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Guidelines for rare earth elements (REE) exploration in Malaysia: A look into the rise of REE exploration in the country

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Abstract: The ion-adsorption clay type rare earth elements deposit (IAC-REE) is recognised as one of Malaysia's strategic mineral resources due to its high global demand and economic potential. REEs are important raw materials for advanced sectors such as electronics, green technology, defence, catalysis, and automotive manufacturing. As IAC-REE exploration in Malaysia is relatively new and not yet well understood, the Department of Mineral and Geoscience Malaysia (JMG) has developed guidelines to assist its officers with the fundamentals of exploration and the interpretation of laboratory results. JMG has published two editions of these guidelines. The first edition, published in 2015, provides an overview of REE genesis and global deposit types, along with a step-by-step approach to conducting reconnaissance surveys. The second edition, published in 2023, is an updated version that focuses more on the genesis of IAC-REE deposits, provides guidance for subsequent exploration, and includes methods for calculating resources, while also addressing in-situ leaching (ISL) method and environmental concerns associated with irresponsible REE mining. These guidelines are based on reputable local and international journals and research studies. This paper aims to outline the contents of the second edition of the guidelines and highlight their relevance to the IAC-REE exploration conducted by JMG.

Keywords: Rare earth elements, ion adsorption clay, exploration guidelines, in-situ leaching, Malaysia

Abstrak: Endapan unsur nadir bumi jenis lempung jerapan ion (IAC-REE) diiktiraf sebagai salah satu mineral strategik Malaysia kerana permintaan global yang tinggi dan potensi ekonominya. REE merupakan bahan mentah penting dalam sektor berteknologi tinggi seperti elektronik, teknologi hijau, pertahanan, pemangkin, dan pembuatan automotif. Memandangkan penerokaan IAC-REE di Malaysia masih baharu dan kurang difahami, Jabatan Mineral dan Geosains Malaysia (JMG) telah membangunkan garis panduan bagi membantu pegawai-pegawai geosains memahami asas-asas aktiviti penerokaan dan tafsiran hasil makmal. JMG telah menerbitkan dua edisi garis panduan ini. Edisi pertama yang diterbitkan pada tahun 2015 merangkumi pengenalan kepada genesis REE dan jenis-jenis endapan di peringkat global, serta pendekatan langkah demi langkah untuk menjalankan tinjauan peninjauan awal. Edisi kedua, diterbitkan pada tahun 2023, merupakan versi terkini yang memberi fokus lebih mendalam kepada genesis endapan IAC-REE, panduan untuk kerja susulan penerokaan, serta kaedah pengiraan sumber. Ia turut merangkumi penerangan tentang kaedah perlombongan larut resap setempat (ISL) dan isu alam sekitar berkaitan perlombongan REE yang tidak bertanggungjawab. Garis panduan

ini dibangunkan berdasarkan jurnal dan kajian penyelidikan tempatan serta antarabangsa yang berwibawa. Justeru, kertas kerja ini bertujuan menghuraikan kandungan edisi kedua garis panduan ini dan mengetengahkan kepentingannya dalam konteks penerokaan IAC-REE oleh JMG.

Kata kunci: Unsur nadir bumi, lempung jerapan ion, garis panduan eksplorasi, larut resap setempat, Malaysia

INTRODUCTION

Rare earth elements (REEs) are a group of 17 chemically similar metallic elements comprising the 15 lanthanides together with yttrium (Y) and scandium (Sc). They are generally divided into two subgroups based on atomic number and geochemical behaviour: light rare earth elements (LREEs)—from lanthanum (La) to samarium (Sm)—and heavy rare earth elements (HREEs)—from gadolinium (Gd) to lutetium (Lu), including yttrium.

REEs are critical components in the rapidly evolving global technology landscape. Their unique magnetic, catalytic, and luminescent properties make them indispensable in high-value sectors such as renewable energy, advanced electronics, defence systems, green technology, and electric vehicles. The growing global demand for REEs, particularly HREEs, has intensified exploration and development efforts worldwide, driven by their critical role in permanent magnets, electric vehicles, wind turbines, and advanced electronics.

REEs occur in a wide range of geological environments and mineral phases. Common primary REE-bearing minerals include monazite (rich in LREEs such as Ce, La, Nd, and Pr), xenotime (dominated by Y and HREEs including Dy, Er, and Yb), bastnäsite (a major host of LREEs, particularly Ce, La, Nd, and Pr), allanite (an LREE-bearing silicate containing Ce, La, and Nd), and zircon (typically enriched in Y and HREEs such as Yb, Er, and Dy). In tropical weathering environments, however, REEs are often enriched within ion-adsorption clays (IACs)—formed through prolonged chemical weathering and leaching of granitic rocks. These IAC-type deposits are of increasing interest due to their relative ease of extraction through ion-exchange leaching, which is more environmentally sustainable than conventional hard-rock mining.

In Malaysia, potential REE occurrences have been reported primarily in Terengganu, Kedah, Pahang, Negeri Sembilan, Perak, and Kelantan, where deeply weathered granitic bodies provide favourable conditions for the formation of IAC-type REE deposits. Malaysia's tropical climate and lateritic-granitic terrains share strong geological similarities with REE-producing regions in southern China, the world's leading producer of IAC-REEs.

Recognising this geological potential, the Department of Mineral and Geoscience Malaysia (JMG) initiated structured REE exploration programmes and took a pivotal step by developing REE Exploration Guidelines

tailored to the Malaysian context. These guidelines serve to standardise exploration procedures, ensure scientific accuracy, and provide a solid foundation for responsible, effective, and environmentally sound REE exploration across the country.

The main objective of this paper is to present and describe the updated framework outlined in the second edition of Malaysia's Rare Earth Elements (REE) Exploration Guidelines developed by JMG. The paper aims to highlight key technical aspects of the guidelines—particularly those related to the exploration of ion-adsorption clay-type REE (IAC-REE) deposits—covering sampling methods, analytical procedures, data interpretation, and resource estimation approaches.

FIRST EDITION OF THE GUIDELINES (2015)

The first edition of the REE Exploration Guidelines, published in 2015, was a fundamental step in Malaysia's journey toward the development of rare earth resources (Figure 1). It introduced essential concepts related to REE deposit formation and described major types of occurrences, including alkaline igneous rocks, carbonatites and ion adsorption clay (IAC) deposit types. The issue also outlines general exploration workflows such as regional geological mapping, geochemical sampling, and preliminary geophysical surveys.

While it effectively laid the groundwork for REE exploration, the first edition provided only limited coverage of IAC-type deposits. Critical aspects such as the tropical weathering processes responsible for REE enrichment, specific sampling strategies for weathered profiles, and in-situ recovery techniques were only briefly mentioned. As fieldwork in Malaysia progressed, new findings—alongside a growing body of international research—highlighted the need for more in-depth and context-specific technical guidance, especially for REEs associated with weathered granitic terrains.

The seminal works by Banfield & Eggleton (1989), Bao & Zhao (2008) and Aubert *et al.* (2000) provided key insights into REE mobilisation, fractionation, and fixation during granite weathering. Studies by Compton *et al.* (2003) and Imai *et al.* (2008) further enhanced the understanding of REE behaviour in tropical soils and granitic crusts, while Sanematsu & Kon (2013) contributed crucial geochemical evidence from ion-adsorption deposits in southern China. Together with regional data from Thailand (Imai *et al.*, 2008; Sanematsu *et al.*, 2013) and global assessments by Kanazawa & Kamitani (2006),



Figure 1: Front covers of the first edition (left) and second edition of REE exploration guidelines (right), published by JMG.

these pre-2015 studies formed the foundational scientific framework underpinning the first edition of Malaysia's REE exploration guidelines, particularly in relation to REE mobilisation and fractionation during granite weathering.

Overall, these studies emphasized the importance of climate-driven weathering, horizon-specific REE enrichment, and the distinct mineralogical and geochemical characteristics of IAC deposits—factors that would become central in the second edition of the guidelines.

SECOND EDITION OF THE GUIDELINES (2023)

The second edition of the REE Exploration Guidelines, published in 2023, reflects the growing strategic importance of ion-adsorption clay (IAC)-type REE deposits in Malaysia and introduces significant refinements in exploration and extraction methodologies. A major improvement is the clearer and more systematic explanation of REE abstraction mechanisms within weathered profiles, which are classified into three distinct phases: ion-exchange, colloidal, and mineral-bound phases.

The ion-exchange phase represents the most accessible and economically significant component, accounting for approximately 60–90% of recoverable REEs. In this phase, REEs are

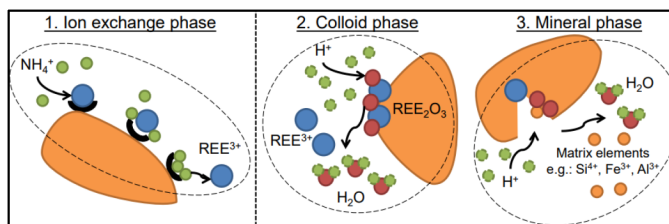


Figure 2: Illustration of the ion-exchange, colloid and mineral phases in ion-adsorption clay (after Voßenkaul *et al.*, 2015).

weakly adsorbed onto clay mineral surfaces and can be extracted through cation-exchange reactions using monovalent cations, most commonly ammonium (NH_4^+) in the form of ammonium sulfate $[(\text{NH}_4)_2\text{SO}_4]$. The colloidal phase comprises REEs present as insoluble oxides, hydroxides, or organometallic complexes, which typically require mild to moderate acid leaching for recovery. In contrast, the mineral-bound phase consists of REEs locked within resistant primary or secondary mineral lattices and can only be liberated through aggressive treatments such as high-temperature alkaline processing or strong acid digestion (Figure 2).

Since the publication of the first edition in 2015, substantial advances have been made in understanding the mineralogical controls, adsorption mechanisms, and leaching behaviour of IAC-type REE deposits. These post-2015 studies provided the scientific foundation for the refinements incorporated into the second edition of the guidelines. In particular, Li *et al.* (2017; 2019) and Li & Zhou (2020) proposed integrated genetic models for regolith-

hosted REE deposits in South China, highlighting the critical role of clay mineralogy and progressive weathering in governing REE mobility and enrichment.

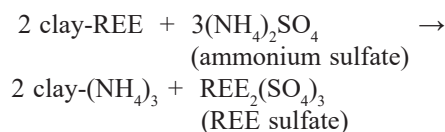
Earlier mineralogical studies, such as those by Papoulis *et al.* (2004a; 2004b), which documented kaolinization and monazite alteration processes, remain relevant as supporting background, while more recent works—including Verplanck (2017)—have further elucidated the role of fluids in REE transport and redistribution within weathered profiles.

From a processing perspective, recent studies by Voßenkaul *et al.* (2015) and Nawab *et al.* (2022) have advanced the understanding of REE speciation and recovery behaviour, including the use of oxalic acid and alternative leaching agents applicable to non-Chinese IAC deposits. These findings underpin best-practice recommendations for environmentally responsible extraction methods suited to Malaysia's tropical regolith conditions.

Overall, the second edition of the guidelines promotes a more focused mineralogical and geochemical approach to IAC-REE exploration and recovery, aligning Malaysia's REE exploration framework with contemporary international standards and evolving global best practices.

IN-SITU LEACHING (ISL) TECHNIQUES

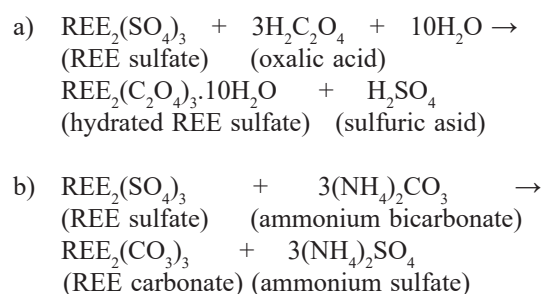
The second edition guideline contains details procedures for ISL, a minimally invasive mining method suitable for IAC-REEs. Site preparation begins with shallow borehole drilling (1.5–3.0 m depth, at 2–3 m spacing). Horizontal collection trenches or pipes are constructed parallel to the bedrock to direct the pregnant solution into a containment area. Lixivants solution such as ammonium sulphate or other monovalent salts are injected, and flocculants such as polyacrylamide (PAM) are added to remove impurities such as Al and Zn. During the in-situ leaching (ISL) process, the use of ammonium sulphate $[(\text{NH}_4)_2\text{SO}_4]$ as a lixiviant leaching agent triggers a cation exchange reaction, in which ammonium ions (NH_4^+) are adsorbed by clay minerals in the soil, releasing rare earth elements (REEs) into solution as REE sulfates. The reaction can be simplified as follows:



The ISL method is environmentally friendly but geographically limited; it is best implemented in hilly terrain. Comprehensive site investigations—including geotechnical, hydrogeological, and mineralogical studies—are essential to assess the REE grade, leaching efficiency, and potential risks such as groundwater contamination and slope instability.

Precipitation and recovery

The guidelines examine several precipitation agents for the recovery of REEs from the pregnant leach solution. Oxalic acid is the most commonly used due to its strong affinity for REEs and its ability to produce high-purity REE oxalates. However, it is also known to be carcinogenic and poses environmental health concerns. In contrast, ammonium bicarbonate is a more practical and environmentally safer alternative for large-scale operations, providing REE carbonates along with recyclable by-products such as ammonium sulphate. The chemical reactions that take place during REE precipitation with oxalic acid and ammonium bicarbonate are as follows:



Oxalic acid and ammonium bicarbonate exhibit contrasting environmental, economic, and processing characteristics as precipitants for REE recovery from pregnant leach solutions. Oxalic acid precipitates REEs as insoluble oxalates through a highly selective mechanism, producing high-purity products due to its strong affinity for REEs and limited co-precipitation of impurities such as Fe, Al, and Mn (Han, 2020). However, its application involves higher reagent costs, strict pH control under acidic conditions (pH ~1–2), and the generation of acidic by-products that increase waste management and environmental burdens, particularly at large scales.

In contrast, ammonium bicarbonate precipitates REEs as carbonates and offers a more cost-effective and environmentally benign option for bulk operations, with simpler process control and fewer persistent waste residues due to its decomposition into CO_2 , NH_3 , and H_2O . Nevertheless, the resulting REE carbonates generally exhibit lower purity owing to co-precipitation of elements such as Ca and Mg, which may require additional downstream purification if high-grade products are desired. In line with Malaysia's REE mining standard operating procedures (SOPs), the use of ammonium-based reagents—particularly ammonium sulphate—is mandated in preference to oxalic acid to minimise environmental risks and ensure regulatory compliance.

Accordingly, ammonium-based systems are favoured for large-scale and environmentally responsible REE operations in Malaysia, while oxalic acid remains more suitable for controlled laboratory or small-scale applications where high selectivity and product purity are prioritised.

Impurity removal

Within the precipitation and recovery process, impurity removal is achieved through controlled pH manipulation, enabling the staged separation of impurities and rare earth elements.

Ammonium bicarbonate functions not only as a precipitating agent but also as a pH regulator, progressively increasing the solution pH with increasing reagent dosage. At an approximate 1:1 molar ratio of ammonium bicarbonate to rare earth elements, the solution pH rises to around 5, promoting the selective precipitation of impurities such as Fe and Al.

Further addition of ammonium bicarbonate, at molar ratios exceeding 3, increases the pH to above 8, triggering the precipitation of REEs as carbonates. To maximise REE recovery, a molar ratio of approximately 4:1 between ammonium bicarbonate and REO is typically applied.

Following precipitation, the recovered REE carbonates are calcined at an optimum temperature of about 900 °C to produce rare earth oxides (REOs).

FOLLOW-UP EXPLORATION AND SAMPLING TECHNIQUES

The second edition emphasizes rigorous and systematic sampling protocols. Soil samples are collected at consistent depth intervals (e.g., every 1 m) using control holes, with sampling conducted on a regular grid at approximately 200 m spacing, and focused on the lower B to upper C horizons—zones generally recognised as the main REE enrichment layers (Figure 3), as supported by numerous studies including Yaraghi *et al.* (2020) and Ubaidillah *et al.* (2024). Soil samples are organized by depth, with colour classified according to the Munsell soil colour chart. Notable mineral grains, such as quartz, feldspar and biotite, are also recorded (Figure 4). All

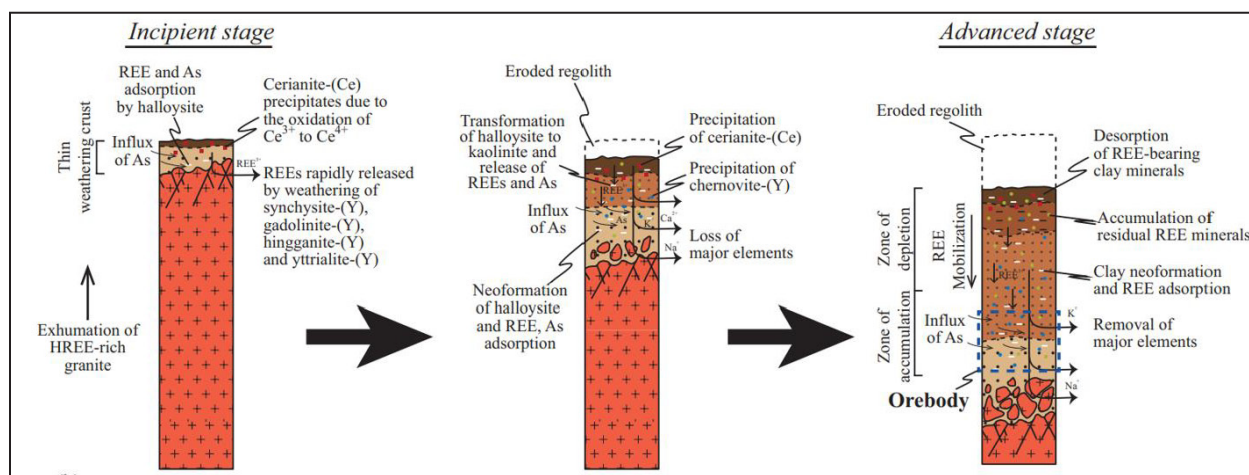


Figure 3: A schematic model illustrating the development of the weathering profile and the formation of the REE enrichment zone within the lower B to upper C horizons, based on the Zudong deposit as referenced in this guideline (adapted from Li *et al.*, 2019).



Figure 4: Soil samples arranged by depth for visual inspection. Observations include color determination using the Munsell soil color chart and identification of mineral grains.

observations are systematically recorded on a standardized sheet (Figure 5).

Fresh rock samples are collected to determine background REE concentrations, while concentrates from the weathered profile are analysed to identify associated REE-bearing minerals.

Soil samples are air-dried prior to sieving, preferably in the field, mainly to reduce moisture content and sample weight for ease of transport and subsequent processing. Although oven-drying in the laboratory provides better temperature control and consistency, field drying is considered more cost-effective and time-efficient for JMG's large-scale exploration activities, particularly in remote or high-sampling-density areas.

Sieving is performed to remove coarse quartz and possible REE-bearing minerals, thereby concentrating the

finer clay-sized fraction that better represents ion-adsorbed REE content. This approach, adopted by JMG, is based on internal orientation studies conducted prior to detailed exploration. The objective was to obtain representative REE values for IAC deposits while minimising the influence of mineral-bound REE phases and coarse detrital minerals such as quartz, which are known to contain negligible REE concentrations.

Laboratory analyses for soil samples should include:

- XRF: for major oxides (including SiO_2 , Al_2O_3 , Fe_2O_3 , CaO , K_2O , Na_2O , MgO , MnO and TiO_2)
- LOI: to estimate total mass lost upon ignition at high temperature (950°C).
- LA-ICP-MS: for REE (La to Lu), Th, and U concentration

PROJECT: REE RIH SERIAN			NO : P16/L2	MAP SHEET : _____			
TYPE OF LOG : Gangnan Auger Drill			LOCATION : Rihi, Serian	DATE STARTED : 13.04.2021			
LOGGED BY : Pegawai 1			CO- ORDINATE : N 098900 E 125800	DATE COMPLETED : 13.04.2021			
			DEPTH : 6.01	metres			
Depth (m)	Thickness (m)	Graphic Log	Soil / Sediment types : colour , grain size , mineral texture , etc Structure : Bedding < etc.	Sample No	Horizon	Remarks	
0.34	0.49		Topsoil- Dark brown clayey soil.		Horizon B	Foto 1 1	
1	0.87		Orange clayey soil				Foto 2 - Foto 3 2
1.36			Orange clayey soil + rock chips (white), hard rock chips (quartz) + weathered and oxidised saprolite				
2	1.43		Dark yellow clayey soil + white hard rock chips (size 1-2 mm) + weathered feldspar			Foto 7 5	
2.79			Reddish friable, silty clay soil also reddish weathered rock fragments (size 1 - 2 cm)				Horizon C
3	1.36		Dark brown; Friable silty clay clayey soil - with white weathered rock chips size 1-3 mm				
4	0.33		Friable deep brown color, highly weathered rock + dark (black mineral) + white weathered rock chips, medium porosity.				
4.15	0.44		Weathered grey color rock chips. Hard/solid : Andesite (Serian Volcanics)?				
4.48			Bedrock				
4.92	0.99						
6.01							

Figure 5: Example of a soil sampling log sheet, documenting depth intervals, soil color, texture, and mineral constituents observed.

- XRD: to identify clay and REE minerals
- SEM/FESEM: for mineral morphology (optional)

Rock samples are subjected to similar tests with additional petrographic analysis.

Concentrate samples are obtained through panning of soil materials that previously showed exceptionally high REE concentrations. This procedure aims to verify whether the elevated REE values are associated with ion-adsorbed clays or influenced by the presence of heavy REE-bearing minerals. The concentrates are then analysed using QME to quantify REE-bearing mineral phases and validated through XRF, XRD, and SEM analyses.

RADIOACTIVITY

Thorium (Th) and uranium (U) concentrations are also analysed to confirm the low radioactivity of IAC-REE deposits, a characteristic generally expected for this deposit type. In Malaysia, naturally occurring radioactive material (NORM) is regulated under the Atomic Energy Licensing (Radioactive Waste Management) Regulations 2011. According to Schedule 2 of the regulations, materials with a radioactivity content of less than 1 Bq/g are classified as NORM and are not subject to regulatory control. This threshold corresponds to approximately 246.5 ppm for Th-232 and 80.9 ppm for U-238.

SUPPORTIVE STUDIES AND FIELD TESTS

Leaching and precipitation in the field tests provide quick, indicative assessments of REE potential. In leaching tests, 0.3 M ammonium sulphate is used to extract REEs as REE sulphates. Oxalic acid or ammonium bicarbonate is added to precipitate REE oxalates and carbonates, respectively. Increased turbidity during oxalate addition indicates a higher REE content.

DATA PROCESSING AND INTERPRETATIONS

Data interpretation includes statistical analysis, calculation of Ce, Eu, and La/Yb anomalies, and construction of chondrite-normalized REE diagrams. Representative ICP-MS results showing characteristic Ce, Eu, and La/Yb anomalies are presented in Table 1.

The IAC-REE enrichment layer in weathered profiles is commonly characterised by relatively lower or negative Ce anomalies compared to the upper and lower parts of the profile, reflecting downward migration and accumulation of trivalent REEs during oxidative weathering (Compton *et al.*, 2003; Bao & Zhao, 2008; Sanematsu *et al.*, 2013). Positive Ce anomalies toward the D horizon (Table 1) likely reflect parent-rock inheritance and reduced Ce mobility under less weathered conditions, where Ce is preferentially retained as insoluble Ce⁴⁺ associated with Fe–Mn oxides or cerianite.

Negative Eu anomalies generally reflect the geochemical signature inherited from granitic parent rocks, where Eu²⁺ is preferentially incorporated into plagioclase

during magmatic crystallisation, leading to Eu depletion in the residual melt (Sun & McDonough, 1989; Braun *et al.*, 1990). This magmatic signature is typically preserved during weathering and is consistently observed in IAC-REE profiles (Imai *et al.*, 2008; Sanematsu *et al.*, 2013).

La/Yb ratios indicate the degree of LREE–HREE fractionation, with higher values reflecting preferential LREE enrichment due to the greater weathering susceptibility of LREE-bearing fluorocarbonates relative to more resistant HREE-bearing minerals such as zircon (Sanematsu & Kon, 2013).

Chondrite-normalized REE patterns (Sun & McDonough, 1989) generally show similar trends between rock and soil samples, with consistently higher REE concentrations in soils, reflecting geochemical inheritance from the bedrock and enrichment within the weathered zone. Deviations from these patterns may reflect heterogeneity in the geochemical characteristics of the weathered profile, potentially arising from variations in parent rock composition, differential weathering intensity, localized reworking of the soil profile, or minor post-depositional alteration.

MAPPING AND ECONOMIC ASSESSMENT

Spatial interpolation of rare earth element (REE) concentration data using Kriging or Inverse Distance Weighting (IDW) in GIS software allows for the creation of total REE (TREE), heavy REE (HREE), and light REE (LREE) distribution maps. These visualisations serve as a guide for further work and resource prioritisation (Figure 6).

Initial surveys indicate REE concentrations over 300 ppm are considered promising for further investigation. Areas with more than 500 ppm are considered suitable for potential exploitation.

The resource estimation assumes a bulk density of 1.5 t/m³ for disturbed soils. In IAC-REE deposits, approximately 65% of the REE content is recoverable through leaching and precipitation, whereas the rest remains bound in supergene or refractory residual minerals (after Li *et al.*, 2019). Detailed estimations can be refined using sector-based calculations or Thiessen polygon models.

Resource estimation for IAC-REE is classified as measured when sampling is conducted at relatively close spacing—typically between 50 m and 200 m—allowing reliable estimates of tonnage, density, grade, and mineral content with a high degree of confidence. If the sampling spacing exceeds 200 m, up to 500 m, the classification is downgraded to an indicated resource due to increased uncertainty in geological continuity and estimation accuracy. In general, the estimation focuses on the lower B to upper C horizons, where REE accumulation is typically higher, as supported by numerous studies. However, this may vary case by case depending on the local geological setting and profile depth.

Table 1: Examples of ICP-MS results and Ce, Eu, and La/Yb anomalies, in ppm.

Sample	Horizon	Th	U	Sc	Y	LREE						TLREE
						La	Ce	Pr	Nd	Sm	Eu	
KS901B	B	154.00	23.50	10.80	94.80	283.00	430.00	56.50	234.00	56.30	1.67	1,061.47
KS902B	B	213.00	15.50	12.10	90.30	324.00	565.00	70.00	291.00	58.30	2.06	1,310.36
KS903B	B	271.00	37.60	12.40	241.00	348.00	509.00	84.90	380.00	90.40	2.81	1,415.11
KS904B	B	236.00	11.40	11.90	118.00	350.00	765.00	80.80	333.00	59.80	2.81	1,591.41
KS905B	B	201.00	19.10	11.90	115.00	307.00	507.00	75.60	317.00	60.30	3.63	1,270.53
KD9104	C	144.00	16.90	14.60	112.00	210.00	349.00	52.50	192.00	38.20	2.05	843.75
KD9105	C	137.00	21.80	14.40	120.00	205.00	310.00	43.70	159.00	32.30	1.86	751.86
KD9106	C	204.00	29.90	17.00	90.00	180.00	408.00	48.60	139.00	31.90	1.80	809.30
KD9107	C	258.00	31.00	16.20	70.30	170.00	428.00	50.60	124.00	30.50	1.64	804.74
KR901	D (Rock)	89.70	18.10	5.92	53.40	150.00	251.00	21.90	94.30	19.80	1.00	538.00

Table 1: Continued.

Sample	Horizon	HREE									THREE	TREE	Anomaly		
		Gd	Tb	Dy	Ho	Er	Tm	Yb	Lu	Ce/Ce*			Eu/Eu*	La/Yb	
KS901B	B	26.80	3.45	19.60	3.33	9.40	1.19	7.90	1.19	167.66	1,239.93	0.82	0.15	35.82	
KS902B	B	31.70	3.39	17.80	2.86	7.85	0.91	7.09	0.82	162.72	1,485.18	0.90	0.19	45.70	
KS903B	B	53.70	7.63	41.20	7.06	19.00	2.62	16.50	2.42	391.13	1,818.64	0.71	0.14	21.09	
KS904B	B	34.10	4.37	24.50	4.28	11.70	1.52	9.47	1.28	209.22	1,812.53	1.10	0.22	36.96	
KS905B	B	33.50	4.45	24.80	4.33	12.00	1.53	9.50	1.28	206.39	1,488.82	0.80	0.29	32.32	
KD9104	C	24.90	4.45	23.20	4.76	12.10	2.02	12.10	1.88	197.41	1,055.76	0.80	0.20	17.36	
KD9105	C	22.80	4.39	23.70	4.97	12.60	2.08	12.30	1.89	204.73	970.99	0.79	0.20	16.67	
KD9106	C	22.20	4.26	23.10	4.93	11.80	2.00	12.20	1.85	172.34	998.64	1.05	0.20	14.75	
KD9107	C	20.40	3.68	20.00	4.20	10.00	1.69	10.40	1.57	142.24	963.18	1.11	0.20	16.35	
KR901	D (Rock)	14.10	1.87	11.50	2.09	6.11	0.65	4.82	0.59	95.13	639.05	1.06	0.21	31.12	

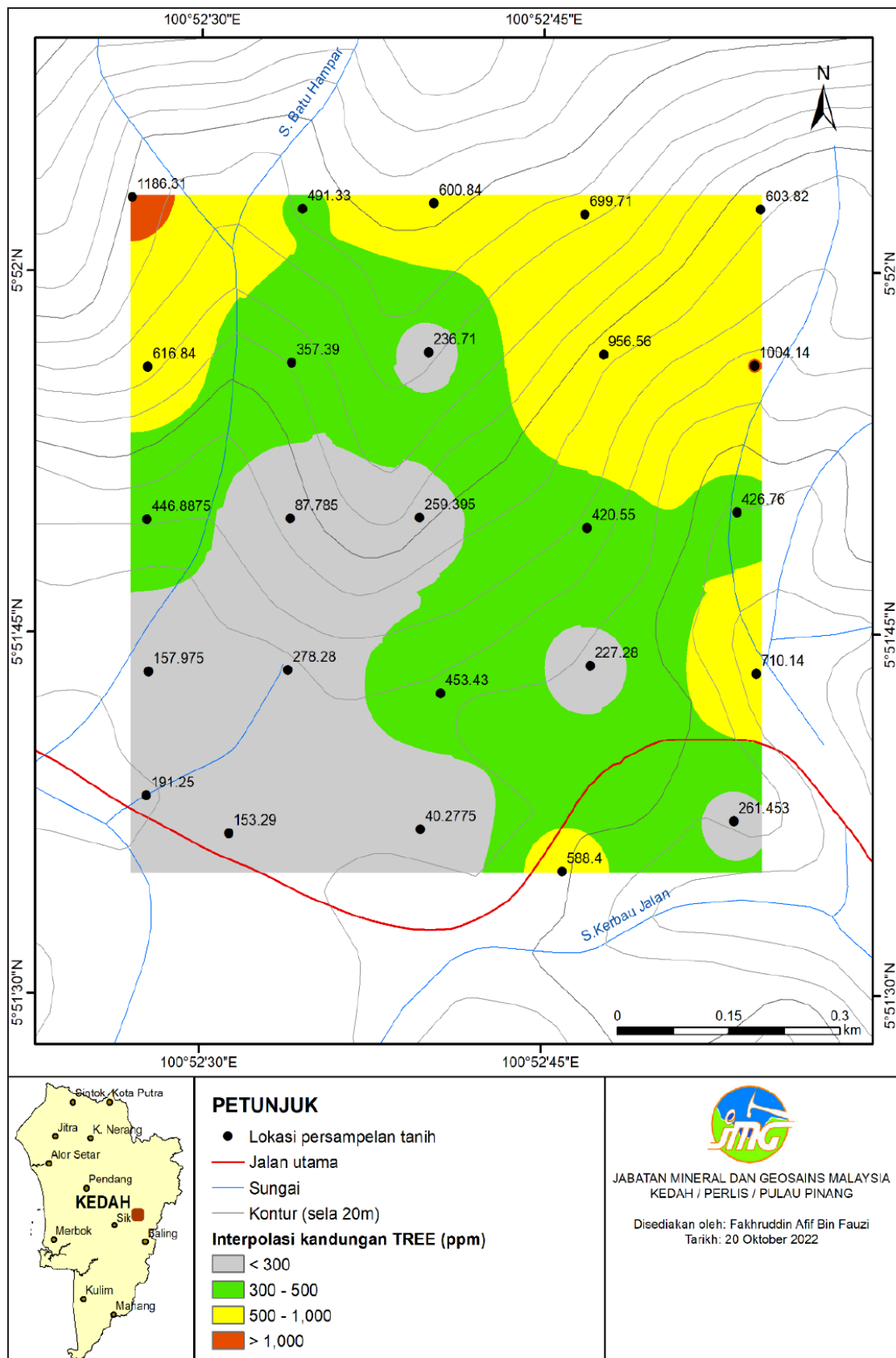


Figure 6: Example of a total REE (TREE) distribution map generated using Kriging interpolation, based on the average REE content at each sampling point.

The general formula for estimating a measured IAC-REE resource, based on a 1 km² study area adopted by JMG, is as follows:

$$\begin{aligned}\text{Total density of studied weathered} \\ \text{profile (soils)} &= \text{Study area (m}^2\text{)} \times \text{average depth (m)} \\ &= 1,000 \text{ m} \times 1,000 \text{ m} \times 10 \text{ m} \\ &= 10,000,000 \text{ m}^3\end{aligned}$$

$$\begin{aligned}\text{Average TREE content} &= 609.89 \text{ ppm} \\ &= 0.060989\% \\ &= 0.60989 \text{ kg/tonne}\end{aligned}$$

$$\begin{aligned}\text{Measured resource of} \\ \text{IAC-REE} &= 10,000,000 \text{ m}^3 \times 1.5 \text{ tonne/m}^3 \times \\ &\quad 0.60989 \text{ kg/tonne} \times 65\% \\ &= 5,946,428 \text{ kg} \\ &= 5.946 \text{ metric tonne / km}^2 \\ &= 24 \text{ metric tonne / acre}\end{aligned}$$

JMG applies the measured resource classification, instead of inferred or estimated because exploration is conducted within a confined 1 km² study area using closely spaced sampling grids (50–200 m). This approach provides a high level of confidence in estimating tonnage, density, grade, and mineral content.

CONCLUSION

The second edition of Malaysia's REE Exploration Guidelines represents a major advancement in the nation's geoscientific capability and governance of critical mineral resources. By focusing on ion-adsorption clay (IAC)-type deposits and aligning exploration methodologies with international best practices, the guidelines provide an essential framework for geoscientists, policymakers, and the mining industry.

This study underscores the importance of establishing systematic, science-based exploration procedures for IAC-REE deposits in Malaysia. The guidelines developed by JMG serve as a national reference for standardising exploration workflows, analytical techniques, and data interpretation. By aligning local practices with global standards, these guidelines enhance the accuracy, efficiency, and environmental accountability of REE exploration activities.

While comprehensive, the guidelines are not intended to be final or exhaustive. They remain open to further improvement through collaboration, feedback, and contributions from external experts, research institutions, and industry stakeholders. Such continuous enhancement will ensure that Malaysia's REE exploration framework evolves in line with new scientific insights, technological advancements, and global sustainability standards.

Overall, the findings strengthen Malaysia's technical capacity in critical mineral exploration and support

the nation's strategic goal of sustainable resource development. The implementation of these guidelines ensures that REE exploration is conducted in a scientifically robust, transparent, and environmentally responsible manner—laying the groundwork for future innovation and responsible exploitation of Malaysia's REE potential.

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AUTHORS CONTRIBUTION

AIZ and FAF conceptualized the paper. KNHY, AHAR, MS, JJJ, SI, and YB contributed to data gathering, drafting, and critical revisions. All authors reviewed and approved the final manuscript.

CONFLICT OF INTEREST

The authors declare no conflict of interest.

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Sifat penyerakan tanah aluvium di Shah Alam, Selangor (Dispersive behavior of alluvial soil in Shah Alam, Selangor)

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Abstrak: Tanah terserak merupakan tanah yang berisiko terhadap hakisan apabila butiran tanah bertindak balas dengan air. Tindak balas pengasingan tanah berlaku apabila kehadiran jumlah ion natrium yang tinggi akibat penyerapan di permukaan lempung menolak di antara satu sama lain menyebabkan deflokulasi butiran. Penentuan sifat serakan tanah alluvium dijalankan melalui 3 jenis ujian penyerakan iaitu ujian *Crumb*, ujian hidrometer berganda dan ujian serakan lubang pin. Berdasarkan keputusan yang diperolehi, tanah alluvium dikategorikan sebagai terserak tinggi oleh ujian *Crumb*, manakala untuk ujian hidrometer berganda dan ujian serakan lubang pin kedua-duanya menunjukkan pada tahap sederhana terserak. Keadaan ini didorong oleh sifat tanah alluvium dengan kehadiran koloid lempung yang tinggi dan menyebabkan proses penembusan air terhadap keseluruhan butiran tanah menjadi perlahan. Dapatan ini penting dalam menafsir sifat semulajadi tanah ini terutama melibatkan permasalahan seperti kegagalan empangan, kestabilan cerun dan pendasaran bangunan.

Kata kunci: Tanah terserak, tanah aluvium, ujian *Crumb*, ujian hidrometer berganda, ujian lubang pin

Abstract: Dispersive soils are prone to erosion when soil particles react with water. The dispersion process occurs when a high amount of sodium ions adsorbed onto clay surfaces causes repulsion between particles, leading to deflocculation. The dispersive characteristics of alluvial soil were determined using three types of dispersion tests, namely the Crumb test, the double hydrometer test, and the pinhole dispersion test. Based on the results obtained, the alluvial soil was classified as highly dispersive by the Crumb test, while both the double hydrometer and pinhole tests indicated a moderately dispersive level. This condition is influenced by the nature of alluvial soils, which contain a high amount of clay colloids, resulting in slower water penetration throughout the soil particles. These findings are important for understanding the natural behaviour of this soil, particularly in relation to issues such as dam failure, slope stability, and building foundations.

Keywords: Dispersive soil, alluvial soil, Crumb test, double hydrometer test, pinhole test

PENGENALAN

Tanah terserak aluvium merupakan fenomena penting yang memberikan impak signifikan terhadap kestabilan tanah dan perancangan guna tanah di pelbagai kawasan serantau dan global. Tanah terserak banyak ditemui di sepanjang lebihan sungai, delta, dan kawasan banjir yang mempunyai lapisan sedimen halus yang mudah terhakis dan tererosi. Fenomena ini menimbulkan cabaran besar dalam pembinaan infrastruktur, pengurusan sumber air, serta mitigasi bencana seperti tanah runtuh dan hakisan pesisir (Mitchell & Soga, 2005; Fan & Kong, 2013). Kajian terhadap tanah terserak penting untuk memahami

bagaimana sifat mekanik dan kimianya, terutamanya interaksi dengan ion natrium, mempengaruhi kestabilan struktur tanah kawasan yang berisiko (Sherard *et al.*, 1976; Goodarzi & Salimi, 2015).

Shah Alam merupakan sebuah bandar yang terletak di Selangor berkeluasan 8.104 dengan populasi penduduk 6.9 juta (Jabatan Perangkaan Malaysia, 2024). Topografi Shah Alam adalah kawasan tanah rendah di mana sebahagian kawasan tersebut diliputi oleh tanah rata dengan ketinggian kurang daripada 20 m dari aras laut. Walau bagaimanapun, terdapat juga kawasan yang bertopografi tinggi iaitu di Bukit Jelutong yang mempunyai ketinggian melebihi 150

m. Pada tahun 1973, Gobbett & Hutchison telah menyusun serta menganalisis semua maklumat geologi yang tersedia bagi kawasan Selangor pada ketika itu. Himpunan data tersebut menjadi rujukan asas dalam memahami susun atur geologi, jenis batuan, dan evolusi geotektonik di negeri Selangor serta kawasan Lembah Klang secara keseluruhan. Secara geologinya, kawasan Selangor terdiri daripada Formasi Bukit Kenny yang merupakan jujukan sedimen klastik dan aluvium Kuaterner. Formasi Bukit Kenny terbentang dari Kuala Lumpur hingga ke Petaling Jaya dan memanjang ke arah selatan sejauh sekurang-kurangnya 30 km, memperlihatkan satu struktur sinklin yang luas dan jelas di kawasan tersebut (Stauffer, 1973). Formasi Bukit Kenny terletak secara tidak selaras di atas Batu Kapur Kuala Lumpur dan direjah oleh granit Trias. Usia Formasi Bukit Kenny telah ditentukan berdasarkan jumpaan fosil di Sepang, Selangor.

Menurut Kamal Roslan (1999), Formasi Bukit Kenny berusia Karbon hingga Perm manakala Norhafizah (2002) pula berpendapat ia berusia Silur hingga Trias Tengah. Menurut Suntharalingam & Teoh (1985), sedimen Kuaterner terbahagi kepada empat unit litostratigrafi berdasarkan litologi, usia dan sekitaran pengendapan. Unit-unit tersebut dikatakan berusia Pleistosen hingga Holosen, di mana Formasi Simpang dan Formasi Kempadang berusia Pleistosen manakala Formasi Gula dan Formasi Beruas berusia Holosen. Walau bagaimanapun, dipercayai terdapat dua formasi di sekitar kawasan kajian iaitu Formasi Beruas dan Formasi Gula (Fadlee, 1997).

Kehadiran tanah terserak terutamanya di kawasan tanah lembut seperti Klang dan Shah Alam menimbulkan kebimbangan terhadap kestabilan dan perancangan guna tanah. Shah Alam terletak di atas Formasi Bukit Kenny yang terdiri daripada jujukan batu pasir, sabak, syal, dan filit yang mengalami metamorfosis ringan. Selain itu, kawasan ini juga meliputi aluvium Kuaterner seperti Formasi Beruas dan Formasi Gula. Walau bagaimanapun, kawasan kajian ini lebih dikaitkan dengan Formasi Beruas yang umumnya kaya dengan bahan organik berbanding Formasi Gula (Kamal Roslan, 1999). Kawasan Klang pula didominasi oleh Formasi Gula yang berlitologi lodak, lempung dan pasir dengan sebilangan kecil kelikir, cangkerang dan terumbu. Kehadiran bahan organik terutama dari tinggalan tumbuhan dan serpihan cangkerang mencirikan kedua-dua kawasan ini sebagai mendapan Kuaterner. Secara amnya, tanah lembut di Shah Alam terdiri daripada tanah gambut manakala tanah lempung halus dengan kandungan air tinggi mendominasi di Klang.

Tanah lembut biasanya dicirikan sebagai tanah yang mempunyai kekuatan ricih yang rendah, kebolehmampatan yang tinggi dan kebolehtelapan rendah. Tujuan kajian ini dilaksanakan adalah untuk melihat tindak balas tanah lembut iaitu mineral lempung terhadap tanah terserak apabila kehadiran peratusan ion natrium yang tinggi ke

dalam tanah itu wujud. Serakan tanah lempung adalah tanah yang mempunyai butiran yang halus, di mana tanah lempung terserak dengan kehadiran air untuk membentuk sistem serakan berkoloid. Sifat tanah lempung berkait rapat dengan saiz butiran 1-100nm dan bercas negatif. Aliran air melalui tanah lempung terserak boleh menyebabkan pemisahan bebas zarah lempung, manakala struktur tanah yang longgar, ketumpatan rendah dan tempoh masa yang singkat menunjukkan berlakunya proses hakisan dalaman. Sherard *et al.* (1976) menjelaskan bahawa perbezaan utama antara tanah lempung terserak dan tidak terserak terletak pada susunan struktur kation dalam air liang tanah.

Analisis makmal dijalankan bagi tujuan pengesanan tahap penyerakan sampel tanah yang diambil. Dapatan kajian berpotensi membantu meningkatkan pemahaman ke atas struktur tanah lembut di Shah Alam dan Klang bagi mencadangkan langkah mitigasi bersesuaian bagi merangka pelan pembangunan yang lestari.

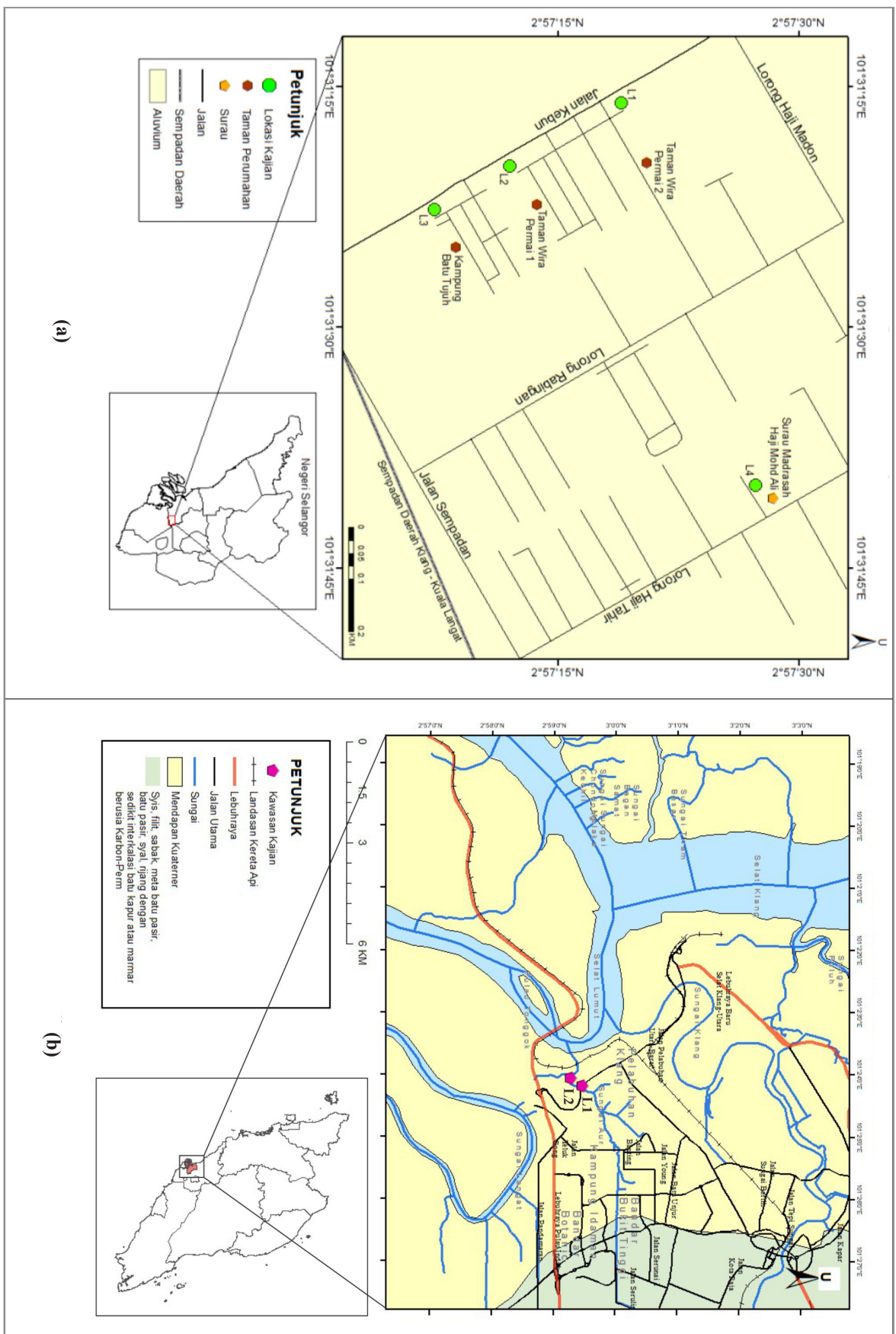
BAHAN DAN KAEDAH

Persampelan dan ujian makmal

Kaedah persampelan di lokasi kawasan kajian adalah menggunakan teknik gerimit tangan (*hand auger*). Pemasangan alat di lakukan dengan menyambung gerimit jenis heliks (*spiral*) pada pemegang T untuk kedalaman 1 meter pertama bagi memudahkan korekan lubang. Bagi kedalaman 1 hingga 3 meter, gerimit jenis lempung terbuka (*open clay*) digunakan untuk mengambil sampel sehingga kedalaman yang ditetapkan. Sampel tanah di ambil sebanyak 5 kg bagi setiap lokaliti untuk proses ujian makmal dilakukan. Sampel-sampel tanah terganggu ini di dapatkan dari 2 kawasan yang berbeza iaitu di Jalan Kebun, Shah Alam (Rajah 1(a)) dan di Kampung Sungai Aur, Pelabuhan Klang (Rajah 1(b)). Berikut adalah nombor persampelan mengikut lokaliti bagi kedua dua kawasan kajian (Jadual 1).

Sampel tanah yang diambil terlebih dahulu dikeringkan pada suhu bilik selama 72 jam (3 hari) untuk memastikan kestabilan bahan sebelum dijalankan pelbagai analisis sifat indeks mengikut piawaian ASTM (2007, 2014, 2017, 2019, 2020, 2021). Ujian sifat indeks fizikal terdiri daripada pengukuran tahap kelembapan tanah mengikut piawaian ASTM D2216-19, analisis taburan saiz butiran menggunakan ASTM D7928-21e1, ujian graviti tentu dengan ASTM D854-00, serta pengujian had-had Atterberg berdasarkan ASTM D4318-17e1. Kesemua ujian ini bertujuan untuk mengkaji aspek fizikal utama tanah seperti kandungan air, klasifikasi saiz butiran, kepekatan zarah, dan tingkah laku tanah dalam keadaan berubah kelembapan.

Seterusnya, ujian sifat indeks kimia dilakukan dengan mengukur pH tanah (ASTM D4972-19) untuk menilai tahap keasidan dan kealkalian tanah, analisis pembelauan sinar-X menurut ASTM D4972-19 untuk menentukan mineralogi tanah, serta pengimbasan mikroskop elektron



Jadual 1: Pengelasan nombor persampelan.

Lokaliti	Nombor pengelasan persampelan
Jalan Kebun, Shah Alam	
L1	SA3, SA4
L2	SA6
L3	SA7
L4	SA8
Kampung Sungai Aur, Pelabuhan Klang	
L1	KLG 3, KLG 5, KLG 7
L2	KLG 9, KLG 10

(ASTM E1508) bagi meneliti struktur mikro tanah secara lebih terperinci. Kapasiti penukaran kation (ASTM D7503-08) juga diuji untuk memahami keupayaan tanah menukar ion, manakala kandungan organik diukur menggunakan ASTM D2974 yang penting dalam analisa sifat biologi dan kimia tanah.

Untuk pengesanan tahap penyerakan tanah, tiga ujian tambahan digunakan iaitu ujian *Crumb* (ASTM D6572-00) yang menilai kestabilan agregat tanah terhadap hakisan. Ujian ini juga boleh dilakukan di lapangan dengan merendamkan sampel berbentuk bebola di dalam air suling. Menurut Davies & Lacey (2009), darjah serakan bagi ujian *Crumb* adalah terdiri daripada empat tahap iaitu tiada, sedikit (<0.5 cm), sederhana (0.5 cm - 1.5 cm) dan kuat (>1.5 cm).

Ujian hidrometer berganda ASTM D4221-99 (ASTM, 2005) adalah untuk mengkaji pemisahan zarah halus dalam tanah dengan membandingkan larutan yang mempunyai campuran agen serakan dan tiada agen serakan. Darjah serakan ujian hidrometer berganda ini adalah ditentukan melalui peratusan serakan. Peratus serakan kurang daripada 30% menunjukkan tanah tersebut adalah tidak terserak, diikuti 30% hingga 50% dikelaskan sebagai sederhana terserak dan melebihi 50% adalah terserak.

Ujian serakan lubang pin (ASTM D4647/D4647-13) dijalankan adalah bertujuan untuk mengenal pasti tahap serakan dan hakisan tanah berdasarkan kadar aliran air, tahap keruhan efluen dan diameter lubang spesimen yang ditebuk. Tahap serakan tanah kemudiannya ditentukan berdasarkan indikasi serakan tanah (Jadual 2).

HASIL DAN PERBINCANGAN

Sifat indeks fizikal

Jadual 3 menunjukkan keputusan sifat indeks fizikal sampel tanah. Tanah Jalan Kebun Shah Alam mempunyai kandungan kelembapan melebihi 100% kerana tanah gambut umumnya mempunyai kandungan organik yang tinggi. Kandungan air dalam sampel tanah SA7 adalah paling tinggi iaitu sebanyak 257% dan kandungan air dalam SA4 adalah paling rendah iaitu 163%. SA8,

SA3 dan SA6 pula mengandungi peratus kandungan kelembapan 208%, 204% dan 178% masing-masing. Nilai graviti tentu tanah di kawasan kajian adalah ber julat 1.79 hingga 2.49, di mana sampel SA3 merekodkan bacaan tertinggi dengan 2.49, diikuti oleh SA8 dengan nilai 2.34 dan SA4 dengan nilai 2.26.

Sampel SA7 merekodkan nilai 1.96 dan SA6 merekodkan nilai terendah dengan 1.79. Sampel tanah menunjukkan peratusan pasir yang dominan ber julat antara 76% hingga 87% manakala kandungan butiran halus bagi lodak dan lempung adalah sekitar 12% - 20% dan 1% - 3%. Sampel SA4 dan SA6 menunjukkan lempung pada tahap keplastikan tinggi manakala sampel SA3, SA7 dan SA8 pula menunjukkan kandungan lodak pada tahap keplastikan tinggi. Secara keseluruhan, semua sampel tanah mempunyai had cecair dan indeks keplastikan yang tinggi.

Sebaliknya, tanah di Kampung Sungai Aur, Pelabuhan Klang mempunyai kandungan kelembapan yang ber julat daripada 57.07% hingga 130%. Hasil ujian graviti tentu piknometer menunjukkan nilai berada pada julat dari 1.89 hingga 2.43. Menurut Bowles (1979) nilai graviti tentu antara 1.00 hingga 2.60 menunjukkan jenis tanah organik. Pasir ber julat 92-96% manakala peratus lempung dan lodak menunjukkan nilai yang rendah. Keputusan yang diperoleh adalah seperti jadual di bawah yang menunjukkan had cecair di kawasan ini ber julat dari 58.82% sehingga 89.44% manakala had keplastikan adalah ber julat dari 25.39% sehingga 53.53%.

Sifat indeks kimia

Berdasarkan hasil kajian (Jadual 4), sampel tanah SA6 dan SA3 mempunyai bahan organik tertinggi berbanding tanah yang lain dengan nilai 38.23% dan 38.08% masing-masing, diikuti oleh sampel SA6 dan SA7 dengan nilai kandungan organik sebanyak 21.87% dan 21.01%. SA4 mempunyai bahan organik terendah iaitu 12.28%. Hasil analisis mendapati pH tanah di kawasan kajian adalah dalam julat 2.72 – 4.20 yang dapat dikategorikan sebagai

Jadual 2: Indikasi serakan tanah berdasarkan ujian lubang pin.

Tahap serakan	Tinggi hidraulik (mm)	Masa (minit)	Kadar aliran effluen (mL/s)	Darjah keruhan effluen		Saiz lubang spesimen (mm)
				Tepi	Atas	
Kaedah A						
D1	50	5	1.0 – 1.4	Gelap	Sangat gelap	≥ 2
D2	50	10	1.0 – 1.4	Sederhana gelap	Gelap	>1.5
ND4	50	10	0.8 – 1.0	Sedikit gelap	Sederhana gelap	≤1.5
ND3	180 380	5 5	1.4 – 2.7 1.8 – 3.2	Sedikit jernih	Sedikit gelap	≥1.5
ND2	1020	5	>3.0	Jernih	Sedikit jernih	<1.5
ND1	1020	5	≤3.0	Sangat jernih	Sangat jernih	1.0
Kaedah B						
D	50	10	-	Sedikit gelap hingga gelap	Sangat gelap hingga sederhana gelap	≥1.5
SD	180–380	5	-	Sedikit jernih	Sedikit gelap	≥1.5
ND	380	5	-	Jernih	Sedikit jernih	<1.5

D1, D2, D – Terserak; ND4, ND3, SD – Sederhana hingga sedikit terserak; ND2, ND1, ND – Tidak terserak.

Jadual 3: Keputusan sifat indeks fizikal tanah.

No. sampel		Graviti tentu, Gs	Kandungan kelembapan, %	Pasir (%)	Lodak (%)	Lempung (%)	Had cecair	Had plastik	Indeks keplastikan
Jalan Kebun, Shah Alam	SA3	2.49	204%	83.89	14.1	2.01	71.13	40	31.13
	SA4	2.26	163%	86.97	12.47	1.56	73.32	21.41	51.91
	SA6	1.79	178%	76.94	20.29	2.78	84	25	59
	SA7	1.96	257%	85.26	13.19	1.56	89.09	61.07	28.02
	SA8	2.34	208%	83.7	15.17	1.13	77.68	44.05	33.63
Kampung Sungai Aur, Pelabuhan Klang	KL3	1.89	130.65%	95.61	4.27	0.12	73.14	44.17	28.97
	KL5	1.98	103.65%	92.04	7.77	0.19	77.31	53.53	23.78
	KL7	2.03	101.51%	94.84	5.04	0.12	80.98	25.39	55.59
	KL9	2.42	71.04%	96.31	3.58	0.11	89.44	31.38	58.06
	KL10	2.43	57.07%	95.95	3.88	0.17	58.82	26.79	32.03

sangat berasid. Sampel SA8 menunjukkan nilai keupayaan pertukaran kation paling rendah iaitu 10.5 cmol/kg, diikuti SA4 sebanyak 12.4 cmol/kg dan SA6 sebanyak 14.0 cmol/kg. SA3 dan SA7 mempunyai nilai keupayaan pertukaran kation yang tinggi iaitu 17.8 cmol/kg dan 17.9 cmol/kg masing-masing.

Keputusan analisis XRD bagi sampel tanah Jalan Kebun, Shah Alam menunjukkan kehadiran mineral

utama iaitu kuarza diikuti oleh mineral lempung daripada kumpulan kaolinit serta illit. Kehadiran kuarza dikenal pasti melalui puncak intensiti yang jelas pada sekitar $26.6^\circ 2\theta$, manakala mineral kaolinit dicirikan pada intensiti 12.4 – $12.5^\circ 2\theta$ yang mewakili jarak antara lapisan kira-kira $7.1 \text{ \AA}$. Fasa illit pula dikenal pasti berdasarkan puncak pada sekitar 8.8 – $9.0^\circ 2\theta$ dengan puncak sokongan berhampiran 17 – $18^\circ 2\theta$. Bagi sampel SA3 dan SA4, corak XRD menunjukkan

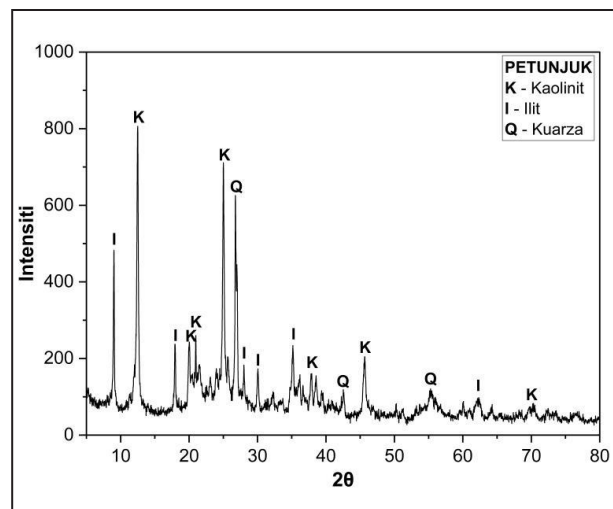
Jadual 4: Keputusan sifat indeks fizikal dan kimia tanah.

No. sampel		Peratus organik (%)	Nilai pH	Keupayaan pertukaran kation (cmol/kg)
Jalan Kebun, Shah Alam	SA3	38.08	3.98	17.8
	SA4	12.28	4.15	12.4
	SA6	38.23	2.98	13
	SA7	21.01	2.72	17.9
	SA8	21.87	4.2	10.5
Kampung Sungai Aur Pelabuhan, Klang	KLG3	6.8	6.98	9.9
	KLG5	8.8	6	9.8
	KLG7	7.2	6.75	2
	KLG9	4.8	6.99	6.7
	KLG10	4.1	7.15	2.9

dominasi mineral kuarza yang menunjukkan kandungan silika yang tinggi berbanding mineral lain. Sampel SA6 dan SA7 turut didominasi oleh kuarza dengan kehadiran mineral lempung pada keamatan yang lebih rendah. Sampel SA8 menunjukkan puncak mineral lempung yang lebih ketara berbanding sampel lain, namun puncak berintensiti rendah yang berpotensi mewakili mineral lempung lain tidak dapat dikenal pasti secara jelas. Oleh itu, pengecaman mineral lempung dalam kajian ini dibuat secara kuantitatif memandangkan analisis dijalankan menggunakan kaedah XRD serbuk pual (Rajah 2).

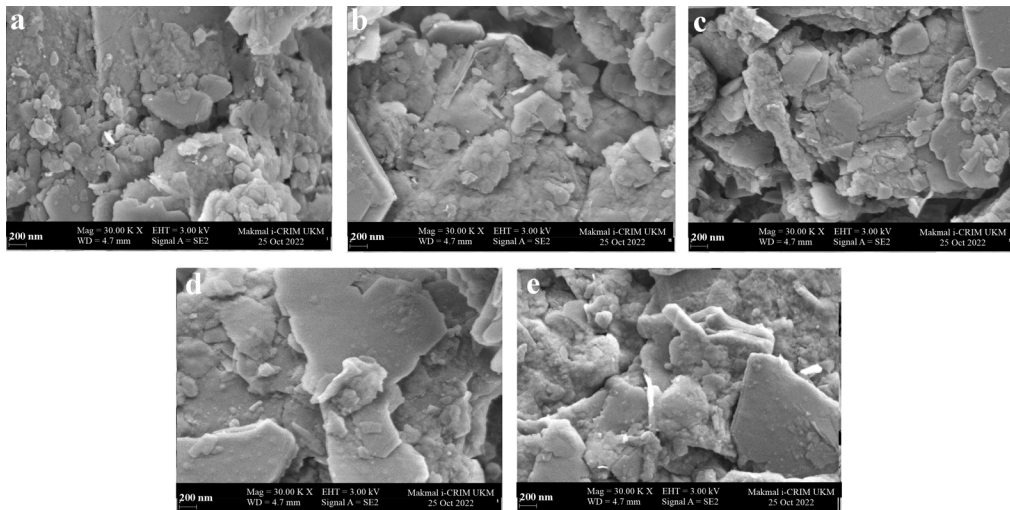
Rajah SEM bagi sampel tanah Jalan Kebun, Shah Alam menunjukkan morfologi mineral lempung adalah berkeping dan berlapis yang lazimnya menunjukkan mineral filosilikat khususnya kumpulan kaolinit. Struktur kepingan ini menunjukkan kehadiran mineral lempung bersaiz halus yang tersusun secara rawak. Selain itu, butiran yang lebih besar dan tidak berlapis turut diperhatikan dan berkemungkinan mewakili zarah kuarza. Walaupun analisis XRD bagi sampel tertentu menunjukkan kehadiran puncak berintensiti rendah yang berpotensi mewakili mineral lempung lain, ciri morfologi yang jelas bagi mineral lempung 2:1 tidak dapat diperhatikan melalui analisis SEM. Oleh itu, analisis SEM digunakan sebagai sokongan morfologi kepada keputusan XRD dan bukan sebagai kaedah pengecaman mineral secara spesifik (Rajah 3).

Bagi sampel Kampung Sungai Aur, Pelabuhan Klang, keputusan analisis XRD menunjukkan bahawa kuarza merupakan mineral dominan dalam semua sampel, selari dengan kandungan pasir yang tinggi berdasarkan analisis sifat indeks fizikal. Mineral lempung daripada kumpulan kaolinit serta ilit turut dikenal pasti, namun pada keamatan yang lebih rendah berbanding kuarza. Corak puncak mineral lempung yang diperoleh adalah hampir serupa dengan sampel dari Jalan Kebun, Shah Alam, menunjukkan kemungkinan asal usul sedimen aluvium yang sama.

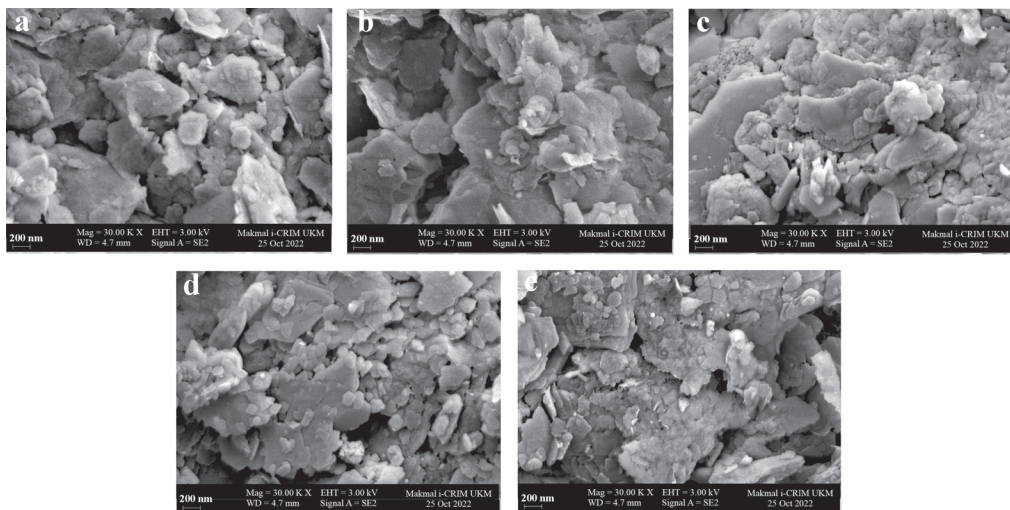
**Rajah 2:** Hasil keputusan analisis XRD bagi sampel tanah SA8.

Walaupun bagaimanapun, pengecaman mineral lempung dalam kajian ini dibuat secara kuantitatif memandangkan analisis XRD dijalankan menggunakan kaedah serbuk pual yang mempunyai keterbatasan dalam membezakan fasa mineral lempung secara terperinci. Imej SEM bagi sampel Kampung Sungai Aur, Pelabuhan Klang menunjukkan dominasi morfologi mineral lempung adalah berkeping yang konsisten dengan kumpulan kaolinit. Walaupun bagaimanapun, butiran kuarza yang lebih kasar dan jelas kelihatan berbanding sampel dari Jalan Kebun selari dengan kandungan pasir yang tinggi di kawasan ini.

Sampel Kampung Sungai Aur adalah sama seperti sampel Jalan Kebun di mana analisis SEM tidak membolehkan pengecaman spesifik polimorf mineral lempung dilakukan dan oleh itu digunakan sebagai sokongan morfologi kualitatif kepada keputusan XRD (Rajah 4).



Rajah 3: Keputusan SEM menunjukkan morfologi kaolinit yang berkeping. (a) SA3; (b) SA4; (c) SA6; (d) SA7; (e) SA8.



Rajah 4: Keputusan SEM menunjukkan morfologi kaolinit. (a) KLG 3; (b) KLG 5; (c) KLG 7; (d) KLG 9; (e) KLG 10.

Pengesanan tahap penyerakan Ujian *Crumb*

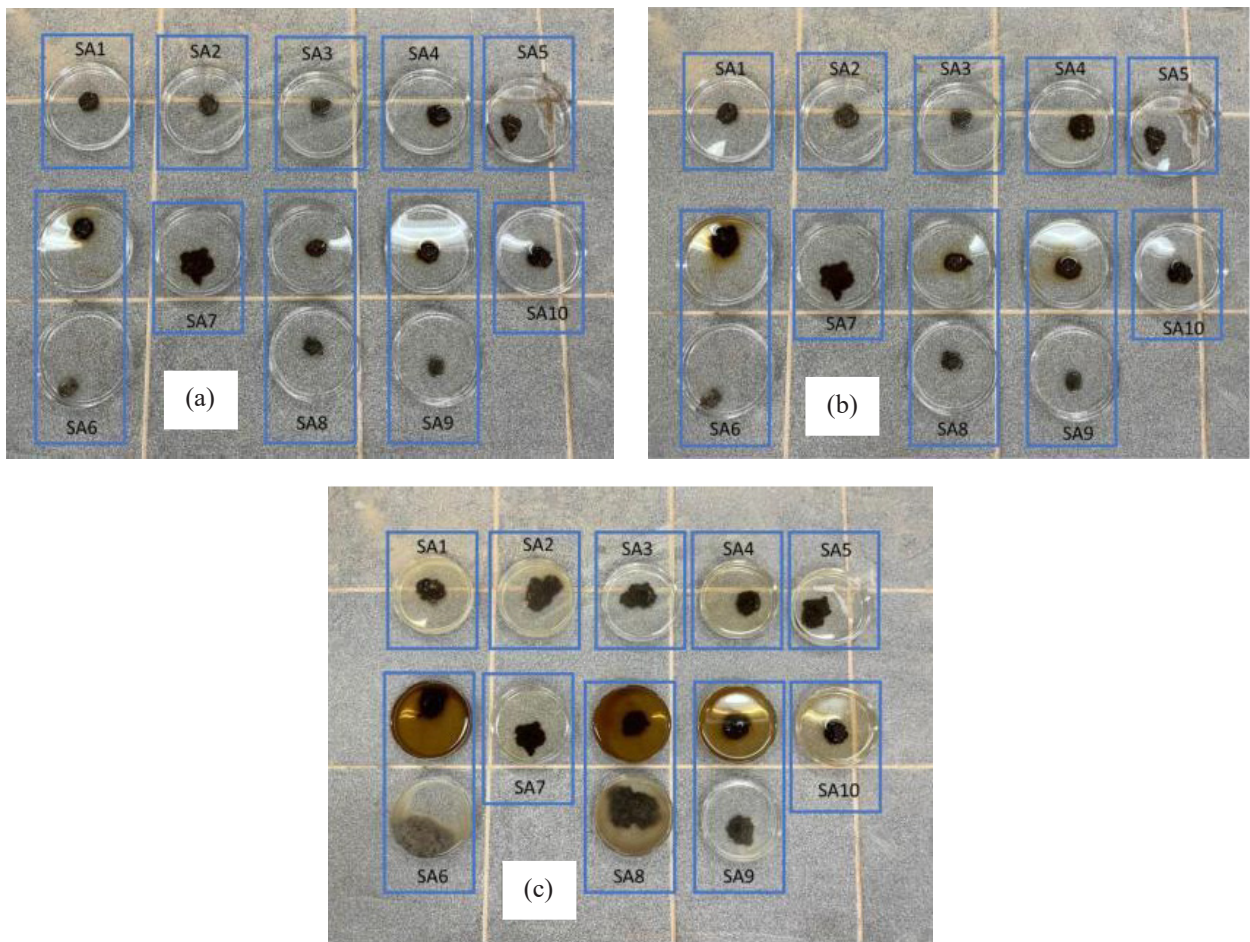
Ujian *Crumb* telah dilakukan sebanyak dua kali iaitu di kawasan lapangan dan juga di makmal (Rajah 5) di Jalan Kebun, Shah Alam. Berdasarkan ujian *Crumb* di lapangan iaitu selama 5 minit, SA3 tidak menunjukkan sebarang perubahan, manakala SA4 SA6, SA7 dan SA8 telah menunjukkan sifat serakan yang sedikit. Kemudian, selepas 24 jam di makmal, kesemua sampel kecuali SA3 menunjukkan darjah serakan tersendiri iaitu SA7 menunjukkan darjah serakan sedikit, SA4 menunjukkan darjah serakan sederhana manakala SA6 dan SA8 menunjukkan darjah serakan tinggi.

Rajah 6 iaitu keputusan ujian *Crumb* bagi kawasan Kampung Sungai Aur, Pelabuhan Klang menunjukkan serakan berlaku bagi sampel KLG9 dan KL10 berbanding

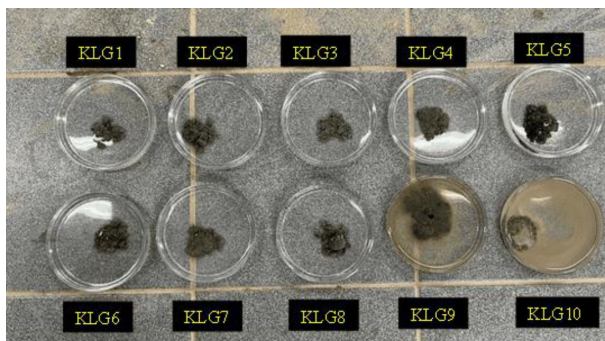
KLG3, KLG5 dan KLG7 tidak menunjukkan sebarang perubahan.

Ujian hidrometer berganda

Ujian hidrometer berganda hanya dijalankan pada beberapa sampel tanah iaitu SA3, SA4, SA6, SA7 dan SA8 (Rajah 7). Hasil analisis graf menunjukkan sampel SA3 dan SA6 adalah tidak terserak kerana nilai peratus partikel kurang 0.005mm adalah di bawah 30%, dengan nilai masing-masing adalah 15.58% dan 14.18%. Tahap serakan bagi SA4 dan SA7 pula adalah sederhana terserak kerana nilai peratus partikel kurang 0.005mm adalah di antara 30% - 50%, dengan nilai masing-masing adalah 39.15% dan 39.78%. Hasil analisis ujian hidrometer berganda bagi SA8 menunjukkan ianya adalah tanah terserak berdasarkan nilai peratus partikel



Rajah 5: Keadaan tanah terserak selepas (a) 5 minit; (b) 30 minit; (c) 24 jam.



Rajah 6: Hasil ujian *crumb* selepas 24 jam.

kurang 0.005 mm yang diperoleh adalah melebihi 50%, iaitu 65.45%.

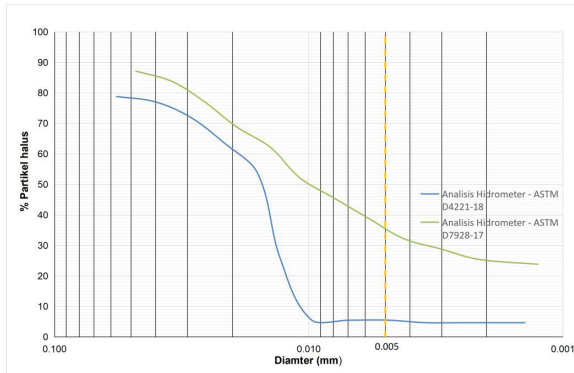
Keputusan graf ujian hidrometer berganda bagi tanah di Kampung Sungai Aur Pelabuhan Klang (Rajah 8) menunjukkan satu sampel terserak iaitu KLG7 (60%), diikuti sampel KLG3 (36%) sederhana terserak dan selebihnya menunjukkan peratusan tidak terserak KLG5(29%), KLG 9 (28%), KLG 10 (24%).

Ujian serakan lubang pin menunjukkan KLG3, KLG7, KLG9, KLG10 adalah ND3 iaitu sedikit terserak. Manakala KLG5 adalah tanah yang terserak. Efluen akhir menunjukkan warna yang keruh lebih jelas mengikut darjah serakan. Seterusnya, saiz lubang pin akhir bagi tanah terserak menjadi lebih besar berbanding tanah tidak terserak (Rajah 9).

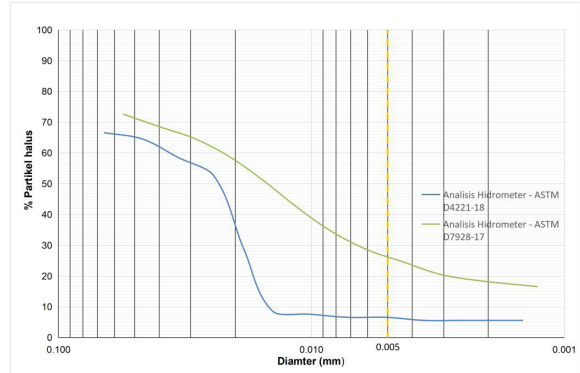
Ujian serakan lubang pin (Rajah 10) menunjukkan sampel SA3, SA4, SA7 dan SA8 adalah bergred ND3 iaitu sedikit terserak manakala SA6 adalah bergred ND2 iaitu tidak terserak. sampel SA6 tidak menunjukkan serakan (ND2) apabila efluen yang keluar dari lubang spesimen adalah adalah jelas dan tidak keruh. Saiz lubang pin akhir bagi tanah sedikit terserak menjadi lebih lebar berbanding tanah tidak terserak yang kekal pada saiz asalnya. Selain itu, efluen akhir juga akan menunjukkan darjah keruhan warna yang lebih nyata mengikut darjah serakan.

Analisis sifat fizikal tanah aluvium di kawasan kajian menunjukkan bahawa sampel Jalan Kebun, Shah Alam mempunyai kandungan kelembapan sangat tinggi (melebihi 100 %) dan julat graviti tentu 1.79 hingga 2.49. Keadaan ini menggambarkan bahawa tanah tersebut

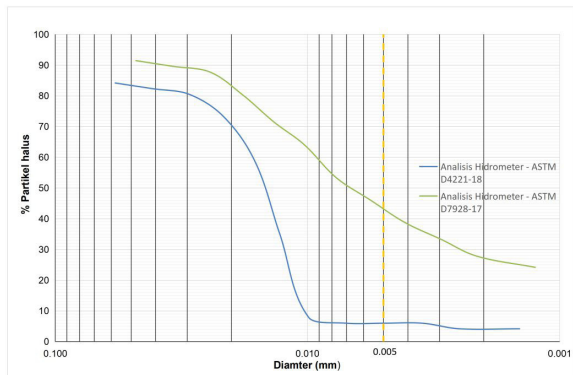
SA3



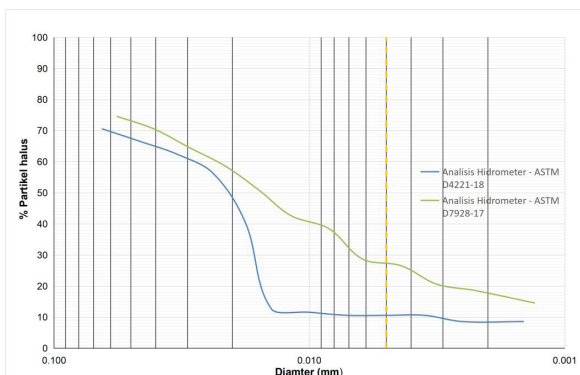
SA4



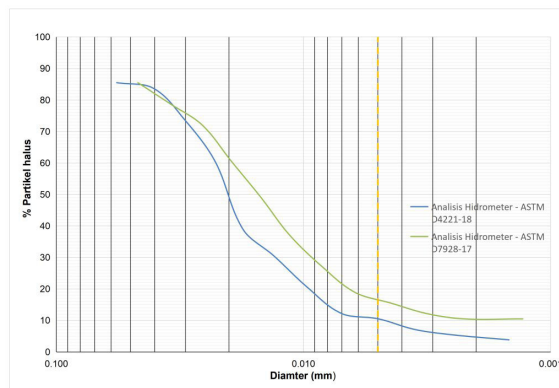
SA6



SA7



SA8



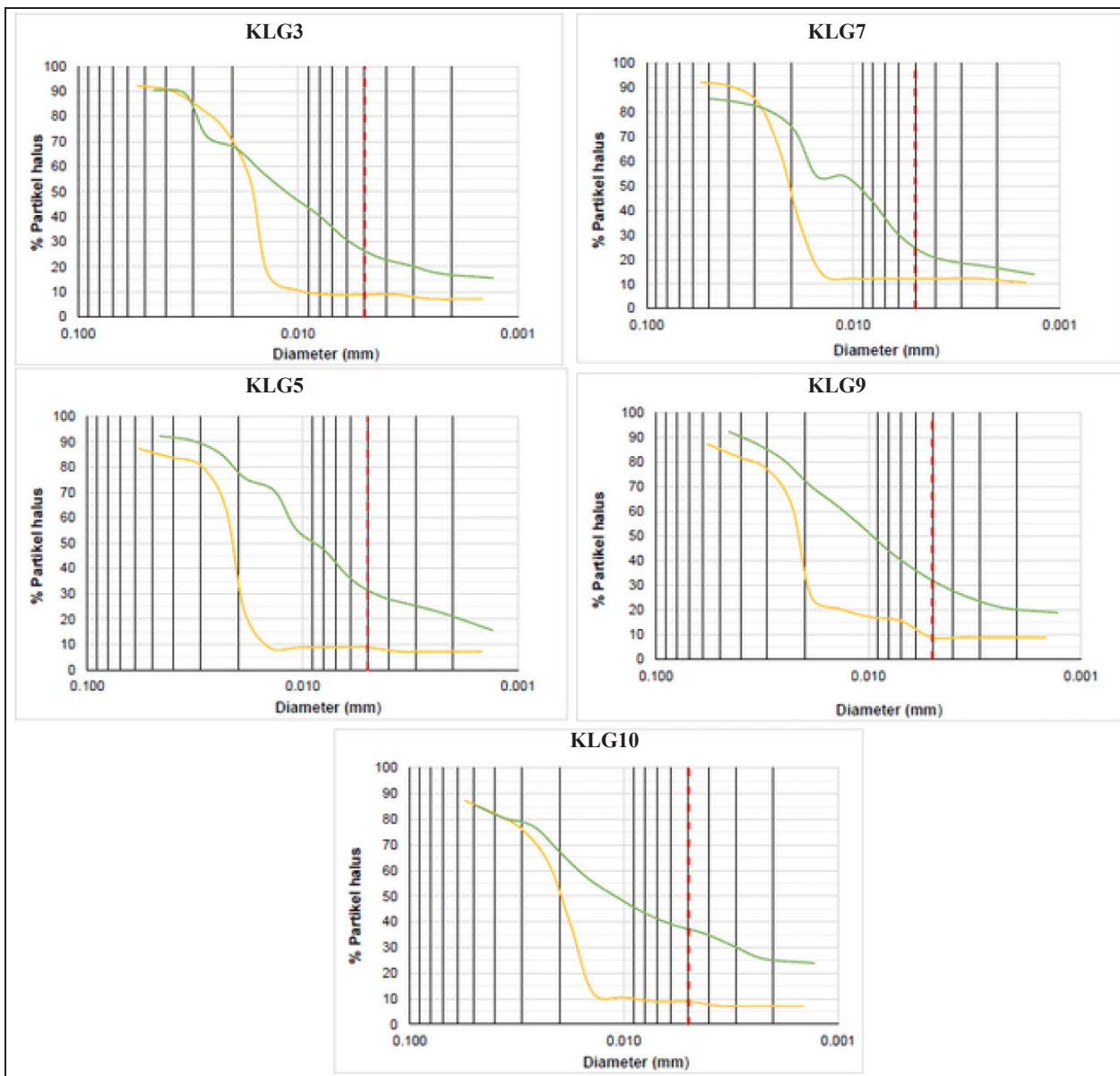
Rajah 7: Graf ujian hidrometer berganda bagi tanah di Jalan Kebun, Shah Alam.

mengandungi jumlah bahan organik yang besar dan mempunyai struktur agregat yang longgar yang seterusnya menjadikan butiran halus lebih mudah terpisah apabila dikenakan pengaliran air merujuk kepada fenomena yang biasa dikaitkan dengan tanah terserak (Luo *et al.*, 2024).

Dari aspek kimia, nilai pH yang rendah (2.72–4.20) serta nilai CEC yang sederhana hingga tinggi (10.5–17.9 cmol/kg) menunjukkan bahawa tanah berada dalam keadaan kimia yang mudah untuk berlaku pertukaran

kation terutamanya daripada $\text{Ca}^{2+}/\text{Mg}^{2+}$ ke Na^{+} yang mampu melemahkan kestabilan agregat (NACOE Project O21, 2023). Kajian terkini menunjukkan bahawa ion natrium yang tinggi dalam pertukaran kation (ESP) dan kekurangan kation multivalen adalah faktor utama yang menyumbang kepada sifat serakan tanah (Luo *et al.*, 2024).

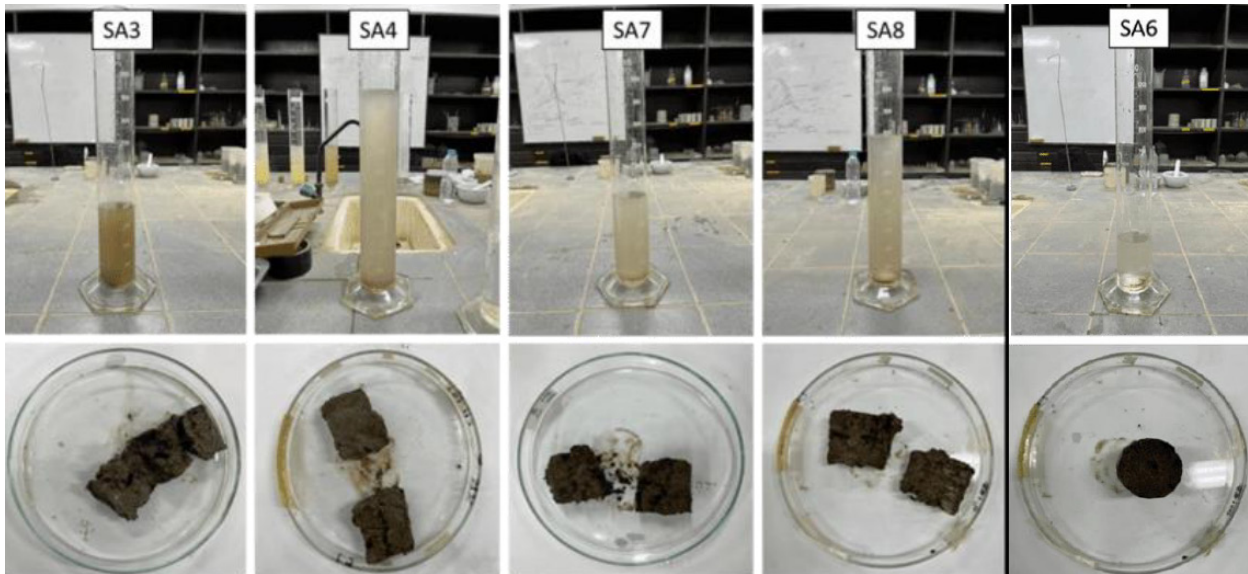
Dari sudut mineralogi, analisis XRD dan SEM menunjukkan bahawa tanah aluvium di kawasan kajian didominasi oleh kuarza dengan kehadiran mineral lempung



Rajah 8: Graf ujian hidrometer berganda bagi tanah di Kampung Sungai Aur, Pelabuhan Klang.



Rajah 9: Efluen spesimen selepas ujian yang menunjukkan perbezaan warna terhadap tahap serakan dan spesimen tanah selepas ujian dijalankan menunjukkan perbezaan lubang jarum bagi tanah tidak terserak dan sederhana terserak.



Rajah 10: Efluen spesimen selepas uji kaji yang menunjukkan perubahan warna air dan saiz tebusan spesimen bagi tanah terserak.

daripada kumpulan kaolinit dan ilit. Kehadiran mineral lempung ini dikenal pasti secara kuantitatif berdasarkan puncak intensiti dan corak pembelauan piawai dalam analisis XRD manakala analisis SEM menyokong dapatan tersebut melalui pemerhatian morfologi mineral lempung berbentuk berkeping. Secara umumnya, jenis mineral lempung yang dikenal pasti memainkan peranan penting terhadap kestabilan struktur tanah, khususnya apabila digabungkan dengan keadaan kimia yang menggalakkan pertukaran kation (Gupta, 2021). Kehadiran mineral lempung 2:1 seperti ilit meningkatkan keupayaan pertukaran kation lebih tinggi berikutan sifat pengembangannya yang lebih aktif berbanding mineral lempung 1:1 (kaolinit) (Kumari & Mohan, 2021). Oleh sebab itu, tanah dengan kehadiran mineral lempung ini bersifat lebih sensitif terhadap serakan yang mempengaruhi kebolehan tanah (Vakili *et al.*, 2024; Shah *et al.*, 2025; 2026).

Ujian serakan seperti *crumb test* dan hidrometer berganda menunjukkan bahawa sampel dengan nilai tekstur halus dan indeks keplastikan tinggi menunjukkan tahap serakan yang lebih tinggi (contohnya SA8 mencatat > 50 % partikel <0.005 mm). Ini selari dengan penemuan bahawa struktur agregat yang kurang stabil akan memudahkan hakisan dalaman apabila sistem saliran berfungsi atau apabila hujan lebat berlaku (Shah *et al.*, 2025).

Secara keseluruhannya, keputusan kajian ini menegaskan bahawa kombinasi tekstur, mineralogi dan sifat kimia termasuk kadar pertukaran kation, pH dan kandungan bahan organik adalah faktor utama dalam menentukan ciri serakan tanah aluvium di Shah Alam. Pemahaman mengenai mekanisme ini adalah penting untuk penilaian risiko geoteknikal, terutama bagi pembinaan di kawasan tanah aluvium dimana sifat serakan boleh menjejaskan kestabilan jangka panjang struktur binaan.

KESIMPULAN

Pengesanan tahap serakan dalam tanah aluvium adalah penting bagi memastikan sifat kejuruteraan tanah diambil kira dalam sebarang pembinaan di kawasan ini. Hasil kajian menunjukkan bahawa serakan tanah dipengaruhi oleh faktor mineralogi, terutamanya kehadiran natrium pertukarganti tinggi, pH, saliniti, serta intensiti hujan dan kadar aliran air yang tinggi. Gabungan faktor ini menyebabkan peleraian agregat dan hakisan dalaman yang meningkatkan keporosan tanah. Apabila zarah halus terserak, berlaku peningkatan isipadu dan dilatansi semasa pemampatan, lalu mengakibatkan mampatan tidak sekata serta potensi kerosakan struktur seperti retakan asas bangunan. Bagi mengurangkan risiko tersebut, disarankan penggunaan rawatan ameliorasi kimia seperti penambahan gipsium atau kapur untuk menstabilkan agregat tanah, di samping pengurusan air permukaan melalui sistem saliran dan penanaman vegetasi penutup bumi. Pemantauan berkala terhadap parameter kimia tanah serta pembangunan model ramalan berasaskan dimensi fraktal juga penting bagi menilai kecenderungan serakan secara kuantitatif. Secara keseluruhannya, kajian ini memberikan sumbangan penting dalam memahami mekanisme serakan tanah aluvium di Shah Alam serta implikasinya terhadap kestabilan struktur binaan. Penemuan ini dapat dijadikan asas saintifik bagi penilaian risiko geoteknikal dan pembangunan strategi mitigasi yang lebih berkesan di kawasan tanah aluvium.

PENGHARGAAN

Penulis ingin merakamkan setinggi-tinggi penghargaan dan ucapan terima kasih kepada Universiti Kebangsaan Malaysia atas peluang yang diberikan serta sokongan kewangan melalui Geran Penyelidikan Universiti berkod

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SUMBANGAN PENULIS

Semua penulis memberikan sumbangan yang jitu dalam menyiapkan penyelidikan ini seperti berikut: konsep dan reka bentuk kajian dipimpin oleh NSMN dan ASNS; pengumpulan data dilakukan oleh ZNAP, NN & ASJ; analisis serta interpretasi keputusan dijalankan oleh ZNAP, NN dan ASJ; penyediaan draf manuskrip dilakukan oleh ZNAP; manakala NSMN dan ASNS telah menyumbang idea berkaitan reka bentuk eksperimen. Pernyataan pembahagian sumbangan ini menekankan usaha kolaboratif serta memastikan ketelusan mengenai penglibatan setiap penulis dalam keseluruhan proses penyelidikan.

KONFLIK KEPENTINGAN

Para penulis mengisytiharkan bahawa tiada sebarang konflik kepentingan yang berkaitan dengan artikel ini.

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Global research patterns on earthquake-induced landslides: A bibliometric analysis

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Abstract: Earthquake-induced landslides represent a critical global challenge, contributing significantly to secondary hazards associated with seismic activity. This study presents a comprehensive bibliometric analysis of earthquake-induced landslides research to highlight dominant trends, research interests, and future directions. Literature published between 2000 and 2024 was retrieved from the Web of Science (WOS) database using search terms “earthquake-induced landslides” and “coseismic landslides,” yielding 1,090 relevant publications. Bibliometric analysis was conducted using VOSviewer, focusing on co-authorship networks, citations, keyword co-occurrence, and publication sources. The results indicate that the keywords ‘landslides and earthquakes’ exhibited the highest frequency and total link strength, with strong associations to ‘earthquake chain hazards’ and ‘hazard and risk assessment’. Landslides emerged as the leading journal with 85 publications and ranked second in total citations. Chong Xu was identified as the most prolific author, contributing 70 articles, followed by Qiang Xu and Xuanmei Fan, both with high citation impacts. Institutional analysis highlighted Chengdu University of Technology as the most influential organization with 35 articles. Overall, bibliometric trends reveal a sustained emphasis on susceptibility, hazard, and risk assessment of earthquake-induced landslides and mitigation strategies. Future research is expected to expand rapidly, underscoring the importance of interdisciplinary frameworks and international collaboration to enhance resilience to earthquake-induced geohazards.

Keywords: Earthquake-induced landslides, coseismic landslides, Web of Science, VOSviewer, bibliometric trends

Abstrak: Tanah runtuh akibat gempa bumi merupakan cabaran global yang signifikan dan menyumbang secara langsung kepada pembentukan bahaya sekunder yang berkaitan dengan aktiviti seismik. Kajian ini membentangkan analisis bibliometrik yang komprehensif terhadap penyelidikan tanah runtuh akibat gempa bumi bagi mengenal pasti corak perkembangan, kecenderungan penyelidikan, serta hala tuju masa hadapan dalam bidang ini. Literatur yang diterbitkan antara tahun 2000 hingga 2024 telah diperolehi daripada pangkalan data Web of Science (WOS) menggunakan kata kunci *earthquake-induced landslides* dan *coseismic landslides*, menghasilkan sebanyak 1,090 penerbitan yang relevan. Analisis bibliometrik dilaksanakan menggunakan perisian VOSviewer dengan menumpukan kepada rangkaian kerjasama penulisan, analisis sitasi, kewujudan bersama kata kunci, dan sumber penerbitan. Hasil kajian menunjukkan bahawa kata kunci “*landslides and earthquakes*” mencatatkan kekerapan dan kekuatan hubungan tertinggi, serta mempunyai kaitan rapat dengan “*earthquake chain hazards*” dan “*hazard and risk assessment*”. Jurnal Landslides dikenal pasti sebagai jurnal paling dominan dari segi bilangan penerbitan dan jumlah sitasi. Chong Xu muncul sebagai penyumbang paling prolifik, diikuti oleh Qiang Xu dan Xuanmei Fan yang turut menunjukkan impak sitasi yang tinggi. Analisis institusi menonjolkan Chengdu University of Technology sebagai institusi paling berpengaruh dalam bidang ini. Secara keseluruhannya, dapatan bibliometrik memperlihatkan penekanan berterusan terhadap penilaian kerentanan, bahaya dan risiko tanah runtuh akibat gempa bumi, serta pembangunan strategi mitigasi. Penyelidikan masa hadapan dijangka berkembang secara pesat, menekankan keperluan kerangka antara disiplin dan kerjasama antarabangsa bagi meningkatkan daya tahan terhadap bahaya geologi berkaitan gempa bumi.

Kata kunci: Tanah runtuh akibat gempa bumi, *coseismic landslides*, Web of Science, VOSviewer, corak perkembangan bibliometrik

INTRODUCTION

Earthquakes are generated by the sudden release of accumulated stress within the Earth's crust, and strong events can produce widespread ground deformation and

slope instability. In mountainous areas, seismic shaking may trigger numerous slope failures, commonly referred to as earthquake-induced landslides (EQILs) (Umar *et al.*, 2014; Fan *et al.*, 2019). These landslides can inflict

severe economic losses and cause widespread human casualties through the destruction of buildings, critical infrastructure, and natural environments. In some cases, EQILs also obstruct rivers, forming dammed lakes that pose significant risks of outburst floods and debris flows, threatening downstream communities and properties (Cui *et al.*, 2009; Alfaro *et al.*, 2012; Mehmood *et al.*, 2021). The spatial distribution of EQILs is controlled by several interacting factors, including seismic intensity, terrain morphology, lithology, tectonic setting, and human modification of slopes (Meunier *et al.*, 2008; Korup & Stolle, 2014; Fan *et al.*, 2018). Because these controls vary considerably from one region to another, predicting post-earthquake landslide-prone areas remains challenging (Korup & Stolle, 2014; Parker *et al.*, 2015). In recent decades, numerous models, both physical- and numerical-based, have been developed for assessing landslide susceptibility and identifying potential hazard zones (Romeo, 2000; Mao *et al.*, 2019; Song *et al.*, 2019; Yigit, 2020; Mehmood *et al.*, 2023). These models seek to enhance our understanding of how factors such as local geology, slope inclination, terrain features, and anthropogenic modifications contribute to the likelihood of slope failures during seismic events.

Historically, EQILs are reported back in 1789 BC in China and 373 BC in Greece, highlighting their centuries-old influence on human settlements and infrastructure (Keefer, 1994). More recent events, including the 1999 Chi-Chi earthquake in Taiwan, the 2005 Kashmir earthquake, the 2008 Wenchuan earthquake in China, the 2010 Haiti earthquake, and the 2023 Kahramanmaraş earthquake, have demonstrated the devastating consequences of EQILs. These events triggered thousands of landslides, causing major loss of life and long-term socio-economic disruption (Weissel & Stark, 2001; Chigira *et al.*, 2002; Gorum *et al.*, 2011, 2014; Basharat *et al.*, 2014; Kazmi *et al.*, 2014). For instance, the 2005 Kashmir earthquake saw landslides causing 30% of the total fatalities, while the Wenchuan earthquake-induced landslides resulted in over 20,000 deaths (Dunning *et al.*, 2007; Tang *et al.*, 2011). Additionally, the Kahramanmaraş earthquake triggered more than 3,000 landslides with numerous casualties, highlighting the persistent nature of these threats (Mehmood *et al.*, 2026). The aftermath of EQILs can extend beyond immediate destruction, causing sustained increases in soil erosion, sediment transport, and geomorphological changes in the impacted regions (Kazuo *et al.*, 2009; Hovius *et al.*, 2011; Tang *et al.*, 2011; Parkash, 2013). Such changes can persist for years, altering landscape stability and increasing vulnerability to future hazards (Parker *et al.*, 2011). Understanding and predicting the spatial distribution of EQILs is thus critical for effective disaster mitigation and the protection of human life and property (Gorum *et al.*, 2011; Parker *et al.*, 2015).

Bibliometric analysis has emerged as a prominent quantitative review method that leverages statistical analysis, data mining, and mathematical approaches to reveal evolving trends within specific scientific domains (Donthu *et al.*, 2021). This approach is being increasingly adopted across a range of research areas (Tamala *et al.*, 2022) and is now regarded as a contemporary means of evaluating scholarly work (Cui *et al.*, 2022). By examining publications based on variables such as publication year, keywords, authorship, and country of origin, bibliometric analysis effectively identifies, explains, and classifies research outcomes, thereby aiding in the detection of research gaps and trends in a systematic manner (Zhang *et al.*, 2020; Yang *et al.*, 2024). The data for such analyses are typically derived from major citation databases like Web of Science and Scopus. Although multidisciplinary research groups have extensively studied earthquake-induced landslides, a comprehensive bibliometric analysis of this topic has yet to be undertaken. Numerous studies have been published on predicting and analyzing earthquake-induced landslides, but no bibliometric analysis is available in the literature. Therefore, bibliometric analysis provides a suitable framework for systematically evaluating the development, contributors, collaboration patterns, and thematic evolution of EQIL research. This quantitative method employs statistical and data mining techniques to identify trends, patterns, and gaps in scientific literature. Bibliometric analysis facilitates a structured understanding of research developments by categorizing publications according to variables such as publication year, keywords, authorship, and geographic origin. Data for such analyses is commonly sourced from established citation databases like Web of Science (WOS) and Scopus.

The analysed literature shows strong growth in earthquake-induced landslide research, but its geographic distribution remains uneven. Publications are concentrated mainly in China, the USA, Japan, Italy, Taiwan, and selected European countries, whereas several seismically active and landslide-prone regions remain comparatively underrepresented. These include parts of Central Asia, the Hindu Kush-Karakoram-Himalaya region outside the most frequently studied areas, the Middle East, Central and South America, Central and Eastern Africa, Southeast Asia, and Eastern Europe. This imbalance is important because many of these regions experience high seismicity, steep terrain, rapid land-use change, and limited monitoring infrastructure. The keyword and thematic results also suggest that some subtopics remain less developed than susceptibility and hazard assessment, including post-seismic landslide reactivation, earthquake-triggered debris flows, landslide-dammed lake formation and breaching, long-term sediment cascading effects, real-time monitoring and early warning, uncertainty quantification in predictive models, and socio-economic vulnerability assessment.

Addressing these geographic and thematic gaps would improve the global representativeness of earthquake-induced landslide research and strengthen its relevance for disaster-risk reduction. Despite the significant body of work exploring EQILs and their influencing factors, a comprehensive bibliometric analysis on this topic has not been conducted. Such an analysis is essential for summarizing the evolution of research, identifying leading contributors, and guiding future studies. This study presents a bibliometric analysis of publications in from 2000 to 2023 on earthquake-induced landslides using “coseismic landslides” as an additional search term in the Web of Science database. The search focuses on publication trends, author collaborations, geographic distribution, journal impact, and keyword mapping in the WOS database. The findings aim to provide valuable insights for researchers, policymakers, and stakeholders invested in advancing the field of earthquake-triggered landslide studies.

METHODOLOGY

A comprehensive bibliometric analysis was conducted to examine publication growth, leading contributors, dominant journals, and significant authors in earthquake-induced landslide research. In this study, “earthquake-induced landslides” is used as the main term, while “coseismic landslides” is retained as an additional search term because it is commonly used in the literature. Our methodology offers an extensive overview of authorship, country-level contributions, institutional affiliations, prevalent keywords, and collaborative networks, thereby enhancing the global literature in this field (Ahmad *et al.*, 2021; Yang *et al.*, 2024). To carry out bibliometric analysis, we utilized the WoS Core Collection (<https://www.webofscience.com/WOS>), a widely respected database that indexes a broad array of sources such as journals, books, reviews, and conference proceedings. This database is renowned for its comprehensive citation records and frequent updates, making it a trusted tool for bibliometric research (Liaqat *et al.*, 2023; Rasera *et al.*, 2023).

For this research, we searched the WOS database to retrieve documents related to earthquake-induced landslides, using “coseismic landslides” as an additional search term. The search covered the period from January 1, 2000, to January 1, 2024, and was limited to journal articles, books, review papers, and conference proceedings. It was conducted in the “Topic” field using the keywords “earthquake-induced landslides” OR “coseismic landslides,” which resulted in 1,090 publications. These records were extracted on July 01, 2024, to ensure consistency and mitigate the effects of ongoing database updates. The data was collected in tab-delimited format for further processing. We employed VOSviewer (version 1.6.20) for data analysis. VOSviewer, developed by Leiden

University, is a robust tool for bibliometric visualization and analysis that supports clustering, tagging, and density views (Van Eck & Waltman, 2010). The software’s strong text-mining capabilities allow it to extract significant terms and visualize co-occurrence networks, making it popular in bibliometric studies across multiple disciplines (Lv *et al.*, 2021; Liaqat *et al.*, 2023; Rasera *et al.*, 2023).

The analysis began with a basic examination of publication trends directly within the WOS interface. Advanced analyses, including co-authorship patterns, keyword co-occurrences, and co-citation networks, were then performed using VOSviewer. Network maps generated by VOSviewer consist of nodes representing entities such as authors, institutions, countries, and keywords. The node size reflects the frequency of occurrences, while the links indicate relationships between these entities; thicker links denote stronger connections. VOSviewer’s visualization capabilities facilitated the identification of high-frequency keywords and the exploration of research clusters, contributing valuable insights into research dynamics and collaboration within the field of earthquake-induced and coseismic landslide studies.

RESULTS

Publication trends

The earliest Web of Science record identified in the broader search was Wachs and Levitte’s 1981 article, “Earthquake-Induced Landslides in the Galilee” (Wachs & Levitte, 1981). This publication is recognized as the foundational work in the study of this phenomenon. During the initial years of research, spanning from 1981 to 1999, the literature on this topic was relatively sparse, with only a few documents available. Figure 1 presents the annual number of articles published in this field from 1981 to 1999, illustrating the progression of scholarly activity over time. The quantitative bibliometric analysis in this study was restricted to publications from 2000 to 2024, as stated in the methodology. During the analyzed period, a total of 1,090 publications related to

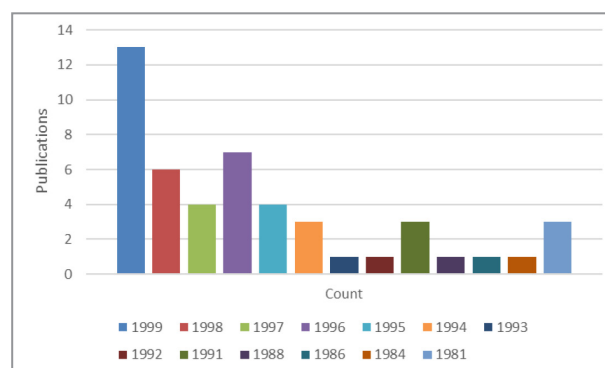


Figure 1: Annual publication trends in earthquake-induced landslide research WOS database (1981-1999).

earthquake-induced landslides were identified in the Web of Science database for the period 2000 to 2024, using “coseismic landslides” as an additional search term. The results show a clear increase in research output during the 21st century, reflecting growing academic interest in earthquake-triggered slope failures, susceptibility assessment, hazard evaluation, and related multi-hazard processes. The annual publication trend from 2000 to 2024 is presented in Figure 2, illustrating the progressive growth of scholarly activity in this field. These publications comprised 875 (80.3%) original research articles, 154 (14.13%) conference papers, 48 (4.4%) book chapters, and 13 review articles. The highest output was recorded in 2023, with 114 publications, closely followed by 113 publications in 2022 (Figure 2). English was the predominant language for these works, accounting for 970 publications (89%), while other languages included Chinese (115), Spanish (5), French (1), and Korean (1). Notably, 330 (28.1%) of the total publications were open-access, with 182 (16%) published under the gold open-access model.

Keyword network analysis

Figure 3 presents a visualized network of keywords with a minimum occurrence threshold of eight, generated

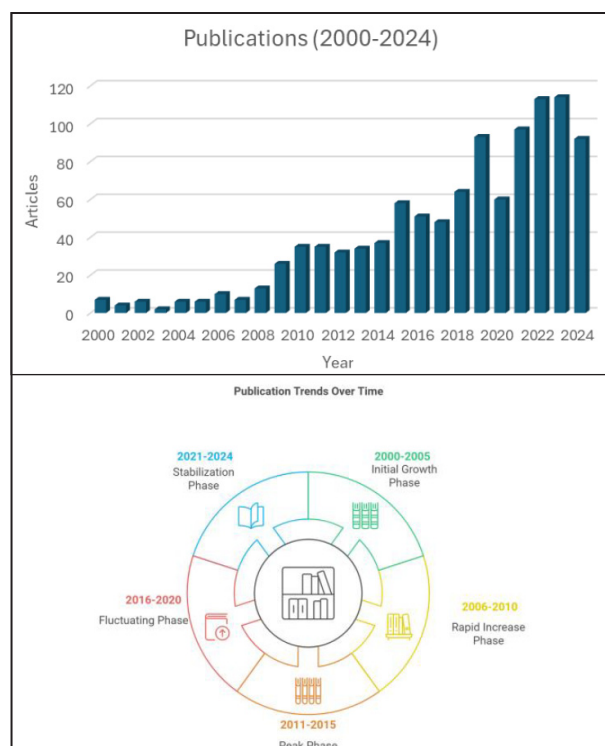


Figure 2: Annual publications trends in earthquake-induced landslides between 2000 and 2024.

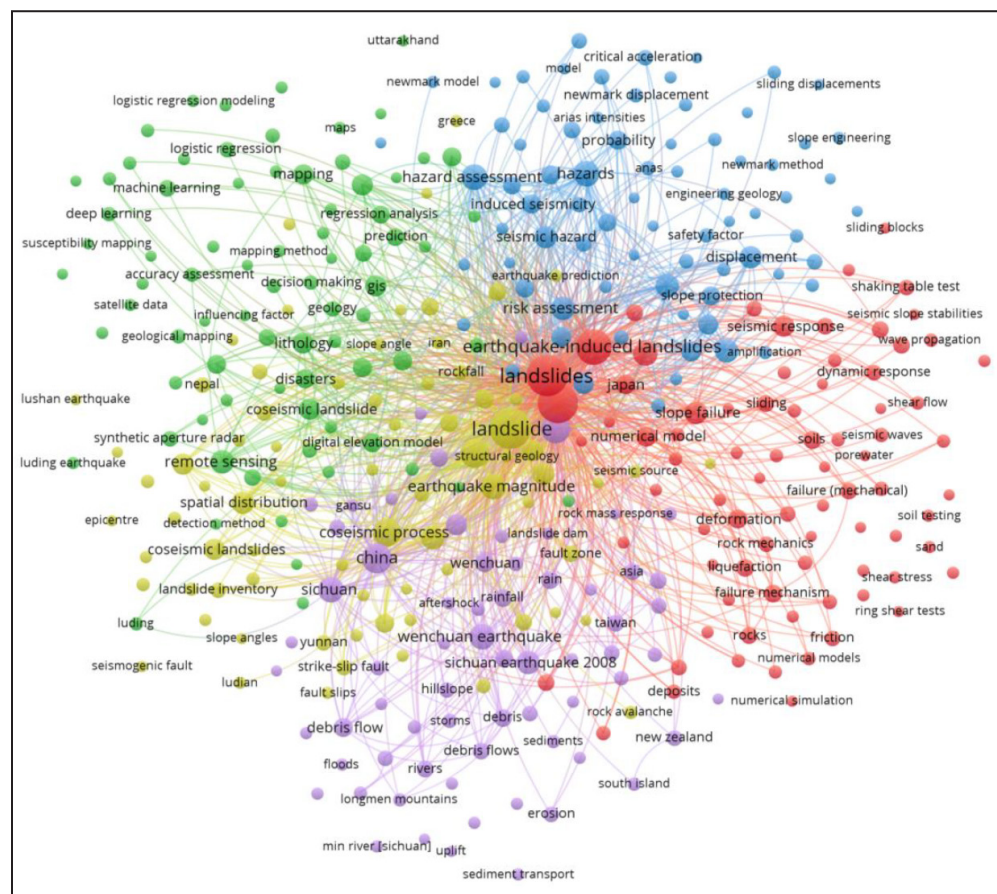


Figure 3: Keyword co-occurrence network for publications on earthquake-induced landslides, with “coseismic landslides” included as a related search term. Node size represents keyword frequency, while links indicate co-occurrence relationships among keywords.

using VOSviewer software. The network comprises five clusters, each represented by a different color, illustrating the thematic focus and interconnections within earthquake-induced landslide studies. The largest cluster, highlighted in red and consisting of 80 items, includes key terms such as Wenchuan earthquake, catastrophic landslide, earthquake-induced landslides, hazard assessment, and coseismic landslides. This cluster emphasizes the strong association between earthquake-induced landslides and hazard assessment. The second major cluster, depicted in yellow, features keywords like accuracy assessment, controlling factors, damage detection, and coseismic landslide, pointing to research themes related to the detection and accuracy of hazard assessments under seismic event conditions.

The most common keywords in the data set were landslides and earthquake-induced landslides, with accumulated connection strengths of 373 and 368, respectively. Other prominent keywords included earthquake events and coseismic processes, which had link strengths of 347 and 333, respectively (Figure 3). This analysis demonstrates central themes and interconnected areas of research, providing insight into the main focus areas and collaborative potential within the field.

Publication and citation overview

Table 1 highlights the thirty of the most cited documents focused on earthquake-induced or coseismic landslides. The majority of these influential publications are original research articles, supplemented by conference papers and book chapters. The average citation count among the top thirty documents was 315.63, indicating their substantial influence within the field. Jibson *et al.* (2000) was the most cited publication, with 659 citations, followed by Fan *et al.* (2019), with 604 citations. Overall, earthquake-induced landslide research was distributed across 132 journals, of which 40 published at least five documents. The top ten journals collectively published

379 articles, representing 34.7% of the total output in the field. The journal 'Landslides' leads this group, with 85 articles published (7.8% of the total publications) and an impressive impact factor of 5.8. Additionally, 'Landslides' is the most frequently cited journal in the field, accumulating 3,755 citations. Following closely is Engineering Geology, which published 75 articles and received a cumulative citation count of 6,106. Geomorphology ranks third, contributing 41 articles and earning 2,736 citations (Figure 4). These leading journals indicate key dissemination channels for earthquake-induced landslide research.

Leading contributors and geographic trends

Table 2 outlines the top ten countries, authors, and institutions contributing to research on earthquake-induced landslides. Xuanmei Fan from the State Key Laboratory of Geohazard Prevention and Geoenvironment Protection (SKLGP) in China, in collaboration with The Faculty of Geo-Information Science and Earth Observation (ITC) at the University of Twente in the Netherlands, has been identified as the most frequently cited author. Fan's work, comprising 28 publications, has been cited 2,683 times. The University of Twente has also made a significant impact, garnering 783 citations across five key articles.

Geographically, China leads in the number of cited articles, with 546 (49.7%) articles that have collectively received 12,410 citations. The USA and Japan follow, each contributing 134 (16.8%) articles with citation counts of 8,320 and 4,570, respectively (Figure 5). This data underscores the central role of China as a dominant force in the field, both in terms of publication volume and citation impact, with significant contributions also from other leading research hubs. The research in this field has received substantial financial support from various organizations in China (Figure 6), further highlighting the country's pivotal role in advancing this area of study.

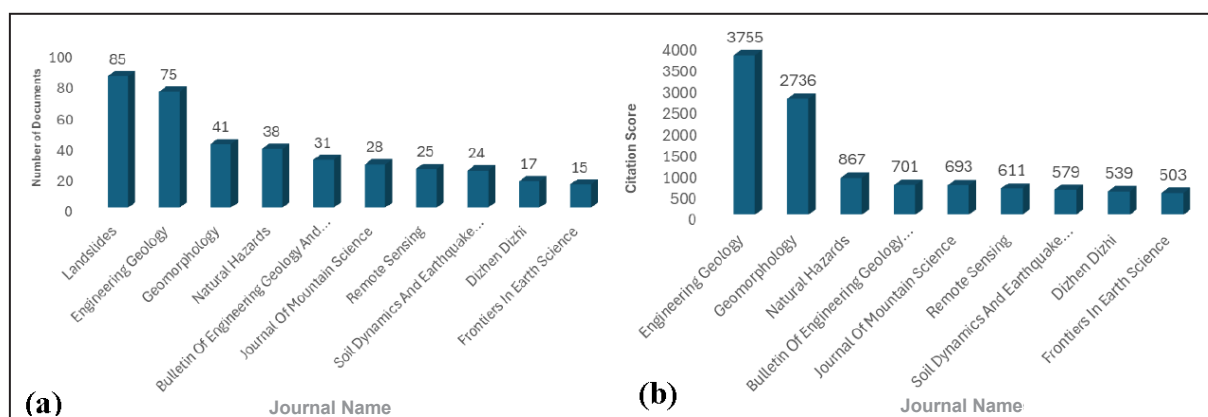


Figure 4: (a) Leading journals in earthquake-induced landslide research: (a) journals with the highest number of publications and (b) journals with the highest citation counts.

Table 1: Thirty most cited publications on earthquake-induced landslide research identified from the WOS database.

Rank	Article Title	Authors	Journal	Affiliated Country	Citations Score	Publishing Year
1	A method for producing digital probabilistic seismic landslide hazard maps	(Jibson <i>et al.</i> , 2000)	Engineering Geology	United States	659	2000
2	Earthquake-induced chains of geologic hazards: Patterns, mechanisms, and impacts	(Fan <i>et al.</i> , 2019)	Reviews of Geophysics	China	604	2019
3	Investigating landslides caused by earthquakes - A historical review	Keefer D.K., 2002	Surveys in Geophysics	United States	600	2002
4	Regression models for estimating coseismic landslide displacement	Jibson R.W., 2007	Engineering Geology	United States	556	2007
5	Distribution pattern of earthquake-induced landslides triggered by the 12 May 2008 Wenchuan earthquake	(Gorum <i>et al.</i> , 2011)	Geomorphology	Netherlands	537	2011
6	Earthquake-triggered increase in sediment delivery from an active mountain belt	(Dadson <i>et al.</i> , 2004)	Geology	Taiwan	464	2004
7	Mass wasting triggered by the 2008 Wenchuan earthquake is greater than orogenic growth	(Parker <i>et al.</i> , 2011)	Nature Geoscience	United Kingdom	450	2011
8	Topographic site effects and the location of earthquake induced landslides	(Meunier <i>et al.</i> , 2008)	Earth and Planetary Science Letters	United Kingdom	410	2008
9	Statistical analysis of an earthquake-induced landslide distribution - The 1989 Loma Prieta, California event	Keefer D.K., 2000	Engineering Geology	United States	369	2000
10	The 12 May Wenchuan earthquake-induced landslide lakes: Distribution and preliminary risk evaluation	(Cui <i>et al.</i> , 2009)	Landslides	China	360	2009
11	The size, distribution, and mobility of landslides caused by the 2015 Mw7.8 Gorkha earthquake, Nepal	(Roback <i>et al.</i> , 2018)	Geomorphology	United States	319	2018
12	Earthquake induced landslide susceptibility mapping using an integrated ensemble frequency ratio and logistic regression models in West Sumatera Province, Indonesia	(Umar <i>et al.</i> , 2014)	Catena	Malaysia	289	2014
13	Seismic slope behavior in a large-scale shaking table model test	Lin M.-L.; Wang K.-L., 2006	Engineering Geology	Taiwan	285	2006
14	Evaluation of factors controlling earthquake-induced landslides caused by Chi-Chi earthquake and comparison with the Northridge and Loma Prieta events	Khazai B.; Sitar N., 2004	Engineering Geology	United States	273	2004
15	Impacts of the Chi-Chi earthquake on subsequent rainfall-induced landslides in central Taiwan	(Lin <i>et al.</i> , 2006)	Engineering Geology	Taiwan	267	2006
16	Undrained dynamic-loading ring-shear apparatus and its application to landslide dynamics	(Sassa <i>et al.</i> , 2004)	Landslides	Japan	266	2004

Table 1: Continued.

Rank	Article Title	Authors	Journal	Affiliated Country	Citations Score	Publishing Year
17	Coseismic landslides triggered by the 8 th August 2017 M s 7.0 Jiuzhaigou earthquake (Sichuan, China): factors controlling their spatial distribution and implications for the seismogenic blind fault identification	(Fan <i>et al.</i> , 2018)	Landslides	China	225	2018
18	A systematic review of landslide probability mapping using logistic regression	(Budimir <i>et al.</i> , 2015)	Landslides	United Kingdom	221	2015
19	Seismically induced landslide displacements: A predictive model	Romeo R., 2000	Engineering Geology	Italy	220	2000
20	The characteristics and failure mechanism of the largest landslide triggered by the Wenchuan earthquake, May 12, 2008, China	(Huang <i>et al.</i> , 2012)	Landslides	China	219	2012
21	Surface rupture of the 2005 Kashmir, Pakistan, earthquake and its active tectonic implications	(Kaneda <i>et al.</i> , 2008)	Bulletin of the Seismological Society of America	Japan	216	2008
22	Landslides induced by the Wenchuan earthquake and the subsequent strong rainfall event: A case study in the Beichuan area of China	(Tang <i>et al.</i> , 2011)	Engineering Geology	China	209	2011
23	Natural and human-induced landsliding in the Garhwal Himalaya of Northern India	(Barnard <i>et al.</i> , 2001)	Geomorphology	United States	208	2001
24	Statistical approach to earthquake-induced landslide susceptibility	(Lee <i>et al.</i> , 2008)	Engineering Geology	Taiwan	203	2008
25	Earthquake-induced landslides in Central America	(Bommer; Rodríguez, 2002)	Engineering Geology	United Kingdom	185	2002
26	Presentation and analysis of a worldwide database of earthquake-induced landslide inventories	(Tanyaş <i>et al.</i> , 2017)	Journal of Geophysical Research: Earth Surface	Netherlands	182	2017
27	Database and spatial distribution of landslides triggered by the Lushan, China Mw 6.6 earthquake of 20 April 2013	(Xu <i>et al.</i> , 2015)	Geomorphology	China	180	2015
28	Effects of near-fault seismic loadings on run-out of large-scale landslide: A case study	(Zhang <i>et al.</i> , 2013)	Engineering Geology	Japan	170	2013
29	Modeling typhoon- and earthquake-induced landslides in a mountainous watershed using logistic regression	(Chang <i>et al.</i> , 2007)	Geomorphology	Taiwan	164	2007
30	Toward the next generation of research on earthquake-induced landslides: Current issues and future challenges	(Wasowski <i>et al.</i> , 2011)	Engineering Geology	Italy	159	2011

Table 2: A compilation of countries, international organizations, and authors contributing to publications on earthquake-induced and coseismic landslides.

Country Name	Publications	Citations
China	542	12410
USA	183	8320
Japan	174	4570
Italy	137	3710
Taiwan	80	3141
England	72	3050
Greece	53	2032
India	53	1590
France	49	1285
New Zealand	44	1220
Organization		
SKLGP, China	35	763
National Institute of Natural Hazards, China	32	318
Key Laboratory of Compound and Chained Natural Hazards, Beijing, China	24	231
University of Chinese Academy of Sciences, Beijing, China	23	542
Key Laboratory of Active Tectonics and Volcano, China Earthquake Administration	22	763
Institute of Geology, China Earthquake Administration	15	71
Institute of mountain hazards and environments, CAS, China	13	258
Southeast Jiaotong University, China	12	185
Institute of Crustal Dynamics, China	12	312
Chinese Academy of Geological Sciences, China	10	155
Key Laboratory of Seismic and Volcanic hazards, China Earthquake Administration	10	145
Author		
Chong Xu	70	2234
Qiang Xu	29	2582
Xuanmei Fan	28	2683
Runqiu Huang	23	2165
Guangqi Chen	21	465
Yingbin Zhang	19	474
Xiwei Xu	17	667
Xiaoyi Shao	17	238
Siyuan Ma	16	342
Xiangjun Pei	15	1269

Co-authorship network analysis

Co-authorship analysis helps illuminate the collaborative networks within a research domain by evaluating the number of publications co-authored by different researchers. In the field of earthquake-induced landslide research, 3,224 authors have contributed to the body of literature. Among these, Chong Xu stands out as the most prolific author, with 70 publications that have amassed 2,234 citations. Jiang Xu follows closely

with 29 articles and 2,582 citations, while Xuanmei Fan has authored 28 documents that garnered 2,683 citations. The total link strength, which represents the cumulative strength of an author's co-authorship connections, was recorded at 135 for Chong Xu, 88 for Jiang Xu, and 83 for Xuanmei Fan. This metric underscores the degree of collaboration each researcher has established within the scientific community as shown in Figure 7a.

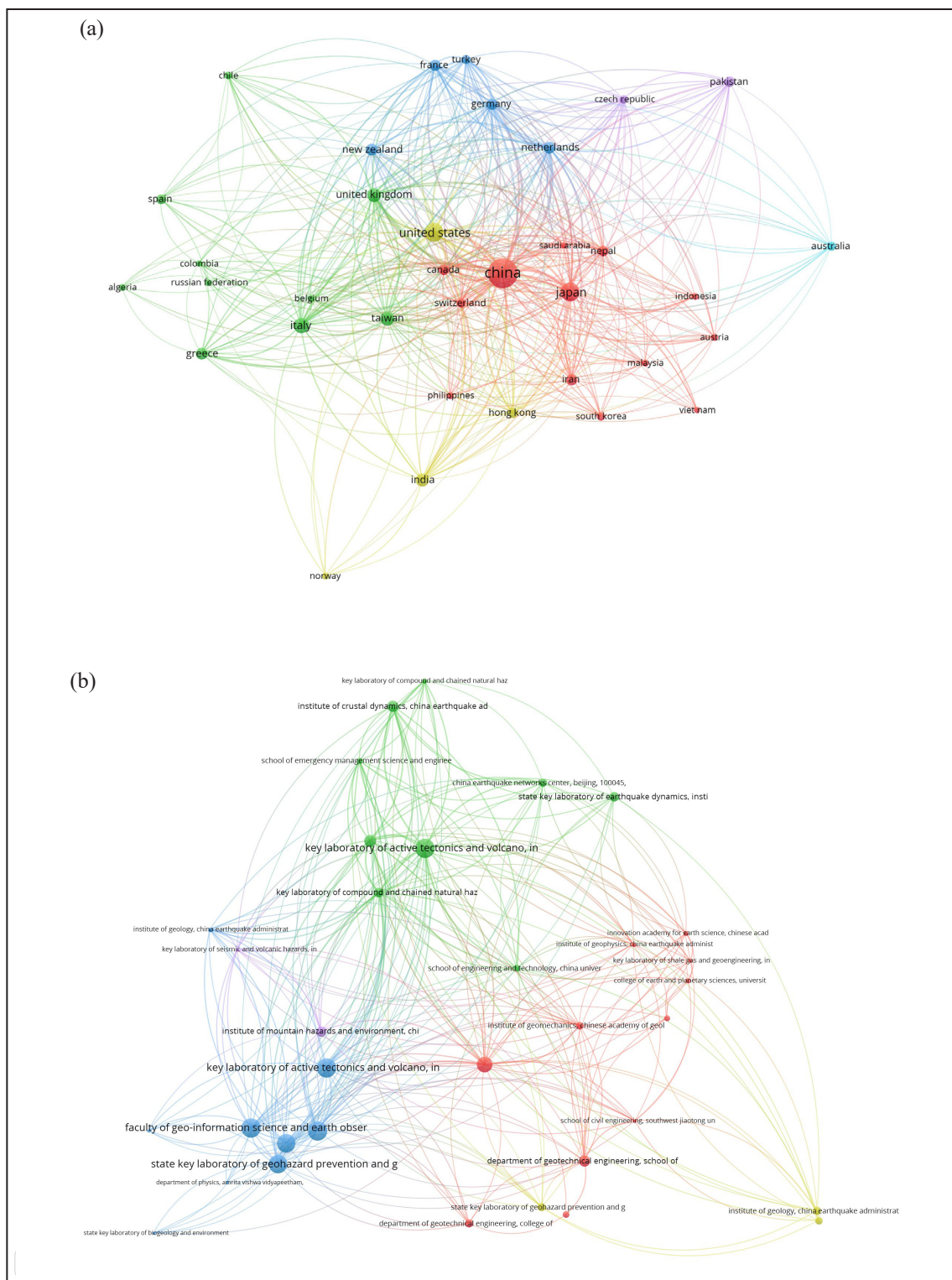


Figure 5: Citations analysis (a) Countries citations; China receives the highest number of citations (12410) presented in green. (b) Organization citations. The University of Twente received a maximum citation (783) presented in the blue cluster. Circle size represents citation score and colors indicate different grouping.

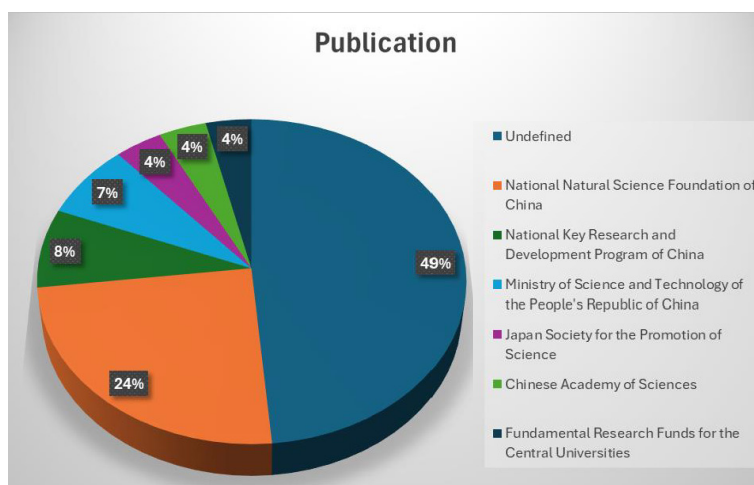


Figure 6: Leading research sponsorship organization in earthquake-induced landslides research.

The analysis extends to organizational involvement, revealing that 2,292 organizations have contributed to publications on the subject. Of these, 34 institutions have published at least five documents each. The State Key Laboratory of Geohazard Prevention and Geoenvironment Protection in China leads with 35 articles and 763 citations. It is followed by the National Institute of Natural Hazards in China, which has published 32 documents and received 318 citations. The collaborative strength, indicated by the total number of co-authors and their link strength, was notable for these institutions. The State Key Laboratory reported four collaborators and a total link strength of 5, while the National Institute of Natural Hazards had 13 collaborators with a total link strength of 59 (Figure 7b). In terms of international collaboration, China has partnered with 27 other entities, achieving a total link strength of 227, whereas the USA has also collaborated with 27 partners but with a lower total link strength of 130 (Figure 7c). This data highlights the extensive research network centered in China and indicates a strong collaborative framework contributing to advancements in the field.

To reduce the collaboration gap between well-funded and less-funded regions, future research should promote more inclusive international partnerships. Researchers from less-funded but hazard-prone regions can strengthen collaboration by developing open-access earthquake-induced landslide inventories, sharing field observations and local geological data, and co-designing case studies with institutions that have advanced remote-sensing, seismic, and computational facilities. Joint supervision of graduate students, short-term research exchanges, regional training workshops, and participation in international networks such as engineering geology, landslide, and disaster-risk-reduction consortia can also improve visibility and technical capacity. Collaborative projects should prioritize equitable authorship, shared

data ownership, and capacity building rather than treating low-resource regions only as study sites. Such partnerships would help bridge funding and infrastructure gaps while improving the global representativeness of earthquake-induced landslide research.

Coupling and co-citation patterns in literature

Bibliographic coupling occurs when two separate works cite the same source, while co-citation refers to two publications cited by a third. Figures 8a and 8b illustrate the bibliographic coupling maps for documents and sources, respectively. Out of the 1,090 documents analyzed, 675 met the threshold of at least 10 citations, resulting in the identification of eight clusters. Jibson *et al.* (2000) recorded the highest citation count, with 659 citations and a total link strength of 433. Fan *et al.* (2019) followed with 603 citations and a total link strength of 545, indicating strong connectivity within the research network. Among the 321 analysed sources, 44 met the threshold of at least five documents. The journal 'Landslides' emerged as the leading source with 85 documents, followed by 'Engineering Geology' journal with 75 documents and 'Geomorphology' journal with 41. The total link strengths for these sources were recorded as 35,933 for Landslides, 36,070 for Engineering Geology, and 26,307 for Geomorphology. The most highly cited source was Engineering Geology, which amassed 6,106 citations, while Landslides and Geomorphology followed with 3,755 and 2,637 citations, respectively.

In the co-citation analysis, a total of five clusters of cited sources were identified. The two largest clusters comprised 15 and 14 items, showcasing key groups of highly interconnected and frequently co-cited literature within the domain (Figure 8C). This analysis underlines the significant influence of core publications and sources that shape the research landscape of earthquake-induced

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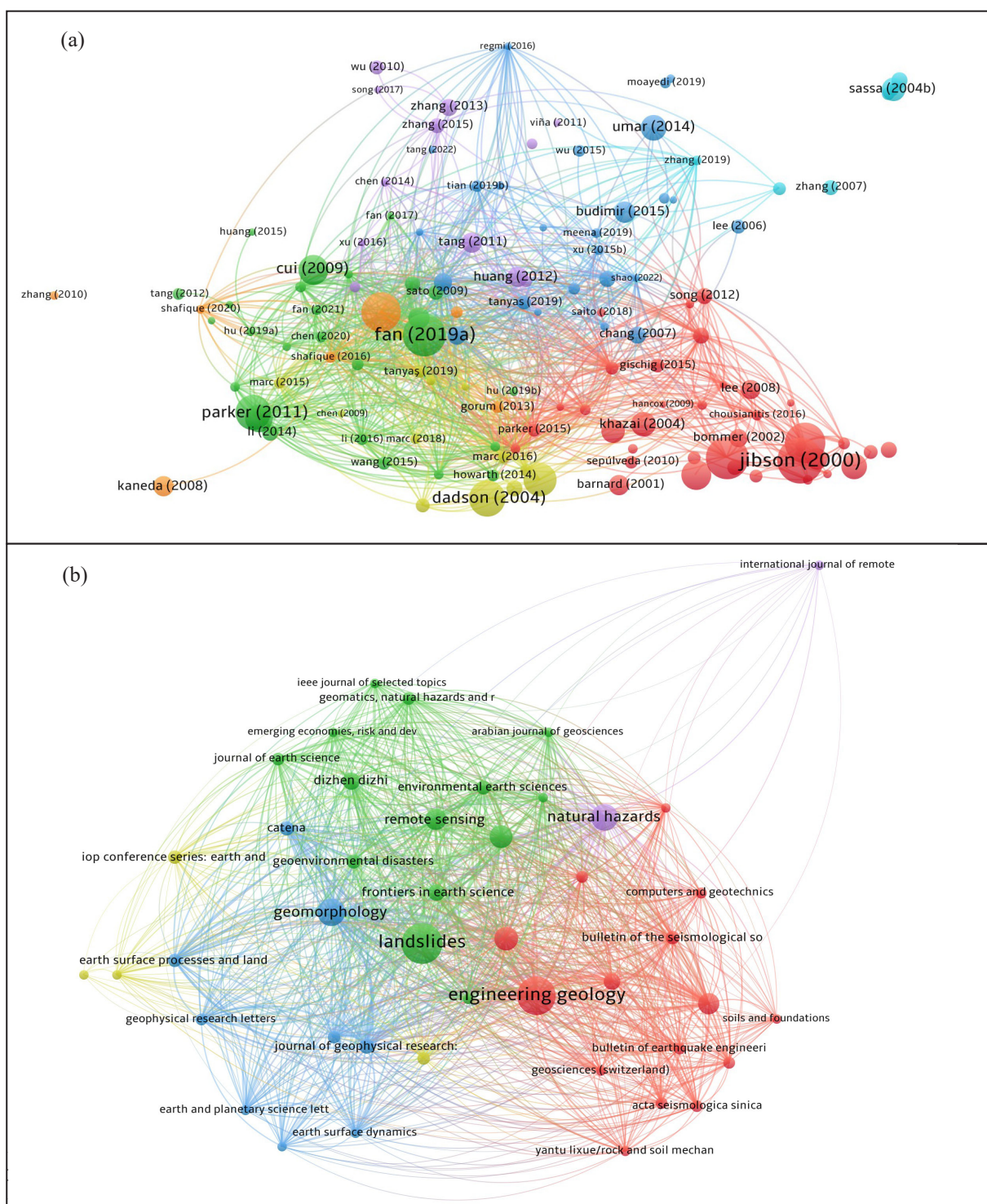


Figure 8: Bibliographic coupling and co-citation networks: (a) document coupling, (b) source coupling, and (c) source co-citation. Node size represents citation or co-citation frequency, and link distance indicates the strength of relationship.

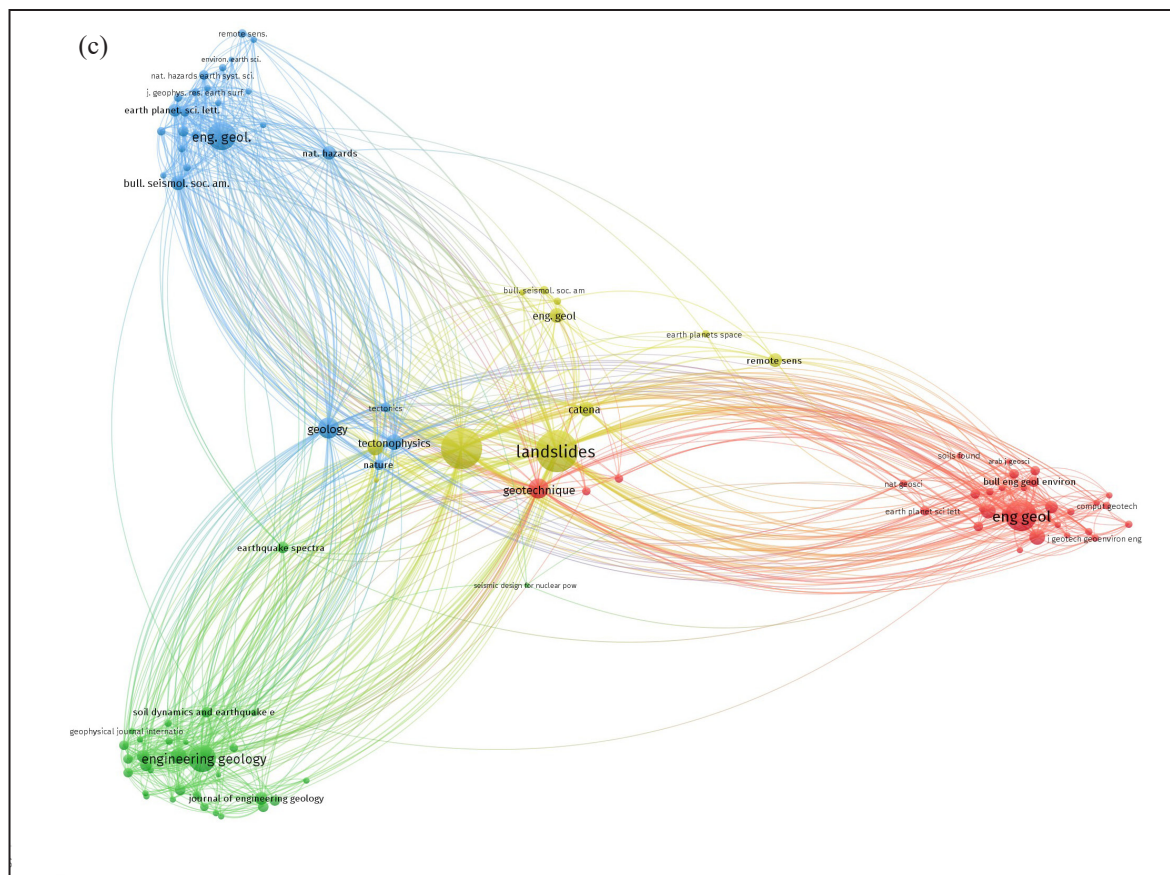


Figure 8: Continued.

landslides, demonstrating how foundational studies continue to inform and connect with newer research efforts.

Bibliometric analysis of keywords co-occurrence

The co-occurrence analysis of keywords revealed eight distinct clusters, each representing thematic areas within earthquake-induced landslide research. The largest cluster, shown in purple, encompasses 72 items, followed by the red cluster with 61 items. The yellow, green, and blue clusters include 56, 55, and 54 entries, respectively (Figure 9a). Figure 8b illustrates a trend network map that visualizes how research themes have evolved over time based on keyword usage. The purple cluster indicates topics that were the focus of earlier studies, highlighting foundational research areas. In contrast, the yellow and green clusters represent more recent areas of exploration, suggesting emerging trends and modern research directions.

Keywords such as earthquake events, coseismic process, remote sensing, machine learning, landslide inventory, landslide forecasting, and seismic response appear within the green and yellow clusters. Their presence underscores their prominence in contemporary studies and indicates a shift towards incorporating advanced

technological and analytical methods in the field (Figure 9b). This co-occurrence analysis reflects the progression and broadening of research, emphasizing the integration of innovative approaches like machine learning and remote sensing in recent investigations. The recent growth in modelling approaches is most strongly associated with data-driven and hybrid techniques for susceptibility, hazard, and inventory mapping. In particular, machine-learning models such as random forest, support vector machine, artificial neural networks, decision-tree-based algorithms, gradient boosting, and ensemble approaches combining frequency ratio, logistic regression, and other statistical classifiers have become increasingly prominent. Deep-learning techniques, especially convolutional neural networks applied to remote-sensing imagery and landslide inventory extraction, also represent an emerging direction. At the same time, physically based and probabilistic approaches, including Newmark displacement modelling, seismic slope displacement estimation, and runout simulation, continue to be used, but recent keyword trends indicate a stronger shift toward machine learning, remote sensing, and hybrid modelling frameworks. This trend reflects the increasing availability of satellite imagery, digital elevation models, open landslide inventories, and computational tools for large-scale earthquake-induced landslide assessment.

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DISCUSSION

The bibliometric results show that earthquake-induced landslide research has expanded substantially during the past two decades, with a particularly clear increase after the 2008 Wenchuan earthquake. The analysis identifies China, the USA, Japan, Italy, Taiwan, and selected European countries as the main contributors to the field, while several seismically active and landslide-prone regions remain comparatively underrepresented. The results also show that research has been concentrated mainly on susceptibility, hazard, and risk assessment, with increasing attention to remote sensing, machine learning, landslide inventories, and earthquake-induced chain hazards. These patterns indicate that earthquake-induced landslides have become an important research theme within geohazard science because of their severe socio-economic impacts and their role in cascading disaster processes. The strong growth in publications after major seismic events suggests that research activity is closely linked to destructive earthquakes, especially those that generate large landslide inventories and long-term geomorphic impacts. The uneven geographic distribution of publications also points to differences in funding, technical capacity, monitoring infrastructure, and international collaboration among regions.

The dominance of a limited number of countries and institutions also indicates an imbalance in global research capacity. Although leading research centres have contributed substantially to methodological development and citation impact, earthquake-induced landslide studies would benefit from stronger participation by less-funded but highly exposed regions. Future work should therefore promote equitable international collaboration through shared landslide inventories, open-access remote-sensing data, joint field campaigns, co-supervised postgraduate research, regional training workshops, and open-source modelling workflows. Such mechanisms can help improve technical capacity in underrepresented regions while producing more globally representative assessments of earthquake-induced landslide hazards. Based on the recent research activities the emerging trends and future directions can be summarized as follows:

Research in EQILs is becoming increasingly interdisciplinary, intersecting with fields such as geology, remote sensing, environmental science, and hydrology. This multidisciplinary approach supports comprehensive analyses and innovative solutions, signalling a progressive shift towards collaborative and integrated research methods. Keyword clustering over time illustrates the transition from empirical and theoretical models to data-driven, technology-enhanced paradigms, with future research likely focusing on the application of intelligent methods to boost precision and efficiency in early warning and disaster mitigation. Key areas for future research include:

- Continued exploration of how climate change impacts the triggering mechanisms of EQIL, which will be critical as global weather patterns evolve.
- Investigating earthquake-induced chain geological hazards, including secondary effects like debris flows and collapses, especially in complex geological settings.
- Technological Advancements in Hazard Identification: The application of cutting-edge remote sensing, monitoring systems, machine learning techniques, and artificial intelligence for more effective identification, prediction, and early warning.
- Enhancing the precision of probability models to predict the timing and spatial occurrence of EQIL.
- Develop real-time monitoring and integrated risk assessment frameworks to enhance disaster preparedness and response strategies in earthquake and landslide prone areas.

CONCLUSION

This study analysed 1,090 Web of Science publications on earthquake-induced landslides and coseismic landslides from 2000 to 2024. The results show a clear increase in research activity after major seismic events, particularly the 2008 Wenchuan earthquake, reflecting growing scientific attention to EQIL mechanisms, susceptibility assessment, hazard evaluation, and risk mitigation. The bibliometric patterns also show that publication output is concentrated in a relatively small number of countries and institutions, whereas several hazard-prone regions remain underrepresented. Keyword trends further show a shift from conventional susceptibility and hazard assessment toward remote sensing, machine learning, landslide inventory development, and integrated risk assessment. Future research should strengthen international collaboration, improve data sharing, and include less-funded but highly exposed regions through equitable research partnerships. These efforts will improve the global representativeness of EQIL research and support more effective disaster-risk reduction strategies.

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STATEMENTS AND DECLARATIONS

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

The data and list of publications used in this study are available upon request from the author.

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60th ANNUAL GENERAL MEETING & ANNUAL REPORT 2025

PERSATUAN GEOLOGI MALAYSIA GEOLOGICAL SOCIETY OF MALAYSIA

60th ANNUAL GENERAL MEETING & ANNUAL REPORT 2025



17th April 2026

Geology Department, Universiti Malaya, Kuala Lumpur

Agenda

The Agenda for the Annual General Meeting is as follows:

1. Welcoming Address by the President for Session 2025/2026
2. Confirmation of Minutes of the 59th AGM held on the 25th April 2025
3. Matters arising
4. Annual Reports for Session 2025/2026
 - President's Report
 - Secretary's Report
 - Editor's Report
 - Treasurer's and Honorary Auditor's Reports
 - GSM Endowment Fund Report
5. Election of Board of Trustees of the GSM Endowment Fund
6. Election of Honorary Auditor
7. Other Matters
 - 7.1 GSM's 60th Anniversary – by Dr. Mohd Hariri Arifin
 - Planned events
 - Soft launching of the Projek Kamus Istilah Geologi
 - 7.2 Proposal to create small grants for undergraduate final year students to support final year research project and publications – by Dr. Arindam Chakraborty
 - 7.3 Announcement of Dato' Sia Hok Kiang Economic Geology Research Grant Award – by Ms. Norazianti Asmari
8. Announcement of New Council for 2026/2027
9. Presidential Address for 2025/2026

Confirmation of Minutes of the 59th AGM

PERSATUAN GEOLOGI MALAYSIA GEOLOGICAL SOCIETY OF MALAYSIA (GSM)

MINUTES OF 59th ANNUAL GENERAL MEETING

Date: 25th April 2025
Time: 5.30 p.m.
Venue/Platform: Department of Geology, Universiti Malaya, Kuala Lumpur

Members' Attendance: Appendix 1

1. Welcoming Address by the President for Session 2024/2025

Mohd Hariri Arifin, the President of Geological Society of Malaysia welcomed all the members to the AGM. He was hopeful for the in-coming Council to continue serving the members with renewed vision and dedication.

2. Adoption of Agenda

The Agenda for the Annual General Meeting:

1. Welcoming Address by the President 2024/2025
2. Adoption of Agenda
3. Confirmation of the Minutes of the Previous AGM
4. Matters arising from the Minutes of the Previous AGM
5. Annual Reports for Session 2024/2025
 - President's Report
 - Secretary's Report
 - Editor's Report
 - Treasurer's and Honorary Auditor's Reports
 - GSM Endowment Fund Report
6. Election of Honorary Auditor
7. Other Matters
 - 7.1 N.S. Haile Publication Award/Young Geoscientist Award Fund and Student Loan Fund
Proposal for the sums of RM 3143 and RM 2055 of the respective funds, to be absorbed into the GSM General Fund – The Treasurer
 - 7.2 "Shifting away from business as usual: exploring opportunities that put the geosciences profession in the forefront of climate challenges"- Danny Soo
8. Announcement of the New Council for 2025/2026
9. Presidential Address

Fateh Chand proposed for the agenda to be accepted, with Farah Fazulah Abdullah as the seconder. The agenda was unanimously accepted by the AGM.

3. Confirmation of Minutes of the previous AGM

The Minutes of the 58th AGM held on the 23rd April 2024 was tabled for confirmation. Joy Jacqueline Pereira proposed the minutes be confirmed, and it was seconded by Fateh Chand. The minutes were unanimously confirmed without any amendment.

4. **Matters arising from the Minutes of the Previous AGM**

Appendix 2

Action: In-coming Council

5. **Annual Reports 2023/2024**

5.1 President's Report

Mohd Hariri Arifin tabled the President's Report (As in the 59th AGM Proceedings).

There was no comment raised at the meeting concerning the report presented.

Tan Boon Kong proposed the President's Report be accepted and this was seconded by Sia Hok Kiang.

5.2 Secretary's Report

Ling Nan Ley tabled the Secretary's Report (As in the 59th AGM Proceedings).

The AGM discussed the followings:

5.2.1 Attendance of Council Members to the Council Meetings

Fateh Chand raised concern that a few of the Council Members did not at all or hardly attended the Council meeting during the last session.

The AGM proposed that in the coming sessions, the Secretary should write a show-cause letter to any Council member who is absent for 3 consecutive Council meetings.

Action: In-coming Council/Secretary

5.2.2 NGC Paper Submission & GSM Paper Publication

Abdul Hadi Abd Rahman brought to the attention of the AGM that 2 of his/his students' abstracts submitted to NGC 2024 were asked to reduce the number of words which had resulted in the abstracts losing the intended content.

The AGM opined for any submission whether it is to NGC or any other conference, the author should conform to the requirement set by the organiser to ensure uniformity.

The AGM also proposed for the Editor Joy Jacqueline Pereira to organise a briefing session for the members concerning the publication requirements.

Action: In-coming Council/Editor

5.2.3 Functions and activities of Working Groups

The AGM proposed:

1. The Council to review the set-up of Working Groups and their functions that would reflect current developments in geoscience and the needs of the society. In this context, the Working Groups were requested to consider expanding their scope of activities, beyond the usual practise of organising technical talks.

2. The Council was requested to set up a page for each Working Group on the GSM website, detailing the functions and and the activities of each Working Group and how members may participate and contribute.

Action: In-coming Council/Working Group Chairs

Joy Jacqueline Pereira proposed the Secretary's Report be accepted and this was seconded by Fateh Chand.

5.3 Editor's Report

Joy Jacqueline Pereira tabled the Editor's Report (As in the 59th AGM Proceedings).

Abdul Hadi Abd Rahman enquired if the members could publish books through GSM. Joy Jacqueline Pereira explained that GSM would publish good quality works that are reviewed by a panel of independent reviewers.

Arnout J.W. Everts proposed that the Editor's Report be accepted and Allagu Balaguru seconded.

5.4 Treasurer's and Honorary Auditor's Report

Lim Choun Sian tabled the Treasurer's and Honorary Auditor's Report (As in the 59th AGM Proceedings). No issue was raised concerning the reports presented.

Ibrahim Komoo proposed that the Treasurer's report to be accepted and this was seconded by Mazlan Madon.

The Honorary Auditor's Report was proposed to be accepted by Sia Hok Kiang, with Fateh Chand as the seconder.

5.5 GSM Endowment Fund's Report

Yunus Abd Razak, the Chairman of Board of Trustees of the GSM Endowment Fund, tabled the GSM Endowment Fund report (As in the 59th AGM Proceedings).

Sia Hok Kiang requested to allow more flexibility in the award amount when considering the award from his donation, based on a case-by-case basis for some research that may require additional funding.

The Board of Trustees made 4 recommendations to the 59th AGM as follows:

- (i) The GSM Council is requested to apply for an extension of its "tax deductible" status from the LHDN as soon as possible before December 2025.
- (ii) The AGM is requested to approve the sum of RM 40,000.00 that is requested by the GSM Council for the publications for the year 2025. The GSM Council is requested to report the usage of the fund to the Board of Trustees of the GSM Endowment Fund.
- (iii) The GSM Council is requested to increase the principal amount in the GSM Endowment Fund by RM 50,000.00.
- (iv) The AGM is requested to consider the inclusion of the GSM Vice President at every meeting of the GSM Endowment Committee.

The AGM accepted all the above 4 recommendations.

Action: In-coming Council

In addition to the above, Fateh Chand requested the Council to negotiate with the bank concerned for more favourable interest rates for the fixed deposits of the Endowment Fund.

Action: In-coming Council/Treasurer

Joy Jacqueline Pereira proposed that the GSM Endowment Fund's Report be accepted and Tanot Unjah seconded the proposal.

6. Election of Honorary Auditor

Lim Choun Sian proposed to continue appointing S.F Lee & Co as the Honorary Auditor for the year 2025. The AGM unanimously agreed to the appointment.

7. Other Matters

7.1 N.S. Haile Publication Award/Young Geoscientist Award Fund and Student Loan Fund

Lim Choun Sian proposed for the respective sums of RM 3143 and RM 2055 of the funds, to be absorbed into the GSM General Fund.

The AGM unanimously agreed to the proposal, and the initial award's intention and condition shall remain unchanged.

Information

7.2 "Shifting away from business as usual: exploring opportunities that put the geosciences profession in the forefront of climate challenges"

GSM member, Danny Soo proposed an opportunity framing workshop for GSM to shape certain aspects of the GSM vision and mission in order to stay relevant with societal needs in addressing the impacts of climate change. Potential outputs of the proposed workshop was highlighted. He also volunteered to facilitate the workshop.

The AGM took note of the proposal and requested that it be forwarded to the Incoming Council for their consideration.

Action: In-coming Council

8. Announcement of New Council for 2025/2026

Mohd Shafiq Firdaus, the Chairman of the Nominations Committee had prepared the nomination/election report (as in the 59th AGM Proceedings).

The Council for 2025/2026.

President	:	Associate Prof. Dr Meor Hakif Amir Hassan, P.Geol. (UM)
Vice-President	:	Associate Prof. Dr. Tanot Unjah, P.Geol. (UKM)
Imm. Past President	:	Associate Prof. Ts Dr Mohd Hariri Arifin, P.Geol. (UKM)
Secretary	:	Ling Nan Ley, P.Geol.
Assistant Secretary	:	Norazianti Asmari, P.Geol. (GeoExpert)
Treasurer	:	Dr. Lim Choun Sian, P.Geol. (UKM)
Editor	:	Prof. Dr. Joy Jacqueline Pereira, P.Geol. (UKM)
Councillors (2 year)	:	Dr. Arindam Chakraborty (UM)
		Dr. Hamzah Hussin, P. Geol. (UMK)
		Mohamad Shaufi Sokiman, P.Geol. (Sundaland Geoscience Services)
		Dr Suraya Hilmi Hazim (UKM)
Councillors (1 years)	:	Dr. Allagu Balaguru, P.Geol. (G&G Consultant/Geosolutions)
		Muhammad Ashahadi Dzulkafli, P.Geol. (UKM)
		Muhammad Azri Ismail, P.Geol.(JMG)
		Tan Boon Kong

9. Presidential Address

The newly elected GSM President Meor Hakif Amir Hassan felt greatly honoured to be elected and also humbled by the members' trust and confidence in him. He pledged that he and the new Council would do their best to attain the objective of GSM in promoting geoscience knowledge in Malaysia and the surrounding area. He realised the role of GSM was ever more important than before and he wanted to see GSM to be always in the forefront in solving the geological-related problems and bringing benefits to the society.

The President recorded a vote of thanks to the out-going Council.

The AGM was adjourned at 7:50 pm.

LING NAN LEY
Secretary 2024/2025

MOHD HARIRI ARIFIN
President 2024/2025

Appendix 1: Members' Attendance

1	Abdul Hadi Abd Rahman	20	Mohd Rizal Lai
2	Allagu Balaguru	21	Mohd Talha Anees
3	Arindam Chakraborty	22	Muhammad Hatta Roselee
4	Arnout J.W. Everts	23	Norazianti Asmari
5	Choo Mun Keong	24	Numair Ahmed Siddiqui
6	Arnout J.W. Everts	25	Nur Iskandar Taib
7	Elanni Md Affandi	26	Ros Fatihah Hj. Muhammad
8	Farah Fazulah Abdullah	27	Sia Hok Kiang
9	Fateh Chand	28	Tan Boon Kong
10	Ibrahim Komoo	29	Tanot Unjah
11	Joy Jacqueline Pereira	30	Wan Hasiah Abdullah
12	Lee Chai Peng	31	Woo Chaw Hong
13	Lim Choun Sian	32	Yunus Abd Razak
14	Lin Chin Yik	33	Azimah Ali (on-line)
15	Ling Nan Ley	34	Ban Zhuan (on-line)
16	Mazlan Madon	35	Lutfi Hamidee Abd. Latif (on-line)
17	Meor Hakif Amir Hassan	36	Suraya Hilmi Hazim (on-line)
18	Mohamad Shaufi Sokiman		-----
19	Mohd Hariri Arifin		

Total number of members present at the AGM: 36

Appendix 2: Matters arising from the Minutes of the Previous AGM

Matters Arising	Actions
1. GSM Working Groups	
Arnout J.W. Everts suggested the GSM Working Groups formed should reflect the current geoscience scenario encompassing the current interest and the growing expectation of the society. He proposed the formation of a new group “Environmental Geology and Climate Change”.	The Council discussed the matter and in response to the suggestion, reviewed the naming and functions of the following Working Groups: 1. Engineering Geology & Environmental Geology 2. Disaster Risk Reduction & Climate Change
2. Publication of “CEO GEO”	
Mohd Hariri Arifin proposed 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 geologists in their profession. The AGM discussed the matter and preferred a book of this nature to be published by IGM because the role of IGM is to promote professional development. Alternatively, GSM could select a few CEOs and publish their stories in Warta, with the CEOs advertising their respective companies in Warta.	The Council discussed the matter and agreed with the decision of the AGM in 2024. The matter is being pursued by Mohd Hariri Arifin.

3. Publication of “Kamus Istilah Geologi”	
The AGM welcomed the proposal and suggested a committee should be formed to that effect. Lim Choun Sian proposed to include “Disaster and Climate” page and the publication to be in the form similar to Wikipedia format that allows constant updating.	The Council discussed the matter. Mohd Hariri Arifin has volunteered to lead the committee.
4. Promotion of Geoscience knowledge to the society/public	
Ibrahim Komoo proposed that GSM’s role should change, instead of only building up geological knowledge among the members, GSM should reach out to the general public, promoting the contribution of geoscience for the welfare of the public.	GSM has been reaching out to both geological fraternity and the general public through GSM website, Facebook and other social media. The activities of GSM and relevant news and messages are constantly shared in the social media. There were reports of interaction between GSM and the public in Facebook whereby the public reached out to GSM on geological related matters. The records of GSM talks are also put up in GSM Facebook for the public. The Promotion of Geoscience, Social Media & Digital Content Working Group will continue to keep the social media platforms active and make sure that the materials shared are constantly updated.
5. GSM Student Chapters	
Tan Boon Kong opined that the main criteria for approving fund to GSM Student Chapter is that the activity content must be on geology. The meeting proposed an SOP or guideline should be set in place for approving any funding request from the Student Chapters.	The TOR for GSM Student Chapter was drafted and endorsed by the Council. The Working Group Chair for Young Geologist & Student Outreach was mandated to manage and regulate the GSM Student Chapters within the framework of the TOR.
6. Implementation of Dato’ Sia Hok Kiang’s donation	
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 (RM14,946.16 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.	The promotion poster and application form were prepared, to be distributed to invite submissions. This fund would be promoted among postgraduate students to encourage research proposals on economic geology, with a requirement for publication in an indexed journal. The Council suggested up to a ceiling sum of RM 5000 for each award. The Council also proposed to form an assessment committee to conduct and evaluate the applications.
7. GSM Endowment Fund for publication	
The AGM had approved the sum of RM 40,000.00 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.	The Council has submitted a report, detailing the usage of the fund provided, to the Board of Trustees of the GSM Endowment Fund.

8. GSM Endowment Fund for subsidising NGC 2024	
The AGM had approved the maximum sum of RM 24,000.00 that is requested by the NGC 2024 Organizing Committee to subsidize for the registration fees of GSM student members only.	A total sum of RM 13,200 was drawn from GSM Endowment Fund to sponsor student members attending NGC 2024.
9. Waiver of registration fee for National Geoscience Conference (NGC)	
Askury Abd. Kadir proposed the followings: (i) 100% waiver of registration fee for GSM members above 60 years old, who present papers in NGC; (ii) 50% discount of registration fee for GSM members aged above 60; (iii) Free for Honorary and Life Members above 60 years old to attend NGC. The AGM rejected proposal (iii) above. The AGM proposed the Incoming Council to look into the proposal (i) and (ii) and to bring up the Council's view to the next AGM for decision.	The GSM Council agreed in principle with the AGM's proposal (i) and (ii), on a case- by-case basis commencing in 2025, depending on the financial performance of the respective NGC, and will be subjected to the Council's approval, on a refundable basis.

Annual Report for Session 2025/2026

President's Report

Introduction

I would like to extend my deepest gratitude to the 2025/2026 Council Members and the Secretariat for their unwavering hard work, dedication, and support, as well as to all GSM members present at this session's Annual General Meeting.

Programmes and Collaborations

During this session, we successfully organized 44 activities, which is slightly fewer than the 49 activities held in the previous session. A large portion of these events were collaborative efforts alongside esteemed institutions, including the Institute of Geology Malaysia (IGM), the Board of Geologists Malaysia (BoG), the Department of Minerals and Geoscience Malaysia (JMG), the Institution of Geospatial and Remote Sensing Malaysia (IGRSM), the American Association of Petroleum Geologists (AAPG), the Malaysia Geothermal Association, Beicip-Franlab Asia, Jabatan Meteorologi Malaysia, GPSLands, the KL Geoscience Group (KLGG), Agensi Nuklear Malaysia, Universiti Malaya (UM), Universiti Kebangsaan Malaysia (UKM), Universiti Malaysia Sabah (UMS), and Kyoto University.

I am also pleased to share that, in addition to our Facebook Live broadcasts, GSM talks are now being uploaded to our official YouTube channel. To date, we have uploaded a total of 34 videos and gained 91 subscribers, with individual video viewership reaching up to 226 views.

Our student chapters have also made remarkable contributions by hosting numerous activities that offer mentoring, career guidance, and valuable networking opportunities. I offer my apologies if I have inadvertently left anyone out, but I am deeply appreciative of the overwhelming support from the agencies, organizations, and numerous individuals who have dedicated their time and resources to the Society; I tip my hat to you all.

NGC 2025: Looking Ahead to NGC 2026

Dear esteemed members, I extend my sincere gratitude for your steadfast support throughout 2025/2026. The past session was highlighted by major achievements, most notably the highly successful NGC 2025 held in Tawau, Sabah. This event was co-organized with UMS and JMG Sabah, and was led by Assoc. Prof. Dr. Mohd Hariri Arifin, our Immediate Past President, alongside Dr. Zulherry Isnain from UMS. Universiti Malaysia Sabah provided complete support for the conference, which drew approximately 200 participants to the Borneo Royale Hotel in Tawau from October 18 to 20, 2025. The conference was followed by an enriching field trip to the Southsea Gold Sdn Bhd and Wullersdorf Resources Sdn Bhd gold mines, as well as the Balung Cocos columnar basalts.

Looking forward, GSM is thrilled to announce that the 39th National Geoscience Conference (NGC 2026) will take place from October 1 to 3, 2026, at the Pullman Miri Waterfront Hotel in Miri, Sarawak. This upcoming event is co-organized with the Department of Minerals and Geoscience Malaysia (JMG) Sarawak and Curtin University, working in collaboration with the Board of Geologists (BoG) and the Institute of Geology Malaysia (IGM). The theme of the conference, "Innovation and Sustainable Geoscience for a Resilient Future," highlights the critical role of geosciences in tackling modern challenges. Miri provides unique geological attractions, such as Tertiary sedimentary formations, the Niah Caves, and the Petroleum Museum, which features the "Grand Old Lady," Miri's first drilled oil well.

I sincerely hope you can all join us for this exciting gathering. Furthermore, we are officially inviting proposals to host the 40th National Geoscience Conference (NGC 2027). This presents a fantastic opportunity for institutions, universities, and organizations to demonstrate their dedication to advancing the field of geoscience in Malaysia.

60th Anniversary of GSM

The year 2027 will also mark the 60th Anniversary of the Geological Society of Malaysia. GSM is actively planning a series of activities to commemorate this Diamond Jubilee, and we will share updates with our members very soon. As part of these milestone celebrations, Assoc. Prof. Dr. Mohd Hariri Arifin and Dr. Suraya Hilmi Hazim from UKM will announce the launch of the Geological Terminology Dictionary project (Istilah Geology), an initiative that requires collaboration with Dewan Bahasa dan Pustaka (DBP).

GSM Dato' Sia Endowment Fund for Economic Mineral Research

I am delighted to highlight the GSM Dato' Sia Endowment Fund, which was established through a generous RM50,000 donation by YBhg. Dato' Sia Hok Kiang in 2014, and the interest generated from this fund is specifically designated to support economic mineral exploration and development research via the Dato' Sia Hok Kiang Economic Geology Research Grant. This initiative provides grants of up to RM5,000 to fund research in metallogenic and ore geology, mineral processing, and mining across Malaysia. Applications for the grant were open from April 2025 to March 15, 2026, and the successful awardee will be announced during this evening's AGM. I would like to express my gratitude to the members of the grant committee, led by Ms. Norazianti Asmari, for their diligent and fair screening of all applications.

Closing Remarks

In the years ahead, it is my profound hope that GSM continues to grow more established and garners widespread recognition through the ongoing contributions and support of its members. GSM acts as a vital platform for nurturing both emerging and seasoned professionals, fostering a vibrant community and a strong support network within the geological field. We remain highly enthusiastic about welcoming new members from diverse backgrounds, ranging from fresh graduates to seasoned industry professionals. I strongly encourage you all to consider joining us as part of the Council. Finally, I would like to reiterate my thanks to all of our esteemed members for your continuous and invaluable support of the Society.

MEOR HAKIF AMIR HASSAN
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 2025/2026.

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 10 Geoscience Working Groups and 4 Operations. The Geoscience Working Groups' main function is to promote the advancement and exchange of knowledge in specific geoscience areas whereas the role of the Operations is to promote the publicity of the society and to support the running of the Council.

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

3.0 Membership

The table below presents the details of membership categories and their geographical breakdown (based on the members' mailing addresses).

As of 31st December 2025, the total number of registered members in the Society stands at 1071, which shows a slight decrease when compared to the year 2024.

The table shows there wasn't much fluctuation in the different membership categories, except the Student Membership category, which shows a huge decrease, hence causing the overall decrease. There was an overall increase in the Life and Full Membership categories. The membership from other countries was almost entirely of Life Membership category.

Breakdown of Membership

COUNTRY	Hon.	Life	Full	Assoc.	Student	Total 2025	Total 2024	Variance (2025-2024)
Malaysia	11	492	141	9	337	990	1072	-82
Australia	1	19	-	-	-	20	20	0
Bangladesh		1				1	2	-1
Brunei		2				2	1	+1
Canada	-	3	-	-	-	3	2	+1
China	-	1	-	-	-	1	1	0
Europe	-	13	-	-	-	13	14	-1
Hong Kong	-	1	-	-	-	1	1	0
India		1				1	2	-1
Indonesia	-	9	-	-	-	9	9	0
Japan	-	3	-	-	-	3	2	+1
Libya		1				1	4	-3
New Zealand		2				2	2	0
Nigeria		1				1	1	0
Philippines		2	-	-	-	2	2	0
Qatar		1	-	-	-	1	1	0
Singapore		9	-	-	-	9	9	0
Thailand		1	-	-	-	1	2	-1
USA		10	-	-	-	10	11	-1
TOTAL 2025	12	572	141	9	337	1071		
TOTAL 2024	12	566	131	8	441		1158	
Variance (2025-2024)	0	+6	+10	+1	-104			

4.0 The Council

The Council for the Geological Society of Malaysia (GSM) for 2025/2026 session resumed their office after the 59th AGM on the 25th April 2025.

4.1 Council Members

The Council Members for 2025/2026 are as follows:

President:	Dr. Meor Hakif Amir Hassan
Vice President:	Dr. Tanot Unjah
Immediate Past President:	Dr. Mohd Hariri Arifin
Secretary:	Mr. Ling Nan Ley
Assistant Secretary:	Ms. Norazianti Asmari
Treasurer:	Dr. Lim Choun Sian
Editor:	Prof. Dr. Joy Jacqueline Pereira
Councillors: (2025/2026)	Dr. Allagu Balaguru Mr. Muhammad Ashahadi Dzulkafli Mr. Muhammad Azri Ismail (Resigned) Tan Boon Kong
(2025/2026 - 2026/2027)	Dr. Arindam Chakraborty Dr. Hamzah Hussin Mr. Mohamad Shaufi Sokiman Dr. Suraya Hilmi Hazim

4.2 Council Meetings

During the 2025/2026 session, the Council met almost monthly for a total of 10 times. The attendance of the meetings is presented in the table below. Four of the Council Meetings were held at the meeting room of the Department of Geology, University of Malaya, Kuala Lumpur. All the other meetings were conducted on-line.

Attendance of Council Members to the Council Meetings

NAME	1	2	3	4	5	6	7	8	9	10	Total
	16/5 (UM)	20/6	18/7	15/8 (UM)	17/10	13/11 (UM)	18/12	15/1/26	12/2 (UM)	12/3	
Meor Hakif Amir Hassan	/	/	/	/	/	/	/	/	/	/	10/10
Tanot Unjah	0	/	0	0	/	/	/	/	0	/	6/10
Ling Nan Ley	/	/	/	/	/	/	/	/	/	/	10/10
Norazianti Asmari	/	0	0	/	/	0	/	0	0	/	5/10
Lim Choun Sian	/	0	/	/	/	/	/	0	0	/	7/10
Joy Jacqueline Pereira	/	/	/	0	/	/	/	0	/	/	8/10
Mohd Hariri Arifin - IPP	/	/	/	0	/	/	0	0	/	/	7/10
Allagu Balaguru	/	/	/	/	0	0	0	/	0	/	6/10
Muhammad Ashahadi Dzulkafli	0	0	0	0	/	0	/	0	0	/	3/10
Muhammad Azri Ismail	0	0	0	0	-	-	-	-	-	-	Resigned
Tan Boon Kong	/	/	/	/	/	/	/	/	/	/	10/10
Arindam Chakraborty	/	/	/	0	/	/	/	/	/	/	9/10
Hamzah Hussin	0	0	0	0	/	0	/	0	0	/	3/10
Mohamad Shaufi Sokiman	/	/	/	/	/	0	/	0	0	/	7/10
Suraya Hilmi Hazim	/	/	/	/	0	0	/	/	/	/	8/10

Note: / = present 0 = absent with apologies - = Resigned

5.0 Working Groups/Operations

The Working Groups/Operations and the Chairs/Leads for this Session are as follows:

	A. GEOSCIENCE WORKING GROUPS	CHAIRS
1	Engineering Geology & Environmental Geology	Mr. Tan Boon Kong
2	Hydrogeology	Datuk Ir. Dr. Azuhan Mohamed
3	Economic Geology & Mineral Resources	Dr. Zakaria Endut
4	Regional Geology & Stratigraphy	Dr. Meor Hakif Amir Hassan
5	Geophysics	Dr. Muhammad Hafeez Jeofry
6	Petroleum Geoscience & Energy Transition	Dr. Allagu Balaguru
7	Quaternary & Marine Geology	Dr. Arindam Chakraborty
8	Disaster Risk Reduction & Climate Change	Prof Dr. Joy Jacqueline Pereira
9	Geological Heritage	Dr. Tanot Unjah
10	Karst & Caves	Dr. Ros Fatihah

	B. GSM OPERATIONS	LEADS
1	Membership Database	Dr. Arindam Chakraborty
2	Promotion of Geoscience, Social Media & Digital Content	Dr. Suraya Hilmi Hazim
3	Young Geologist & Student Outreach	Dr. Muhammad Hatta Roselee
4	IT & Website	Dr. Arindam Chakraborty Dr. Lim Choun Sian Ms. Norazianti Asmari

6.0 Activities

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

6.1 Activities organised by GSM

During the session, the Council, mainly through the Chairs of Working Groups, were able to organise a total of 29 activities.

Summary of activities organized by GSM

NO	DATE	TITLE	SPEAKER	COLLABORATOR	ATTENDANCE	CPD
1	25.4.2025	GSM AGM 2025				
2	21.5.2025	Common challenges in cavity detection	P. Geol. Devendran Arumugam	IGM, UM	100	
3	18.6.2025	Common challenges in design and construction of injection piles on limestone	Ir. Chow Chee Meng	IGM, UM	56	
4	18.6.2025	GeoGPT: An open AI system for geoscientists	Prof. Hongyang Chen Dr. Mohamed Jaward Bah	UKM, IGRSM	100	
5	17.7.2025	Stratigraphy of the Kenny Hill Formation in western Selangor: Pre-Tertiary reservoir implications	Allan J. Filipov	UM	59	
6	23.7.2025	Initial insights into block-in-matrix slopes: Challenges and characterisation in tropical terrain	Ir. Assoc. Prof. Dr. Rini Asnida Abdullah	IGM, UM	50	

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

NO	DATE	TITLE	SPEAKER	COLLABORATOR	ATTENDANCE	CPD
7	10.8.2025	Fieldtrip- Kenny Hill Formation	Allan J. Filipov and Mr Akmal Anuar	UM	21	YES
8	3.8.2025	Air panas di Johor: Ada kaitan dengan gempa bumi di Segamat?	P.Geol. Assoc. Prof. Dr. Mohd Hariri Arifin	UKM	100	
9	13.8.2025	You pay for geological assessment whether you do it or not 2.0 - A call to regulate geological (impact) assessment report for pre-development phase	P.Geol. Abd Rasid Jaapar	IGM, UM	62	
10	17.9.2025	National Geoscience Conference (NGC) 2025- Pre-Conference Workshop: Integrated Geothermal Short Course- Resource Assessment of Tawau and Power Conversion Systems for Volcanic and Granitic Settings			22	YES
11	18-19.9.2025	National Geoscience Conference (NGC) 2025: Earth, Energy and Environment: Navigating the Future			231	YES
12	20.9.2025	Post- Conference NGC 2025: Field Excursion			100	YES
13	24.9.2025	Kampung Pasir revisited- Case history of a liquefaction slide	Ir Dr Toh Cheng Teik	IGM, UM	50	
14	10.10.2025	Engineering geophysics for subsurface characterization	Prof. Dr. Aziman Madun	UKM	70	
		Subsurface characterization of soft soils using Multichannel Analysis of Surface Wave (MASW)	Dr. Nur Zulfa Abdul Kalid			
15	15.10.2025	Slope Management by JKR Malaysia	Ir. Dr. Mohamad Niizar Abdurahman	IGM, UM	54	
16	12.11.2025	Diagenetic pyrite chemistry: A key to identifying gold-fertile clastic rocks in Malaysia	Dr. Charles Makoundi	USM	32	YES
17	19.11.2025	Investigation of human-induced landslides	Dr. Lim Choun Sian	IGM, UM	78	
18	20.11.2025	Foraminifera: The Ocean and Climate Storyteller	Dr. Fatin Izzati Minhat	UM	36	
19	3.12.2025	Geoheritage and Geopark Virtual Forum 2025- The Role of Geoscientist in Geopark Development	Prof. Dr. Nickolas Zouras	Geopark Research Centre, LESTARI UKM	151	

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

NO	DATE	TITLE	SPEAKER	COLLABORATOR	ATTENDANCE	CPD
20	16.12.2025	Earth Observation Training Program and Launch of the TRIGGER Project	Prof. Joy Jacqueline Pereira & Mr. Navakanesh M. Batmanathan (SEADPRI-UKM, Universiti Kebangsaan Malaysia), Dr. Nikhil Nedumpallile Vasu & Dr. Alessandro Novellino (British Geological Survey (BGS))	BGS, SEADPRI		
21	17.12.2025	Case Study on Stabilization of a Rock Slope at a Former Quarry in The Kuala Lumpur Limestone	Dr. John Kuna Raj	IGM, UM	50	
22	21.1.2026	Potensi Hakisan, Runtuhan & Pelembutan Tanah Baki Granit Bergaram. (Potential erosion, slope failure & softening of dispersive granitic residual soil).	P.Geol. Dr. Nor Shahidah Mohd Nazer	IGM, UM	100	
23	27-29.1.2026	Basin Analysis and Petroleum System Evaluation Short Course	Robert Bob Shoup	UM	10	YES
24	25.2.2026	GSM Publications: Townhall Session	Prof. Dr. Joy Jacqueline Pereira, Dr. Mazlan Madon, Dr. Meor Hakif Amir Hassan, Dr. Mohd Hariri Arifin, Dr. Lim Choun Sian, Dr Iskandar, Dr. Elanni Md Affandi		24	
25	10.3.2026	Workshop on Modelling Landslide Risk for Climate Finance & Resilience – Bridging the Gap	Mr. Qalam A'zad bin Rosle, Mr. Muhammad Firdaus Ammar bin Abdullah Mr. Abdul Halim bin Jantan, Dr. Nikhil Nedumpallile Vasu	The Academy of Risk Management Malaysia (ARiMM) Malaysian Association of Risk and Insurance Management (MARIM) Malaysian Meteorological Department (MET Malaysia) Department of Mineral and Geoscience Malaysia (JMG Selangor/ Wilayah Persekutuan) Selangor State Climate Change Adaptation Centre (SCAC)		

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

NO	DATE	TITLE	SPEAKER	COLLABORATOR	ATTENDANCE	CPD
26	11.3.2026	Knowledge Exchange & Engagement Workshop: Landslide Risks, Climate Hazards, and Climate Finance for Resilience	Prof. Dr. Joy Jacqueline Pereira, Dr. Nurfashareena Muhamad, Dr. Nikhil Nedumpallile Vasu, Assoc. Professor Dr. Rohayu Che Omar, Dr. Elanni Affandi, Dr. Iffah Farhan Abu Talib, Dr. Izni Zahidi, Dr. Alyaa Afifah Abu Talib	Malaysian Meteorological Department (METMalaysia) Department of Mineral and Geoscience Malaysia (JMG Selangor/ Wilayah Persekutuan) Selangor State Climate Change Adaptation Centre (SCAC)		
27	11.3.2026	Active Tectonics and Seismic Source in Peninsular Malaysia: A Case Study of the Johor Fault System	Prof. Emeritus Dr. Felix Tongkul	IGM, UM	100	
28	8.4.2026	Sea-Level Rise in Southeast Asia: From Paleo Constraints to Modern Acceleration and Future Risk	Prof. Benjamin P. Horton	UM		
29	17.4.2026	Pre-Annual General Meeting (AGM 2026) Talk- Development of Windfarm Industry in Asia, What's for us?	P.Geol. Mr. Juzaili Azmi			

6.2 Activities collaborated with other institutions

GSM, collaborated in 16 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	10-11.6.2025	AAPG-GSM Asia Pacific Geopressure Workshop (APGW) 2025	Agus Ramdan, Dr Jamaal Hoesni, Dr. Mark Tingay, Stephen O'Connor	BFA	GSM, AAPG Asia Pacific Region
2	23.7.2025	Empowering Geopark Community Webinar 1: Nature and cultural heritage conservation	Mr Jones Kansirong, Mr Mohd Syukri Jali, Ms Siti Najwa Mokhtar	Geopark Research Centre, LESTARI UKM	GSM and National Geopark Implementation Committee, NRES
3	29.7.2025	Aplikasi kepakaran geologi dalam menilai tapak bencana: Kajian kes tragedi kebakaran paip gas Putra Height	Tuan Rusli Tuan Mohamed	UKM	GSM
4	14.8.2025	Empowering Geopark Community Webinar 2: Geopark Management	Mr. Imran Ismail, Ms Madeline George Pau, Dr Johan Afendi Ibrahim	Geopark Research Centre, LESTARI UKM	GSM and National Geopark Implementation Committee, NRES
5	17.9.2025	Empowering Geopark Community Webinar 3: Community Empowerment	Mr Wan Baharuddin Wan Harun, Mr Effy Hamsha Arrifin, Ms Noina Baharuddin	Geopark Research Centre, LESTARI UKM	GSM and National Geopark Implementation Committee, NRES

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

NO	DATE	TITLE	SPEAKER	ORGANISER	COLLABORATORS
6	22.10.2025	Empowering Geopark Community Webinar 4: Geotourism and social innovation development	Dr Mohd Amin Ali, Pn Mimie Duasah, Mr Mohd Hafiz Che Mahmud	Geopark Research Centre, LESTARI UKM	GSM and National Geopark Implementation Committee, NRES
7	28-29.10.2025	Malaysia Mining and Mineral Resources Conference 2025		Malaysia Chamber of Mines and Tin Industry (Research and Development) Board	NRES, JMG, IGM, GSM
8	31.10.2025	International landslide monitoring and prediction	Dr. Mohd Talha Anees, Dr. Elanni Md Affandi, P.Geol. Qalam A'zad Rosle, Prof. Koichi Hayashi, Assoc. Prof. Dr. Shintaro Yamasaki, Dr. Masayuki Nakayama	UM	IGM, GSM, Research Center for Landslide Disaster Risk Cognition and Reduction (LCR) and Disaster Prevention Research Institute (DPRI), Kyoto University, Japan
9	7.11.2025	Engaging in the IPCC expert review process	Prof. Joy Jacqueline Pereira	SEADPRI-UKM	Academy of Sciences Malaysia (ASM) and GSM
10	18.11.2025	Earthquakes and Tsunami: Challenges, Science and Action	Dr Harry Telajan Anak Linang, Dr Mazlan Madon, Dr Norhadizah Mohd Khalid, A.P. Dr Meldi Bin Suhatri	UM, MetMy	GSM
11	18.11.2025	Reimaging Subsurface with GSSI Ground Penetrating Radar (GPR) Technology	Mr Ahmad Hanif Ahmad Termizi	UKM	GSM, Malaysia Geothermal
12	10.12.2025	Magnetotelluric (MT) Technology for Geothermal Exploration	Prof. Dr. Yunus Daud	UKM	GSM, Malaysia Geothermal
13	3.12.2025	Geoheritage and Geopark Virtual Forum 2025- The Role of Geoscientist in Geopark Development	Prof. Dr. Nickolas Zouras	Geopark Research Centre, LESTARI UKM	GSM and National Geopark Implementation Committee, NRES
14	2-4.1.2026	UMGC X FTS Launch "Conservation Project: Urban Forest Initiative" Planting 1,100 Trees for a Greener Future		UM	Free Tree Society (FTS) and the American Association of Petroleum Geologists UM Student Chapter (AAPG UM SC).
15	12.1.2026	Past and Future Collaboration between Malaysia and Japan in Geoscience	Prof. Takahashi Yukihiro	UKM	GSM, Malaysia Geothermal
16	13.3.2026	Sesi Pengembangan Ilmu JSBAS Siri 1/2026	YBr. Ustaz Wan Jamizan bin Wan Deraman, Lt Kol Mohd Ridfazrin bin Razali, Tuan Zahari Affendi bin Abdul Kadir	UKM	GSM, Malaysia Geothermal, IGM, KTHO

7.0 National Geoscience Conference

7.1 The National Geoscience Conference 2025 (NGC 2025)

In collaboration with Universiti Malaysia Sabah and JMG Sabah, the National Geoscience Conference 2025 (NGC 2025) was successfully held from 18-20 Sept 2025 at the Grand Royale Hotel, Tawau, Sabah. The theme of NGC 2025 was “*Earth, Energy, and Environment: Navigating the Future*”.

The conference was officially opened by P.Geol. Prof. Ts. Gs. Dr. Rodeano Roslee, Dean of Faculty Science and Technology, UMS, representing the Vice Chancellor.

A total of 231 participants comprising academicians, students, researchers, government officers, private industry professionals, and representatives from NGOs attended the conference.

The post-conference fieldwork was attended by more than 60 participants.

7.2 The National Geoscience Conference 2026 (NGC 2026)

The National Geoscience Conference 2026 (NGC 2026) will be held in Pullman Miri Waterfront, Miri, Sarawak from 1-3 October 2026.

The event shall be co-organised by Jabatan Mineral dan Geosains Malaysia (Sarawak) and Curtin University Malaysia.

8.0 GSM Awards

GSM awarded the GSM HUTCHISON Best Student Award 2025 during NGC 2025. Each award was RM1000.00.

No	Name	University
1	Norfadzwinilyani binti Mohd Effandi	UMK
2	Muhammad Azmi bin Amran	UKM
3	Maha Letchummy a/p Balasingam	UMS
4	Aiman Haziq bin Hamzan	UM
5	Qalisha Maisarah Shah	UMT
6	Chan Xian Hwa	USM
7	Muhammad Halim Sutton	UTP

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 GSM 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 both Presidents was established under the agreement signed on 5th April 2013 by GSM and Institute of Geology Malaysia (IGM).

During this session, one Joint Committee meeting was held on 6th April 2026. The joint Committee meeting agreed:

- GSM and IGM shall continue the cooperation as stipulated in the agreement between GSM and IGM signed on 5 April 2013

- b. To co-organise Geoscience Education Workshop
- c. To conduct Programmes for Young Geologists
- d. Shall form a Joint Committee to jointly pursue the registration of GEOSEA/AFGEO as a society in Malaysia
- e. To jointly organise a workshop on the implementation of BoG's Strategic Plan 2040

GEOSEA/AFGEO

- a. GSM is the present host of the permanent Secretariat
 - b. The country's liaison representatives:
 - 1. The President of GSM
 - 2. The President of IGM
 - c. Dr. Lim Choun Sian is the Chairman of Malaysia GEOSEA/AFGEO committee
 - d. The 55th IAGI Annual Scientific Meeting Convention & Exhibition and GEOSEA XIX Regional Congress 2026, Yogyakarta which shall be held on 2-5 November 2026
- Confederation of Scientific and Technological Association of Malaysia (COSTAM)
 - GSM is paying subscription to COSTAM
 - Formation Evaluation Society Malaysia (FESM)
 - American Association of Petroleum Geology (AAPG)
 - AAPG Student Chapter of Universiti Malaya
 - Universities
- GSM had signed MoU with the following universities:
- Universiti 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 and facilitating 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, 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 active support and participation 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 2025 (Bulletin only)

Publications	Sales 2025	Stock remaining by end of 2025	Remarks
Bulletin 1	Out of Stock		
Bulletin 2	0	59	
Bulletin 3	7	75	
Bulletin 4	13	55	
Bulletin 5	Out of Stock		
Bulletin 6	6	303	
Bulletin 7	9	206	
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	3	2	
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	2	311	
Bulletin 20	3	280	
Bulletin 21	3	69	
Bulletin 22	5	146	
Bulletin 23	3	149	
Bulletin 24	10	312	
Bulletin 25	3	106	
Bulletin 26	9	126	
Bulletin 27	0	-	
Bulletin 28	2	86	
Bulletin 29	1	62	
Bulletin 30	0	357	
Bulletin 31	1	51	
Bulletin 32	0	36	
Bulletin 33	0	91	
Bulletin 34	0	18	
Bulletin 35	Out of Stock		
Bulletin 36	2	46	
Bulletin 37	7	179	
Bulletin 38	6	302	
Bulletin 39	Out of Stock		

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

Publications	Sales 2025	Stock remaining by end of 2025	Remarks
Bulletin 40	2	23	
Bulletin 41	Out of Stock		
Bulletin 42	Out of Stock		
Bulletin 43	3	49	
Bulletin 44	0	-	
Bulletin 45	Out of Stock		
Bulletin 46	Out of Stock		
Bulletin 47	Out of Stock		
Bulletin 48	9	4	
Bulletin 49	2	198	
Bulletin 50	4	311	
Bulletin 51	3	152	
Bulletin 52	5	173	
Bulletin 53	7	204	
Bulletin 54	5	285	
Bulletin 55	6	401	
Bulletin 56	5	131	
Bulletin 57	9	184	
Bulletin 58	Out of Stock		
Bulletin 59	5	9	
Bulletin 60	10	3	
Bulletin 61	10	99	
Bulletin 62	Out of Stock		
Bulletin 63	Out of Stock		
Bulletin 64	Out of Stock		
Bulletin 65	4	89	
Bulletin 66	6	339	
E-Bulletin 67	5	190	
E-Bulletin 68	0	0	
E-Bulletin 69	4	9	
E-Bulletin 70	6	19	
E-Bulletin 71	5	24	
E-Bulletin 72	5	23	
E-Bulletin 73	2	5	Ministry and library
E-Bulletin 74	2	21	
E-Bulletin 75	7	-	
E-Bulletin 76	6	-	
E-Bulletin 77	6	-	
E-Bulletin 78	5	-	
E-Bulletin 79	8	-	
E-Bulletin 80	15	-	

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 2025 (All other GSM publication)

Other Publications	Sales 2025	Stock remaining by end of 2025
Proceeding AGC 2000	Out of Stock	
Proceeding AGC 2001	9	66
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)	11	661
Geol. Evolution of SEA	19	257
Geology of P. Malaysia	80	1056

List of organizations and institutions that are exchanging publications with GSM

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

NORAZIANTI ASMARI
Assistant Secretary
Geological Society of Malaysia

Editor's Report

Publication of the two scientific journals of the Geological Society of Malaysia (GSM), *Bulletin of the Geological Society of Malaysia* and *Warta Geologi* continued in 2025. Two volumes of the *Bulletin* were published in 2025, Volume 79 (May 2025) and Volume 80 (November 2025). Three issues of *Warta Geologi* were also published in the same year, Vol. 51, No. 1 (April 2025), Vol. 51, No. 2, (August 2025), and Vol. 51, No. 3 (December 2025). Both publications are available on the GSM website (<https://gsm.org.my/>). We seek the support of members to conduct regular checks and alert the GSM Secretariat of any broken links or errors.

Bulletin of the Geological Society of Malaysia and *Warta Geologi* are both indexed by Scopus; the Malaysian Citation Index (MyCite); and the Directory of Open Access Journals (DOAJ). The Scopus index ranking of the *Bulletin of the Geological Society of Malaysia* is Q3 (with a CiteScore of 2.3 and rank of 110/179); and *Warta Geologi* is ranked at Q4 (with a CiteScore of 0.2 and rank of 326/330). The online manuscript submission via the Open Journal System (OJS) is operational with about 50% of the manuscripts coming through this channel, and the remaining being sent via email.

The application of both the scientific journals of GSM to be indexed by the Web of Science did not clear the second step of Editorial Triage related to Publication Volume. The Contact Details for the primary editorial and production roles also need to be clarified. We have been requested to re-submit our application after resolving these two technical issues, with no embargo period for resubmission. However, we have been strongly recommended to meet the next step of Editorial Evaluation Process before resubmission. This requires further development and professional advisory services for improvement. A one-off supplementary budget in addition to the usual operating budget would be required for this purpose.

The GSM Editor 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 2025 will be listed in the upcoming issue of *Warta Geologi*. Reviewers are also provided with a certificate upon request, regardless of whether the manuscripts they review are eventually accepted or declined.

I would like to acknowledge the Editorial Board, Assistant Editors, Editorial Manager, Production Editorial Managers, GSM Council Members and Trustees of the GSM Endowment Fund for their unwavering support in the past year. I especially record my appreciation to Dr. Iskandar Taib, Dr. Ng Tham Fatt, Ms. Wan Aida Wan Zahari, Ms. Nazatul Athirah Abdul Khalil, and Ms. Anna Lee and. Finally, I express my deepest gratitude to all the authors, contributors, and reviewers of both the *Bulletin* and *Warta Geologi*.

JOY JACQUELINE PEREIRA
Editor
Geological Society of Malaysia

Treasurer's Report

For Financial Year 2025, the Society posted an increased surplus before tax of income over expenditure, rising from RM 110,751 in 2024 to RM 117,465.

Total sundry income (excluding time deposit interest) increased from RM 165,250 in 2024 to RM 184,341. Total operating expenses increased slightly to RM 140,736, compared to RM 130,751 in 2024.

The income was derived from several main sources: (i) Sales of publications in the form of royalties from AAPG; (ii) The National Geoscience Conference in 2025; and (iii) Membership fees; as well as (iv) Time deposit interest. Sales of publications in the form of royalties increased from RM 83,693 in 2024 to RM 92,675. Membership subscriptions saw a significant decrease, from RM 23,455 in 2024 to RM 16,209. There was a slight decrease in interest rates on fixed deposits, from RM 76,252 in 2024 to RM 73,860, which includes more than 70% of the interest earned in the Endowment Fund account.

The major expenses were salaries and honorariums. The printing cost for *Warta Geologi* and the Bulletin increased slightly from RM 20,350 in 2024 to RM 21,100; however, this is still significantly lower than the amount of over RM 40,000 incurred when the Society was publishing full hard copies prior to the year 2000.

In 2025, the Society awarded a total of RM 7,000 for student awards via their respective geology departments in universities. A disbursement of RM 1,760 was made for student activities organized mainly under university geology clubs, which was higher than the RM 1,000 disbursed in 2024.

The Treasurer wishes to express deep appreciation to donors, sponsors, and all contributors for their support throughout the year. Special thanks are extended to the GSM Endowment Fund and the shared resources from projects jointly carried out with UKM, which funded allowances for human resources and electronic journal publishing, including the websites for publication and submission. Lastly, heartfelt gratitude is extended to Ms. Anna Lee for her invaluable contribution in managing the accounts and addressing numerous miscellaneous tasks throughout the year.

LIM CHOUN SIAN

Treasurer

Geological Society of Malaysia

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

**FINANCIAL STATEMENTS
31 DECEMBER 2025**

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

THE SOCIETY INFORMATION FOR 2025 / 2026

President	:	Meor Hakif Amir Hassan
Vice President	:	Tanot Unjah
Immediate Past President	:	Mohd Hariri Arifin
Secretary	:	Ling Nan Ley
Assistant Secretary	:	Norazianti Asmari
Treasurer	:	Lim Choun Sian
Editor	:	Joy Jacqueline Pereira
Councillors	:	Allagu Balaguru
	:	Muhammad Ashahadi Dzulkafli
	:	Muhammad Azri Ismail
	:	Tan Boon Kong
	:	Arindam Chakraborty
	:	Hamzah Bin Hussin
	:	Mohd Shaufi Sokiman
	:	Suraya Hilmi Hazim
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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FINANCIAL STATEMENTS
31 DECEMBER 2025

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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, Meor Hakif Amir Hassan 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 2025, and of the financial performance and cash flows of the Society for the year then ended.

Signed on behalf of the Council



Meor Hakif Amir Hassan
President



Lim Choun Sian
Treasurer

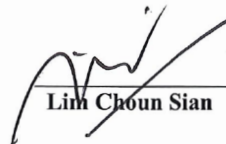
Dated: 02 APR 2026

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 02 APR 2026



Suite 2-5-4, 5th Floor
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S.F. LEE & CO (AF : 0670)
CHARTERED ACCOUNTANTS

No. 5-3, Jalan 1/64A,
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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 2025, 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 2025, 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.

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

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

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
01179/09/2026 (J)
CHARTERED ACCOUNTANT

Kuala Lumpur
Dated: 02 APR 2026

PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF FINANCIAL POSITION
As at 31 December 2025

	Note	2025 RM	2024 RM
FUND ACCOUNTS			
GENERAL FUND	4	1,126,956	1,033,961
ENDOWMENT FUND	5	2,023,818	2,003,781
STUDENT LOAN FUND		-	2,055
YOUNG GEOSCIENTIST AWARD FUND		-	3,143
		<u>3,150,774</u>	<u>3,042,940</u>
Represented by:			
NON-CURRENT ASSETS			
PROPERTY, PLANT AND EQUIPMENT	6	6,776	7,914
CURRENT ASSETS			
Time deposits with licensed bank	7	2,529,701	2,479,701
Cash and bank balances		674,943	751,208
		<u>3,204,644</u>	<u>3,230,909</u>
CURRENT LIABILITIES			
Other payables and accrued expenses	8	58,447	191,147
Current tax liabilities		2,199	4,736
		<u>60,646</u>	<u>195,883</u>
NET CURRENT ASSETS		3,143,998	3,035,026
		<u>3,150,774</u>	<u>3,042,940</u>

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

**PERSATUAN GEOLOGI MALAYSIA
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**STATEMENT OF COMPREHENSIVE INCOME
For the year ended 31 December 2025**

	<u>Note</u>	2025 RM	2024 RM
INCOME			
Sundry income	9	184,341	165,250
Time deposits interest		73,860	76,252
		<u>258,201</u>	<u>241,502</u>
EXPENDITURE			
Administrative and operating expenses	10	(140,736)	(130,751)
Surplus before taxation		<u>117,465</u>	<u>110,751</u>
Tax expense	11	(4,433)	(4,888)
Surplus for the financial year		<u>113,032</u>	<u>105,863</u>
Represented By:			
General fund		92,995	97,757
Endowment fund		20,037	8,106
		<u>113,032</u>	<u>105,863</u>

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

**PERSATUAN GEOLOGI MALAYSIA
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**STATEMENT OF CHANGES IN FUNDS
For the year ended 31 December 2025**

	Endowment Fund RM	General Fund RM	Total RM
At 1 January 2024	1,995,675	936,204	2,931,879
Surplus of income over expenditure for the year	8,106	97,757	105,863
At 31 December 2024	<u>2,003,781</u>	<u>1,033,961</u>	<u>3,037,742</u>
Surplus of income over expenditure for the year	20,037	92,995	113,032
At 31 December 2025	<u>2,023,818</u>	<u>1,126,956</u>	<u>3,150,774</u>

The accompanying notes are an integral part of the financial statements

PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF CASH FLOWS
For the year ended 31 December 2025

	2025	2024
	RM	RM
Cash flows from operating activities		
Surplus of income over expenditure for the year	117,465	110,751
Adjustments for:-		
Interest income	(33,860)	(23,022)
Depreciation on property, plant & equipment	1,138	1,363
Student Loan fund written back	(2,055)	-
Young Geoscientist Award written back	(3,143)	-
Surplus before working capital changes	79,545	89,092
(Decrease) / Increase in other payables	(132,700)	112,768
Cash (used in) / generated from operations	(53,155)	201,860
Tax paid	(6,970)	(1,613)
Net cash (used in) / generated from operating activities	(60,125)	200,247
Cash flows from investing activities		
Interest income	33,860	23,022
Net cash generated from investing activities	33,860	23,022
Cash flows from financing activities		
Advance from third parties	-	(589)
Net cash used in operating activities	-	(589)
Net (decrease) / increase in cash and cash equivalents	(26,265)	222,680
Cash and cash equivalents at beginning of the year	3,230,909	3,008,229
Cash and cash equivalents at end of the year	3,204,644	3,230,909
	2025	2024
	RM	RM
<u>Cash and cash equivalents comprised of:</u>		
Deposits with licensed banks	2,529,701	2,479,701
Cash at bank	674,938	750,928
Cash in hand	5	280
	3,204,644	3,230,909

The accompanying notes are an integral part of the financial statements

PERSATUAN GEOLOGI MALAYSIA
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NOTES TO THE FINANCIAL STATEMENTS –31 DECEMBER 2025

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 **02 APR 2026**

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 comprehensive income 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: -

Office equipment	10% - 20%
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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 statement of comprehensive income 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 statement of comprehensive income) 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 statement of comprehensive income.

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.

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(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 statement of comprehensive income.

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 statement of comprehensive income.

(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.

**PERSATUAN GEOLOGI MALAYSIA
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4. GENERAL FUND

	2025 RM	2024 RM
At 1 January	1,033,961	936,204
Surplus for the year	92,995	97,757
At 31 December	<u>1,126,956</u>	<u>1,033,961</u>

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

5. ENDOWMENT FUND

	2025 RM	2024 RM
At 1 January	2,003,781	1,995,675
Surplus for the year	20,037	8,106
At 31 December	<u>2,023,818</u>	<u>2,003,781</u>

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

6. PLANT AND EQUIPMENT

	Office equipment RM
<i>Cost</i>	
At 1 January 2025	32,849
Additions	-
Disposal and deletion	-
At 31 December 2025	<u>32,849</u>
<i>Accumulated depreciation and impairment losses</i>	
At 1 January 2025	24,935
Charge for the year	1,138
Disposal and deletion	-
At 31 December 2025	<u>26,073</u>
Carrying amounts at 1 January 2025	<u>7,914</u>
Carrying amounts at 1 December 2025	<u>6,776</u>

**PERSATUAN GEOLOGI MALAYSIA
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7. TIME DEPOSITS WITH LICENSED BANKS

	2025	2024
	RM	RM
General fund	537,701	537,701
Endowment fund	1,992,000	1,942,000
	<u>2,529,701</u>	<u>2,479,701</u>

The time deposits with licensed banks have an average maturity of between 3 to 15 months (2024: 3 to 15 months). Interest rates for the deposits ranged from 1.60% to 3.10% (2024: 1.6% to 3.20%) per annum.

8. OTHER PAYABLES AND ACCRUED EXPENSES

	2025	2024
	RM	RM
Other payables	44,402	189,302
Accrued expenses	14,045	1,845
	<u>58,447</u>	<u>191,147</u>

9. SUNDRY INCOME

	2025	2024
	RM	RM
	3,168	-
Donation received	200	3,038
Entrance fee	840	1,160
Geological Evolution of Southeast Asia	1,277	1,650
Geology of Peninsular Malaysia	374	3,195
Kenny Hill field trip	228	-
Membership fee	16,209	23,455
National Geoscience Conference	57,426	46,895
Others: Student loan write back	2,055	-
Publications	99,421	85,857
Young Geoscientist Award	3,143	-
	<u>184,341</u>	<u>165,250</u>

**PERSATUAN GEOLOGI MALAYSIA
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10. ADMINISTRATIVE AND OPERATING EXPENSES

	2025 RM	2024 RM
Audit fee	2,500	2,300
Best student award	7,000	8,000
Depreciation on property, plant and equipment	1,138	1,363
Department of geology	12,000	12,000
Donation	-	1,000
Honorarium	36,620	36,060
Printing and stationary	22,886	21,926
Professional fee	900	2,200
Subscription	5,535	1,628
Other expenses	52,157	44,274
	<u>140,736</u>	<u>130,751</u>

11. TAX EXPENSE

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

	2025 RM	2024 RM
Current tax on result for the year	<u>4,433</u>	<u>4,888</u>

12. FINANCIAL INSTRUMENTS

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

	2025 RM	2024 RM
Financial assets measured at amortised cost less impairment		
Time deposits with licensed bank	2,529,701	2,479,701
Cash and bank balances	<u>674,943</u>	<u>751,208</u>
	<u>3,204,644</u>	<u>3,230,909</u>
Financial liabilities carried at amortised cost		
Other payables and accrued expenses	<u>58,447</u>	<u>191,147</u>

PERSATUAN GEOLOGI MALAYSIA
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STATEMENT OF INCOME AND EXPENDITURE
 For the year ended 31 December 2025

INCOME	2025 RM	2024 RM
APGW	3,168	-
Donation received	200	3,038
Entrance fee	840	1,160
Geological Evolution of Southeast Asia	1,277	1,650
Geology of Peninsular Malaysia	374	3,195
Kenny Hill field trip	228	-
Membership fee	16,209	23,455
National Geoscience Conference	57,426	46,895
Others: Student loan write back	2,055	-
Publications : AAPG royalties	92,675	83,693
Publications : Sales	1,746	1,664
Publications : Topi Bulat	-	500
Publications : Advertisement	5,000	-
Time deposits interest income	73,860	76,252
Young Geoscientist Award	3,143	-
	<u>258,201</u>	<u>241,502</u>
EXPENDITURE		
Annual dinner	1,489	4,174
Audit fee	2,500	2,300
Staff EPF and Socso	8,425	7,816
Bank charges	181	111
Best Student's award (UKM and UM)	7,000	8,000
Board of geologist fee	900	700
Depreciation on property, plant and equipment	1,138	1,363
Department of Geology	12,000	12,000
Donation	-	1,000
Honorarium	36,620	36,060
Miscellaneous expenses	1,741	1,856
Penalty	733	-
Postages	800	488
Printing and Stationery		
- Warta Geologi	13,000	12,500
- Bulletin	8,100	7,850
- Stationery	1,786	1,576
Professional fee	900	2,200
Refreshment	490	709
Repair and maintenance	1,696	-
Service tax	-	120
Souvenirs	-	104
Subscription fee	5,535	1,628
Salary	31,424	25,915
Student events	1,760	1,000
Speakers expenses	1,145	144
Telephone and internet	1,373	1,137
	<u>140,736</u>	<u>130,751</u>
Surplus before tax	<u>117,465</u>	<u>110,751</u>

GSM Endowment Fund Report

GSM ENDOWMENT FUND: BOARD OF TRUSTEES REPORT FOR THE 60th ANNUAL GENERAL MEETING OF THE GEOLOGICAL SOCIETY OF MALAYSIA 17 April 2026

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. The 59th AGM in 2025 approved the inclusion of the GSM Vice-President as a member of the Board.
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 59th AGM held on 25 April 2025 are as follows:
 - (i) The GSM Council is requested to apply for an extension of its “tax deductible” status from the LHDN as soon as possible before December 2025.
 - (ii) The AGM is requested to approve the sum of RM 40,000.00 that is requested by the GSM Council for the publications for the year 2025. The GSM Council is requested to report the usage of the fund to the Board of Trustees of the GSM Endowment Fund.
 - (iii) The GSM Council is requested to increase the principal amount in the GSM Endowment Fund by RM 50,000.00.
 - (iv) The AGM is requested to consider the inclusion of the GSM Vice President at every meeting of the GSM Endowment Committee.
 - (v) The GSM Council is requested to negotiate with the bank concerned for more favourable interest rates for the fixed deposits of the Endowment Fund.

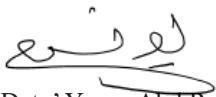
Report of the Board of Trustees

1. This report covers the period from 1 January 2025 to 31 December 2025. The Board of Trustees met on 10 April 2026 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, Assoc. Prof. Dr. Meor Hakif Amir Hassan; GSM Vice President, Assoc. Prof. Dr. Tanot Unjah; Immediate Past President, Assoc. Prof. Dr. Mohd Hariri Arifin; Assistant Secretary, Ms. Norazianti Asmari; Treasurer, Dr. Lim Choun Sian; Editor, Prof. Joy Jacqueline Pereira and GSM Members, Dr. Lee Chai Peng, Dr. Wan Hasiah Abdullah, and Puan Azimah Ali. Observer included Puan Nazatul Athirah Abdul Khalil. Secretary, Mr. Ling Nan Ley 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 1,991,999.99. This principal amount has increased after the GSM Council

transferred a total sum of RM 50,000.00 on 31 December 2025 from the UOB Current Account to the UOB Fixed Deposit account.

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 2025 is RM 60,066.95. The balance in the Current Account of the Endowment Fund as of 31 December 2025 is RM 31,817.09. The balance in the Current Account of the Endowment Fund in the previous year (as of 31 December 2024) was RM 61,780.64.
4. The GSM Council on 24 December 2025, 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 2025, to be used for publication purposes. The detailed report of the expenses has been reported by the GSM Council and accepted by the Board.
5. 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.
6. 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 18,033.77 as of 31 December 2025. The GSM Council has discussed the modality for disbursement of the research grant. The GSM Council has advertised for research proposals on economic geology from graduate and postgraduate students, with a requirement for publication in an indexed journal. Applications are being shortlisted.
7. The Board took note that the GSM Council was not able to negotiate a higher interest for the principal amount. The Board also took note that the GSM Council has successfully obtained "tax deductible" status from the LHDN until 2035.
8. Recommendations of the Board of Trustees to the 60th AGM of the GSM on 17 April 2026 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 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 2026. 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 30,000.00 (subject to the interest accrued) that is requested by the NGC 2026 Organizing Committee to subsidize GSM student members only.
 - (iv) The AGM is requested to encourage the GSM Council to transfer a minimum of RM25,000.00 from the GSM operating account at the Standard Chartered Bank Bhd. to the Endowment Fund to increase the principal amount.
 - (v) The AGM is requested to appoint the Chair of the Board of Trustees of the GSM Endowment Fund, and at least three independent Full Members "in good standing", to serve until the AGM in 2029.

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 60th AGM of the GSM.



Dato' Yunus Abd Razak

Chairman

Board of Trustees of the GSM Endowment Fund

Geological Society of Malaysia

10 April 2026

Report by the Nomination Committee for GSM Council Elections for 2026/27:

As required by the Constitution, the Council sent out the call for nominations via email to the members on 16 August 2025.

Nomination Committee Chair, Arindam Chakraborty was appointed by GSM council. Later to this two committee members Harry Telajan Anak Linang and Mohd Talha Anees were nominated.

By 30 September 2025, the following nominations were received by the Nomination Committee for all the councilor posts that are up for election for the term 2026/27.

The nominations are as follows:

- President:** Meor Hakif Amir Hassan (UM)
Vice-President: Tanot Unjah (UKM)
Secretary: Ling Nan Ley (Consultant)
Assistant Secretary: Elanni Md Affandi (UM)
Treasurer: Lim Choun Sian (UKM)
Editor: Joy Jacqueline Pereira (UKM)
Councilors (for 2-year term) [in alphabetical order]
- Abdul Hadi Abdul Rahman (Consultant)
 - Lin Chin Yik (UM)
 - Mohammad Yasir Bin Mohammad Said (Petronas)
 - Tan Boon Kong (Consultant)

Four councilor posts are still being held by current council members serving the remaining part of their 2-year term. The councilors continuing are:

- Arindam Chakraborty (UM)
- Hamzah Hussin (UMK)
- Mohamad Shaufi Sokiman (Sundaland Geoscience Services Sdn Bhd)
- Suraya Hilmi Hazim (UKM)

They will serve the remaining period of their term.

For the incoming 2-year councilor posts, since there are only 4 nominations for four posts so there is no need of any elections.


Dr. Arindam Chakraborty
 Senior Lecturer
 Department of Geology, Faculty of Science
 Universiti Malaya
 50603 Kuala Lumpur, Malaysia

Chair- **ARINDAM CHAKRABORTY**


Dr. Harry Telajan Anak Linang
 Senior Lecturer (DS51)
 Department of Geology
 Faculty of Science, Universiti Malaya
 50603 Kuala Lumpur
 harytelang@um.edu.my (03-7967 4235)

Member- **HARRY TELAJAN ANAK LINANG**


Dr. Mohd Talha Anees
 Senior Lecturer
 Department of Geology, Faculty of Science,
 Universiti Malaya,
 50603, Kuala Lumpur, Malaysia

Member- **MOHD TALHA ANEES**

Attachments: Scan copy of the Nominations form received.

Townhall Session

GSM publications townhall session 2026

Date: 25 February 2026

Platform: Zoom

Introduction

The Geological Society of Malaysia (GSM) convened a townhall session with its members on 25 February 2026 to discuss its two flagship publications, “Bulletin GSM” and “Warta Geologi”. The session was moderated by the GSM Editor, Prof. Joy Jacqueline Pereira, and the Panel Members were as follows:

- Associate Professor Dr. Meor Hakif Amir Hassan (GSM President)
- Associate Professor Dr. Mohd Hariri Arifin (GSM Immediate Past President)
- Dr. Mazlan Madon (GSM Past President)
- Dr. Lim Choun-sian (GSM Editorial Management Committee Member)
- Dr. Nur Iskandar Taib (GSM Editorial Management Committee Member)
- Dr. Elanni Md Affandi (GSM Assistant Secretary Elect)

About 30 members attended the event. The event commenced with an overview of GSM publications by the Editor, followed by sharing of experiences by Panel Members based on their perspectives as authors, reviewers and language editors. This was followed by an open discussion on challenges related to manuscript quality, particularly language proficiency.

Outlook

The scope of the two GSM flagship publications is similar with a major difference being the inclusion of current activities of GSM in “Warta Geologi.” Both the publications are indexed by Scopus, the Malaysian Citation Index (MyCite), and the Directory of Open Access Journals (DOAJ). Improvements are being made to re-submit both the publications for indexing by Web of Science. The author guidelines emphasise the submission of original research, high standard of language quality prior to submission, and formatting requirements. Non-compliance with author guidelines is a common error when manuscripts are submitted, in addition to incomplete references and language-related issues.

Associate Professor Dr. Meor Hakif Amir Hassan focused on the advantages of publishing in GSM publications. He shared his experience of starting to write for the GSM bulletin in 2002 and emphasized the importance of publishing for academic career progression and fulfilling Ph.D. requirements. He highlighted that “Bulletin GSM” and “Warta Geologi” are free, available online and well-indexed, making it easily accessible and valuable for sharing geological knowledge. Associate Professor Dr. Mohd Hariri Arifin introduced the “Kamus Istilah Geologi” initiative, which aims to update and expand the existing geology dictionary in Malay, by incorporating new geological terms and strengthening its industrial relevance to meet current professional and academic requirements. The dictionary is intended to be a flagship product to celebrate the 60th anniversary of the Geological Society of Malaysia in 2027.

Dr. Mazlan Madon outlined the need to enhance the quality of manuscripts, with respect to language proficiency and manuscript preparation. He called on authors to ensure a certain standard before submission. Dr. Elanni shared her personal publishing journey, emphasizing the importance of persistence and treating reviewers as collaborators. Authors should not take rejections from journals as a setback but should accept the comments and make corrections or improvement to their manuscripts. She also recommended the use of free online tools to enhance the quality manuscripts before submission. Dr. Iskandar suggested that authors utilize AI-assisted language tools, such as Grammarly, to improve grammar, clarity, and overall language quality, thereby reducing common language-related issues encountered during the editorial screening process. Dr. Lim highlighted that the GSM Online Journal Systems (OJS) is now fully functional. However, many authors still prefer to submit their manuscripts via email rather than through the online system.

Way Forward

The current submission rates and the need to maintain a sustainable pace of publication was emphasized. Manuscripts should be reviewed and published in a timely manner, and authors should be encouraged to resubmit papers if rejected. There were several suggestions for improving GSM publications including the following:

- Establish a two-step evaluation process for rejection, where the language and structure of the manuscript would be assessed initially, followed by review of the scientific content;
- Conduct training for manuscript preparation targeting early career researchers, including publicising programmes provided by universities to prospective authors;
- Convene writing workshop for preparing manuscripts, including guidance on structure, use of tools such as Grammarly, and best practices;
- Explore the possibility of charging authors for proof-reading services to ensure quality, drawing on local experts;
- Update submission guidelines and website to include recommended language resources and sample references (e.g. Nature Geoscience);
- Provide clear feedback for rejected papers and encourage resubmission after improvements, especially for language and structure;
- Increase exposure of published papers by providing authors, upon manuscript acceptance, the means promoting their work;
- Engage with publishing houses such as Universiti Malaya as well as the Ministry of Higher Education, to seek advisory services for indexing by the Web of Science.

Attention was also drawn to other related topics. A common technical issue encountered in submitted manuscripts relates to the quality of X-ray diffraction (XRD) analysis, and a training course was suggested to address the matter. A special publication to mark the 60th anniversary of GSM was proposed, featuring personal stories and experiences of members. The session concluded with a call for papers in the upcoming National Geoscience Conference that will be held in Sarawak, Malaysia.

Prepared by,
Wan Aida Wan Zahari, Nazatul Athirah Abdul Khalil and Joy Jacqueline Pereira
Geological Society of Malaysia

CERAMAH TEKNIK TECHNICAL TALK

Sea level rise in Southeast Asia: From paleo constraints to modern acceleration and future risk

Benjamin Horton

School of Energy and Environment, City University of Hong Kong

Date: 8 April 2026

Platform: Zoom

Moderator: Dr. Arindam Chakraborty

On 8th April, 2026, Geological Society of Malaysia (GSM) in partnership with Department of Geology, Universiti Malaya hosted a technical talk titled “Sea Level Rise in Southeast Asia: From Paleo Constraints to Modern Acceleration and Future Risk”. The talk was delivered by Professor Benjamin Horton (City University of Hong Kong) in online mode (Zoom platform). A total of 100 members participated online through zoom and others viewed through GSM Facebook page. The talk has been later uploaded in GSM YouTube channel (<https://www.youtube.com/watch?v=yCkAzY0eFMk>).

Abstract of the talk: Coastlines across Southeast Asia face mounting challenges from relative sea-level (RSL) rise, requiring a unified assessment that integrates geological reconstructions, historical evidence, and probabilistic future projections. In this synthesis, we bring together findings from across the region to provide an end to end framework linking paleo constraints, modern observations, and future risk. Geological records from the Sunda Shelf reveal that since the Last Glacial Maximum (~20 ka), RSL has risen by ~121 m, with peak rates approaching ~15 mm yr⁻¹. This dramatic rise reshaped ~2.3 million km² of paleo-landscapes and altered the distribution of early human populations. Early Holocene data document a rapid rise from -21 m to -1 m between 10–7 ka, followed by a mid Holocene high stand of approximately +4 m at ~5 ka and a gradual fall thereafter. These Holocene patterns show notable discrepancies with glacial isostatic adjustment (GIA) models, indicating that regional to local processes remain insufficiently represented in global-scale solutions. New proxy records from Indonesian coral microatolls, combined with historical “data archaeology” in Singapore, refine modern sea level histories and cut uncertainties by roughly 50%. These records indicate near stable RSL (0.1 ± 0.1 mm yr⁻¹) from the late 19th century until 1993. A pronounced acceleration begins around 1993, with recent rates of 4.0 ± 0.1 mm yr⁻¹—exceeding both global satellite altimetry estimates and regional averages—likely linked to anomalous ocean warming and localized vertical land motion. Accounting for vertical land motion in Singapore updates IPCC aligned projections, yielding a likely (17th–83rd percentile) RSL rise of 0.75 m (0.58–1.04 m) by 2100 under a high emissions scenario. To address uncertainty surrounding high end outcomes, we integrate model based and expert elicited approaches into a unified probabilistic distribution, which produces a 95th percentile estimate of 2.2 m by 2100 for high emissions. Even under a moderate emissions pathway, projected future rates of RSL rise are surpassed only during abrupt ice loss events at ~14.5 and ~9 ka. Altogether, these linked paleo, modern, and probabilistic constraints illustrate how deep time benchmarks can sharpen our interpretation of present day trends and enhance decision relevant projections for some of the world’s most vulnerable coastlines.

Synopsis of the talk: The talk presented an integrated assessment of sea-level change in Southeast Asia by linking geological (paleo) records with modern observations and future projections. It emphasized that understanding long-term sea-level behaviour from the Late Quaternary and Holocene is essential for constraining present trends and improving predictive models. Paleo-records derived from coral reefs, mangroves and sedimentary archives demonstrate that sea level rose rapidly following the Last Glacial Maximum (LGM) and then stabilised for several millennia before the industrial era.

The speaker highlighted that modern sea-level rise represents a clear departure from this long-term stability, with accelerated rates driven primarily by anthropogenic warming, including thermal expansion and ice-sheet melt. Regional variability in Southeast Asia is strongly influenced by vertical land motion (e.g., subsidence), ocean dynamics and sediment compaction, which amplify the local risk beyond global averages.

A key focus of the talk was the application of paleo constraints to refine projections of future sea-level rise and associated coastal hazards. By integrating geological data with instrumental records and modelling approaches, the

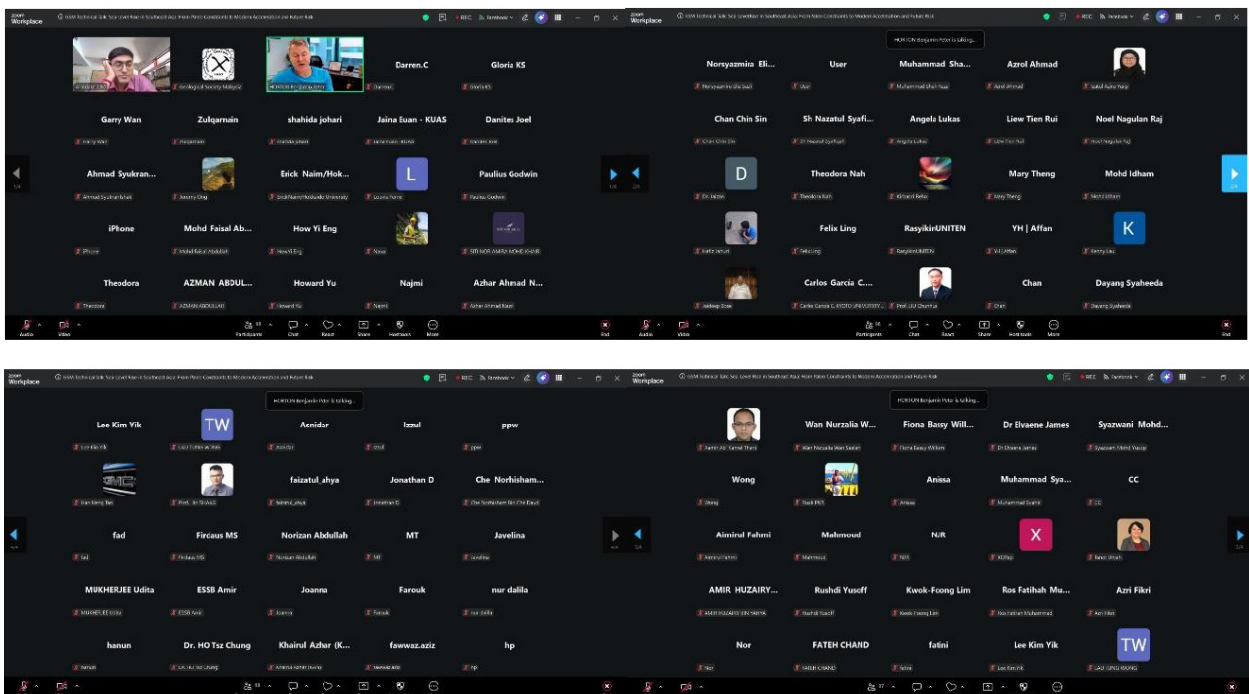
PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)

study provided improved estimates of future inundation risk, particularly for densely populated low-lying coasts in Southeast Asia. Overall, the talk underscored the importance of interdisciplinary approaches in linking past, present and future sea-level dynamics for robust climate risk assessment and coastal management.

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



Poster for the online talk organized.



Online participants.

Prepared by,
Arindam Chakraborty
Chair, Quaternary and Marine Geology Working Group, GSM
Senior Lecturer and Supervisor, Geology Museum, Dept. of Geology, UM

CERAMAH TEKNIK TECHNICAL TALK

Development of windfarm industry in Asia, what's for us?

Juzaili Azmi

UGeo Solutions Sdn. Bhd.

Date: 17 April 2026

Venue: Dewan Kuliah Geologi, Jabatan Geologi, Universiti Malaya

Online: Zoom

Program Report: GSM Pre-AGM 2026 Talk on Asia's Windfarm Industry

On Friday, 17th April 2026, the Geological Society of Malaysia (GSM) successfully hosted its Pre-Annual General Meeting (AGM 2026) Talk, titled “Development of Windfarm Industry in Asia, What's For Us?”.

The insightful session was delivered by esteemed speaker P.Geol. Mr. Juzaili Azmi, Chief Operating Officer (COO) of UGEO Solutions Sdn. Bhd. We were thrilled to see a highly engaged hybrid audience, with approximately 30 participants joining us physically at the Dewan Kuliah Geologi, Universiti Malaya, and another 99 professionals tuning in via our online Zoom platform.

Key Highlights from the Session

Mr. Juzaili addressed the rapid expansion of the offshore wind (OSW) industry across Asia—projected to contribute over 215 GW by 2034—and its profound impact on the professional landscape. As the region pivots from traditional hydrocarbon extraction toward renewable energy, the demand for subsea site characterization and geohazard assessment has reached a critical inflection point.

A major takeaway for Malaysian geoscientists is that this energy transition represents a strategic “re-skilling” rather than a replacement of core competencies. Traditional expertise in seismic interpretation, borehole logging, and sedimentology is now being repurposed to solve high-stakes engineering challenges in the renewables sector, including:

- **Foundation Integrity:** Analysing cyclic loading and soil stability for monopile and jacket structures.
- **Geofohazard Mitigation:** Identifying shallow gas and seabed mobility to secure subsea cable routes.
- **Floating Offshore Wind (FOW):** Leveraging deep-water expertise from the Oil & Gas sector to pioneer anchoring systems for floating turbines in deeper Asian waters.

Furthermore, Mr. Juzaili highlighted that despite Malaysia's lower average wind speeds, the domestic market is evolving through low-wind-speed technology and strategic alignment with the National Energy Transition Roadmap (NETR). This positions Malaysian geoscientists perfectly as a regional “talent hub,” equipped to export technical consultancy and geophysical services to rapidly emerging wind markets across Vietnam, Taiwan, and the Philippines.

We extend our deepest gratitude to Mr. Juzaili Azmi for generously sharing his time, profound industry insights, and continuous support for the Society's activities. As he aptly noted, the professional shift from *exploration* to *site characterization* truly defines an exciting new era for the Malaysian geoprofessional.





GSM PRE-ANNUAL GENERAL MEETING (AGM 2026) TALK

DEVELOPMENT OF WINDFARM INDUSTRY IN ASIA, WHAT'S FOR US?

DATE : 17 APRIL 2026 (FRIDAY)

TIME : 3.00 PM – 4.30 PM

VENUE : DEWAN KULIAH GEOLOGI, JABATAN GEOLOGI, UNIVERSITI MALAYA

ONLINE : ZOOM

LINK : <https://tinyurl.com/3tkrk7sj>

MEETING ID : 810 1534 1151

PASSCODE : 749385



Speaker
P.GEOL. MR. JUZAILI AZMI
COO, UGEO SOLUTIONS SDN BHD

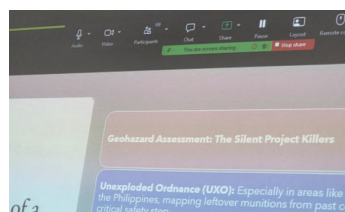
ABSTRACT:

The rapid expansion of the offshore wind (OSW) industry in Asia—projected to contribute over 215 GW by 2034—is fundamentally reshaping the professional landscape for geoscientists in Malaysia. As the region pivots from traditional hydrocarbon extraction toward renewable energy, the demand for subsea site characterization and geohazard assessment has reached a critical inflection point.

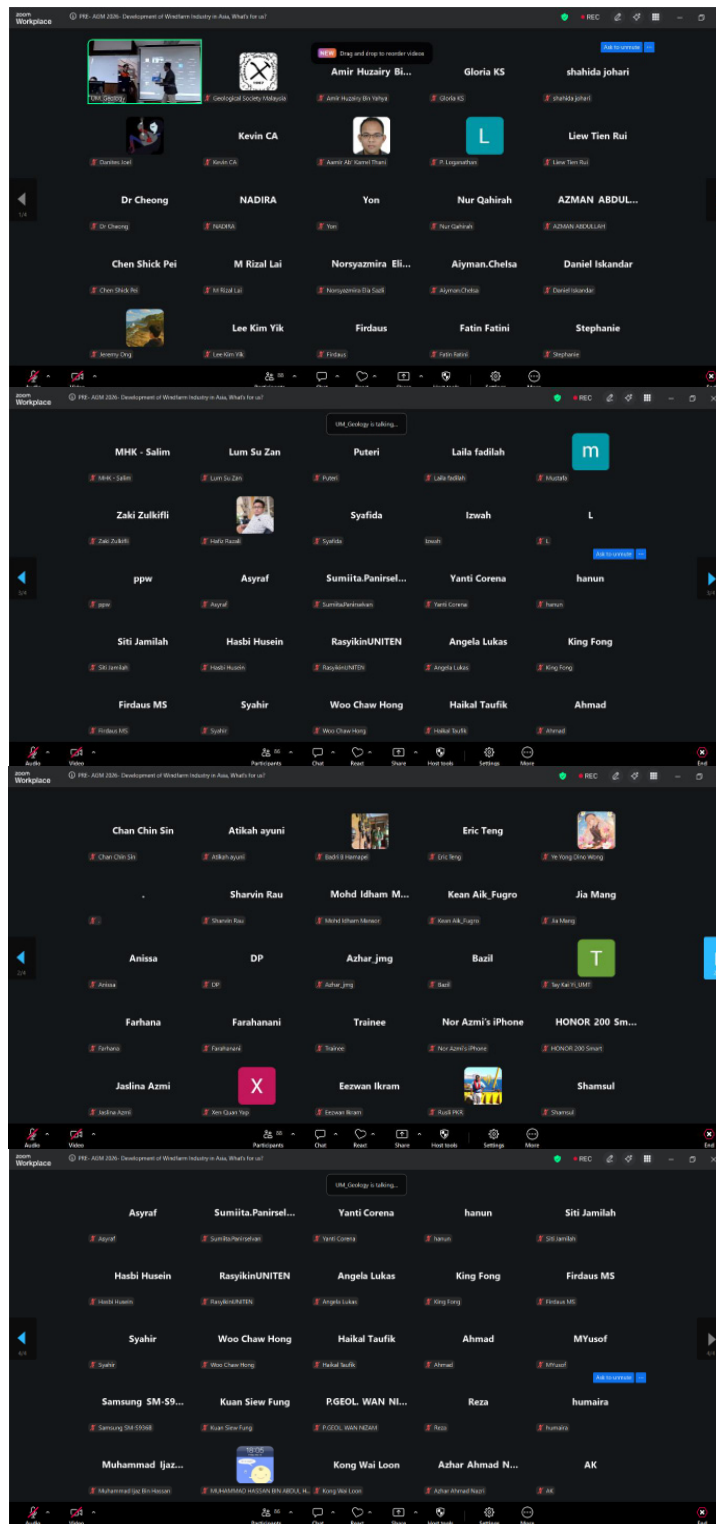
For the Malaysian geoscientist, this transition represents a strategic “re-skilling” rather than a replacement of core competencies. Traditional expertise in seismic interpretation, borehole logging, and sedimentology is now being repurposed to solve high-stakes engineering challenges, such as:

- **Foundation Integrity:** Analysing cyclic loading and soil stability for monopile and jacket structures.
- **Geohazard Mitigation:** Identifying shallow gas and seabed mobility to secure subsea cable routes.
- **Floating Offshore Wind (FOW):** Leveraging deep-water expertise from the Oil & Gas sector to pioneer anchoring systems for floating turbines in deeper Asian waters.

Despite Malaysia’s lower average wind speeds, the domestic market is evolving through low-wind-speed technology and strategic alignment with the National Energy Transition Roadmap (NETR). Malaysian geoscientists are uniquely positioned as a regional “talent hub,” exporting technical consultancy and geophysical services to emerging wind markets across Vietnam, Taiwan, and the Philippines. The shift from Georation (Exploration) to Site Characterization defines the new era of the Malaysian geoprofessional.



PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)



Prepared by,
Muhammad Hafeez Jeofry
Chairman, Working Group Geophysics

CERAMAH TEKNIK TECHNICAL TALK

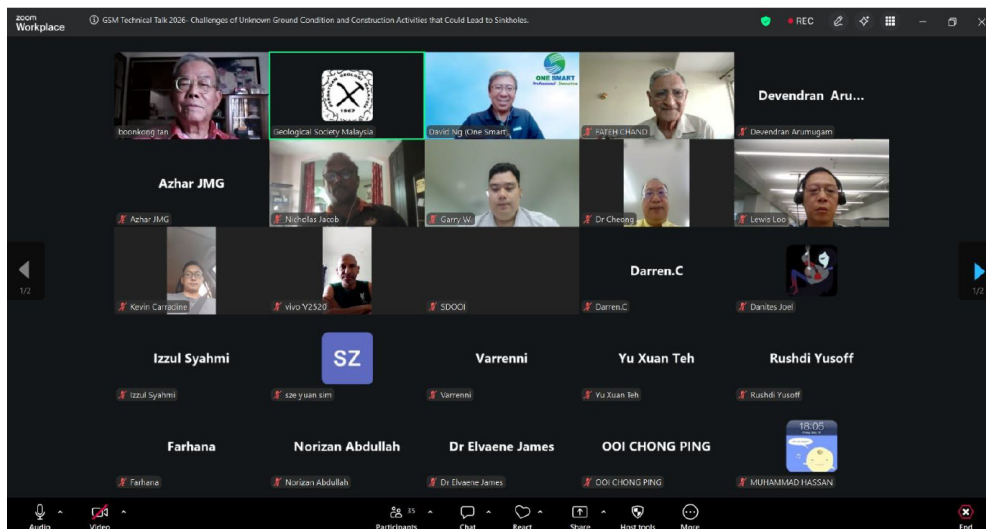
Challenges of unknown ground condition and construction activities that could lead to sinkholes

David Ng Chew Chiat
One Smart Engineering, Singapore
Date: 22 April 2026
Platform: Zoom

The above talk was delivered by Er. Dr. David Ng Chew Chiat (One Smart Engineering, Singapore) on 22nd April, 2026 via Zoom. Some 60 members participated. An abstract of the talk is given below:

Abstract: This presentation will give an introduction to the geological conditions of Singapore based on the latest geological mapping and classification of Singapore ground and compared with the conventional geological mapping and classifications. Based on the current understanding of the geological conditions of Singapore, we will explore the risk we are facing in terms of unknown ground conditions in Singapore and the risks of sinkholes due to construction activities. This presentation will discuss about Singapore geological conditions, challenges of unknown ground conditions and construction activities that could lead to sink holes on ground surface.

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



Prepared by,
Tan Boon Kong
Chairman, Working Group on Engineering Geology & Environmental Geology

CERAMAH TEKNIK TECHNICAL TALK

Microbial transformation of the elements: From contaminants to resources

Muammar Mansor

University of Tübingen, Germany

Date: 6 May 2026

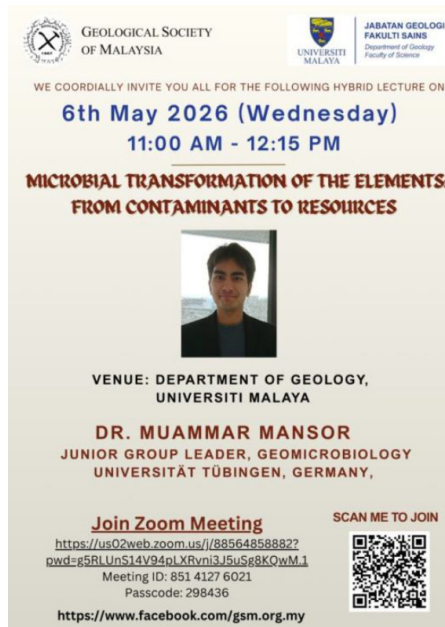
Platform: Hybrid (Zoom and Meeting Room, Department of Geology, Universiti Malaya)

Moderator: Dr. Arindam Chakraborty

On 6th May, 2026, Geological Society of Malaysia (GSM) in partnership with Department of Geology, Universiti Malaya hosted a technical talk titled “Microbial Transformation of the Elements: From Contaminants to Resources”. The talk was delivered by Dr Muammar Mansor (University of Tübingen) in Hybrid mode. A total of 6 members were present at the Department of Geology (UM), 24 members participated online through Zoom and others viewed through GSM Facebook page. The talk is available for viewing at GSM’s YouTube channel (<https://www.youtube.com/watch?v=Laj4W7IlyKM&t=49s>).

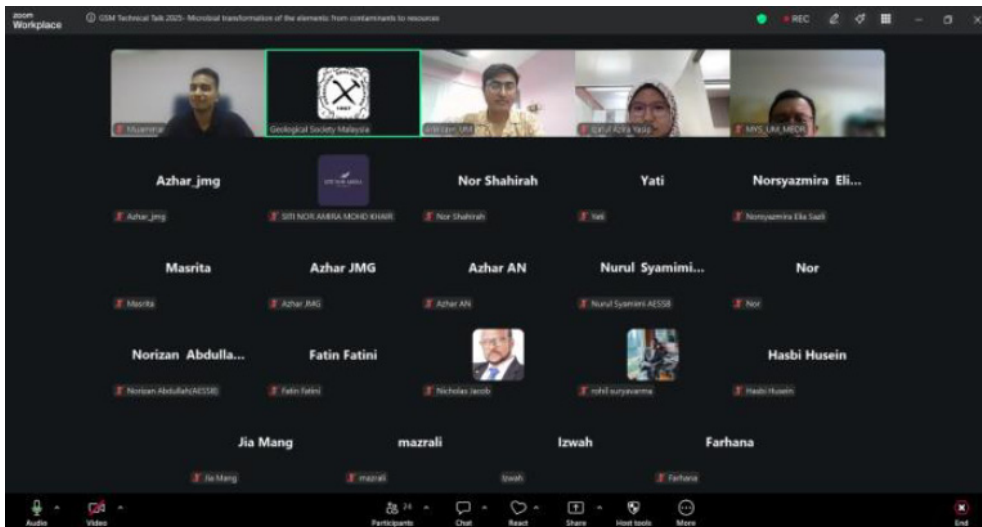
Synopsis of the talk: The technical presentation was hosted by the Geological Society of Malaysia where Dr. Mansor explores the intersection of geology, microbiology, nanotechnology, and environmental sustainability by demonstrating how microorganisms interact with and transform chemical elements present in nature. He also explains that microbes can neutralize hazardous environmental contaminants - such as arsenic, cadmium and antimony through metabolic pathways such as anaerobic respiration and reductive dissolution. Instead of allowing industrial and mining wastes to pollute ecosystems, these microbially mediated turnover processes can be engineered to precipitate stable, extracellular biominerals such as biogenic iron sulfides, magnetite and pyrite. This biomineralization pathway enables circular resource recovery by converting toxic environmental liabilities into high-value assets, fundamentally shifting the paradigm of modern waste management. Furthermore, study of these specific microbe-mineral interactions provide the essential framework for recognizing geological biosignatures from the early Earth and identifying potential life-bearing environments on other planets. Ultimately, by bridging microbiology with geochemistry, we can leverage natural microbial systems to achieve critical environmental remediation goals and advance sustainable, circular resource extraction.

We thank Dr Muammar for his support and contribution to the Society’s activities.



Poster for the online talk organized.

PERTEMUAN PERSATUAN (MEETINGS OF THE SOCIETY)



Online participants.



Offline participants.



Presenting the token of appreciation to Speaker.

Prepared by,
Arindam Chakraborty
Chair, Quaternary and Marine Geology Working Group, GSM
Senior Lecturer and Supervisor, Geology Museum, Dept. of Geology, UM

CERAMAH TEKNIK TECHNICAL TALK

Sesi pengembangan ilmu JSBAS siri 4/2026

Ambar bin Yarmo

Fakulti Sains dan Teknologi, UKM

Sarah binti Rahman & Nazira binti Nazari

DGEG Sdn. Bhd.

Tarikh: 19 Mei 2026

Waktu: 10:00 – 12:00 tengahari

Tempat: Bilik Mesyuarat Geologi, Aras G, Bangunan Sains Geologi, FST dan juga dalam talian

Program kali ini membawakan 3 orang panel untuk memberi peluang kepada pihak yang berkaitan terutama ahli akademik dan pengamal industri untuk peluang mempelajari proses mendapatkan geran industri dari Malaysia-Thailand Joint Authority (MTJA). Strategi permohonan dan pengurusan geran MTJA telah disampaikan oleh Prof. Dr. Ambar bin Yarmo dari Fakulti Sains dan Teknologi, UKM manakala Dr. Sarah binti Rahman dari DGEG Sdn. Bhd. Panel ke-3 pula adalah Puan Nazira binti Nazari juga dari DGEG Sdn. Bhd. telah menyampaikan sesi ceramah berkaitan proses untuk mendaftarkan lebih ramai ahli geologi dalam program Latihan HRDF (Human Resources Development Fund). HRDF telah dijenamakan semula sebagai HRD Corp (Human Resource Development Corporation) di bawah Kementerian Sumber Manusia Malaysia. HRDF mengurus kutipan levi daripada majikan dan membolehkan dana tersebut digunakan semula untuk melatih pekerja.

Pihak Program Geologi ingin merakamkan berbilang terima kasih kepada Lembaga Ahli Geologi (BoG), Pertubuhan Geoterma Malaysia (MyGA) dan Institut Geologi Malaysia (IGM) atas kerjasama yang telah diberikan dalam menjayakan ceramah ini.

Maklumat lanjut berkaitan geran MTJA boleh diperolehi dipautan berikut: <https://www.mtja.org/home2>. Manakala butiran lebih jelas mengenai HRDF pula seperti dipautan berikut: <https://hrdcorp.gov.my/>

JSBAS Sharing Session Series 4/2026

THE SPEAKERS

- 1** Navigating MTJA Research Grants: Strategies for Successful Securing and Management
Prof. Dr. Ambar bin Yarmo
Faculty of Science and Technology, UKM
- 2** Sharing experiences on MTJA Grant Application Process
Dr. Sarah binti Rahman
DGEG Sdn. Bhd./ Secretary of IGM
- 3** Engaging Academics as Professional Trainers with BoG & IGM; Guidelines and Eligibility
Madam Nazira binti Nazari
DGEG Sdn. Bhd.

JOIN US

19 May 2026 (Tuesday)
10.00 am - 12.00 noon
Geology Meeting Room, Level G,
Geological Science Building, FST

<https://tinyurl.com/4eucay67>
Meeting ID: 9341396 3221
Passcode: 828036

Organized by:
Department of Earth Sciences and Environment
Faculty of Science and Technology

Logos: Malaysia Madani, Vatan Kita, Sustainable Development Goals, #126 CS, World University Rankings, #53 Times Higher Education Impact Rankings

Poster ceramah yang melibatkan 3 panel yang berpengalaman dalam agenda pemerkasaan ilmu di kalangan ahli akademik dan pemain industri.



Sesi penyampaian cenderamata kepada panel penceramah. Dari kiri: Puan Nazirah, Dr. Sarah dan Prof. Dr. Ambar.

Disediakan oleh,
Mohd Hariri Arifin
Mantan Presiden Persatuan Geologi Malaysia

CERAMAH TEKNIK TECHNICAL TALK

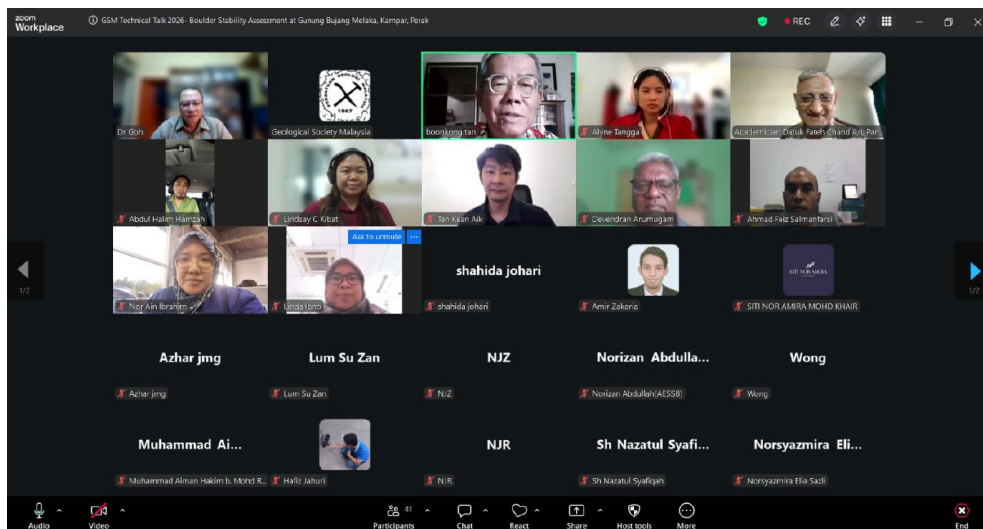
Boulder stability assessment at Gunung Bujang Melaka, Kampar, Perak

Goh Thian Lai
Universiti Kebangsaan Malaysia (UKM)
Date: 20 May 2026
Platform: Zoom

The above talk was delivered by P.Geol. Ir. Dr. Goh Thian Lai (UKM) on 20th May, 2026 via Zoom. Some 60 members participated. An abstract of the talk is given below:

Abstract: Gunung Bujang Melaka, Kampar, Perak is set to be developed into a tourist attraction, prompting a study of the granite boulders in the area to ensure visitor safety. This paper aims to identify potential unstable boulders and produce a stability zonation map of the designated area. Aerial photogrammetry was conducted to create a 3D model of the project area, capturing the boulders' characteristics. Each boulder was delineated using 3D processing software, ShapeMetrix UAV, to acquire dimensions, base dipping angles, and azimuths. The general slope angle of the project area was generated using the moving average grid method on the digital elevation model (DEM) produced from the 3D model. Over 1,600 boulders were identified across the area, with 274 boulders having visible base angles evaluated using the Hoek & Bray block model for stability assessment. Mitigation measures such as bracing and anchoring are recommended based on their modes of failure.

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



Prepared by,
Tan Boon Kong
Chairman, Working Group on Engineering Geology & Environmental Geology

CERAMAH TEKNIK TECHNICAL TALK

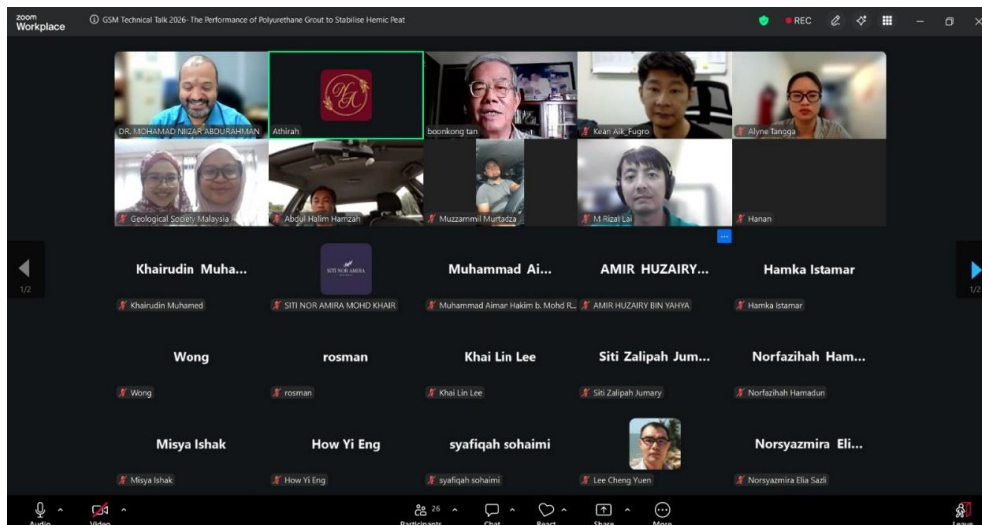
The performance of polyurethane grout to stabilise hemic peat

Mohamad Niizar Bin Abdurahman
Cawangan Kejuruteraan Cerun, JKR
Date: 10 June 2026
Platform: Zoom

The above talk was delivered by Ir. Dr. Mohamad Niizar Bin Abdurahman (Cawangan Kejuruteraan Cerun, JKR) on 10th June, 2026 via Zoom. Some 50 members participated. An abstract of the talk is given below:

Abstract: Peat has always been considered as challenging ground for any form of construction due to its engineering characteristics, such as high short-term settlement, prolonged long-term post construction settlement and high natural moisture content exceedingly more than 100%. Numerous construction materials and methods have been developed in recent years for sustainable construction on peat. The polyurethane (PU) grouting as an option is similar to the cement base grouting application widely used for ground improvement. However, the PU grouting is a strong lightweight material with very short curing time. The Parit Nipah hemic peat has high natural moisture content ($> 500\%$) with high initial void ratio (6.72-10.11) and compression index, cc between 3.17 to 4.57. The depth of grouting for laboratory scale models were determined at 100 mm and 200 mm, while for the field scale models was at 1 m and 2 m deep. The settlement for natural and treated peat under embankment constructed in stages were monitored. The results of laboratory physical scale models and field models displayed similar settlement pattern. The PU grouted peat showed improvement in term of ground settlement compared to natural peat. PU grouting managed to reduce the settlement of peat up to 30% compared to natural peat. For the PU grouted peat, the increment in term of depth of grouting displayed better settlement improvement. Results showed that PU grouting has good potential to reduce the settlement of hemic peat.

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 & Environmental Geology

Geologists Day Write-up

National Geologists' Day Celebration 2026 - GSM at the celebration

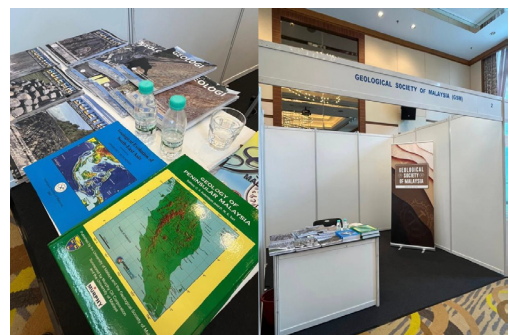
The Geological Society of Malaysia was honoured to be part of the nation's very first National Geologists' Day celebration, held on the 4th of May 2026 at the Zenith Hotel, Putrajaya. The inaugural celebration, carrying the theme of "Geologi Memacu Ekonomi, Melindungi Komuniti, Asas Pembangunan Lestari", was organised to recognise and acknowledge the invaluable roles and contributions of geologists in advancing the nation's development.

The Geological Society of Malaysia maintained an active presence throughout the event, with Council members engaging fellow geoscientists in conversation, sharing updates on Society activities, and promoting membership and involvement. Representing the Society on the day were President, Assoc. Prof. P.Geol. Dr. Meor Hakif, Immediate Past President, Assoc. Prof. P.Geol. Ts. Dr. Mohd Hariri Arifin, alongside Council Members Dr. Elanni Md Affandi, Dr. Lin Chin Yik, and P.Geol. Dr. Suraya Hilmi Hazim. Selected publications were also available for sale at the GSM booth, drawing interest from attendees across industry, government and academic sectors.

The highlight of the day for the Society was a visit to the GSM booth by YB Dato' Sri Arthur Joseph Kurup, Minister of the Natural Resources and Environmental Sustainability Ministry (NRES), accompanied by Deputy Minister, YB Tuan Syed Ibrahim bin Syed Noh and Secretary General, YB Datuk Wira Anis Rizana binti Mohd Zainudin. The delegation took the opportunity to talk to the Council Members to learn more about the Society's work and contributions to the geoscience community in Malaysia.

The event also brought a moment of well-deserved recognition for one of our own, Prof. P.Geol. Dr. Joy Jacqueline Pereira, Editor of the Society, who was presented with the "Tokoh Wanita" award at the "Anugerah Tokoh Geologi 2026". Her achievement is a source of immense pride for the Society and a strong testament to the calibre of expertise within our membership.

GSM looks forward to continued collaboration with JMG, BoG, IGM, and MyGEO in advancing the geoscience agenda for Malaysia.



Prepared by,
Suraya Hilmi Hazim
GSM Council Member / Operations Lead
Promotion of Geoscience, Social Media & Digital Content

New Membership

Associate Member

1. Ahmad Zaharuddin Zahari
2. Mohd Ezani Abdul Aziz
3. Muhamad Syazwan Norilham
4. Sithi Vinayakam Muniandy

Full Member

1. Chin Soon Mun
2. Fatini Nabilah Faizal
3. Hazlinda Ibno
4. Jennytah Julimin
5. Ledyhernando Taniou
6. Lindsay Constantine Kibat
7. Mohamad Hisham Ismail
8. Muhd Nur Ismail Abdul Rahman
9. Nurfarahin Rambedan
10. Razin Ahmad Rahimi
11. Rohil Suryavarma Kunasegar
12. Zulkarnain Ishak

Student Member

1. Abdul Qayyum Karya
2. Ahmad Adha Syamil Ahmad Taufik
3. Aidid Hakimi Shamsul Kamar
4. Anis Syakireen Shahar
5. Ariff Zul Ashraf Yakob
6. Aristotle Joshua Talabis Endaya
7. Beatriz Vanelly Lumpoh
8. Cheah Xin Yi
9. Christabelle Lim Xin Rou
10. Dayang Ervinna Natasha Awang Hishamudin
11. Esmiya Edriyana Zulkhibri
12. Evienstein Wilfred
13. Farrah Aina Mohd Zulkifli
14. Fong Yuen Sie
15. Ilham Azizuddin Ebrahim
16. Imran Raheemi
17. Jayanti Rauf
18. Kamal Das

19. Kanij Fatema
20. Ker Kai Mun
21. Kim Meng Heng
22. Laavanyaa M Navamany
23. Ling Sin Yi
24. Lo Lin Lin, Winnie
25. Mohamad 'Abid Azizi Mohd Asri
26. Mohamad Aidil Imran Lapirin
27. Mohammad Ribie Arif
28. Mohd Uvaish Ansari
29. Muhamad Amsyar Fakhruallah Mohd Sahnahar
30. Muhamad Hazim Aiman Hisam
31. Muhammad Asyraf Danial Osman
32. Muhammad Haziz Safwan Jatun
33. Muhammad Irfan Sakhawi Mohd Azlan
34. Muhammad Safwan Shaiful Najib
35. Muhammad Zamir Abdul Rasid
36. Natasha Cindy Richard Pie
37. Noor Amirah Syahirah Noor Aizam
38. Nur 'Ain Solehah Mat Hasan
39. Nur Aisyah Saffiya Juhaidi
40. Nur Al Maidah Che Mod
41. Nur Farhana Salleh
42. Nur Fatin Najwa Alias
43. Nur Irdina Insyiraah Mohd Salwira
44. Nur Nariza Nazari
45. Nur Syaakiirroh A'qilah Haji Sahari
46. Nuramirah Adlin Azmi
47. Nurul Asikin Mohd Araha
48. Patricia Henry
49. Phang Xin Yen
50. Ricanna Sofya Mamma
51. Sharifah Nur Shaghirrah Syed Ismail
52. Sharrah Shaarifah Abdul Latif
53. Siti 'Aaisyah Pg Haji Mohd Yani
54. Siti Farah Ezdiani Miasin @ Awang
55. Sun Haosong
56. Tang Tuang Ling, Sally Jane
57. Tharshinni Devi Shanmugam
58. The Nesda Rojuin
59. Umma Tamim

IN MEMORIAM



Farah Fazulah binti Abdullah (1983-2026)

On 5 May 2026, the geological community sadly lost a rising star, an active member of GSM who had served as Secretary from 2020 to 2023.

Farah was born in Pulau Pinang on 14 December 1983, as the youngest of four siblings. Following her secondary schooling at Tunku Kurshiah College (TKC), Farah studied geology at Universiti Kebangsaan Malaysia (UKM). She graduated with BSc in 2005 and was immediately hired by Shell, based in Miri, Sarawak. She initially worked on geomodelling of carbonate reservoirs offshore Sarawak but gradually acquired other skills through on-the-job assignments. These included a year-long attachment as a wellsite petroleum engineer and a one-and-a-half-year stint as a geohazard analyst.

In 2010, Farah joined Talisman Energy as a reservoir geologist in oil recovery projects in the Malay Basin. She re-joined Shell in 2012 as a production geologist and was seconded to Petronas's Enhanced Oil Recovery (EOR) Centre where she had the opportunity to work on Bokor and Baram, two of the biggest oil fields in Baram Delta.

From 2014 to 2016, while at Shell, Farah studied part-time for her MSc in Petroleum Engineering from Herriot-Watt University. As a production geologist, having both geological and petroleum engineering skills proved valuable for her in providing technical support for Shell's Sabah assets, such as St Joseph, South Furious, SF30, and Barton. Her other roles at Shell also included well planning and operations for their deepwater exploration campaign. After leaving Shell in February 2018, Farah joined Carigali-Hess Operating Co. in Kuala Lumpur as a development geologist, where she stayed until the end of 2019.

While in Kuala Lumpur, Farah was co-opted as a council member on 1 June 2018 and actively participated in GSM activities. In 2019, as part of the GSM outreach and promotion team effort, Farah helped organised a highly successful field trip to the Sg Lembing Mine. She was elected to assistant secretary in April 2019, and secretary in April 2020. In 2021, in the aftermath of the Covid-19 pandemic, Farah made a career move to Brisbane, Australia, but still managed to continue as GSM secretary by remotely convening online meetings of the council. She served as GSM secretary until April 2023.

In Australia, Farah was attached to Central Petroleum (2021-2023) as a field development geologist, working in the Amadeus Basin (Northern Territory), and later joined Santos Ltd (2023-2025) where she worked on the Cooper Basin (South Australia). In 2023, she volunteered with the Queensland branch of the Petroleum Exploration Society of Australia (PESA), and joined its committee in 2024. Farah also regularly volunteered with charity organisations such as Foodbank Queensland and Community Friends West End.

In September 2025, after about five years in Australia, Farah returned to Kuala Lumpur to be closer to her family. She joined Vestigo Petroleum as a senior geomodeller for their Sarawak assets. She also reconnected with GSM and had hoped to participate in its activities.

Farah loved books, “shiny stones”, and travelling. Friends and colleagues remember her as genuine, kind, warm, helpful, “crazy”, adventurous, daring, carefree, “full of life”, and “always had something to tell”. She will be dearly missed. *May Allah grant her Jannah.*

Prepared by,
Mazlan Madon

In loving memory of Farah Fazulah; a personal remembrance from a former GSM committee colleague

بِسْمِ اللَّهِ الرَّحْمَنِ الرَّحِيمِ

إِنَّا لِلَّهِ وَإِنَّا إِلَيْهِ رَاجِعُونَ

Surely we belong to Allah, and surely to Him we shall return.

It is with deep sadness that I received the news of the passing of Farah Fazulah, someone I had the honour of knowing during our time together in the Geological Society of Malaysia (GSM).

Although we may not have remained closely connected in recent years, Farah was part of a meaningful chapter in my life. During our time serving together in GSM, alongside colleagues such as Mr Nizam, Dr Hariri, Azianti and other committee members, she was part of a group of people who contributed their time, energy, and commitment to the geological community in Malaysia.

I remember Farah through that shared season — meetings, discussions, committee work, and the spirit of service that brought us together under GSM. Those moments may have felt ordinary at the time, but news like this reminds us that every sincere contribution, every friendship, and every shared effort has value in the eyes of those who remember.

Farah’s passing is a painful reminder of how fragile life is. Sometimes we do not realise the weight of a person’s presence until we hear that they are no longer with us. Even if life took us in different directions after our GSM days, her name remains connected to a period of service, friendship, and contribution that I will always remember with respect.

On behalf of those who knew her during our GSM committee days, I extend my heartfelt condolences to her family, loved ones, friends, and all who had the honour of knowing her. May Allah SWT forgive her, accept her good deeds, grant her peace and mercy, and place her among the righteous.

Farah Fazulah will be remembered with kindness, respect, and du‘a.

اللَّهُمَّ اغْفِرْ لَهَا، وَارْحَمْهَا، وَعَافِهَا، وَاعْفُ عَنْهَا، وَأَكْرِمْ نُزُلَهَا، وَوَسِّعْ مَدْخُلَهَا

May Allah forgive her, have mercy on her, pardon her, honour her resting place, and grant her Jannatul Firdaus.

Al-Fatihah.

Prepared by,
Ahmad Tariq Ahmad Ziyad
Former Committee Member, GSM

REPORT

TRIGGER Project events 2026 - Modelling landslide risk for climate finance

Navakanesh M. Batmanathan & Joy Jacqueline Pereira
SEADPRI-UKM, Universiti Kebangsaan Malaysia
Nikhil Nedumpallile Vasu
British Geological Survey
Date: 10-11 March 2026
Venue: Shah Alam, Selangor

The Geological Society of Malaysia collaborated with University Kebangsaan Malaysia's Southeast Asia Disaster Prevention Research Initiative (SEADPRI-UKM), British Geological Survey (BGS) and other key partners to convene two consecutive events under the Trigger Index for Rainfall-Induced Landslide Risk Assessment for Enhanced Resilience (TRIGGER) Project in Shah Alam, Selangor on 10 and 11 March 2026. The TRIGGER Project is supported by the UK Government's Climate Action for a Resilient Asia (CARA) program through the Foreign, Commonwealth & Development Office (FCDO). It aims to enhance climate adaptation and resilience across the Indo-Pacific region by developing advanced landslide risk assessment tools.

TRIGGER Project events

The first event, titled "Workshop on Modelling Landslide Risk for Climate Finance & Resilience – Bridging the Gap" was held on 10 March 2026. The focus was on bridging technical geohazard data with economic architectures. The target group was government agencies involved various aspects related to landslide hazards in Selangor as well the financial sector represented by the insurers, bankers and risk assessors. This was followed by the "Knowledge Exchange & Engagement Workshop: Landslide Risks, Climate Hazards, and Climate Finance for Resilience" on 11 March 2026. This workshop featured a variety of case-studies presented by universities working on landslides, other climate related hazards and financial aspects in Selangor and the Federal Territory of Kuala Lumpur. The event was attended by representatives from government, non-government organisations and the private sector.

Highlights

The events provided several key insights on landslide information for finance and insurance. These included the following:

- ✧ Standard rainfall-only models are inadequate for parametric insurance due to high basis risk; financial models must evolve into multi-parameter triggers (soil moisture, slope geometry, human activity) and bundle landslide coverage with floods or earthquakes to create a viable risk pool.
- ✧ The regional screening baseline grids (5 m–15 m) are useful; however, they are too coarse for site-specific financial triggers. Insurers require a 20 m resolution for district screening and a 3 m scale as the gold standard to capture micro-terrain features, buffer zones, and legal boundaries.
- ✧ Landslide risk is a critical missing link in banking stress tests. While applying risk maps to new hillside developments is manageable, assessing historical mortgage portfolios creates property revaluation concerns; banks need these hazards translated into financial metrics such as Loan to Value (LTV) ratios and Probability of Default (PD) and clear direction from Bank Negara Malaysia.
- ✧ Human activities such as deforestation, slope cutting and clogged drainage lower the rainfall thresholds that trigger landslides. Local authorities can use predictive modeling to enforce zoning and implement Nature-Based Solutions but face local skills gaps and data compilation bottlenecks.

- ✧ Scaling is blocked by bureaucratic barriers and technical fragmentation between public hazard data and private insurer loss data. Stakeholders advocated for a secure, centralized national platform. The Malaysian Geospatial Data Infrastructure (MyGDI) initiative by the government to enhance awareness on data availability was highlighted as an example to standardize data formats and streamline sharing.

Concluding remarks

The TRIGGER Project workshops concluded that bridging the gap between landslide assessments and finance requires transitioning to multi-parameter and high-resolution risk models. About 100 participants attended both the events. They served to bring geoscientists together and link them to financial experts and policymakers to develop data-driven disaster risk reduction approaches.



Participants of the workshop on “Modelling Landslide Risk for Climate Finance & Resilience – Bridging the Gap” that was held on 10 March 2026 in Shah Alam, Selangor.

Prepared by,
Navakanesh M. Batmanathan
SEADPRI-UKM

Board of Geologists Malaysia



Klinik Pembangunan Profesional Berterusan (CPD) secara atas talian anjurkan Lembaga Ahli Geologi Malaysia

Lembaga Ahli Geologi Malaysia (BoG) melalui Jawatankuasa Program Pembangunan Profesional (JPPP) telah menganjurkan Klinik Pembangunan Profesional Berterusan (Continuing Professional Development, CPD) secara atas talian pada 27 Jun 2026 melalui platform Google Meet. Program yang berlangsung dari 10.00 pagi hingga 11.30 pagi ini telah disertai oleh 22 orang Ahli Geologi Berdaftar.

Penganjuran Klinik CPD ini merupakan salah satu inisiatif BoG bagi meningkatkan kefahaman Ahli Geologi Berdaftar mengenai pelaksanaan sistem Pembangunan Profesional Berterusan (CPD), di samping memberi penerangan berhubung keperluan pematuhan mata kredit CPD, tatacara pengemukaan rekod CPD serta proses pembaharuan pendaftaran selaras dengan kehendak Akta Ahli Geologi 2008 [Akta 689] dan garis panduan yang berkuat kuasa.

Program dimulakan dengan ucapan aluan oleh Prof. P.Geol. Dr. Joy Jacqueline Pereira, Pengerusi Jawatankuasa JPPP. Seterusnya, sesi pembentangan telah disampaikan oleh Setiausaha CPD yang merangkumi penerangan mengenai kuasa pelaksanaan CPD di bawah Seksyen 4(1)(k) Akta Ahli Geologi 2008 [Akta 689], latar belakang pelaksanaan CPD, keperluan dan pematuhan mata kredit tahunan, garis panduan semasa, tatacara pengemukaan rekod CPD serta panduan pengisian Lampiran C bagi tujuan pembaharuan pendaftaran ahli geologi.

Program diteruskan dengan Sesi Soal Jawab bersama Panel Klinik CPD yang dianggotai oleh Prof. P.Geol. Dr. Joy Jacqueline Pereira, P.Geol. Suhaileen binti Shahar, dan P.Geol. Mohd Badzran bin Mat Taib. Sesi ini memberi peluang kepada peserta mendapatkan penjelasan secara langsung mengenai pelbagai perkara berkaitan pelaksanaan CPD, termasuk kategori aktiviti yang layak dituntut, pengiraan mata kredit, dokumen sokongan yang diperlukan serta proses pembaharuan pendaftaran. Perbincangan yang berlangsung secara interaktif telah membantu menjawab persoalan peserta dan memberikan kefahaman yang lebih jelas mengenai keperluan CPD.

Peserta yang menghadiri Klinik CPD ini telah diberikan 2 mata kredit CPD serta sijil penyertaan, sebagai sebahagian daripada pematuhan keperluan CPD bagi tahun semasa.

Secara keseluruhannya, Klinik CPD Atas Talian ini telah mencapai objektif penganjurannya dalam meningkatkan kesedaran dan kefahaman Ahli Geologi Berdaftar terhadap pelaksanaan sistem CPD serta kepentingan pematuhan kepada keperluan pembaharuan pendaftaran yang ditetapkan oleh Lembaga Ahli Geologi Malaysia. BoG berharap penganjuran program seumpama ini dapat diteruskan pada masa hadapan sebagai platform perkongsian ilmu, peningkatan kompetensi dan pengukuhan pembangunan profesional berterusan dalam kalangan Ahli Geologi Berdaftar.

Disediakan oleh,
Nur 'Izzati binti Md Hussin
Eksekutif Pendaftaran dan CPD
Lembaga Ahli Geologi Malaysia



UPCOMING EVENTS

August 17-20, 2026: International Meeting for Applied Geoscience & Energy (IMAGE); Houston, Texas. More details at <https://www.imageevent.org/about-image26>.

September 2-3, 2026: Latin America Geothermal Systems Workshop 2026: Exploring Sustainable Solutions to Meet the Region's Energy Demand; Mexico City, Mexico. More details at <https://www.aapg.org/events/details/event/articleid/69394/latin-america-geothermal-systems-workshop-2026-exploring-sustainable-solutions-meet-regions-energy-demand>.

September 4-12, 2026: 9th Asia Pacific Geoparks Network (APGN) Symposium 2026; Langkawi, Kedah, Malaysia. More details at <https://apgn2026.lada.gov.my/>.

September 9-11, 2026: Discoveries in the Tasmanides Conference; New South Wales, Australia. Checkout <https://discoveriesinthetasmanides.com.au/> for more details.

September 28-30, 2026: AAPG/EAGE Hydrocarbon Seals of the Middle East GTW; Kuwait City, Al Ahmadi, Kuwait. Visit <https://www.aapg.org/events/details/event/articleid/69371/5th-edition-aapgeage-hydrocarbon-seals-middle-east-gtw> to learn more about this event.

September 30 - October 3, 2026: Society of Economic Geologists (SEG 2026); Salt Lake City, USA. More details can be found at <https://www.segweb.org/SEG-2026/seg-conference/seg-2026/home.aspx>.

October 1-3, 2026: National Geoscience Conference (NGC) 2026; Miri, Sarawak, Malaysia. More details at <https://gsm.org.my/event/national-geoscience-conference-ngc-2026/>.

October 30 - November 6, 2026: XV IAEG 2026 World Congress; Delft, The Netherlands. More details at <https://iaeg2026.org/>.

November 2-5, 2026: 55th IAGI-GEOSEA XIX 2026 Annual Convention; Yogyakarta, Indonesia. Visit <https://www.pitiagi.cloud/> for details.

November 11-15, 2026: International Association for Gondwana Research (IAGR) 2026 Convention, the 23rd International Conference on Gondwana to Asia, and the International Conference on Tectonics of Southeast Asia (ICTSEA 2026); Chiang Mai, Thailand. More details at <https://iagrglobal.org/iagr-2026-annual-convention-chiang-mai-thailand/>.

November 16-17, 2026: Asia Petroleum Geoscience Conference & Exhibition (APGCE); Kuala Lumpur, Malaysia. For further enquiries, please contact email apgce@icep.com.my.

November 19-20, 2026: 15th World Conference on Earth Science & Geology; Dubai, UAE. Event scheduling can be tracked at <https://www.conferenceseries.com/uae-meetings>.

December 7-9, 2026: AAPG International Conference & Exhibition (ICE) 2026; Jakarta, Indonesia. More details at <https://www.aapg.org/news-and-media/details/explorer/articleid/69424/preview/43C7C2A4520551011F83B55E36524056>.

February 3-5, 2027: NAPE Summit; Houston, Texas. More details at <https://napeexpo.com/>.

March 24-26, 2027: The International Petroleum Technology Conference (IPTC) 2027; Bangkok, Thailand. More details at <https://www.iptcnet.org/iptc>.

UPCOMING EVENTS

FIRST CIRCULAR



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39th National Geoscience Conference (NGC 2026)

"Innovation and Sustainable Geoscience for a Resilient Future"

01 - 03 OCTOBER 2026

PULLMAN MIRI WATERFRONT, SARAWAK

Call for Submissions

Join us for the 39th National Geoscience Conference (NGC 2026), the premier gathering of geoscience professionals, researchers and students. Explore the latest advancements, challenges and innovations in the field of geosciences. We invite abstracts for oral and poster presentations that will fit the sub theme of the conference.

Abstracts submission: geologicalsociety@gmail.com

Submission Deadline: 1st July 2026

Themes:

- ♦ Disaster Risk Reduction, Climate Hazards,
- ♦ Climate Change & Engineering Geology
- ♦ Energy & Mineral Resources
- ♦ Groundwater Resources
- ♦ Conservation Geology & Geotourism
- ♦ Quaternary, Coastal & Marine Geology
- ♦ Tectonics & Structural Geology
- ♦ Stratigraphy, Sedimentology & Palaeontology
- ♦ Karst
- ♦ Geochemistry
- ♦ Geophysics, Geospatial Applications & Geotechnology
- ♦ Policies, Ethics & Professional Practice
- ♦ Petroleum Geology

Attractions:

- ♦ Conference Field Trip
- ♦ CPD points (BOG)
- ♦ Best Oral and Poster presentation awards
- ♦ Full paper can be published in Bulletin of the Geological Society of Malaysia/Warta Geologi (Scopus, AAPG Datapages and MyJurnal/MyCite indexed) after peer review

Contact Us: <https://gsm.org.my>

geologicalsociety@gmail.com

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39th National Geoscience Conference (NGC 2026)

"Innovation and Sustainable Geoscience for a Resilient Future"

01 - 03 OCTOBER 2026

PULLMAN MIRI WATERFRONT, SARAWAK

Abstract Submission guidelines

Abstracts should be sent to geologicalsociety@gmail.com, with Subject NGC 2026 Abstract_Author name

Guidelines

- The abstract will only be accepted if they pay their conference registration fees.
- English abstract should not exceed 300 words.
- Please provide 3–5 keywords for your abstract.
- Participants are encouraged to present their research in the English language.
- The mode of presentation (Oral/Poster) will be conveyed to the Participants later after acceptance.
- Participants are not allowed to revise their abstracts after submission.

Title: Title must be informative and reflects the content of the paper. Title in Bahasa Malaysia should include an English translation. It should be concise (less than 20 words). Avoid using abbreviation in the title.

Author's Address: Affiliations and addresses of all the authors must be provided. The email address of the corresponding author must be indicated.

Abstract: Should **not exceed 300 words**. It should clearly identify the subject matter, results obtained, interpretations discussed and conclusions reached. The abstract should not contain any undefined abbreviations or references. Abstract in Bahasa Malaysia should also have an abstract in English.

Keywords: Please include maximum 5 keywords (including in Malay language for manuscript in Malay) that best describe the content of the manuscript.

Contact Us: <https://gsm.org.my>

geologicalsociety@gmail.com

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FIRST CIRCULAR



ORGANISERS

**39th National Geoscience Conference (NGC 2026)***"Innovation and Sustainable Geoscience for a Resilient Future"***01 - 03 OCTOBER 2026****PULLMAN MIRI WATERFRONT, SARAWAK****Registration Fees**

Registration Type	Early Bird Registration (by 01 August)	Late Registration (after 01 August)
GSM/IGM Member (with paper presentation)	RM 400	RM 500
GSM/IGM Member (without paper presentation)	RM 500	RM 600
Non-GSM Members (inclusive of 1-year GSM membership fee)	RM 700	RM 800
GSM Student members	RM 300	RM 400

Post Conference Field Trip Fee: to be announced later (open to conference participants only)

Payment Method:

1. Bank transfer to **Account Details: Geological Society of Malaysia**

Bank Name: Standard Chartered Bank

Account no.: 794105402263

Please send the payment slip to geologicalsociety@gmail.com for receiving the confirmation receipt.

Contact Us: <https://gsm.org.my>

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- Abstract Submission
February 9 - March 21, 2026
- Announcement of Selected Paper
May 7, 2026
- Manuscript Submission
May 7 - August 7, 2026
- Main Event
November 2-5, 2026

TOPICS & SUB-TOPICS

- **Fundamental & Digital Geoscience**
 - * Geodynamics, Seismology, Petrology and Volcanology
 - * Sedimentology and Paleontology
 - * Pore Pressure and Geomechanics
 - * Remote Sensing
 - * Technology and Application of Big Data, Machine Learning and Artificial Intelligence in Geoscience
- **Advanced Mining & Mineral Technology**
 - * Economic Minerals and Coal Exploration
 - * Economic Minerals and Coal Resources Conservation
 - * Economic Minerals Processing and Refining
 - * Mine Geology, Grade Control and Reconciliation
 - * Mine Geotechnical and Hydrogeology
 - * Geometallurgy
 - * Gemology
- **Petroleum Geoscience, Engineering and Management**
 - * Petroleum Geoscience
 - * Petroleum Engineering and Production Technology
 - * Enhanced Oil/Gas Recovery and Drilling Well Completion
 - * Reservoir and Production Management
- **Engineering Geology, Environment and Geohazard**
 - * Engineering Geology for Infrastructure Development
 - * Monitoring and Instrumentation in Geotechnical Projects
 - * Environmental Geology and Land Use Planning
 - * Geohazards and It's Risk Assessment, Mitigation and Prevention
- **Energy Transition & Sustainable Future**
 - * Unconventional and Renewable Energy
 - * Geothermal
 - * CCS/CCUS
 - * Natural Hydrogen
- **Governance, Culture and Social Impact**
 - * Energy and Economic Mineral Policies
 - * CSR and Social Impact
 - * Health, Safety and Environment (HSE)
 - * Natural Resources of Indonesia
 - * Geotourism, Geoheritage and Geopark
 - * Geomithology

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- 1) Scopus-Indexed Journal
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