新南向國土之海洋地球環境變遷暨未來可再生能源

Changing Ocean and Earth Environments and Future Renewable Energy in New Southbound Policy Territori

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2025 年 6 月 24 日至 25 日

June 24th-25th, 2025

海洋大學行政大樓第二演講廳

The Second Auditorium(二講) in the Administration Building at National Taiwan Ocean University

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Agenda

Time	**June 24 (Tuesday), 2025**
07:45~08:00	Group pick up (invited speaker only) at Kodak Hotel and transport to NTOU
08:30~09:00	Registration (The Second Auditorium［第二演講廳］, NTOU)
09:00~09:15	Welcome speech by the host and conveners / Take group photos
09:15~09:40	**Session 1 (keynote)** *Chair: Min-Te Chen* **Prakrit Noppradit (Prince of Songkla University, Tailand)** Songkhla lagoon: the origin and current situation
09:40~10:05	**Ban To Xuan (University of Mining and Geology, Vietnam)** The erosion and accretion of Day River mouth, Ninh Binh province, Vietnam
10:05~10:30	Coffee Break
10:30~10:50	**Session 2　Coastal & Offshore Geo-Engineering and Risk Management** *Chair: Effi Helmy Ariffin & Chih-Yu Liu* **Effi Helmy Ariffin (Universiti Malaysia Terengganu, Malaysia)** Employing Dune Vegetation as Nature Based Solution to Rehabilitate Coastal Erosion
10:50~11:10	**Habibah Hanan Mat Yusoff (Universiti Malaysia Terengganu, Malaysia)** Late Quaternary continental shelf-to-slope of Sunda Shelf: Implications for offshore asset planning and potential for offshore groundwater exploration
11:10~11:30	**Chih-Yu Liu 劉芷妤 (National Taiwan Ocean University, Taiwan)** Artificial Intelligence for Assessing Liquefaction Risk in Taiwan Offshore Wind Farms
11:30~11:50	**Ting-Chieh Lin 林鼎傑 (National Taiwan Ocean University, Taiwan)** **(presented by Chun-Yuan Lin 林俊遠)** Laboratory and numerical study of the interaction between extreme water-waves and offshore deck structure
11:50~14:00	Lunch (lunch box)
14:00~14:20	**Session 3　Geo-reservoir Characterization and Slope/Turbidity Dynamics** *Chair: Muhd Nur Ismail Abdul Rahman & Huei-Fen Chen* **Muhd Nur Ismail Abdul Rahman (Universiti Malaysia Terengganu, Malaysia)** Elucidating Pore Geometry, Connectivity, and Adsorption in a Neogene Paralic Hydrocarbon Reservoir Outcropin North Sarawak, Malaysia: A Hydrogen Geostorage Analogue
14:20~14:40	**Muhamad Zaki Zulkifli (Universiti Malaysia Terengganu, Malaysia)** Cracking the Code of Delta Front Slope Failure: Uncovering Insights through Detailed Monitoring
14:40~15:00	**Huei-Fen Chen 陳惠芬 (National Taiwan Ocean University, Taiwan)** Integrated Geological and Geophysical Approaches to Assess the Carbon Sink Capacity of the Sun Moon Lake Reservoir
15:00~15:20	**Mohd Amir (National Sun Yat-sen University, Taiwan)** Records of the turbidites from the Beinan River estuary and upper Taitung Canyon off east Taiwan: Inferences on triggering mechanisms of the turbidity currents
15:20~16:00	Coffee Break

Time	June 24 (Tuesday), 2025
16:00~17:00	**Session 4　Poster flash, welcome short presentation by young researchers and students (3-5mins)** *Chair: Hui-Juan Pan* **#1 Pai-Sen Yu 尤柏森 (Taiwan Ocean Research Institute, Taiwan)** Unraveling dispersal patterns of modern marine sediments offshore eastern Taiwan based on physical properties from non-destructive analysis **#2 Ting-Ting Chen 陳婷婷 (Taiwan Ocean Research Institute, Taiwan)** Source-to-sink dispersal of modern marine sediments in the Taiwan Strait and offshore southwestern Taiwan:Evidence from non-destructive analysis of physical properties **#3 Nur Khatibah Md Yunos (Universiti Malaysia Terengganu, Malaysia)** Colour variation of ceramic assemblages from the Bidong Shipwreck **#4 Hsuan-Cheng Liu 劉軒誠 (National Taiwan Ocean University, Taiwan)** Quantify Biogenic Sedimentary Proxies in Marine Sediments Using VIS-NIR Reflectance Spectra **#5 Liang-Chi Wang 汪良奇 (National Chung Cheng University, Taiwan) (presented by Abdur Rahman)** Holocene Environmental Changes of Pinqing Lagoon, South China **#6 Min-Chia Huang 黃敏嘉 (National Taiwan Ocean University, Taiwan)** East Asian Monsoon Variability and Extreme Climatic Events Recorded in East China Sea Shelf Sediments Over the Past Two Millennia **#7 Andi Suci Islameini Husain (National Chiayi University, Taiwan)** Effects of Electrolyzed Water on Water Quality for Shrimp Culture in Controlled Environments **#8 Shun-Wen Yu 俞舜文 (CPC Corporation, Taiwan)** Sea level and climate controls on deep marine carbon accumulation – An example from a deep marine core in the lower Gaoping Slope **#9 Hung-Lin Tsai 蔡宏霖 (National Taiwan Ocean University, Taiwan)** Late Quaternary Monsoon Variability: Insights from Indo-Pacific Warm Pool Organic Biomarker Hydrographic Reconstructions with Time-Series Analysis Focused at the Precession Cycles **#10 Yen-Cheng Liang 梁晏甄 (Freshwater Aquaculture Research Center, Fisheries Research Institute Ministry of Agriculture, Taiwan)** Development of Two Photovoltaic On-Site Modules in Aquaculture Applications **#11 Fujung Tsai 蔡富容 (Department of Marine Environmental Informatics, National Taiwan Ocean University, Taiwan)** Influence of Indian Dust and Southeast Asian Biomass Burning on the East Asian Coastal Atmosphere
17:00	Invitation-only Banquet (Kodak Hotel)

Time	June 25 (Wednesday), 2025
08:00~08:30	Group pick up (invited speaker only) at Kodak Hotel and transport to NTOU
08:30~09:00	Registration (The Second Auditorium [第二演講廳], NTOU)
09:00~09:15	Meeting logistics
09:15~09:40	**Session 5 (keynote)** *Chair: Fatin Izzati Minhat* **Babu Nallusamy (Central University of Karnataka, India)** Amphistegina the Symbiont-bearing foraminifera dominant Island, Kavaratti, Lakshadweep Archipelago, India:Environment and Climate Indicators
09:40~10:05	**Fatin Izzati Minhat (Universiti Malaysia Terengganu, Malaysia)** Examining the Relationship Between Planktonic Foraminifera Preservation and Gypsum Deposition in the Deep Sea of Sarawak
10:05~10:30	Coffee Break
10:30~10:50	**Session 6　Sea-Level and Marine Environmental Change** *Chair: Hafeez Jeofry & Min-Te Chen* **Hafeez Jeofry (Universiti Malaysia Terengganu, Malaysia)** Projections of 21st Century Sea Level Change in Southeast Asia: Insights from CMIP6 SSP3-7.0
10:50~11:10	**Thilina Munasinghe (National Sun Yat-sen University, Taiwan)** Deglacial Laminated Diatom Mats and Their Role in Shaping Western Pacific Bottom Water Redox Conditions Over the 18.4 ka BP
11:10~11:30	**Min-Te Chen 陳明德 (National Taiwan Ocean University, Taiwan)** Half-precessional dynamics of western equatorial Pacific temperature records: insight from biomarker proxies over the past 800 ka
11:30~11:50	**Jih-Pai Lin 林日白 (National Taiwan University, Taiwan)** Echinoid stratigraphy: biofacies and biostratigraphy
11:50~14:00	Lunch (lunch box)
14:00~14:20	**Session 7　Marine Geology & Marine Heritage** *Chair: Muhammad Afiq Md Ali & Hasrizal Shaari* **Muhammad Afiq Md Ali (Universiti Malaysia Terengganu, Malaysia)** Formation of a Highly Arcuate Trench During the Retreat of the Paleo-Pacific Subduction Zone
14:20~14:40	**Dony Adryansyah (Universiti Malaysia Terengganu, Malaysia)** Characteristics and Assessment of Rocky Coasts in Terengganu, Malaysia: A Geological Heritage Perspective
14:40~15:00	**Hasrizal Shaari (Universiti Malaysia Terengganu, Malaysia)** Ancient Shipwrecks: Evidence of the Past Active Trade in the South China Sea
15:00~15:20	**Hui-Juan Pan 潘惠娟 (National Taiwan Ocean University, Taiwan)** Illuminating Sunken Histories: Rapid VIS-NIR Spectroscopic Screening of Shipwreck Ceramics
15:20	Free Evening / Dinner on Your Own (at Keelung Night Market)

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Abstract

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Changing Ocean and Earth Environments and Future Renewable Energy in New Southbound Policy Territori

Sessions 1–2: Day 1 Morning (June 24, 2025)

Songkhla lagoon: the origin and current situation

Prakrit Noppradit
Coastal Oceanography and Climate Change Research Center, Faculty of Environmental Management, Prince of Songkla University, Thailand

Abstract

Across the world's coastlines, climate change—particularly sea level rise, as emphasized by the IPCC—is a critical factor influencing coastal dynamics. Understanding past coastal environments is essential for making accurate predictions about future changes. However, systematic paleo sea level research in Southern Thailand (the Upper Malay Peninsula) remains limited. Sand barriers are valuable indicators of past sea levels. This review of existing literature (4 scientific articles and 1 geological report) offers insights into the barrier systems of Songkhla Province. The oldest identified barriers date back to the last interglacial period, approximately 116,000 years ago. During the last glacial period, coastal sediments were scarce due to much lower sea levels—dropping to less than 120 meters during the Last Glacial Maximum.). In the early Holocene, a sea level transgression occurred. While no distinct paleo-barriers from this time have been identified, the presence of ancient lagoonal and tidal flat deposits indicates a low-energy, wave environment. Following the mid-Holocene sea level highstand (around 7,000 years ago), the shoreline began to regress, with the barrier system prograding toward the northwest. Previous geochronological records (14C and TL and OSL) suggested a progradation rate of approximately 14 meters per year. Today, this barrier system continues to prograde. Furthermore, discrepancies between observed local paleo-sea levels and existing models highlight the need for refinement. Although this region is not highly affected by tectonic activity, it is geologically connected to the tectonically active Sumatra region. Therefore, reconstructing a more accurate paleo-sea level curve for this area remains a priority for future research.

Keywords: Paleo-sea level, Coastal evolution, Barrier systems, Songkhla coast

The erosion and accretion of Day River mouth, Ninh Binh province, Vietnam

Ban To Xuan
Faculty of Geosciences and Geo-engineering, Hanoi University of Mining and Geology, Vietnam

Abstract

The Day River serves as the boundary between Ninh Binh and Nam Dinh provinces in Vietnam. At the mouth of the Day River, the Ninh Binh side features the Kim Son alluvial area, while the Nam Dinh side borders the Nghia Hung coastline. The Kim Son and Nghia Hung areas are key parts of the interprovincial wetland zone of the Red River Delta, which is recognized as a world biosphere reserve. In recent years, the coastal alluvial area of Kim Son has been recorded as the fastest accreting region in the Red River Delta, with an accretion rate of 100–120 meters per year. Studying the processes of accretion and erosion in Vietnam's coastal zones in general, and the Day River mouth in particular, is essential. On the basis of field survey, the analysis of topographic maps, satellite images since 1965, and GIS remote sensing GIS, the changes in the rivershape, erosion, and accretion processes in the Day River estuary have been assessed. Over time, the processes of accretion and erosion occur alternately in both the Kim Son alluvial plain (west of the Day estuary) and the Nghia Hung alluvial plain (east of the Day estuary). Forecasting the trend until 2050, the alluvial plain in the Day estuary will continue to develop the process of accretion and erosion, with accretion being the dominant process, gradually expanding the land area seaward.

Keywords: Day River mounth, accretion, erosion, Vietnam

Employing Dune Vegetation as Nature Based Solution to Rehabilitate Coastal Erosion

Effi Helmy Ariffin
Institute of Oceanography and Environment, Universiti Malaysia Terengganu

Abstract

Coastal erosion poses a persistent challenge to shorelines worldwide, particularly in sandy beach environments where wave action and extreme weather events accelerate land loss. This ongoing issue threatens coastal communities, infrastructure, and ecosystems, making effective mitigation strategies essential. Traditionally, dune vegetation has been employed as a natural coastal protection measure, acting as a buffer against wave energy while stabilizing sediments. Unlike hard-engineering solutions, such as seawalls and breakwaters, dune vegetation enhances shoreline resilience without disrupting natural sediment dynamics. This study evaluates the effectiveness of dune vegetation in mitigating coastal erosion by analyzing vegetation growth patterns, sediment retention, and shoreline stability. Utilizing drone surveys and satellite imagery, changes in dune morphology and vegetation coverage were monitored over time, while shoreline movement was assessed using the Digital Shoreline Analysis System (DSAS) from 2012 to 2022. Preliminary findings indicate that vegetated dunes significantly enhance sediment trapping and provide a sustainable defense against wave-induced erosion. Areas with well-established dune vegetation exhibit greater stability, particularly in regions prone to seasonal monsoon impacts. The study highlights (1) the role of dune vegetation in reinforcing coastal resilience, (2) the effectiveness of vegetation-based solutions in complementing traditional coastal defense mechanisms, and (3) the importance of integrating ecological approaches into coastal management strategies. These findings contribute to the advancement of sustainable coastal rehabilitation, demonstrating the value of nature-based solutions in protecting vulnerable coastlines.

Keywords: Dune vegetation, Nature-based solutions,

Late Quaternary continental shelf-to-slope of Sunda Shelf: Implications for offshore asset planning and potential for offshore groundwater exploration.

Habibah Hanan Mat Yusoff[1,2*], Howard D. Johnson[2], Lidia Lonergan[2], Alexander C. Whittaker[2], and Azli Abu Bakar[3]

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[3]PETRONAS, KLCC, Kuala Lumpur, Malaysia

Abstract

Source-to-sink studies determine the source areas, transport and depositional environments of sedimentary systems under evaluation, but are often incomplete. However, this study of the Late Quaternary of Central Sarawak (NW Borneo) provides an opportunity to investigate a relatively complete source-to-sink system, based on extensive 3D seismic data, high-resolution 2D seismic data and borehole data, most notably on seismic facies and lithofacies properties, from shallow (mainly < 200 m below seabed) site surveys. Seismic stratigraphic methods have defined the morphology and stratigraphic architecture of ca. 200 – 350 km-long incised valleys. The valley mouths terminated in two types of deltas: (i) shelf deltas, and (ii) shelf-edge deltas. The resulting Last Glacial Maximum (LGM) paleogeography map comprised a ca. 360 km long source-to-sink system, extending from the continental drainage divide (presently at ca. 1,500 m elevation) to the basin floor of the NW Borneo Trough (presently ca. 2,500 m deep) and was characterised by the following elements: (i) multiple palaeo-drainages and incised valleys in the source area (i.e., hinterland Sarawak, inner shelf), (ii) a shelfal area characterised by a network of mainly northward-flowing rivers within incised valleys, (iii) shelf deltas and shelf-edge deltas immediately downstream of valley mouths, (iv) canyons, channels and gullies along the upper slope, and (v) basin-floor fans in the sink area. The total palaeo-drainage area of the study area was only ca. 60,000 km2, reflecting the narrow shelf width and short river lengths. This study demonstrates that a complete source-to-sink reconstruction allows for observing fluvial to deltaic variations and understanding siliciclastic sediment pathways for the recently uplifted, humid-tropical climate, and tectonically-influenced shelf-edge of NW Borneo. Mapping the siliciclastic sediments during LGM can be utilized for offshore asset planning (e.g., platform, offshore windfarm) and future offshore groundwater exploration.

Keywords: Last Glacial Maximum, 3D seismic data, fluvial-to-deltaic systems, source-to-sink

Artificial Intelligence for Assessing Liquefaction Risk in Taiwan Offshore Wind Farms

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Abstract

In tectonically active regions such as Taiwan, the development of offshore wind farms demands rigorous geotechnical hazard assessment, with particular attention to soil liquefaction. This study presents an artificial intelligence (AI)-based framework for evaluating liquefaction susceptibility in offshore environments. The AI model was trained on a synthetic dataset derived from empirical procedures and calibrated using field data from central Taiwan. It demonstrated high predictive capability, achieving a coefficient of determination of 0.99, indicating robust model performance. By integrating the AI model with geographic information system data from offshore borehole logs, a liquefaction susceptibility map was generated for Taiwan's western offshore wind farms. The results reveal that several sites exhibit elevated liquefaction risk across multiple subsurface depths. These findings highlight the potential of AI-driven approaches in enhancing geotechnical hazard assessments for offshore wind development, thereby facilitating informed renewable energy planning in the context of evolving oceanic and geological environments across the New Southbound Policy regions.

Keywords: Artificial intelligence; liquefaction; offshore wind farm; Taiwan; renewable energy.

Laboratory and numerical study of the interaction between extreme water-waves and offshore deck structure

Ting-Chieh Lin, Chun-Yuan Lin, Tai-Wen Hsu
Center of Excellence for Ocean Engineering, National Taiwan Ocean University, Taiwan

Abstract

This study applies the OlaFlow numerical model to simulate focused wave generation using the JONSWAP theoretical spectrum at the upstream end of a wave flume, with subsequent breaking wave impacts on a downstream deck and the resulting complex turbulent flow fields. Through a series of simulations under varying wave-making conditions, it is concluded that the numerical model performs better when using experimentally measured wave spectra rather than theoretical spectra. Furthermore, generating irregular waves by uniformly dividing the spectrum into equal frequency intervals—without neglecting either high- or low-frequency components—is essential to accurately reproduce the target wave profile. Regarding the simulation of breaking wave impacts on the downstream deck, different turbulence models were tested. Comparisons with experimental data on deck impact flows indicate that the k-omega SST Buoyancy turbulence model outperforms the commonly used k-epsilon model. The findings of this study provide an optimal combination of numerical tools for investigating focused wave impacts on coastal or offshore structures.

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Sessions 3: Day 1 Afternoon (June 24, 2025)

Elucidating Pore Geometry, Connectivity, and Adsorption in a Neogene Paralic Hydrocarbon Reservoir Outcrop in North Sarawak, Malaysia: A Hydrogen Geostorage Analogue

Muhd Nur Ismall Abdul Rahman
Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, Malaysia

Abstract

This study focuses on the pore geometry, connectivity, and adsorption characteristics of a Neogene paralic hydrocarbon reservoir outcrop in North Sarawak, Malaysia, to evaluate its potential as a hydrogen geostorage analogue. As hydrogen emerges as a promising clean energy carrier, understanding subsurface storage in geological formations becomes critical. The selected outcrop, representing paralic depositional environments, was analyzed through integrated petrographic, petrophysical, and adsorption experiments to characterize its storage-relevant properties. Thin section analysis revealed a heterogeneous pore system dominated by intergranular and intragranular porosity. Mercury intrusion porosimetry and gas permeability tests indicated moderate to good pore connectivity, essential for both hydrogen injection and withdrawal. Additionally, adsorption tests using nitrogen and carbon dioxide provided insights into the material's surface area and its potential for gas retention. The results demonstrate that the studied outcrop possesses suitable characteristics for temporary hydrogen storage, with adequate pore space and connectivity, as well as adsorption capacity that may help mitigate hydrogen leakage. These findings support the consideration of similar Neogene paralic reservoirs for future hydrogen storage initiatives, contributing to Malaysia’s energy transition and global decarbonization goals. The study provides a valuable reference for assessing hydrogen geostorage potential in sedimentary rocks of similar age and depositional setting.

Keywords: Outcrop, Petrographic, Petrophysical, adsorption, hydrogen storage

Cracking the Code of Delta Front Slope Failure: Uncovering Insights through Detailed Monitoring.

Muhamad Zaki Zulkifli
Faculty of Science and Marine Environment, Universiti Malaysia Terengganu, Malaysia

Abstract

Submarine slope failures pose a hazard to seafloor infrastructure and coastal communities. Given the high population densities, slope failures can have a particularly significant impact around river deltas, generating damaging tsunamis and breaking critical telecommunications connections. Despite their risks, a lack of detailed monitoring means that the factors leading to slope collapse remain poorly constrained. Numerical modelling is typically used to assess future slope stability; however, sparse observational data prevent us from fully understanding how submerged delta slopes evolve and progress to failure at the field scale. To address this gap, we analysed repeat seafloor surveys of the submerged Squamish Prodelta, British Columbia, to investigate the physical controls on slope instability. Multibeam bathymetric surveys conducted over 93 consecutive weekdays in 2011 captured at least five large (>50,000 m^3) delta slope collapses, alongside numerous smaller slope failures. These surveys provide an unusually detailed timeframe (i.e., daily) to determine how the delta slope and geometry change in the build-up to slope collapse and how this relates to variable sediment supply from the feeding river and tidal fluctuations. Analysis of the five largest collapses reveals that no single mechanism is responsible for all failures. Different parts of the delta experience major failure at distinct times and locations, as shown by mapping the delta head and quantifying sediment accumulation delivered by the river alongside tidal elevation data. Slope failure appears to be influenced by a combination of modified slope geometry caused by delta lip progradation and pore pressure fluctuations related to progressive sediment loading and tidal effects. Small-scale features, such as the migration of crescentic bedforms, can also play an important role in destabilising delta slopes. This study provides new insights into how multiple individual and compounding processes contribute to the failure of slopes on submerged deltas.

Keywords: Submarine slope failures, Delta slope evolution, Slope instability

Integrated Geological and Geophysical Approaches to Assess the Carbon Sink Capacity of the Sun Moon Lake Reservoir

Huei-Fen Chen[1], Pi-Ju Tsou[1], Zih-Wei Tang[1], Li Lo[2], Gwo-Shyh Song[3]
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[2]Department of Geosciences, National Taiwan University, Taiwan
[3]Global Aqua Survey Company, LTD

Abstract

Sun Moon Lake is a natural lake in Taiwan, where the construction of a dam in 1934 raised the water level from 4 meters to 27 meters. This study investigates the capacity of carbon sink in lake sediments by analyzing sediment cores collected from the Sun Lake and Moon Lake, focusing on measurements of total organic carbon (TOC) and total inorganic carbon (TIC). The total volume of sediments was estimated using sonar-based seismic profiling to assess the sediment surface area and thickness. The sediment accumulation rates was accelerated and induced fast carbon burial after the dam was constructed. Specifically, in Sun Lake, the carbon accumulation rate increased from 47 gC/m²/yr before the dam to 252 gC/m²/yr afterward. In Moon Lake, the rate increased from 1 gC/m²/yr to 15 gC/m²/yr. Previous research suggests that sediment carbon accumulation rate is a reliable indicator of a lake or reservoir's carbon sink efficiency. Despite a decrease in TOC concentration per unit weight of sediment after 1934 CE, the annual carbon storage per unit area increased markedly. The data show that organic carbon accumulation rates increased by a factor of 5 in Sun Lake and 15 in Moon Lake after 1934 CE, confirming that damming enhanced the lake's carbon sink capacity.

Keywords: Sun Moon Lake, carbon sink, accumulation rate, seismic survey

Records of the turbidites from the Beinan River estuary and upper Taitung Canyon off east Taiwan: Inferences on triggering mechanisms of the turbidity currents

Mohd Amir[1], Yuan-Pin Chang[1], Chin-Wen Yang[1], Yu-Shih Lin[1], Chih-Chieh Su[2], Pei-Ling Wang[2]

[1]Department of Oceanography, National Sun Yat-sen University, Taiwan

[2]Institute of Oceanography, National Taiwan University, Taiwan

Abstract

Taiwan has a unique setting with tectonically active high-standing mountains, and intense monsoonal rainfall and cyclonic storms, which result in short-term events such as earthquakes, and typhoon-induced floods and hyperpycnal flows. These short-term events are regarded as the main cause of generation of turbidity currents and in turn deposition of the turbidity layer known as turbidite. The turbidite deposits act as robust archives to evaluate the occurrence of past extreme events, their frequency and related risk. This study utilized three short sediment cores collected from the Beinan River estuary to continental slope, eastern Taiwan. A multi-proxy (sedimentological, and organic and inorganic geochemical) approach was followed to identify the triggers of the turbidity currents. Grain size, X-ray fluorescence, C/N ratio, total organic and inorganic carbon concentrations, stable carbon isotope and lignin results from the short cores combined with multivariate statistical tools suggest that the turbidite layers of these cores were formed by both hyperpycnal flows and earthquake-induced slope failures. The core collected from the Beinan River creek has the turbidite layers dominated by the terrigenous sediments delivered during the hyperpycnal flows in the Beinan River. Whereas, the core taken from the front and middle section of the Taitung Canyon, which has a reverse fault in the middle section of the canyon, is characterized with mixed event layers caused by both the collapse of the continental shelf by the earthquake and hyperpycnal flows. This study outlines the importance of organic geochemistry in identifying triggers of the event layers and further scope of the organic geochemistry in deep-sea turbidites.

Keywords: Turbidite, Extreme event, Hyperpycnal flow, Earthquake, Taitung Canyon

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Sessions 4 (Poster): Day 1 Afternoon (June 24, 2025)

Unraveling dispersal patterns of modern marine sediments offshore eastern Taiwan based on physical properties from non-destructive analysis

Pai-Sen Yu, Ting-Ting Chen
Taiwan Ocean Research Institute, National Institutes of Applied Research

Abstract

Little is known about the past extreme events and likely characteristics around Taiwan that were caused by earthquakes, typhoons, and climate forcing. A detailed paleoclimate reconstruction from offshore eastern Taiwan will enhance our understanding of natural climate variability in the low-latitude Pacific and its teleconnections with changes at high latitudes across glacial and interglacial periods via East Asian monsoon and Kuroshio Current. However, the reconstruction of a continuous, high-resolution paleoceanographic changes and related geological extreme events from offshore eastern Taiwan since the Last Glacial Maximum is limited due to the scarcity of comparable marine records. In this study, the marine sedimentary records we investigate is box cores and piston/gravity cores retrieved along the southern offshore east coast of Taiwan, which is a location of modern winter pathway of the Kuroshio Current, with highly dynamic interactions of the East Asian monsoon, Kuroshio Current, and riverine input from Beinan River. Here we conduct non-destructive measurements on marine sedimentary core representing characteristics of typical sediments and sedimentary structures in deposits of offshore eastern Taiwan by analyzing multi-sensor core logger (MSCL). In addition, we further establish and validate chronology of those marine cores by using C-14 dating and high-resolution non-destructive data (e.g., color reflectance data and physical data from MSCL). Different from traditional technique of stable oxygen isotope stratigraphy, this novel stratigraphy will provide another candidate for other marine cores below the present carbonate compensation depth. Furthermore, we apply relationship between MSCL data-gamma density and magnetic susceptibility in the East China Seas could be an indicator of local coastal rivers and surface currents. This approach will be applied to those box cores and further test its applicability on source-to-sink or Kuroshio Current index.

Keywords: Non-destructive analysis, Source-to-sink, offshore eastern Taiwan

Source-to-sink dispersal of modern marine sediments in the Taiwan Strait and offshore southwestern Taiwan: Evidence from non-destructive analysis of physical properties

Ting-Ting Chen, Pai-Sen Yu
Taiwan Ocean Research Institute, National Institutes of Applied Research

Abstract

The Taiwan Strait is located between the Asian continent and Taiwan, which is surrounded by two large marginal seas (i.e., South China Sea and the East China Sea). The marine environment in the Taiwan Strait regulates water flow between two large marginal seas along the western rim of the Pacific Ocean, and receives sediments from the largest land mass as well as a mountainous island with the highest sediment. For in-depth understanding of the marine environmental and climate interactions that have occurred in nearby land-source areas, previous source-to-sink studies based on marine core concentrated on using clay minerals, magnetic properties, element geochemistry and biogeochemical index. However, there has been a lack of an independent proxy on non-destructive analysis for understanding sedimentation processes for the transport of water and sediments. To better address the source-to-sink dispersal of modern sediments around Taiwan, here we conduct non-destructive measurements on box cores representing characteristics of typical sediments and sedimentary structures in deposits of the Taiwan Strait and offshore southwestern Taiwan by analyzing multi-sensor core logger (MSCL). We observe that MSCL data-gamma density and magnetic susceptibility exhibit a better relationship in the Kaoping River and the East China Sea, which could be serve as an indicator of local coastal rivers and surface currents. This finding cannot be in agreement with those downcore results in the offshore southwestern Taiwan (i.e., Formosa Ridge, FWCR Ridge). This could be due to those fairly complicated environments at gas hydrate area.

Keywords: Source-to-sink, Multi-sensor core logger (MSCL)

Colour Variation of Ceramic Assemblages from the Bidong Shipwreck

Nur Khatibah Md Yunos[1], Hui-Juan Pan[1,] Shouye Yang[2], Elena Ifandi[4], Mohd Nur Ismail Abdul Rahman[5], Effi Helmy Ariffin[1], and Hasrizal Shaari [2,5]

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[2] Institute of Earth Sciences, College of Ocean Science and Resource, National Taiwan Ocean University, Keelung, Taiwan

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Abstract

The Bidong Shipwreck, located off the east coast of Peninsular Malaysia, is a significant underwater archaeological site that provides insights into Southeast Asian maritime trade from the 16th century. This study investigate the colour reflectance properties of ceramic sherds retrieved from the wreck, to enhance comprehension of their variability, post-depositional modifications, and production techniques. A rapid and cost-effective color reflectance analysis was applied to assess the sherd exterior (front), interior (back) and powder samples. The exterior and interior surfaces were measured in their original state, retaining any marine encrustations or deposits while the surfaces were cleaned before ground into powder. Spectral data were transformed into the CIELAB colour space, showing significant correlation patterns among the sample types. The a*-b* correlation coefficient increase from $R^2 \approx 0.50$ on uncleaned surfaces to $R^2 \approx 0.80$ on powdered samples. K-means clustering reveals four clusters characterised by red, brown, grey, and buff hues. The survey provides preliminary information about the salvaged artifacts which can be further correlated with another scientific study for provenance and production techniques interpretation.

Keywords: Reflectance spectroscopy, South China Sea, Underwater cultural heritage (UCH), CIELAB space, Southeast Asia

Holocene Environmental Changes of Pinqing Lagoon, South China

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Abstract

This study investigates Holocene environmental changes in the Pinqing Lagoon, South China, based on a multiproxy analysis of a sediment core spanning approximately 8.5 ka. The results reveal complex interactions among sea-level fluctuations, monsoonal variability, and sedimentary processes. During the early to mid-Holocene (10–4.2 ka), rapid sea-level rise and intensified monsoonal precipitation significantly affected lagoonal conditions. End-member modeling (EM1, EM2, EM3) delineates distinct sedimentary regimes, with EM3 indicative of high-energy events such as typhoons. Shifts in $\delta^{13}C_{org}$ and C/N ratios reflect alternations between C_3- and C_4-dominated vegetation, suggesting variability in hydrological conditions and terrestrial input. Elevated magnetic susceptibility (MS) and Mn/Ti ratios during this period further support unstable environmental conditions under strong marine influence. After 4.2 ka, the lagoon evolved into a more stable system with reduced precipitation and terrestrial influx, evidenced by stable $\delta^{13}C_{org}$ and S-ratio values and a sustained marine connection. In contrast, the past 0.6 ka exhibit marked fluctuations in sediment composition, likely driven by intensified anthropogenic agricultural activities. Notably, increases in EM3, MS, and elemental ratios (Si/Ti, K/Ti, Fe/Ti) during the late Little Ice Age point to enhanced rainfall-induced erosion. These findings highlight the sensitivity of coastal systems to both climatic forcing and human impact, offering critical insights for future coastal management under accelerating climate change.

Keywords: Holocene; Lagoon evolution; Grain size, Relative sea level rise, Typhoon

East Asian Monsoon Variability and Extreme Climatic Events Recorded in East China Sea Shelf Sediments Over the Past Two Millennia

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Abstract

The huge sediments deposited in the Min-Zhe mud area on the East China Sea (ECS) continental shelves are an ideal climate archive for reconstructing East Asian Monsoon (EAM) variability and extreme weather activities such as Tropical Cyclone (TC, Typhoon) in the western Pacific. Sediment delivery to this depocenter of the Min-Zhe mud area is mostly driven by the annually dynamic China Coastal Current (CCC), the Zhejiang-Fujian Coastal Current (ZFCC), Yangtze River Diluted Water (YDW), and Taiwan Warm Current (TWC) in response to EAM. Here we present initial results of core analysis of W12-2 retrieved from the Min–Zhe mud area with the aim of reconstructing centennial to millennial EAM and TC variability since the two millennia. The core W12-2 (132 cm), was gravity-collected at 33 m water depth near the Matsu Islands (26.18°N, 120.06°E) during the 2023 NOR2-0090 cruise from the muddy area of the ECS. The sediment samples of the core were homogeneous silty clay and subsampled at 1 cm intervals. Our initial data reveal that the W12-2 sediment grain-size distributions, obtained with a laser particle-size analyzer in NSTSU, serve as a sensitive proxy for East Asian Winter Monsoon (EAWM) intensity. The coarser sediment fractions reflect stronger winter EAM winds that enhance CCC. Our visible–near-infrared reflectance spectroscopy (350–2500 nm) and handheld X-ray fluorescence (XRF) experiments provide mineralogical and elemental proxies, such as K/Ti for EAWM intensity, Rb/Sr for East Asian Summer Monsoon (EASM) variability, and Zr/Rb for extreme flood and possibly TC activity. We will correlate the data with adjacent cores ST1 and ST3 generated from our laboratory. The integrated data set will allow us to better evaluate the spatio-temporal patterns of EAM and extreme climate events across ECS shelves over the two millennia. Our studies will provide multi-proxy records of centennial to millennial-scale perspective on climate variability in the western Pacific, offering implications from the past to the warming future.

Keywords: East China Sea, East Asian Monsoon; Extreme events, Grain Size, Reflectance Spectroscopy, XRF

Effects of Electrolyzed Water on Water Quality for Shrimp Culture in Controlled Environments

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Abstract

Water treatment has been extensively studied to prevent water discharge and facilitate the reuse of treated water in aquaculture. Further research is essential to explore the potential benefits of electrolyzed water (EW) in reducing chemical treatments and improving water quality in aquaculture systems. The development of efficient prototypes for water reuse in aquaculture is necessary for industry advancement. This study investigates the effects of EW on water quality in a controlled setting for shrimp aquaculture. Utilizing a small tank system, we aimed to optimize the production of hypochlorous acid (HOCl) through electrolysis, focusing on the influence of varying voltage and current settings on key water quality parameters. The experimental setup involved post-larvae shrimp (Litopenaeus vannamei) housed in tanks with artificial seawater, where the impact of EW on growth rate, survival rate, and microbial reduction was assessed. Key parameters of the water quality parameters were monitored throughout the experiment. The results demonstrated that the application of electrolyzed water significantly improved water quality parameters. Compared to the control group, dissolved oxygen (DO) levels increased by 5.8%, while ammonia and nitrite levels decreased by 57.14% and 33.33%, respectively, on the final day (day 30) of the experiment. Furthermore, the use of electrolyzed water significantly enhanced the growth rate by 9% and survival rate by 27.4% of the shrimp compared to the control group. These findings contribute to the understanding of sustainable aquaculture practices by demonstrating the potential of electrolyzed water as an effective water treatment method in shrimp culture systems.

Keywords: Water treatment, aquaculture, electrolyzed water, water quality

Sea level and climate controls on deep marine carbon accumulation – An example from a deep marine core in the lower Gaoping Slope

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Abstract

Terrigenous organic carbon (TC) is traditionally believed to be mainly deposited in deltaic and continental shelf environments, with minimal amounts reaching deep-water areas. However, recent studies indicate significant quantities of TC are found in deep-water depositional systems, particularly in regions like the Gulf of Mexico and the Congo system. Understanding the transport and deposition of TC in these environments is vital for global carbon cycle models and hydrocarbon exploration. This study uses a giant piston core (MD178-3291) collected during a 2010 research cruise by the French vessel Marion Dufresne. By integrating lithological descriptions, radiocarbon dating of foraminifera, total organic carbon (TOC) and total nitrogen (TN) measurements, and stable carbon isotope analysis, we examined TC transport and deposition in the lower Gaoping slope since the Last Glacial Maximum. Results show that between ~26 and 17 kyr BP, TOC often exceeded 0.60%, with $\delta^{13}C$ values ranging from -22.0‰ to -23.0‰. From 17 to 12 kyr BP, as sea levels rose rapidly, TOC values decreased from about 0.70% to 0.55%, while $\delta^{13}C$ values became lighter (from -22.5‰ to -24.5‰). This indicates a decline in TOC despite an increased supply of TC, likely due to changes in sedimentary dynamics within the canyon caused by the rapid sea-level rise. From ~12 kyr BP to the present, TOC and $\delta^{13}C$ values stabilized but remained lower than during earlier periods. This suggests a consistent supply of TC and clastic sediments, possibly due to increased rainfall events leading to more hyperpycnal flows in the canyon. In conclusion, the transport and deposition of TC in the Gaoping lower slope are influenced by sea-level changes and climate-driven factors affecting sediment supply.

Keywords: Terrigenous organic carbon, Deep-water depositional systems, Gaoping lower slope

Late Quaternary Monsoon Variability: Insights from Indo-Pacific Warm Pool Organic Biomarker Hydrographic Reconstructions with Time-Series Analysis Focused at the Precession Cycles

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Abstract

Monsoon climate is an essential component in Earth's climate system. Though annual cycles of monsoons are governed by seasonal differential thermal responses between land and sea at given latitudes, the timing of long-term, orbital-scale monsoon variability, especially of precession, is not well-constrained. Monsoon-indicative (wind, precipitation, upwelling, ocean temperature, etc.) proxy record analyses, using marine sediment and speleothem records, however, yield inconsistent interpretations for the timing of monsoon variability. The heterogeneous spatial and temporal patterns are further complicated by the dominant climate boundary conditions that may jointly control the monsoon proxy changes, such as global ice volume, ENSO-like oceanic conditions, the hemisphere-scale solar insolation gradient, and wind, precipitation, or upwelling associated with the latitudinal migrations of the Intertropical Convergence Zone (ITCZ). This study presents preliminary results on BAYSPLIN-calibrated alkenone-SST, BAYSPAR-calibrated TEX_{86}-subT, and the ΔT (SST minus subT), and alkenone concentration productivity from a sediment core MD012308 located in the Banda Sea, the central Indo-Pacific Warm Pool (IPWP). The records indicate a negative correlation between temperature (SST and subT) and productivity, suggesting upwelling is responsible for SST and subT decreases. The positive correlation between ΔT and the productivity reflects that Banda Sea upwelling effectively brings up cold water from the subsurface, which in turn, increases the ΔT. The study focuses on the past 400 kyr, a period that has been well-studied in monsoonal East Asia and the IPWP. Time-series analysis reveals that SST minima, subT minima, ΔT maxima, and alkenone concentration maxima in the Banda Sea are nearly in-phase with precession maxima, aligning with Southern Hemisphere summer insolation maxima and winter minima. The monsoon precession maxima in the Banda Sea are approximately in phase within the estimated uncertainty with the monsoon maxima in reported from the Arabian Sea and Australia. The results suggest a regionally coherent pattern of Australian-Asian monsoon dynamics. Interestingly, the precession phases of Mg/Ca SST records reported from the open waters of the IPWP vary from those observed from the Banda Sea. The phase differences signify other mechanisms, if not attributable to proxy biases, such as global ice volume, ENSO-like conditions, pCO_2, latitudinal/interhemispheric thermal gradients, are responsible for IPWP SST and subT changes. During precession maxima, SH summer/winter insolation reaches its maxima/minima, conditioning maximum storing/releasing latent heat from the SH to the tropics. The heat transfers further intensify the thermal responses of NH continents, which jointly determine the timing of the Australian-Asian monsoons, as well as Banda Sea upwelling. Such dynamics are implied by this study, highlighting the roles of both high- and low-latitude insolation forcing of tropical monsoons.

Keywords: IPWP, monsoon, precession, TEX_{86}, SST, subT, upwelling

Development of Two Photovoltaic On-Site Modules in Aquaculture Applications

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Abstract

To enhance the energy autonomy and operational stability of aquaculture systems, this study presented the initial development of two photovoltaic (PV) on-site modules deployed for aquaculture in Lukang and Jhihben, Taiwan. The first configuration was integrated a 6 kW PV array with a 15 kWh lithium iron phosphate ($LiFePO_4$) battery storage, enabling limited off-grid functionality and operation of aeration systems at night. The second module consisted of a simplified, direct-use 5 kW PV system without energy storage, optimized for daytime operation under the sufficient irradiance of the sunlight. Experimental results indicated that the storage-based system was affected by energy conversion losses. In contrast, the direct-use system offers a streamlined system with improved conversion efficiency and operational resilience under variable environment conditions, provided adequate irradiance was available. Both systems employed variable-speed, energy-efficient DC paddlewheel aerators, allowing for flexible energy management in response to stocking density and dissolved oxygen requirements. This study should provide insights into the applicability, limitations, and operational advantages of different PV self-consumption strategies for aquaculture. It may contribute to guiding the development of distributed renewable energy systems in the similar context.

Keywords: photovoltaic system, variable frequency waterwheel aerator

Influence of Indian Dust and Southeast Asian Biomass Burning on the East Asian Coastal Atmosphere

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Abstract

During the springtime, dust aerosols originating from India and biomass burning aerosols from Southeast Asia are frequently observed in the high mountains of Taiwan, where they may also influence the surrounding marine environment. In this study, we present daily aerosol samples collected at Mt. Lulin, Taiwan, throughout 2010. These samples were analyzed for water-soluble ions, carbonaceous components, and trace metals. The transport and characteristics of dust particles and biomass burning aerosol identified from high-altitude observations are discussed. Our results indicate that Indian dust particles are most commonly observed in April and May, whereas aerosols from Southeast Asian biomass burning tend to peak in March and April. After emission, both types of aerosols can be uplifted to about 700 hPa in the atmosphere and subsequently transported eastward by the prevailing westerlies. When the frontal systems pass through East Asia, these aerosols can be carried further to Taiwan and the adjacent marine areas. During these months, elevated concentrations of dust-related aerosol components (e.g., Al) and biomass-burning-related components (e.g., K+, NH4+, and NO3-, organic carbon, and elemental carbon) were observed at high elevations in Taiwan. The contributions of Indian dust and Southeast Asian biomass to the background aerosol concentrations at Mt. Lulin are estimated. During dust events, the dust-related particles account for 30% to 90% of the total aerosol mass. Concentrations of K+ (potassium ion) as well as organic and elemental carbon were found to be up to 7 and 4 times higher, respectively, during these events. Additionally, evidence suggests that dust and biomass particles may become mixed during transport, further influencing aerosol composition in the high mountain.

Keywords: Indian dust, biomass burning, Taiwan, Southeast Asia, aerosol

新南向國土之海洋地球環境變遷暨未來可再生能源

Changing Ocean and Earth Environments and Future Renewable Energy in New Southbound Policy Territori

Sessions 5–6: Day 2 Morning (June 25, 2025)

Amphistegina the Symbiont-bearing foraminifera dominant Island, Kavaratti, Lakshadweep Archipelago, India: Environment and Climate Indicators

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Abstract

Amphistegina is a symbiont-bearing, hyaline-walled benthic foraminifera that inhabits warm tropical and subtropical waters. It thrives in clear, warm, low-energy environments and healthy reef habitats. Studies on Amphistegina have been conducted globally due to its unique characteristics, such as its responses to temperature, depth, salinity, water and sediment quality, light intensity, and overall environmental conditions. Amphistegina serves not only as an excellent climate indicator but also as a bio-indicator for depth, environment, and pollution levels.

Initial studies on Amphistegina were conducted at Kavaratti Island in the Lakshadweep archipelago in the north-western Indian Ocean. The results reveal that Amphistegina lessonii dominates the species composition, surpassing others such as Neorotalia calcar, Sorites orbiculus, Planorbulinella larvata, Cornuspira involvens and Quinqueloculina. A. lessonii thrives in clear water, even under oligotrophic conditions, and flourishes in warmer temperatures. It is a light-oriented foraminifera found predominantly in reef environments, with a depth range from 0 to 50 meters.

On Kavaratti Island, A. lessonii is present across all environmental zones, including inland (observed in pit samples), onshore (beach/intertidal zone), lagoon, and outer reefs (depths recorded at 15 to 30 meters). The high population density of A. lessonii in these environments can be attributed to the dominance of sand-grade sediments over silt/clay grades. An interesting observation is the variation in the morphological characteristics of A. lessonii, particularly the size of the shell, which changes in relation to depth and environment. Furthermore, biogeochemical indices of bulk sediments indicate that Kavaratti Island provides an environment highly conducive to reef growth, promoting the proliferation of A. lessonii in the study area.

Examining the Relationship Between Planktonic Foraminifera Preservation and Gypsum Deposition in the Deep Sea of Sarawak

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Abstract

This study explores the relationship between planktonic foraminifera preservation and gypsum deposition in the deepwater regions off Sarawak, Malaysia, situated within the North Luconia province of the southern South China Sea. Bounded by the Bunguran Trough to the west, the Sarawak Shelf (Central Luconia) to the south, and the Dangerous Grounds to the east-northeast, the study area provides a unique setting for examining sedimentological processes. Analysis of twenty core-top sediment samples collected at water depths ranging from 1000 to 1500 meters revealed a clear association between planktonic foraminiferal abundance and gypsum presence. Samples containing substantial gypsum showed significantly reduced foraminiferal counts, suggesting potential influences from methane seepage and sulfate trapping processes, possibly induced by rapid burial events and subsequent pyrite oxidation. Radiocarbon dating confirmed the predominantly modern age of the planktonic foraminifera, despite their proximity to reworked carbonate substrates. A total of eighteen planktonic foraminiferal species were identified, with Globorotalia menardii being the most abundant. Other frequently occurring species included Globigerinoides trilobus, Orbulina universa, Neogloboquadrina dutertrei, Pulleniatina obliquiloculata, Globigerinoides ruber, Globigerinoides sacculifer, and Globigerinella siphonifera. Dominance by Globorotalia menardii suggests elevated seawater temperature and salinity conditions in the water column, potentially associated with nearby hydrothermal activity. This study highlights the complex interactions among sedimentological conditions, gypsum mineralization, and planktonic foraminiferal preservation, providing valuable modern analogues critical for paleoceanographic interpretations.

Keywords: Planktoni foraminifera, palaeoceanography, microfossil, Central Locunia

Projections of 21st Century Sea Level Change in Southeast Asia: Insights from CMIP6 SSP3-7.0

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Abstract

The projected rise in sea levels poses a significant threat to coastal regions worldwide, with Malaysia, where approximately 70% of the population resides in vulnerable coastal areas, being particularly at risk. This study evaluates sea level projections for Malaysia's coastal regions up to the year 2100, incorporating key contributors as identified by the Intergovernmental Panel on Climate Change (IPCC), including thermal expansion, ice sheet and glacier melting, groundwater discharge, and glacial isostatic adjustment (GIA). The results indicate that sea level rise in the South China Sea (SCS), particularly in the South China Sea Peninsular Malaysia (SCSPM) and South China Sea East Malaysia (SCSEM), is expected to outpace other Malaysian coastal regions such as the Straits of Malacca (SM) and the Sulu Sea (SS). By 2100, the maximum projected rise for SCSPM and SCSEM is 366.6 mm and 370.7 mm, respectively, compared to 324.2 mm for the SM and 343.5 mm for the SS. Additionally, spatial variations in sea level rise are evident, with the SCS exhibiting the most pronounced changes. The study further highlights the evolving contributions of different factors to overall sea level rise by century's end. Sterodynamic processes, glacier melting, and groundwater discharge are expected to increase, contributing 49.1%, 8.6%, and 1.4%, respectively, to total sea level rise relative to 2020 levels. In contrast, ice sheet contributions are projected to decrease, accounting for 43% of the total rise. Notably, GIA is expected to have a slight mitigating effect on sea level rise, with a projected negative contribution of -2.1% by 2100. These findings offer critical insights into the spatially variable impacts of sea level rise on Malaysia's coastal regions and underscore the urgent need for adaptive strategies to address the potential consequences of rising sea levels throughout the twenty-first century.

Keywords: Ice sheet melting, glacier melting, sterodynamic processes, groundwater discharge, glacial isostatic adjustment.

Deglacial Laminated Diatom Mats and Their Role in Shaping Western Pacific Bottom Water Redox Conditions Over the 18.4 ka BP

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Abstract

This study presents a comprehensive analysis of paleo-sedimentary processes and geochemical variations within an intra-slope basin of the Ryukyu accretionary prism, located near the Yaeyama Ridge. Sediment core MD18-3532, covering the past 18.4 ka BP, consists predominantly of dark grey clay, interspersed with distinct black silty laminations particularly concentrated during the Heinrich Stadial 1 (HS1) interval. Microscopic examination reveals a high abundance of Ethmodiscus rex, a diatom species associated with laminated diatom mat (LDM) formation during the deglacial period. These LDMs likely resulted from episodic surface ocean blooms. The deglacial interval is marked by a substantially increased sedimentation rate, attributed to enhanced terrigenous input from the East China Sea (ECS) and Taiwan. This is interpreted to result from a partial diversion of the Kuroshio Current (KC) and intensified activity of the East Asian Winter Monsoon (EAWM). The increased accumulation of organic matter during this time created reducing conditions, as evidenced by elevated total sulfur content (TS%), enhanced Fe/Al and S/Al ratios, and high Fe/magnetic susceptibility ratios—indicative of widespread pyrite formation. Post-deglaciation, rising sea levels redirected the KC, leading to a reduced sediment supply from Taiwan and the ECS. This hydrodynamic reorganization suppressed diatom bloom conditions, lowered sedimentation rates, and resulted in Holocene sediments dominated by terrigenous material, as confirmed through XRF elemental cluster analysis. These findings shed light on the complex interactions among ocean circulation patterns, global carbon and silicon biogeochemical cycles, and redox conditions in the western Pacific over the past 18.4 ka BP. In particular, the study underscores the critical role of laminated diatom mats in regulating organic matter deposition and deep-water redox states.

Keywords: Paleo-Redox Proxies, Laminated Diatom Mats, Philippine Sea, Deglacial period

Half-precessional dynamics of western equatorial Pacific temperature records: insight from biomarker proxies over the past 800 ka

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Abstract

The Western Pacific Warm Pool (WPWP) is a particularly sensitive region with regard to half-precessional variability, which is closely linked to the low-latitude process of insolation in the tropics. In contrast to widely reported orbital- and millennial-scale climate records, high-quality proxy records with evident half-precessional variability were rare and received less attention. Yet our understanding of how half-precessional signals evolve over time in response to low-latitude insolation forcing is still very limited. Here, we present high-resolution sea surface and subsurface temperature (SST and subT) records from the western equatorial Pacific over the past 800 ka, using alkenone and Glycerol Dialkyl Glycerol Tetraether (GDGT) biomarkers. The half-precessional variability is prominent in the band-pass filtering SST, subT and differences between the SST and subT (△T) records (hereafter referred to as SST-HP, subT-HP and △T-HP). The alkenone-based SST and GDGTs-based SubT show similar persistent half-precession cycles to Mg/Ca in planktonic foraminiferal shells reconstructed SST and SubT, but significantly different glacial-interglacial amplitude over the past 800 ka. The amplitude of SST-HP differs greatly from that of the maximum equatorial insolation record, implying likely strong extra GHG and ice volume impact on SST variations. However, both subT and △T records reveal a stronger amplitude of the half-precession signal relative to the SST record, and correspond well with the maximum equatorial insolation with higher amplitude during marine isotope stages (MIS) 5, 7, 15, and 17. The consistency in amplitude variation suggests direct maximum equatorial insolation forcing on subT and thermocline water temperatures, which are likely less affected by other long-term orbital forcing factors. Our high-resolution biomarker temperature records suggest that pervasive half-precession cycles in wool pool surface and subsurface water temperature, as well as ocean heat content over the past middle Pleistocene, would likely lead to a strong half-precession imprint in suborbital-scale ENSO variability, and thus influence the hydroclimate in both tropical and subtropical Pacific regions.

Echinoid stratigraphy: biofacies and biostratigraphy

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Abstract

Phylogeny of echinoids is under intense revision due to the advances of molecular sequencing. Our previous work proposed Taiwanasteroidea that is a clade of sand dollars with pan-Pacific distribution. Furthermore, members of this clade have good fossil records in Taiwan; thus, they are potential indicators for paleoecology and biostratigraphy. Although biozones of Nangang is well established based on planktic forams (N8-N9) and nannofossils (NN4-NN5). Detailed examination of sand dollar-rich layers show that there are two distinct morphotypes in the calcareous sandstones in where there are lacking key microfossils. Thus, potential fossil echinoid zones can be used as supplementary biozones to standard foram and nannofossil zones. The goal is to provide a long-term evolutionary trend of Echinoidea across the Miocene sandstone-coal cycles in NE Taiwan.

Keywords: Miocene; Scutelloidea; Taiwanasteroidea; Nangang Formation; NE Taiwan

新南向國土之海洋地球環境變遷暨未來可再生能源

Changing Ocean and Earth Environments and Future Renewable Energy in New Southbound Policy Territori

Sessions 7: Day 2 Afternoon (June 25, 2025)

Formation of a Highly Arcuate Trench During the Retreat of the Paleo-Pacific Subduction Zone

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Abstract

The opening of the South China Sea involved initial Paleocene rifting, followed by seafloor spreading from the Late Eocene to Early Miocene. These tectonic events were primarily governed by the rollback of the Paleo-Pacific subduction and eventual closure of the Proto–South China Sea. However, the interactions between these convergent systems and their broader influence on the tectonic evolution of Eastern Sundaland remain poorly constrained. In this study, we integrate GPlates-based plate tectonic reconstructions with time–space analysis across West Borneo, Peninsular Malaysia, and East Indochina from the Triassic to Neogene. This integrated approach aims to resolve temporal and spatial variations in tectonic regimes across Eastern Sundaland from the Late Cretaceous to the Eocene. Our results indicate a transition from regionally synchronous tectonics regimes during the Late Cretaceous to more spatially variable, asynchronous tectonic regimes in the Paleogene. We suggest that the temporal shift is attributed to the formation of a highly arcuate trench system induced by Paleo-Pacific slab rollback. Evidence from Late Cretaceous extensional basins, ophiolitic assemblages, and post-orogenic magmatism suggests widespread mantle upwelling beneath Eastern Sundaland. Continued rift propagation during Paleogene slab rollback facilitated the southward translation of the Palawan Block from the South China margin to North Borneo. These findings highlight the role of arcuate trench formation during Paleo-Pacific subduction rollback in driving widespread extension across Eastern Sundaland. This extensional regime was accompanied by transient compressional and strike-slip deformation along the leading edge of the subduction zone.

Keywords: South China Sea, Paleo-Pacific subduction, Slab rollback, Plate reconstruction

Characteristics and Assessment of Rocky Coasts in Terengganu, Malaysia: A Geological Heritage Perspective

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Abstract

In Malaysia, Terengganu is the state that is most renowned for its coasts, among others, due to its pristine beaches, crystal-clear ocean waters, traditional fishing villages with authentic Malay culture, and several turtle sanctuaries. Stretching approximately 244 km along the South China Sea—about 11.8% of Peninsular Malaysia's total coastline of 2,068 km—Terengganu's shoreline comprises both sandy and rocky coasts. The rocky coasts of Terengganu exhibit diverse and significant geological features with notable geoheritage values, yet remain under-documented in scientific literature. This study investigates the characteristics and assesses selected rocky coastal sites along the Terengganu coastline, spanning from the northern to the southern parts of the state. The methodology includes field mapping (geosite inventory and documentation), petrographic analysis, remote sensing analysis, and geoheritage evaluation. Eight rocky coasts are proposed as geosites in this study: Keluang-Bubus-Dendong Hills, Chendering Beach, Batu Pelanduk Beach, Teluk Bidara Beach, Kemasik Beach, Penunjuk Beach, Janda Baik Waterfall, and Pejajat Hill-Telaga Simpul Spring. The findings reveal a variety of rock formations and landforms, as well as distinctive features, such as sea caves, sea arches, sea stacks, denudational hills, cliffs, wave-cut platforms, tors, coastal waterfall, and water spring. These open-ocean rocky coasts are shaped by complex processes, predominantly wave- and tide-driven erosion. From a geoheritage perspective, each geosite possesses scientific, educational, aesthetic, recreational, and other geoheritage values. The study concludes that these rocky coasts have high potential for utilization, mainly in geoeducation and geotourism development. It proposes a framework to support their recognition as valuable Malaysia's geoheritage assets.

Keywords: Rocky coasts, coastal geomorphology, Terengganu coastline, geoheritage, geosite

Ancient Shipwrecks: Evidence of the Past Active Trade in the South China Sea

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Abstract

Marine geoarchaeology integrates two distinct fields of marine knowledge. The fortuitous discovery of the Bidong Shipwreck in the coastal region of Terengganu, Malaysia, at a depth of 17 meters, has presented a significant opportunity for advancing historical research on shipwrecks in Malaysia. The Bidong shipwreck excavation and artefact recovery initiative have comprised three phases in 2017, 2022, and 2023. Wood particles were uncovered during phases 2 and 3 of excavation at a depth ranging from 0.5 to 1.0 meters inside the subsurface layer. Intact and fragmented Thai pottery, Maenam Noi and Si Satchanalai, were uncovered during excavation. Significant discoveries were made during the second and third phases of excavation, where the blue-white porcelain fragments were believed to originate from the Ming Dynasty. The principles of geoscience research have been utilised to ascertain the age and provenance of the Bidong shipwreck. We have utilised radiocarbon and thermoluminescence (TL) dating to elucidate the history of the Bidong Shipwreck. This study's major conclusion reveals that the Bidong Shipwreck was not merely a coastal vessel of the South China Sea but a long-distance class of commerce ships. This submerged vessel was intended to convey commercial merchandise from the Thai Kingdom and the Chinese Ming Dynasty. The discovery of the Bidong shipwreck indicates that this topic requires integrating multidisciplinary expertise from social and applied sciences to deliver a more precise account of the historical analysis of shipwrecks in Malaysian waters.

Keywords: Underwater cultural heritage, Thai ceramics, South China Sea, Radiocarbon

Illuminating Sunken Histories: Rapid VIS-NIR Spectroscopic Screening of Shipwreck Ceramics

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Abstract:

Conventional mineral tests on underwater ceramics require invasive sampling and lengthy laboratory time. We introduce a three-stage workflow-intact surface, cleaned surface, and homogenized powder using full-range (350-2500 nm) visible and near-infrared (VIS–NIR) reflectance spectroscopy to characterize thirty sherds from the Bidong shipwreck (Malaysia). Single artefacts are analysed in ≤ 50 s. Chromatic indices in CIELAB space reveal that the a*-b* correlation coefficient rises from ≤ 0.50 on uncleaned faces to 0.80 after de-encrustation, offering a quantitative cleaning metric. Varimax-rotated principal component analysis resolves 18 spectral components in sherd spectra but only 11 in powders, demonstrating that marine accretions inflate apparent mineral diversity. Diagnostic loadings identify hematite and Fe-rich pyroxene (hedenbergite), linking the fabric to Sukhothai red clays and oxidising kiln atmospheres, whereas copper sulphides and carbonate salts fingerprint post-burial interaction with Cu fittings and seawater. The integrated VIS–NIR protocol therefore distinguishes firing technology, raw-material provenance, and diagenetic overprints without destructive sampling, enabling shipboard triage of large cargoes prior to targeted XRD, XRF, or SEM-EDS. This rapid, minimally destructive approach provides a scalable tool for safeguarding submerged cultural heritage across the Indo-Pacific.

Keywords: Underwater ceramics; Reflectance spectroscopy; Minimally destructive; CIELAB space

新南向國土之海洋地球環境變遷暨未來可再生能源

Changing Ocean and Earth Environments and Future Renewable Energy in New Southbound Policy Territori

Field Trip

6/26 東北角地景與產業文化參訪行程

Northeastern Coastal Landscape and Industrial Heritage Excursion

08:30 集合出發 (Departing from Keelung)

09:30 蘭陽博物館 (Lanyang Museum) 官網連結

12:00 於宜蘭享用午餐 (Have lunch in Yilan)

14:00 黃金博物館 (Gold Museum) 官網連結

18:30 美味晚餐 (Dinner)

6/27 臺北城市地標與文化資產參訪行程

Taipei Urban Landmarks and Cultural Heritage Excursion

08:30 集合出發 (Departing from Keelung)

09:30 台北 101 (Taipei 101) 官網連結

11:30 於台北享用午餐 (Have lunch in Taipei)

13:30 故宮博物館 (National Palace Museum) 官網連結

17:30 美味晚餐 (Dinner)

19:00 返回飯店 (Return to the Hotel in Keelung)