unit is well consolidated and contains a few red-colored soil. Some parts of the unit exhibit a fining-upward trend, forming channel deposits. Pieces and entire logs of petrified wood are found in this unit.

Unit 4: Red soil. The contact between unit 3 and unit 4 is gradational. This unit is 1-2 m thick and consists of unconsolidated red soil with a dark reddish-brown weathered color. The red soil was possibly transported and deposited by fluvial processes because the sediments were moderately sorted, and only a few of them are gravel-sized grains.

The petrified wood pit at Ban Non Rang, Khon Kaen, was an open pit, accessible to the public. It has no building for conservation or exhibition, unlike other prominent fossil sites in the region, such as Phum Kum Kao dinosaur excavation in Non Buri District. There were no other visitors at the pit except GEOSEA participants. Nevertheless, the open pit gave a natural feeling like in the forest, and the weather was bright and sunny and all participants benefited from the trip and discussion.

During the GEOSEA conference, the Malaysian delegates took the opportunity to present their geological papers, which were about 15 in total. Seven of them were from the petroleum category; four from engineering, hazard, and

geotourism; three from mining; one talk on geothermal. The research location came from various places, but the majority were from Sarawak and Peninsular Malaysia (Figure 7).

Conclusion

Khon Kaen is indeed a great place to visit, especially for geoscientists in Southeast Asia. The discovery of dinosaur remains in the province of Khon Kaen has inspired the whole city to see itself from a greater perspective; a town with an iconic feature. People can view dinosaur-shaped monuments across several spots such as at the corner of the road outside the Khon Kaen Airport, by the junction, and in the shopping mall's park. Dinosaurs are the pride and treasure of the place. It was all inspiring. In addition, a 'dinosaur' was even used as a token to accompany the memento given to the conference presenters.

References

Arjwech, R., 2024. Pre-Conference Fieldtrip-GEOSEA 2024 Hand-out, Khon Kaen.

Boonchai, N., Grote, P. J. & Jintasakul, P., 2009. Paleontological parks and museums and prominent fossil sites in Thailand and their importance in the conservation of fossils.- In: Lipps, J.H. & Granier, B.R.C. (Eds.), PaleoParks - The protection and conservation of fossil sites worldwide. Carnets de Géologie / Notebooks on Geology, Brest, Book 2009/03, Chapter 07 (CG2009_BOOK_03/07). https://www.researchgate.net/publication/286206751_Paleontological_parks_and_museums_and_prominent_fossil_sites_in_Thailand_and_their_importance_in_the_conservation_of_fossils.

Tourism Authority of Thailand. https://www.tourismthailand.org/Attraction/sirindhorn-museum

Wang, et al., 2006. Recent advances in the study of Mesozoic-Cenozoic petrified wood from Thailand. Progress In Natural Science, 16(5). https://www.nsfc.gov.cn/csc/20345/24371/pdf/2006/Recent%20advances%20in%20the%20study%20of%20Mesozoic-Cenozoic%20petrified%20wood%20from%20Thailand.pdf.

Figure 2: GEOSEA 2024 final circular highlighting the Dinosaurs and the Khorat Plateau terrain and the program outline.

Figure 3: Excavation site of Dinosaur fossils, Khon Kaen, visited by GEOSEA 2024 participants. The guide, Dr. Phornphen Chanthasit, standing on the fossil excavation ground.

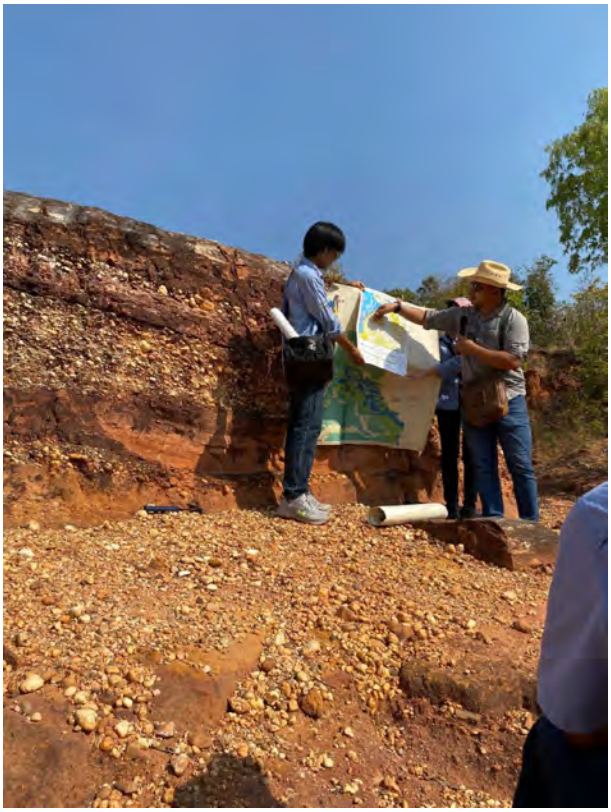

Figure 4: Prof. Rungroj Arjwech, explained the geology of the area and the wood fossils.

Figure 5: A long wood fossil (>10m) trapped in the conglomeratic unit.

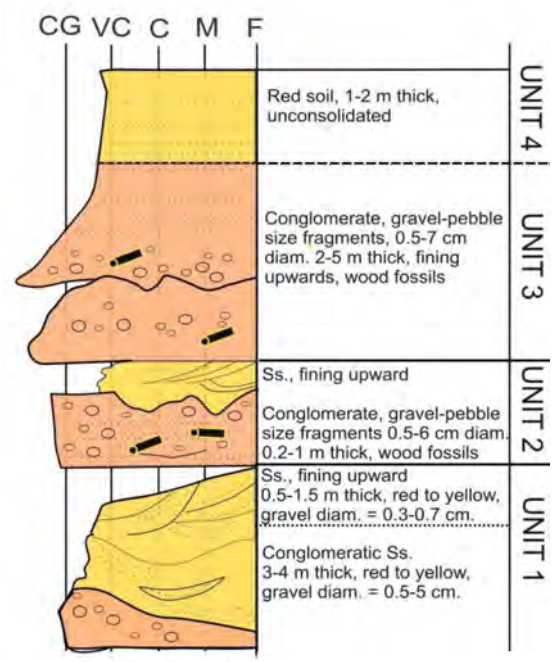

Figure 6: Four Units of Sediment Deposits in Petrified wood pit, Khon Kaen.

Figure 7: GEOSEA 2024-Malaysian delegates.

Prepared by,
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Geology Museum Open Day 2024

Geology Museum Open Day 2024: Bridging the gap with society

In the current century, museums are encountering significant challenges. The public's connection to the scientific mindset has diminished, and the audience demographic is ageing and dwindling. Additionally, geological museums find themselves holding less significance compared to other museum types. The evolving definition of a museum has shifted from a functional focus (acquiring, conserving, and exhibiting art for study and education) to a more purpose-driven approach, emphasizing enjoyment and learning for the public. The primary goal is now to serve society, cater to visitors' needs, enhance accessibility, and cultivate diverse audiences. To achieve these objectives, the museum authorities employ conventional marketing tools, with a particular emphasis on designing special events. Events play a crucial role in fostering community bonds, strengthening a sense of belonging, and ultimately expanding museum audiences. A key responsibility for museums is reaching out to non-visitors, democratizing access, and promoting social inclusion to increase the diversity of museum-goers. Recognized by governments for their societal role, museums have a vital function in promoting social inclusion. Furthermore, attracting new audiences and establishing robust connections with visitors is imperative for the survival of museums. To remain viable and deserving of public support, the Geology Museum at Department of Geology, Universiti Malaya has broadened its appeal to encompass a wider demographic by organising a three days Open Museum from 14th – 16th May 2024.

The Geology Museum of Universiti Malaya is dedicated to educating the public through its exhibits, collections, public lectures, guided tours and other annual programs. We strive to provide a wide range of unique learning experiences that will enhance our visitors' understanding of the natural world. The museum has a wide collection of rocks, minerals and fossils from Malaysia and other parts of the world. It is very important that the students and general public be aware of the importance of the natural resources and the fossils we have in our country. By understanding the past, we can also better prepare to deal with the present environmental and biodiversity crisis. Studying ancient life needs new energy and more people specialising in it in Malaysia. Palaeontology, the study of prehistoric life is an area that should be expanded to reach its full potential here. Currently in Malaysia, there are very few palaeontologists. So, one of our major goals in organizing this event is for visitors to gain a deeper appreciation for the fossil wealth of our region, and a better understanding of how important these fossils are in helping scientists interpret major events in Earth's history, including the evolution and diversification of life on our planet. Globally every year Fossil Day is celebrated in October so in connection with this, the Department of Geology at Universiti Malaya also celebrate the day last year on 04th November 2023 to promote the educational and scientific value of fossils and other geological treasures.

This 2024 Open Day was organized in correlation with the Sapphire Jubilee (65 years) of Faculty of Science, UM in collaboration with the Faculty of Science, UM, UM STEM and several student chapters like UM-AAPG, UM-GSM and UM-EAGE, that featured a variety of activities aimed at connecting with school students to enhance their understanding of Mother Earth and its resources. One notable event was a quiz competition for each groups that attracted a significant number of participants, reflecting the high level of enthusiasm among attendees. Prizes were distributed to all the winners for their enthusiasm. In addition to this there were various activities and hands-on experiences at the museum, organized by the student chapters.

A substantial crowd, totalling approximately 700 participants, visited the Geology Museum, underscoring the evident interest in such activities. This positive response suggests a promising outlook for future engagements. In later part of the year, there are plans for two more Open Days, aiming to foster increased connections between the Geology Museum and society, fostering greater awareness and engagement.

Department of Geology booth at the Faculty of Science.

Students entering the Museum.

Interaction with Dr Harry.

Interaction with Dr Arindam.

Interaction with Dr Hatta.

Interaction with Dr Elanni.

Interaction with Dr Ros.

Interaction with Dr Talha.

Demonstration at rock cutting laboratory.

UM-GSM student chapter booth.

UM-AAPG student chapter booth.

Visitors at Geology Museum.

Young kids experiencing the microscope.

Dr Arindam with young kids.

Group photo.

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Field Excursion

Late Paleozoic clastic deposition & compressional tectonics on Sibumasu: A one-day field excursion from Kuala Lumpur

On Sunday, 14 July, fifteen geoscientists gathered on the steps in front of Suria KLCC for a field trip to exposures of the Carboniferous to Permian Kenny Hill Formation west of Kuala Lumpur. The objective for the casual trip was to learn more about the bedrock that underlies 27% of Selangor State.

Before boarding the chartered bus, trip guides Allan Filipov and Robert Shoup briefed the group about outcrop safety and then spoke about the geologic setting of the Kenny Hill Formation and its relationship to other clastic formations deposited on the margins of Sibumasu during the Late Paleozoic Ice Age when Sibumasu was adjacent to South Polar Gondwana. With that setting in mind, we set off to find which facies have been preserved.

After a 30-minute drive from KLCC, through the Damansara Spur of the Main Range Granite, we reached the rolling hills of the Kenny Hill Formation and Stop 1. The impressive outcrop features beds that dip 23° to the southwest, with easy access on three sides and the top (Figure 1). The complete sequence from the bottom is interpreted as delta lobes that transition to river mouth bars and a transgressive delta plain. That sequence is topped by 30 meters of shale and a high-stand delta; it was pointed out that the thickness of the shale was the maximum change in the sea level. The delta lobes comprise amalgamated, fine-gray sand with sharp, non-erosive bases that pinch out laterally into thin silt and shale layers or into another sand lobe. This contrasts with the scoured base of the yellow-colored mouth bars, which are not laterally extensive and stacked without fine-grained layers between them. On the delta plain, cross-bedded sandstones with a wavy base lie over finely laminated shales with dewatering structures, indicating these sands were rapidly deposited over unconsolidated mud. The fossilized remains of large, unidentified trees are eroding from the delta plain mudstones (Figure 2) and are embedded in the upper shoreface sands. If the species can be identified, it could be helpful as a biostratigraphic marker for regional correlation. This outcrop has been undisturbed for eight years. Development has commenced nearby; we hope it remains untouched so that geoscientists can continue to visit and study geology.

Figure 1: Delta lobes are overlain by river mouth bars and a transgressive delta plain.

Figure 2: A one-meter log and other pieces of petrified wood eroded from the delta plain.

Stop 2 was at a rectangle-shaped quarry, oriented northeast-southwest. The sands in the quarry are mined as an aggregate. Walking through the narrow entrance, we observe a concave erosional surface cutting into a black shale sequence (Figure 3). It is unclear if this is the edge of an incised valley or a slump. The observation of a normal fault just to the left of the erosional surface points to a slump interpretation being more likely. The sandstone in the slump is bedded and thickened toward the fault, indicating that the fault is a growth fault. The beds dip 10 degrees southwest. The black shale also appears in the north face of the quarry, below a massive sandstone (Figure 4). Large blocks of the shale have fallen from the outcrop; in them, we found small-size ripple marks, a trace fossil, and pyrite (Figure 5). Along the 700m east wall, the beds curve around what appears to be a low-angle fault plane. The beds below the fault dip 15 degrees northeast and then curve into the fault plane, giving the appearance that the viewer is looking at the detachment surface of a refolded recumbent fold (Figure 6 a, b & c). Rocks below the detachment are polished and very fine-grained. They appear to be aeolian deposits but not dunes. They may be glacial loess deposits. The complicated relationship between the folded strata above and below the fault plane and the observations from the southeast corner of the quarry and the quarry floor led to some informative discussions and interpretations. Hence, the trip served a purpose: bringing multiple geoscientists to the outcrop, followed by an open debate on the outcrop and the regional context. Given the structural complexity, more work is necessary to fully understand the depositional environment of the black and gray shale, the massive sands, and the channel sands.

Figure 3: A normal fault with a black shale adjacent to channels.

Figure 4: The northeast wall of the quarry and black shale.

Figure 5: Trace fossils in ripples in the black shale.

Figure 6a: The nose of an overturned fold or a thrust fault?

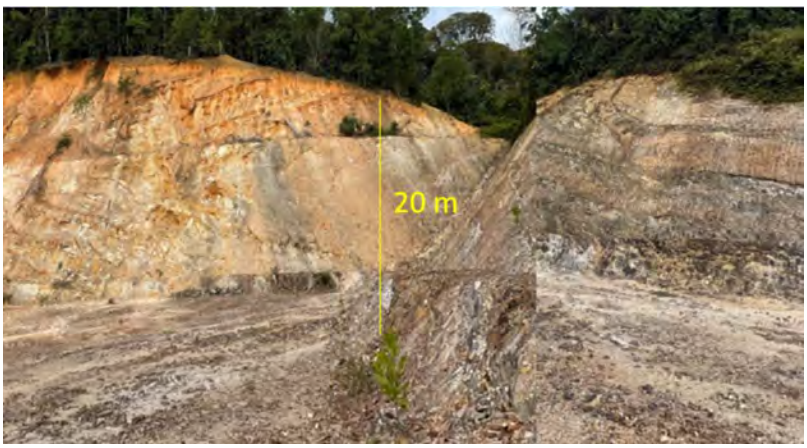

Figure 6b: A composite photo of the southeast corner of the outcrop.

Figure 6c: Close-up of the folded beds in 6b.

The day's final stop was along the entrance to Nirvana Klang Memorial Park. At this stop, we observed near-vertical beds overlying near horizontal beds (Figures 7 – 9). The steep dips at the outcrop and the hogback ridge in a road cut result from a westward-verging detachment fold or a duplex structure formed by imbricate thrust faults. The group noted the stratigraphy of the dipping beds was similar to the beds observed at Stop 1. The near horizontal beds are the detachment surface observed at Stop 2. They comprise a massive fine to very fine-grained sandstone layer that appears to have frosted grains, making a solid case that this is an eolian deposit. A new road cut at the northern end of the outcrop reveals a cross-section of the steeply dipping beds truncated by a sub-horizontal surface. This unconformity is a weathering feature resulting from the tropical climate and the development of laterite soils.

As we began to ponder the implications of the various structures we had observed, the weather, which had been pleasant all day, began to turn. Following a group photo, we boarded the bus and headed to KLCC, arriving by 3:30. The trip leaders are grateful for the opinions and comments from the participants; we hope they enjoyed the trip as much as we enjoyed having them. The next trip will be to visit the deepwater facies of the Kenny Hill Formation sometime in Q4.

Figure 7: Folded strata and the development of duplex thrust sheets (yellow arrows) are common structures in this part of the Kenny Hill Formation. The yellow box is the location for Figure 8.

Figure 8: Flaser bedding in the upper shoreface.

Figure 9: Group photo in front of vertical beds of the Kenny Hill Formation. Shown are (not in order):
Mohammed Amiruddin Amran, Irfan Othman, Nur Khaleeda Muhamad Adzrill, Aliff Imran Bin Nor Azham, Shereen Farisha Azlan Shah, Farrah Aina Mohd Zulkifli, Irving Tan, Hannah Birrah Binti Saini, Yi Zheng Lim, Chan Xian Hwa, Jonathan Brown, Mohamed Firdaus Md Jamal, Bob Shoup, Allan Filipov.

Prepared by,
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30th July 2024

AAPG UM Student Chapter

Executive Summary Report
Industrial visit to Petronas Geoscience Centre, Kuala Lumpur

On June 7th, 2024, the AAPG UM Student Chapter organized an industrial visit to the Petronas Geoscience Centre (PGSC) in Kuala Lumpur. A group of 29 students, accompanied by Associate Professor Dr. Meor Hakif, participated in this trip. The visit aimed to provide members with a firsthand understanding of the geological processes and technologies utilized in the oil and gas industry, specifically in core sample storage. Additionally, it sought to facilitate connections between students and PGSC experts to enhance their industrial and career knowledge.

At the PGSC Kuala Lumpur, the event kicked off at 9:30 am with a safety briefing given that the warehouse is an active working place followed by an introductory talk by the representatives from Petronas. During the talk, the members were introduced to the machines and operations adopted in analyzing and storing the sample data, eg: myCORE360. They also had a career-sharing session with an expert from Petronas to learn more about the alternative and unconventional pathways students could take post-graduate in the field of geology as well as oil and gas. Following that, the students were taken on a facility tour of the warehouse. Moreover, PGSC also prepared light refreshments for the students. Additionally, AAPG UM SC held a gift ceremony to express gratitude to Petronas for facilitating the visit.

The event concluded on a positive note, with an engaging and informative atmosphere. Participants gained valuable knowledge about industry practices, safety protocols, and diverse career opportunities, making it a highly enriching experience for all.

Career-sharing session by an expert from Petronas.

Students on the PGSC facility tour.

Gift presentation ceremony.

AAPG UM SC 23/24 at PGSC.

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GSM-UMS Geology Club Program

Tech-In-Geo: Paleoscan - Upskilling programme

KOTA KINABALU – In late June this year, Geology Club – GSM UMS held Tech-In-Geo: Paleoscan, an upskilling program which lasted for three days starting from 26th until 28th June 2024 at the Faculty of Science and Natural Resources (FSSA), Universiti Malaysia Sabah. This programme was organised together with Eliis, a renowned geoscience imaging solutions company that provides an array of services and training for Paleoscan software. It was a prolific event with engaging and enriching experiences with the total participation of 30 students from the UMS Geology programme.

Over the three-day programme, participants delved deep into the functionalities and technical fundamentals of the cutting-edge technology of Eliis Paleoscan, getting to know its subsurface imaging and geological interpretation features. The tutorial and live demonstration sessions were led by three proficient trainers from Eliis; Najiatun Najla Mohamad,

Welcoming of Paleoscan trainers from Eliis.

Tutorial and live demonstration session.

Nabilah Mohamed Zainuddin, and Nurbalqis Azfaruddin. Throughout the training sessions, participants learned how to interpret subsurface seismic data based on several different easy-to-follow modules including fault interpretation, horizon stacking, well data correlation and 3-dimensional relative geological time model. One of PaleoScan's primary strengths lies in its model grid generation capabilities, which utilize seismic data to produce a detailed Relative Geological Time (RGT) model of the entire seismic cube. This allows for full visualization and interpretation. The RGT model can be sliced into horizon stacks, enabling users to efficiently screen through the entire seismic volume.

Overall, this programme is beneficial to participants and sparked their enthusiasm for further learning and skill development of Paleoscan skills in the future. This programme is not only intriguing for students, but also lecturers.

A big thank you to Eliis for their generous support in guiding the next generation of future geoscientists and helping to equip them with valuable skills that are in high demand by the industries. We also would like to take this opportunity to express our heartfelt gratitude to Prof. Dr. Jualang, Dean of FSSA and Assoc. Prof. Dr. Chee, Deputy Dean of Student Affairs and Alumni (FSSA) for their endorsements in this programme.

Honouring certificate of appreciation to Eliis Paleoscan trainers by the dean of the Faculty of Science and Natural Resources.

Honouring certificate of training completion to participants by Eliis trainers.

Prepared by,
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Universiti Malaysia Sabah, Malaysia

Board Of Geologists Malaysia

The Board of Geologists Malaysia (BoG) was established under Section 3 of Geologists act 2008, Act 689 Laws of Malaysia. This Act officially went into operation on 28th November 2014, as appointed by the Minister.

The BoG is a body corporate and a professional body under the Ministry of Natural Resources and Environmental Sustainability (NRES). The Board's mandate is for the registration of Geologists, the regulations of Geological Practice and for related matters. Another function of the Board is to make recommendations to the Government or to any public authority, local authority or statutory authority or to any institute, body or society which, in the opinion of the Board, represents the Geological Profession.

It was in late 2015, after the regulations titled "Geologists (Registration of Geologists) Regulations 2015" was approved and in force, the Board began its process of registration. There are four (4) categories of registration, which are Registered Professional Geologist, Registered Graduate Geologist, Registered Foreign Geologist and Registered Practitioner. Only Registered Professional Geologists are entitled to use the abbreviation "P.Geol." in association with his/her name.

For the year 2023, the number of Registered Geologists was 1,494 from various fields of Geology. The number of registered geologists according to category are as follows:

Registered Professional Geologists	: 932
Registered Graduate Geologists	: 456
Registered Foreign Geologists	: 103
Registered Practitioners	: 3

In 2022, the BoG initiated upgrades of their examination system for the Registration of Professional Geologists. By the end of June 2023, a new version of a two-part examination system was ready to be implemented, and the first two-part examination was conducted on 6th July 2023.

As of today (25th June 2024), the BoG has successfully organised three rounds of examinations, and 73 candidates have successfully passed the examinations. However, of these 73 candidates, only 38 candidates have completed their registration as Registered Professional Geologists.

Thus, BoG hereby congratulates the new Registered Professional Geologists as follows:

1. P.Geol. Siti Aisyah Binti Razali (PG 1572)
2. P.Geol. Cyprians Pang (PG 1579)
3. P.Geol. Shazmin Binti Muhammad Afandi (PG 1583)
4. P.Geol. Izharuddin Bin Sakip (PG 1578)
5. P.Geol. Mohamad Fatihi Bin Abdul Patah (PG 1575)
6. P.Geol. Nurul 'Amalina Binti Md Nor (PG 1576)
7. P.Geol. Steffizie Hurie Liwan (PG 1581)
8. P.Geol. Muhammad Hassan Bin Abdul Hamid (PG 1582)
9. P.Geol. How Yi Eng (PG 1580)
10. P.Geol. Nick Farhan Zakiran Bin Mahadi (PG 1577)
11. P.Geol. Damian Luhat Ngau (PG 1571)
12. P.Geol. Mabelyn Tay Yen Choo (PG 1566)
13. P.Geol. Lum Chee Kong (PG 1568)
14. P.Geol. Nur Izzati Binti Mohd Asri (PG 1570)
15. P.Geol. Mohd Baba Mok (PG 1569)
16. P.Geol. Farhana Binti Mansor (PG 1567)

17. P.Geol. Leeroy Gayok Anak Albert Berundang (PG 1564)
18. P.Geol. Saidatul Nadirah Binti Amir (PG 1565)
19. P.Geol. Nordiana Binti Mohd Muztaza (PG 1573)
20. P.Geol. Mohamad Faruq Syahmi Bin Md Aripin (PG 1574)
21. P.Geol. Louvis Ferrer Jefree (PG 1563)
22. P.Geol. Nurazlin Bt Abdullah (PG 1585)
23. P.Geol. Azrae Bin Mohd Saad (PG 1584)
24. P.Geol. Nur Zulfa Binti Abdul Kalid (PG 1586)
25. P.Geol. Mohd Yazid Bin Zulkeply (PG 1587)
26. P.Geol. Shamsul Arif Bin Haruna (PG 1588)
27. P.Geol. Muhamad Herman Bin Jamal (PG 1589)
28. P.Geol. Nurul Jazlina Binti Zairul Rizal (PG 1590)
29. P.Geol. Noran Nabilla Bt Nor Azlan (PG 1591)
30. P.Geol. Abdul Hadi Hashim (PG 1592)
31. P.Geol. Nor Faizah Binti Saudin (PG 1593)
32. P.Geol. Muhammad Nurfathi Bin Mohd Rapi (PG 1594)
33. P.Geol. Jenetius Miun (PG 1595)
34. P.Geol. Nur Azera Binti Meddin (PG 1596)
35. P.Geol. Norshakira Binti Ab Ghani (PG 1597)
36. P.Geol. Muhamad Zubir Bin Mohd Tarmizi (PG 1598)
37. P.Geol. Nur Amirah Binti Roslan (PG 1599)
38. P.Geol. Ahmad Fikri Bin Sarpan (PG 1600)

Prepared by,
Nooramiera Natasha Wizan
Registration Executive BoG
25th June 2024

UPCOMING EVENTS

August 25-31, 2024: 37th International Geological Congress (IGC 2024); Busan, Republic of Korea. Further information about the conference can be found at https://www.iugs.org/igc.

August 26-29, 2024: AAPG International Meeting for Applied Geoscience & Energy (IMAGE) 2024, Houstan, Texas, US. More details at https://www.imageevent.org/.

September 2 - 6, 2024: IFFA 2024 - 13th International Symposium on Fossil algae; Le Castella, Calabria, Italy. Website: https://cresciblureef.unimib.it/ifaa-2024/.

September 22 - 25, 2024: GSA Connects 2024, Anaheim, USA. Website: https://community.geosociety.org/gsa2024/home.

September 23-25, 2024: 2024 Annual Technical Conference & Exhibition (ATCE); New Orleans, Louisiana, USA. More details at https://www.atce.org/.

September 30 - October 2, 2024: AAPG International Conference and Exhibition (ICE); Muscat, Oman. Details at https://muscat2024.iceevent.org/.

October 1 - 4, 2024: Southern African Geophysical Association (SAGA) workshop, "Integrated interpretation of geology and geophysics"; Windhoek, Namibia. Website: https://sagaconference.co.za/workshops/integrated-interpretation-of-geology-and-geophysics/.

October 8 - 12, 2024: EUROENGEO 2024 - 4th European Regional Conference of IAEG - Engineering Geology and Geotechnics: Building for the Future; Dubrovnik, Croatia. Website: https://www.euroengeo2024.com/.

October 15 - 18, 2024: ASEG 2024 Discover Symposium - Australian Society of Exploration Geophysicists; Hobart, Tasmania, Australia. Website: https://asegdiscover.com.au/.

October 21-24, 2024: AAPG/ EAGE/ SEG Digitalization in Geosciences Symposium; Khobar, Saudi Arabia. More details at https://www.aapg.org/global/middleeast/events/announcement/articleid/65046.

October 22 - 24, 2024: DEEP 2024 - Deep Earth Exploration and Practices; Beijing, China. Website: http://deep2024.sinoprobe.org/.

November 4-6, 2024: 4D Forum – Insight to Actions: A global forum on creating value, reducing cycle time and optimizing production and injection in a digital world; Galveston, Texas. More details at https://seg.org/calendar_events/4d-forum-insight-to-actions-creating-value-reducing-cycle-time-and-optimizing-production-and-injection-in-a-digital-world/.

November 7-9, 2024: 5th International Conference on Geology and Earth Sciences; Bali, Indonesia. Get in touch with Ms. Vera Lee (Conference Secretary of ICGES), Tel.: +86-18123342942 or email to icges_contact@academic.net for more information.

November 18-20, 2024: International Geomechanics Conference 2024, Kuala Lumpur, Malaysia. More details at https://www.igsevent.org/.

November 19-21, 2024: Latin America and Caribbean Energy Summit 2024: Security, Strategy and Transition; Punta Del Este, Uruguay. More details at https://www.aapg.org/global/latinamerica/events/announcement/articleid/66156.

November 20-21, 2024: Asia Petroleum Geoscience Conference & Exhibition (APGCE) 2024, Kuala Lumpur Convention Centre, Malaysia. For further enquiries, please contact : Intan Bhaizura, Tel: +6012 342 2979, Email: bhaizura@icep.com.my or Noor Diyana Atiqah, Tel: +6012 614 3063, Email: diyana@icep.com.my.

November 25 - 29, 2024: GSNZ Annual Conference 2024; Dunedin, New Zealand. Website: https://confer.eventsair.com/gsnz2024/.

December 4-5, 2024: 2024 Annual Geological Convention (GEOCON 2024): The Filipino Geologists- Bridging Geoscience, Technology, and Industry for a Better Philippines, Novotel Hotel, Quezon City. More details at https://geolsocphil.com/event/view?id=55.

February 5-7, 2025: 2025 NAPE Summit, Houston, TX. More details at https://napeexpo.com/.

February 18-20, 2025: International Petroleum Technology Conference (IPTC); Kuala Lumpur, Malaysia. More details at https://www.iptcnet.org/2025.

April 6-8, 2025: GeoGulf 2025, Nacogdoches. More details at https://geogulf2025.org/.

August 24-29, 2025: SEG/ AAPG International Meeting for Applied Geoscience & Energy (IMAGE) 2025, Houstan, Texas, US. More details at https://www.aapg.org/events/conferences/ace/announcement/articleid/64036.

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Abstracts in Malay (optional for manuscripts in English) and English, each in one paragraph and should not exceed 300 words, is mandatory. It should clearly identify the subject matter, results obtained, interpretations discussed, conclusions reached and significance of the study. The abstract should not contain any undefined abbreviations or references.

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Chapter of book and Symposium volume:
Hosking, K.F.G., 1973. Primary mineral deposits. In: Gobbett, D.J. & Hutchison, C.S. (Eds.), Geology of the Malay Peninsular (West Malaysia and Singapore). Wiley-Interscience, New York, 335-390.

Article in Malay:
Lim, C.H. & Mohd. Shafeea Leman, 1994. The occurrence of Lambir Formation in Ulu Bok Syncline, North Sarawak. Bulletin of the Geological Society of Malaysia, 35, 1-5. (in Malay with English abstract).

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