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Editorial Note

An account of research findings with implications for regional geology

The 80th volume of the Bulletin of the Geological Society of Malaysia contains eight articles, comprising two reviews and six original research findings. The lead paper by Lunt & Luan (2025) offers a perspective on the interpretation of regional geology that underscore the importance of the Letter Stages in Southeast Asian geology, a biostratigraphic system based on larger foraminifera to subdivide the Tertiary. This is followed by a review of unsaturated peat soil in Malaysia by Al Jaber & Muhammad (2025), which provides insights for managing peat soil, a serious challenge for the construction sector.

This volume documents three significant findings from Peninsular Malaysia, two from East Malaysia and one from Vietnam. Raj (2025) provided an account of denudational chronology of the Kampung Air Jernih area of Terengganu, to shed some light on its geological and climate history. Salmanfarsi & Awang (2025) confirmed the utility of rock mass classification systems for assessing slope conditions in the Karak-Lanchang area of Pahang and found conventional field mapping more dependable than Terrestrial Laser Scanning (TLS), to produce discontinuity datasets. Ismi *et al*. (2025) shared the potential of electrical resistivity imaging (ERI) to delineate metallic minerals and conduct pre-feasibility study for mining in Keratong, Pahang. Ling *et al*. (2025) report that Pulau Layang-Layang have safe levels of heavy metal in its marine sediments, with minimal risk of adverse biological effects, with established baseline levels to detect future changes. Golutin & Rahim (2025) measured displacements and seismic activity in the Lahad Datu area using data from Global Navigation Satellite System (GNSS), to delineate active faults with potential to induce weak to mild earthquakes. Le *et al*. (2025) report on the complex mineralisation in the Kon Ra copper-gold deposits of the central Kon Tum Massif in Vietnam. Highlights from the eight articles in this volume are provided in the following sections.

Lunt & Luan (2025) reviewed the use of the Southeast Asia Letter Stages and their relevance to the geology of Sarawak, to demonstrate their value as significant age markers. The review commences with an overview of the Letter Stages as a scheme based on larger foraminifera that are common around Sundaland, which facilitated easy field identification of the marker taxa and its stratigraphic position. This is followed by an account on the correlation of the Letter Stages to an international time scale, highlighting undisturbed reference sections in Malaysia and Indonesia that better represent Cenozoic larger foraminifera biostratigraphy, compared to the highly faulted and discontinuous sections elsewhere. The next section is devoted to clarify four Letter Stage boundaries that are mixed up in scientific literature, specifically the base of Tb; the Lower to Upper Te boundary, also known as the Te4 to Te5 boundary; the end of Letter Stage Te; and the Lower to Upper Tf boundary. The closing section focuses on implications for the geology of Sarawak, with respect to clarifying the Ta to Tb boundary, age of the Nyalau Formation, and the Lower to Upper Tf boundary. The need for clarity and precision in dating to advance interpretation of regional geology was emphasised.

Al Jaber & Muhammad (2025) conducted a review of unsaturated peat soil in Malaysia with respect to its engineering geology properties. Peat soil covers 8% of the total land area in the country, with the highest distribution in Sarawak. Construction projects in such areas are extremely challenging and a significant knowledge gap on the behaviour of peat soil under unsaturated conditions motivated this review. Key characteristics of unsaturated peat soil appraised include shear strength, unconfined compressive strength, specific gravity, moisture content, and compressibility. Peat soils in Malaysia are like their global typology. A strong correlation exists between high moisture levels and organic content, which is associated with low shear strength and specific gravity, and increased compressibility of the soil. Peat soil is strongly influenced by seasonal rainfall fluctuations. A substantial decrease in shear strength and an increase in water infiltration, leads to settlement, deformation, and slope instability. The hydraulic conductivity of peat soil decreases with depth as the pore structure becomes more complex and impede water flow. The findings offer valuable insights for developing effective soil stabilization techniques, advancing geotechnical guidelines for peat soil, and establishing research programmes.

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Raj (2025) provides a Late Quaternary denudational chronology of the Kampung Air Jernih area, Terengganu, to shed some light on its geological and climate history. Desk-top interpretation of aerial photographs and topographic maps, and field mapping delineated four geomorphological units with distinct subsurface materials in the area. These are floodplains and swamps over the Holocene sediments of the Beruas Formation; river terraces over the Pleistocene sediments of Simpang Formation; and denudational terrain over the Carboniferous metasediments of Sungai Perlis Beds and Triassic granite. The area is drained by two major rivers flowing south, and one flowing east. Correlation with Quaternary global sea-levels indicates that the area was under a tropical savanna climate about 500,000 thousand years ago (circa 500 to circa 140 ka), and all the main rivers flowed south. Rapid rise in global sea-level (circa 140 to circa 120 ka BP) gave rise to a tropical rainforest climate and deposition of Simpang Formation sediments by south flowing rivers. This was followed by denudational processes under a tropical savanna climate and formation of river terraces, as well as eastward river capture (120 to circa 20 ka BP). Global sea-level rise (circa 20 ka to circa 5 ka BP) is linked to deposition of the Beruas Formation sediments, followed by down-cutting of rivers from 5,000 years ago to the present day.

Salmanfarsi & Awang (2025) report on a comparative study using multiple rock mass classification system for slope assessment along the highway in Karak-Lanchang, Pahang. Exposed rock slopes in the tropics form extensive weathering profiles and require continuous monitoring for potential instability and failures. There are a variety of approaches to classify and assess slope stability based on different rock mass parameters such as slope orientation, discontinuities, weather conditions, and rock slope settings. Several of these were examined for their validity in tropical climate. Aspects compared include mapping of discontinuities, kinematic analysis to delineate the potential modes slope failures, and slope conditions. In addition, rock slope mapping was conducted to compare conventional field mapping and Terrestrial Laser Scanning (TLS) in all the three sites within the study area. The findings indicate that all the rock mass classification system assessed are dependable for assessing the slope conditions in the area. Survey data obtained using the conventional scanline mapping and TLS mapping revealed varying levels of correlation. Discontinuity datasets were found to be more reliable when obtained using conventional field mapping compared to TLS mapping, especially for heavily weathered rock slopes.

Ismi *et al*. (2025) deployed electrical resistivity imaging (ERI) in Keratong, Pahang, to delineate metallic minerals for a pre-feasibility study in mining. An area across 1.25 km² was mapped over eight survey lines, using a combination of resistivity and induced polarization technique, resulting in 2D pseudo-sections and a 3D contour model. A stratified profile comprising overburden, weathered metasediments, and fractured sedimentary rocks was extrapolated. A potential metallic mineral deposit was inferred at depths ranging from 5 to 20 meters. The results were used to suggest a cost-effective borehole drilling plan, to further support exploration in the area. Findings from the ERI survey was also combined with topographic information, to suggest an initial mining plan with minimal risk to the environment and operations. This includes the use of natural low-lying areas with existing containment capacity for the tailing pond, to avoid extensive excavation and provide intrinsic structural stability. Areas having moderate elevation, stable subsurface conditions, and easy accessibility, with low potential for metallic minerals, were suggested to assigned as stockpiles. This investigation highlights the transformative potential of ERI for exploration of subsurface mineral resources and designing efficient and environmentally responsible mining operations.

Ling *et al*. (2025) established a baseline level for heavy metals in the marine sediments of Pulau Layang-Layang, Malaysia. Located about 300 km northwest of Sabah, the area comprises a carbonate platform, which is part of the fragmented Spratly Islands near the North-West Borneo Trough. It is an important breeding ground and source of nourishment for a variety of aquatic organisms, critical for maintaining marine biodiversity in the region. Samples collected from 23 locations across the lagoon and coastal areas, were processed and analysed. Mineral properties and total metal concentrations were determined using the Scanning electron microscopy (SEM) and Inductively coupled plasma optical emission spectrometry (ICP-OES), respectively. The results revealed a predominance of biogenic carbonate materials, derived from remnants of corals, benthic foraminifera, calcareous algae, mollusc shells, spicules, and other skeletal fragments of marine biota. The total mean value of calcium was the highest, followed by magnesium, sodium, strontium, potassium, iron, aluminium, manganese, zinc, arsenic, chromium, and nickel. The provenance of the elements was linked to natural sources using statistical correlations. A comparison to established standards indicates that the marine sediments in Pulau Layang-Layang have safe levels of heavy metal content, with minimal risk of adverse biological effects.

Golutin & Rahim (2025) report on the assessment of tectonic movements in Lahad Datu, Sabah, and its implication for earthquakes. The presence of active faults in the area have contributed to the occurrence of frequent, moderate to large earthquakes. Historical records indicate that the area was struck by powerful earthquakes, with a magnitude of 6.6 in 1923, and of 6.2 in 1976. The Department of Mineral and Geoscience (JMG) has been monitoring the area, and this assessment is based on data from their Global Navigation Satellite System (GNSS) from 2019 to 2024. The findings uncovered a correlation between measured displacements and seismic activity in the Lahad Datu area. The GNSS reveal vertical movement that range from -8 mm (downward) to -7 mm (upward), and horizontal movements between 4 and 15 mm. The vertical movement is attributed to the dynamic collision between the Northeast and Northwest Borneo Troughs. The compression of the Pacific-Philippine plate is causing the NE Borneo Trough to migrate westward. The existence of NW-SE sinistral faults and ENE-WSW thrust faults suggests NW-SE compression. About 20 active faults were delineated in the area, with potential to induce weak to mild earthquakes during stress rebalancing along these lines.

Le *et al*. (2025) documents mineralisation styles and sulfur isotopes of the Kon Ra copper-gold (Cu-Au) deposits, located in the central Kon Tum Massif, Vietnam, an area with complex geology and mineralisation. The investigation involved field mapping, detailed core logging, and petrographic analysis. A total of 15 sulphide samples from drill cores and the surface were collected for sulfur isotope analyses from syn-mineralisation stages within the high-grade copper ore zones and the surrounding skarn alteration halo. Skarn within the metamorphic Kham Duc complex is characterised by multi-stage episodes of mineralisation. Mineralisation occurs in hydrothermal veins, stockworks, and disseminations within the skarn and exhibit distinct prograde (pre-ore) and retrograde (syn-ore) metasomatism and alteration. The characteristics suggest a distal skarn system with possible mineralisation at depth. The syn-ore retrograde stage is characterised by chalcopyrite, pyrite, and pyrrhotite, along with subordinate molybdenite and associated hydrothermal alteration minerals such as actinolite, quartz, epidote, chlorite, sericite, calcite, and clay. Isotope analysis indicates a magmatic sulfur source, possibly with minor contamination of sulfur from the host rock and are consistent with those of typical skarn systems. The findings of this study provide insights that could support future exploration in the area.

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