



# International Conference “Marine Geology: Marginal Seas - Past and Future”

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## Abstracts



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## Conference Session's Information

Marginal seas span all climate zones, form under various tectonic and geological conditions, and facilitate socio-economic networking. Such seas play crucial roles in providing habitat, food, and trade routes for humanity, as well as facing climate change and anthropogenic impacts on the natural environment. There is a strong demand from society for marine geoscientists to understand the development of estuary-delta-shelf-deep basin systems within the context of earth sciences systems. To advance cooperative work and research in marine geosciences, three scientific sessions are planned to address the interface between ocean and continent from the Earth Sciences and socio-economic stand-points.

### **(1) Session 1: Sources-to-Sink models and links to climate development**

Using marine sedimentary records to reconstruct the development of environmental conditions and climate over a variety of timescales requires a detailed understanding of how sediment is transported from source areas into the ocean. There are several processes that can affect sediment transport and in turn influence grain size distribution. Suspended sediment that rapidly travels to the open ocean tends to be finer grained than coarser bedload sediments, although clay-rich sediments may be stored in flood plains. Mineralogy also plays a role with denser clasts travelling less rapidly to the open ocean. Changes in climate have an important impact because variations in seasonal climate systems can result in substantial changes in precipitation resulting in incision and reworking of flood plain sediments, similar to what occurs from sea level variations. Presently, considerable disagreement concerning the duration of sediment travel in large fluvial systems exists, yet constraining the transport time is important for reconstructing the response of landscape to climate change based on the sediment preserved in a delta or shelf. A good example of this environment is the Pearl River of the northern South China Sea, where variations in Asian monsoons can result in increased or reduced levels of sediment reworking within the flood plains. Understanding the drivers of recycling and reworking along with quantifying the degree of sediment buffering in flood plains are fundamental scientific question that will be addressed in this session.

**Conveners:** Peter D. Clift (University College London, UK), Gaowen He (Guangzhou Marine Geological Survey, China), Wojciech Jeglinski (Polish Geological Institute-National Research Institute, Poland), Xinong Xie (China University of Geosciences, China).

### **(2) Session 2: River Mouth Systems and Urban Seas**

This session will address interdisciplinary research of Urban Sea and estuarine systems amid multiple stresses from climate change and human activities. River mouth systems, where

rivers meet the sea, are dynamic zones characterized by complex interactions between fluvial and marine processes, which play a crucial role in the dispersal of river sediments into coastal seas, influencing coastal morphology and sediment budgets. We understand the Urban Seas as those parts of the global oceans that are significantly influenced by coastal cities, ports, and industrial developments on adjacent lands. They are susceptible to the impacts of climate change, including increased intense flooding and storm surge events, with some possibly subjected to increased exposure and risk of tsunami amplification from altered coastal morphology. Additionally, Urban Seas experience the simultaneous anthropogenic effects of eutrophication, deoxygenation, and pollution, as well as oil and gas extraction, transportation, overfishing, and other offshore activities. However, Urban Seas provide tourism value, including aesthetics. It is not surprising, therefore, that the implications for the dynamics and management of Urban Seas extend far beyond classical oceanography. Therefore, we invite contributions with particular emphasis on reconstruction and future scenarios of the coastline changes, morpho- and hydrodynamics, sediment dynamics, as well as the impact of natural, anthropogenic, and other threats.

**Conveners:** Joanna Dudzińska-Nowak (University of Szczecin, Poland), Junjie Deng (Sun Yat-Sen University, China), Gary Greene (Moss Landing Marine Laboratories, California, USA), Joanna Waniek (Leibniz Institute for Baltic Sea Research, Warnemünde, Germany), Yuanzhi Zhang (The Chinese University of Hong Kong, China)

### **(3) Session 3: Biogeography - biostratigraphy from Deep-time among marginal seas**

Marginal seas, characterized by connectivity of continents and open oceans, serve as critical hotspots for marine biodiversity and biogeographic studies. From deep-time to the present-day ecological dynamics, marginal seas exhibit unique environmental gradients change, complex oceanographic behaviors, and distinct evolutionary histories that shape species distribution, community assembly, and ecosystem functions that are associated with geological and climatic change. Due to regional variations on salinity, temperature, and nutrient input from both land and ocean, the biogeographic features bring a complexly view of universality and individuality among marginal seas in the past and present. Using a longtime scale, along with marginal seas evolution, to correlate organismal evolution in biostratigraphy within marginal seas is a key to understand the change of paleoceanography, to understand and reconstruct paleoclimate. This session will explore the biodiversity patterns, biogeographic processes, and biostratigraphy application in marginal seas, emphasizing the integration of micropalaeontological, ecological, and biological “big-data” in marine geosciences with the goal of aiding sustainable development.

**Conveners:** Jinpeng Zhang (Guangzhou Marine Geological Survey, CGS, China), Kevin McCartney (University of Maine at Presque Isle, USA), Yenny Risjani (Brawijaya

University, Indonesia), Federica Foglini (The Institute of Marine Sciences of the National Research Council, Bologna, Italy), Baohong Chen (The Third Institute of Oceanography, MNR, China).

## **Plenary Keynote Speech**

# Marginal Seas Sciences – Chances and Challenges

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## **Abstract:**

As highly sensitive areas of the oceans, marginal seas occur in all climatic zones, have formed under diverse geological and tectonic conditions, and are used under a wide variety of socioeconomic conditions and concepts. However, marginal seas are increasingly threatened by rising sea levels, floods, storms, tsunamis, coastal erosion, pollution, and the overexploitation of their resources. These threats have recently become increasingly apparent in light of climate change and anthropogenic impacts on the natural environment. To mitigate these threats, international integration and close interdisciplinary scientific cooperation are urgently needed for the sustainable management of the marginal seas and their coastal zones. To promote this development, an Initiative Group for Marginal Sea Research was established on November 29, 2019, at the first "International Marginal Seas Expert Meeting" in Guangzhou, on the invitation of the Guangzhou Marine Geological Survey / China Geological Survey. In a first work phase entitled "Marginal Seas – Past and Future," the network members generalized the initial focus on the Eurasian supercontinent into a global concept through targeted project research and discussion forums at eight further online and hybrid online/onsite "International Marginal Seas Expert Meetings". This concept aims to describe the dynamics of marginal seas holistically as an interaction between geosystems, ecosystems, climate, and socioeconomic systems using modeling approaches. This approach can be used to depict developments in both the geological past and future scenarios, taking into account changing natural and anthropogenic factors as well as the effects of control measures for sustainable management. Initial approaches to developing advanced concepts in this direction are based on complex data acquisition programs on integrated timescales through new interdisciplinary

cooperation chains. These chains include real-time and longer land-, sea-, and space-based data series, as well as historical data derived from transfer functions – the interpretation of proxies. In addition to project research, the targeted publication of research results, as well as training and capacity building, also play an important role in the implementation of the concepts. For this purpose, the University of Szczecin has established a webinar program on marginal seas research.

After the first phase of basic studies, we are on the threshold of a new phase: "Marginal Seas – Sustainable Future of the Interface between Continents and Oceans." The overarching challenging goal is to bring together marine and environmental scientists, climate researchers, and data scientists – developers of advanced methods for reconstructing the geological past and developing future scenarios for marginal seas and their coastal zones – with stakeholders in effective management strategies. This cooperation is intended to promote shaping a sustainable future for the continental/ocean margins in line with the UN Sustainable Development Goals.

**Keywords:** Marginal seas; Interdisciplinary co-operation; Modeling; Data science; Management; Sustainability.

**Scientific Session One: Sources-to-Sink models and links to climate  
development**

# **Paleogeographic Origins of Microcontinents in the Southern South China Sea and Evolution of the Paleo-Pacific Ocean and Proto-South China Sea**

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## **Abstract:**

The region of West Pacific-Southeast Asia embeds massive microplates, characterized by complex plate motions and geological history. Along with the opening of young ocean basins and the drifting of microcontinents, multiple paleo-oceanic plates subducted in this region. Among them, the Paleo-Pacific Ocean and Proto-South China Sea once occupied the present-day South China Sea during the Late Mesozoic–Early Cenozoic but have completely vanished. The limited surface and deep residual records make their paleogeographic reconstruction highly challenging. Reconstructing the significant tectonic shifts from the Paleozoic–Mesozoic Paleo-Pacific and Tethyan subduction systems to the today's Southeast Asian tectonic collage and West Pacific marginal seas requires clarifying the paleogeographic origins of microcontinents therein, particularly those of Palawan and Sabah in the southern South China Sea.

This study presents the latest results of detrital provenance and geochronology from the oldest accretionary complex (Permian Bacuit Formation) of the Palawan Continental Terrane in West Philippines and from the Cretaceous strata (Baliojong Ocean Plate Stratigraphy) of the Sabah terrane in Northeast Borneo. By combining these results with a newly constructed zircon provenance database for the South China

Sea-Southeast Asia region, this study reveals the paleogeographic origins of the microcontinents and their implications for the evolution of the Paleo-Pacific Ocean and Proto-South China Sea. The Bacuit Formation exhibits predominant continental arc provenance signals, with the maximum depositional age of the oldest sample dated to the Late Triassic. Its ~260-Ma unimodal zircon population suggests that the Paleo-Pacific subduction could have started as early as the Late Permian. Zircon U-Pb-Hf isotopic signatures of the Bacuit Formation contrast with those of the South China margin, pointing to an exotic origin of the Palawan Continental Terrane from the Paleo-Pacific domain. The turbidite sequences of the Baliojong Ocean Plate Stratigraphy show significant variation in both provenance and geochronological proxies, representing multiphase accretionary products during the early Late Cretaceous. Zircon U-Pb-Hf isotopic data suggest their potential source connections with the southern Indochina margin, East Malaya, and Northwest Borneo, implying that the Paleo-Pacific subduction zone responsible for the turbidite formation was located closer to the eastern Sundaland. By integrating geochronology, geochemistry, and paleomagnetism of the Baliojong basalts, this study reconstructs the complete history of this Ocean Plate Stratigraphy. We propose a new geodynamic model in which a Paleo-Pacific sub-plate, independent of the Izanagi plate, ceased subduction in the latest Cretaceous possibly because of trench jamming and left behind remnants that subsequently evolved into the Proto-South China Sea.

**Keywords:** Provenance; Paleogeography; South China Sea; Paleo-Pacific Ocean; Proto-South China Sea.

**Linking sedimentary and biologic characteristics with  
paleoenvironmental evolution since the Late Glacial off the Xisha  
Platform, northwestern South China Sea**

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**Abstract:**

Reconstructing paleoenvironmental variability from hemipelagic sediment archives in marginal seas presents considerable challenges, particularly due to the complex interplay between sediment sources and climate dynamics, which is further influenced by sea-level changes and oceanic circulation. These difficulties are especially evident in the northern South China Sea (SCS). This study introduces new multi-proxy data, including strontium-neodymium (Sr-Nd) isotopes, grain-size distributions, and calcareous nannofossil records, to investigate sediment provenance and depositional processes in the northwestern SCS since the late Marine Isotope Stage 3 (MIS3). Sr-Nd isotopic signatures reveal that the sediments predominantly originate from the weathering of silica-aluminium continental crust, with the Red River drainage system serving as the principal source. Clay mineral compositions further support the Red River's dominance, while also indicating contributions from the Indochina region and the eastern SCS. Integrated proxy analysis reveals that sedimentation and biological activity were influenced by sea-level changes and East Asian monsoon variability, both of which were ultimately driven by global ice volume and solar radiation. Fine-grained sediments and solubility indices closely tracked the East Asian Summer Monsoon, whereas coarse fractions and the kaolinite / (illite + chlorite) ratio aligned more with

the East Asian Winter Monsoon across glacial-interglacial cycles. Notably, the smectite / (illite + chlorite) ratio appears to reflect the influence of the Kuroshio Current rather than monsoonal forcing.

**Keywords:** Biological facies; Paleoenvironment; Asian Monsoon; Northern SCS.

# Controls on Sediment Flux to the Deep South China Sea

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## **Abstract:**

The deep-water sediment record in the South China Sea and other marginal seas around the Asian periphery can be used to reconstruct evolving continent environmental and weathering conditions onshore. This holds out the chance to see how global or regional climate change may impact landscape. However, in order to do this it is important to understand how sediment is transported first to the delta and then into the deep water. This can be a complicated process because of storage and recycling. Large river systems often have extensive floodplains where sediment is stored at times when the sediment supply is high, often linked to strong monsoons. Sediment in floodplains can then experience extensive chemical weathering, a process that can potentially result in significant capture of CO<sub>2</sub> from the atmosphere, although in the case of the Pearl River the volumes of sediments may be insufficient to have a global impact. Sealevel is also critical in modulating the sediment flow to the ocean. When sea level is low sediment is delivered directly into the Pearl River submarine canyon, although only a fraction of this material is freshly eroded from bedrock sources. The continental shelf and parts of the floodplains also incise, increasing reworking. When sealevel is high then sediment is sequestered in the delta, which slowly progrades oceanwards. In regions where the continental shelf is wide the delta may never connect to the submarine canyon until sea level begins to fall again. This is particularly true in the South China Sea, where strong westward directed long shore currents, push the sediment towards Hainan island, so that the Holocene is stored as a large clinoform parallel to the coast. No fresh sediment from the Pearl River delta has been delivered

into the deep water since start of the Holocene. The clinoforms are eroded during times of falling and low sealevel when recycling is at a maximum. Therefore, the deep water will not preserve a higher resolution environmental record. Moreover, the outer parts of the continental shelf likely only accumulate sediment during the transgressive systems tract when sea levels are rising and this can span a remarkably short amount of time. The shelf edge deltas are then eroded again when sea level falls. A true continuous record of erosion and weathering likely requires a transect of drilling sites set within a framework of seismic profiles.

**Keywords:** Sediment; Zircon; Erosion; Sea-level; Weathering; Buffering.

# **Formation and Preservation of Mediterranean Organic-rich S1 unit; Diagenetic Control and Variability**

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## **Abstract:**

Precession-related humid climate conditions and associated processes determine deposition of organic-rich units (sapropels) in the Mediterranean. In addition, the semi-enclosed basin configuration emphasizes contrasts. This resulted in the repetitive occurrence of distinct sapropels in a climate-controlled way in predominantly eastern Mediterranean marine deposits. The amount of precipitation thus stratified water column conditions is associated with North-African monsoonal system, whereas deep-water formation thus collapsed of a stratified water column is related to the Northern-borderland climate system. The most recent sapropel S1 formed between 10.8 and 6.1 kyr BP. This is largely simultaneous with the African Humid Period (11-5 kyr BP). Deposition of organic-rich S1 sediments occurred synchronously at all water depths below ~ 200 m. Increased monsoonal freshwater input resulted in water column stagnation and in deepwater (>1,800 m) to be devoid of oxygen during 4,000 years of S1. This resulted in basin-wide preservation of S1 determined by water depth. Reduced precipitation and consequent abrupt re-ventilation of deep-water at 6.1 kyr BP resulted in a basin-wide MnO<sub>2</sub>-peak. Subsequent oxic conditions resulted in a downward progressing oxidation-front that is not only marked by degradation of organic matter over its active pathway, but also by the built-up of a secondary Mn-peak below the first, ventilation Mn-peak. Apart from the major re-ventilation event at the end of sapropel S1 formation, also other, short-term ventilation events have occurred, notably the 8.2-ka cooling event. Sapropel formation mechanisms are related to a sensitive interplay between S- and N- borderland climate systems. Assessing distinct, sub-Milankovitch

climate variability is vital for understanding and forecasting future climate change.

**Keywords:** Sapropels; Eastern Mediterranean Sea; Diagenetic processes; Sediment geochemistry

# **Contrasting Contourite Systems Along Antarctic Margins: Mixed vs. Elongated Drift**

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## **Abstract:**

Contourite deposits along Antarctic continental margins provide key insights into past bottom current dynamics and the interaction between ocean circulation and margin architecture. Based on seismic reflection and bathymetric analyses, we identify two distinct types of contourite features: mixed drifts and small elongated drifts. Mixed drifts are predominantly developed on passive margins, such as the Ross Sea and Weddell Sea, where broad continental slopes and embayments favor the accumulation of contourite mounds interbedded with gravity flow deposits. In contrast, small elongated drifts are primarily associated with active margins of the Antarctic Peninsula, where steeper slopes and tectonic segmentation constrain along-slope current pathways, resulting in narrow, streamlined drift geometries. These findings highlight a first-order control of margin type on contourite development and distribution, emphasizing the coupling between tectonic setting, slope morphology, and deep-water circulation in shaping Antarctic depositional systems.

**Keywords:** Contourite deposits; Antarctic margins; Mixed drifts; Elongated drifts; Bottom currents; Tectonic setting; Deep-water circulation.

# **The impact of multi-source sediment supply in subaqueous deltas on the distribution of shallow gas: Insights from northern Bohai Bay, China**

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## **Abstract**

Shallow gas, widely present in global estuarine delta sediments, holds significant importance for ocean engineering and the global carbon cycle. However, the underlying control mechanisms governing its gas characteristics and distribution remain enigmatic. This study, conducted within the contact zone of the Yellow and Luan rivers subaqueous deltas, aims to unravel the intricate relationship between gas distribution and sedimentary processes. Through the utilization of dense, high-resolution seismic surveys, analysis of surface sediment clay minerals characteristics, and integration of previous research findings, we have identified three distinct seismic units (SUs) within the post-Last Glacial Maximum stratigraphy. These units, from bottom to top, are designated as SU0, SU1, and SU2, corresponding to the lowstand system tract, the transgressive system tract, and the highstand system tract, respectively. The submarine delta gassy sediments of the Yellow and Luan rivers predominantly display acoustic anomalous reflections that are respectively characterized by gas chimney and acoustic

blinking. In this paper, shallow gas emerges as a geological thermogenic product, with its distribution being comprehensively influenced by sedimentary processes, sediment accumulation rates, sediment properties and clay mineral composition. These research findings underscore the need to heighten our awareness of the sedimentary geological context and anthropogenic disturbances in underwater deltas, with the ultimate goal of mitigating the exacerbation of global warming triggered by gas seepages and reducing marine geohazards, particularly in highly developed coastal regions.

**Keywords:** Shallow gas; Acoustic reflection; Gas distribution; Seismic stratigraphy; Subaqueous delta.

# **Magnetic mineral dissolution front delimited by Late Holocene sediment accumulation acceleration in the inner shelf, northern South China Sea**

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## **Abstract:**

Inner shelf sediment properties are sensitive indicators of Holocene environmental changes; however, magnetic records can be altered by reductive dissolution. To refine our understanding of magnetic mineral dissolution, we conducted detailed analyses of three sediment cores from the inner shelf of the northern South China Sea. AMS<sup>14</sup>C dating, grain-size, magnetic parameters, mineral composition, organic carbon, and sulfur content were examined. The cores, composed uniformly of clayey silt and spanning the past 4-6 ka, were divided into three zones:(1) a suboxic surface layer (40-88 cm thick), (2) an intermediate zone with moderate magnetic properties, and, (3) a basal zone characterized by intense magnetic mineral dissolution. Identified minerals include magnetite, hematite, and iron-sulfide phases such as pyrite. The depth of the suboxic–sulfate boundary (Zones 1-2) was inversely correlated with sedimentation rate and water depth. The magnetic dissolution front (Zones 2-3 boundary) coincided with a sharp increase in sedimentation over the past 1-2 ka, likely linked to intensified human activity. These results suggest that anthropogenic environmental changes may have influenced magnetic mineral reductive dissolution, warranting further investigation.

**Keywords:** Environmental magnetism; Continental shelf; Human activities; Pearl River Estuary.

# Submarine Methane Leakage and the Role of Active Iron Oxides in Carbon (Methane, Organic Carbon) Fixation

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## **Abstract:**

Methane is a potent greenhouse gas, possessing 25 times the radiative forcing capacity of carbon dioxide on a per-unit mass basis over a hundred-year timeframe. Biological production of methane is the last step of the early diagenesis of organic carbon (OC). This study sheds light on the migration pathways for methane leakage from submarine sediments and highlights an underestimated carbon sink, active iron (Fe) oxides, for the fixation of methane and its source material organic matter. Various channels, such as faults, gas chimneys, diapirs, and mud volcanoes, efficiently transport methane from sediments to the water column. Under appropriate temperature and pressure conditions, the continual upward migration of methane can lead to the formation of gas hydrates within shallow subsurface sediments or on the seafloor. Methane can be consumed via microbial-driven anaerobic oxidation (the Anaerobic Oxidation of Methane, AOM). Sulfate is usually considered the primary electron acceptor for AOM. Nevertheless, in marine sediments with insufficient seawater sulfate supply, AOM can also couple with the reduction of Fe oxides to generate Fe-rich carbonates. What's more, large fractions of sedimentary OC are associated with the Fe oxides via sorption or coprecipitation, which provides physical protection to prevent microbiological degradation and promote long-term OC protection. Thus, Fe oxides can, to some extent, act as a potential carbon sink, aiding in mitigating climate change.

**Keywords:** Methane leakage; AOM; Active Fe oxide; Organic carbon; Climate change.

# Continental shelf area inundation drove reduced temperature seasonality in East Asia during the last deglaciation

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## Abstract:

East Asia (EA) has experienced a decreasing trend in the summer-to-winter temperature difference (temperature seasonality) in the context of ongoing global warming. However, the impacts of natural external forcing remain unclear. The last deglaciation, marked by substantial global warming, provides a paleoclimate context for understanding the roles of natural forcing in EA temperature seasonality changes. Here, using transient simulations (iTraCE), we demonstrate that EA experienced greater winter warming compared to summer during the last deglaciation, supported by paleoclimatic reconstructions. Sensitivity experiments indicate that the inundation of continental shelf area due to rising sea-level played a critical role in driving these differential warming trends. Further quantifications highlight the contributions of greater heat capacity instead of reduced surface albedo of the expanded ocean area. Resulting atmospheric responses expanded the seasonality change to EA landmass by cloud–radiation feedback and temperature advection processes. These findings provide insight into the potential climatic impacts of sea-level rise under ongoing global warming.

# **Paleoenvironmental Evolution of Quaternary Sediments in Jakarta Bay, Indonesia**

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## **Abstract:**

The Quaternary coastal sedimentary wedge of Jakarta Bay records a complex succession of marine, deltaic, and alluvial deposits shaped by variations in sediment supply and sea-level changes during the Late Cenozoic. Based on sedimentological analysis from ten boreholes, the stratigraphic succession illustrates the transition from coastal plain to shallow marine settings, overlain by modern offshore deposits.

The depositional architecture reflects at least six types of paleoenvironmental settings, including shallow marine, deltaic plain, alluvial plain, nearshore, deltaic–shallow marine transition, and post-Holocene shallow marine environments. These successions were strongly influenced by glacial–interglacial cycles, where sea-level fluctuations played a dominant role in shaping erosional surfaces and subsequent infill of incised valleys. Lowstand alluvial deposits were reworked during the Last Glacial Maximum, followed by rapid transgression and highstand sedimentation in the Holocene.

The sedimentary record of Jakarta Bay highlights the role of climatic and eustatic sea-level changes as primary drivers of coastal evolution, with minimal influence from tectonic activity. These findings contribute to a better understanding of Quaternary paleoenvironmental evolution and sedimentary dynamics along the northern coast of Java.

**Keywords:** Quaternary sediment; paleoenvironment; Jakarta Bay; coastal evolution.

# **Impact of source-to-sink process variation and sediment supply on sustainable future of coastal ecosystem**

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## **Abstract:**

Sediments transported from land to sea via rivers play a critical role in maintaining coastal stability and nourishing coastal ecosystems. As global climate change intensifies, precipitation frequency and intensity are expected to become more extreme in the future, making erosion, transport, and deposition processes more complex. At the same time, increasing human activities are causing unpredictable changes to river morphology and shoreline characteristics. Climate change and human activities have gradually become the main drivers affecting sediment supply to coastal waters.

A recent global study based on long-term remote sensing data reported that sediment fluxes in Northern Hemisphere rivers have decreased by nearly 50% due to dam construction, while sediment fluxes in the Southern Hemisphere have increased due to deforestation. Studies on major Asian rivers have also found that the sharp reduction in sediment flux caused by dam construction has made deltas more vulnerable to the risks posed by global sea level rise. However, it remains uncertain whether these decreasing or increasing trends will continue. Therefore, understanding and unraveling the natural and anthropogenic drivers of sediment supply and their impacts on coastal areas is not only a focus of environmental geoscience but also crucial for the ecological environment and sustainable development of coastal areas.

With intensified global change and human activities, new changes are emerging in sediment transport and deposition in the Pearl River basin and estuary. Data from the Chinese River Sediment Bulletin show a sustained decline in sediment transport in the

Pearl River basin and estuary over the past few decades. In addition, grain size and magnetic results of surface sediments indicated obvious variation in sediment provenance and deposition in the Pearl River Estuary and its adjacent waters. Questions such as variation of sediment supply, and spatial distribution of sediment erosion and deposition affected by sea level rise caused by global change and human activities urgently require comprehensive assessment to provide scientific evidence for the sustainable future of coastal ecosystem within the Guangdong-Hong Kong-Macao Greater Bay Area.

**Keywords:** Source-to-sink process; Sediment supply; Coastal ecosystem; The Greater Bay Area.

# Indian Summer Monsoon-Driven Organic Carbon Dynamics and Vegetation Shifts in the Bengal Basin Since 37 ka: A Multi-Proxy

## Approach

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### Abstract:

High-resolution paleoenvironmental records from the Bengal Fan covering the late Quaternary are scarce. To address this gap, geochemical proxies, including total organic carbon (TOC), carbon isotopes ( $\delta^{13}\text{C}$ ), total nitrogen (TN), nitrogen isotopes ( $\delta^{15}\text{N}$ ), alongside pollen analysis, were conducted on sediment core E87-32B from the middle Bay of Bengal (BoB). This multi-proxy study reconstructs terrestrial vegetation dynamics, organic carbon (OC) sources, and Indian Summer Monsoon (ISM) variability since Marine Isotope Stage 3 (~37 ka). The results indicate that OC burial and pollen assemblages are strongly influenced by monsoon-driven hydrodynamics, sea-level changes, and shifts in vegetation cover throughout glacial–interglacial cycles. Isotopic signatures ( $\delta^{13}\text{C}$ ) and TOC/TN ratios reveal a composite input from terrestrial  $\text{C}_3$  plants and marine organic matter, with relative contributions fluctuating in response to monsoon strength and sediment supply. Changes in pollen composition, notably between arboreal and herbaceous taxa, effectively track regional vegetation shifts linked to climatic oscillations. Two significant intervals of environmental transformation are identified: first, during MIS 3 (~36.9–29.1 ka BP), elevated TOC values, increased proportions of  $\text{C}_3$  plant pollen, and enriched  $\delta^{13}\text{C}$  values signify enhanced ISM intensity, increased terrestrial organic input, and expansion of

broadleaved forests under warm, humid conditions; second, during the Holocene Climatic Optimum (~7.8–6.9 ka BP), combined palynological and isotopic evidence points to peak monsoon activity, proliferation of tropical–subtropical vegetation, and maximum OC burial. In contrast, MIS 2 (~29.1–14.2 ka BP) reflects a period of weakened monsoons, reduced vegetation cover, and diminished organic matter preservation amid colder, arid climates. Although pollen and geochemical proxies decouple during high sea-level phases such as MIS 1,  $\delta^{13}\text{C}$  and TOC/TN ratios remain robust tracers of terrestrial influence. Overall, this integrated approach highlights the dynamic interactions between climate, vegetation, and sedimentation, providing valuable insights into the late Quaternary monsoon evolution and land–ocean connectivity in the Bengal Basin.

**Keywords:** Indian Summer Monsoon; Organic Carbon Dynamics; Pollen Assemblages; Paleoenvironment; Bay of Bengal.

# **Sundaland Marginal Sea (Last Glacial Maximum to Present) - Implications**

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## **Abstract:**

Sundaland experienced shelf exposure and submergence as sea level changes during the Pleistocene. This phenomenon caused expansions and contractions of its marginal sea. Maximum contraction during low stands created extensive terrestrial area. Conversely, the shelf was completely submerged and sea level even exceeded modern day coastlines during the Holocene high stand (c.a. 5-7 ka BP). Regional scaled maps depicting the effects sea level change from the LGM to the Holocene high stand and present day are presented here. The study utilises present-day satellite bathymetry data of the Sunda Shelf taken from GEBCO 2014 data sets. This is an enhancement of earlier work of Sathiamurthy and Voris (2006) and Voris (2001). Palaeo sea-level curve (a composite curve synthesized by Hanebuth et al. 2011) was related to a digital terrain model of Sundaland. Both changes to the size of marginal sea and land connections were examined. Most of Southeast Asia was connected as a single landmass during the LGM. The Philippines and Sulawesi Islands (including Australia and Papua) however remained separated due to the depth of the sea basin and trench. The connections between continental Asia with Borneo, Sumatra and Java gradually 'disappeared' or disconnected as marginal sea expanded as marine transgression progresses from the LGM (c.a. 22 ka BP). These land disconnections created sea connections (through flow) that altered sea circulation pattern and sea surface temperature profile between West Pacific Ocean and East Indian Ocean. Furthermore, with a different landmass to sea ratio, the regional climate may have become wetter as the present day humid equatorial conditions. Moreover, as the marine front progresses it also created 'shifting' wetlands ecosystem that started near the continental slope to the present-day coast plus extensive

alteration of fluvial systems as coastlines retreated.

**Keywords:** LGM; Holocene marine transgression; Marginal Sea expansion;  
Land connections.

# Depth fluctuations of Mediterranean Outflow Water along its northward propagation during the late Pleistocene

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## **Abstract:**

The saline-warm Mediterranean Outflow Water (MOW) plays a crucial role in Atlantic Ocean circulation dynamics. Although precession-driven MOW strength variability has been documented, its depth variations during northward transport are poorly known. Here, we analyzed terrigenous grain-size sortable silt and benthic foraminiferal carbon isotopes from IODP Site U1588 on the Iberian Margin. Using data from two sites at diagnostic location and depths along MOW's pathway, we develop a unified framework of hydrodynamic proxies to constrain MOW's depth fluctuations over the last 250 kyr. Results reveal that MOW gradually deepened from ~100 ka and stabilized after ~60 ka, corresponding to the prevalence of millennial-scale climate variability. This deepening resulted from: reduced North Atlantic water density due to iceberg melting of Heinrich Stadials, and/or enhanced MOW production driven by Mediterranean cooling/aridification. Glacial MOW sank below Site U1588, whereas it shoaled and directly influenced Site U1588 during interglacials. MOW's depth variations closely follow precession-paced cyclicity, being deeper during precession maxima (Northern Hemisphere summer insolation minima) when flow intensified; and vice versa. This is because intensified flow enhances MOW's attenuation, due to increased density contrasts with ambient waters. Our findings highlight precessional forcing on MOW northward propagation, including both strength and depth fluctuations.

**Keywords:** Mediterranean Outflow Water; Sortable silt; End-member modeling; Precession; Iberian Margin; IODP Expedition 397

# **Mangrove evolution across the Sunda Shelf driven by sea-level and tropical climate changes since the Last Glacial Maximum**

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## **Abstract:**

Southeast Asia harbors the world's highest mangrove biodiversity, yet the processes governing their distribution related to sea-level change since thousands of years ago remain not well understood. This study analyzes high-resolution pollen records from sediment cores (NS07-46, NS2007-8, NS07-25, and ADM-C1) across the Sunda Shelf to reconstruct mangrove development since the Last Glacial Maximum (LGM). Our results show the mangrove pollen influx and percentage were low at the LGM for cores NS2007-8 and NS07-46 located in the western South China Sea (SCS), indicating limited availability of proximal estuarine environments. In contrast, high mangrove pollen influx and percentage at the LGM were shown in core NS07-25 from the southern SCS, likely due to reduced transport distance from exposed nearshore habitats. During the last deglacial period, mangrove pollen influx and percentage increased, suggesting marine transgression facilitated the formation of new tidal and estuarine zones. Comparing previous studies on mangrove dynamics in Southeast Asia, it is concluded that the establishment and persistence of mangrove communities do not only depend on sea level rise but also on local factors: the topography and the potential

of sediment input. Besides, it is found that episodic sea-level anomalies related to ENSO activity in the late Holocene may have also modulated local mangrove dynamics. Overall, our findings highlight the sensitivity of tropical mangrove ecosystems to both long-term sea-level fluctuations and tropical climate changes.

**Keywords:** Mangrove pollen; Sea level change; ENSO; Sunda Shelf; Last glacial maximum (LGM).

# **Sedimentary organic matters within the subtropical mountainous river-estuary-bay continuum: Provenances, fates and implications**

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## **Abstract:**

Deep insight into the spatialtemporal composition and distribution dynamics of suspended particulate organic carbon (POC) and sedimentary total organic carbon (TOC) within the mountainous river-estuary-bay continuum provides us with a unique perspective for examining the impact of estuarine flow on the material cycle within the river-estuary-bay systems. In this study, we conducted a comparative analysis of the river-estuary-bay continuum of two subtropical mountainous rivers, the Jiulong River (JLR) and the Zhangjiang River (ZJR), southern China. Seasonal samples of suspended particles and surface sediments were collected from the lower river reaches, estuaries, and bay areas. Both suspended and sedimentary samples were analyzed for organic content and their isotopic signatures ( $\delta^{13}\text{C}$ ), and C/N ratios. The results reveal notable differences between the two systems. The JLR system exhibits stronger seasonal and spatial variations in POC sources compared to the ZJR system. In contrast, the estuary and bay of the ZJR system show more pronounced marine POC signals than those of the JLR system. In the sediments of the estuary and bay, soil organic matter and C3 plants contribute to over 60 % of the total organic matter in the JLR system, whereas in the ZJR system, marine organic matter and soil are the two most significant contributors. This study identifies that estuarine hydraulic conditions control the provenance,

dynamics, and fate of particulate organic matter (POM). River discharge plays a pivotal role in regulating the dispersion of terrestrial organic matter in the estuary; Estuarine circulation and the position of the turbidity maximum zone govern the temporal and spatial distribution of sedimentary organic matter. Moreover, high soil contribution to the estuarine and bay sediment organic matter suggests strong soil erosion of adjacent land, likely attributed to human activities. Our findings highlight the high sensitivity of POC composition and dynamics in these mountainous river-estuary-bay systems to changes in river discharge, tidal current, and maybe wave conditions. The results of this study will deepen our understanding of the dynamics and fate of POM from different sources within the mountainous river-estuary-bay continuum and provide vital information for the effective management of these highly dynamic and sensitive ecosystems.

**Keywords:** Mountainous river-estuary-bay continuum; Organic carbon isotopic signature; River discharge; Estuarine circulation flow; Jiulong river (JLR); Dongshan bay; Southern China.

# Pollen-inferred vegetation change and carbon sink linkages in the Pearl River Estuary over the last millennium

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## Abstract:

The Pearl River Delta Plain (PRDP) lies at the confluence of the South China Sea shelf and the Pearl River estuary. Since the late Holocene, rapid seaward progradation and vigorous sedimentation have accumulated thick peat, making it an important blue-carbon reservoir. Over the same period, human activities intensified—beginning with the establishment of the Nanyue Kingdom, socio-economic development in South China accelerated—exhibiting a pronounced interaction between environment and civilization. Systematic decoding of multiple environmental signals archived in borehole sediments can elucidate the coupling mechanisms among depositional evolution, climate variability, carbon cycling, and human disturbance. Drawing on pollen records from Pearl River Estuary cores, and integrating total organic carbon (TOC), black carbon (BC), carbon isotopes, foraminifera, ostracods, and grain-size data, this study reconstructs late Holocene vegetation succession, depositional environmental changes, and carbon storage dynamics. Results show that the study area underwent an environmental transition from lagoonal settings to a delta plain, driven by both natural climate oscillations and increasingly intensive human interventions. During the Medieval Warm Period (MWP), evergreen broad-leaved forests flourished under warm and humid conditions; the pollen assemblage is characterized by higher proportions of *Castanopsis* and *Quercus* at moderate total concentrations, while the expansion of

Poaceae is closely linked to southward migration and agricultural activity. During the Little Ice Age (LIA), forests retreated and *Artemisia* together with fern spores increased, closely associated with deforestation/land reclamation and a colder, drier climate. Since around 1850, large-scale embankment and reclamation, agricultural expansion, and urbanization have markedly accelerated terrestrialization. The pollen diagram shows a clear increase in Poaceae, a sharp decline in primary forests, and a drop in total pollen concentration, indicating that human activity has replaced climate as the dominant driver of vegetation change. Shifts in vegetation patterns substantially affected the sources and burial of organic carbon: during the Song–Yuan warm period, a forest-dominated carbon-sink mode prevailed, with higher sedimentary organic carbon. In the LIA, deforestation and land clearance transformed the system toward a carbon source, with concurrent declines in arboreal pollen and organic carbon content. During the Qing reclamation period, wetland Cyperaceae and mangrove pollen showed signs of recovery, and organic carbon content rebounded somewhat, reflecting a weak carbon sink. Since 1850, land reclamation and changes in shoreline/waterfront areas have shifted the Pearl River Estuary from carbon-sink deposition to a carbon-source–dominated regime, manifested by a sharp rise in black carbon from combustion emissions, retreat of Cyperaceae and mangroves, and weakened blue-carbon sequestration in the estuary. Overall, environmental evolution of the Pearl River Delta since the late Holocene reflects a superposition of climatic background with population growth and land-use change, while in modern times human activities have become the decisive force governing changes in vegetation and the carbon cycle.

**Key words:** Pearl River Estuary; Last millennium; Pollen; Vegetation; Human activities; Carbon sink.

# Fe-Mn Nodules in the Southern Baltic Sea as Indicators of Marine Pollution and Redox Variability

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## Abstract:

Fe-Mn nodules occurring in the southern Baltic Sea constitute an important component of bottom sediments, reflecting complex geochemical and biological processes as well as the influence of anthropogenic factors. Investigations carried out on samples collected from two locations within the Polish Exclusive Economic Zone (P1 – the Słupsk Furrow and Gdańsk Basin area; P2 – the Słupsk Furrow and Bornholm Basin area) revealed that the nodules exhibit a complex internal structure and a heterogeneous chemical composition, indicating a mixed diagenetic–hydrogenetic formation mechanism with a possible contribution from deep-seated fluids. Geochemical analyses (SEM-BSE, EPMA, ICP-MS) showed that the nodules consist of a core rich in clay minerals and quartz, surrounded by laminar-dendritic zones composed of amorphous mineral phases (birnessite, vernadite, goethite). The inner zones display considerable chemical variability: Fe<sub>2</sub>O<sub>3</sub> contents range from 2.5 to 51.7 wt%, and MnO from 0.8 to 25.8 wt%, reflecting variable redox conditions during concretion growth. The outer layers exhibit enrichment in phosphorus (up to 8.6 wt% P<sub>2</sub>O<sub>5</sub>) and zinc, interpreted as resulting from the influx of anthropogenic compounds, mainly derived from riverine inputs and agricultural activities. The presence of distinct redox variations in chemical profiles, including negative cerium (Ce) anomalies, confirms fluctuating oxic–suboxic conditions in the sedimentary environment during concretion formation. The relatively high accretion rates (2–21 mm per 1000 years) make them suitable as archives of environmental and pollution-related changes. The obtained results demonstrate that Fe-Mn nodules from the southern Baltic Sea

constitute sensitive indicators of long-term geochemical and anthropogenic processes, recording the accumulation of trace metals and biogenic components. They may serve as natural archives of environmental change and pollution within the Baltic marine ecosystem.

**Keywords:** Fe-Mn nodules; Southern Baltic Sea; Phosphorus; Anthropogenic pollution; Redox conditions.

# Geochemical characteristics and provenance indication of rare earth elements in the offshore of Hainan Island

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## Abstract:

This paper focuses on the distribution characteristics of rare earth elements (REEs) in sediments from the offshore waters of Hainan Island, aiming to reflect changes in material sources and depositional environments. By systematically sampling and analyzing 1083 sediment samples from the area, the distribution characteristics and provenance indicative significance of REEs were explored. The results show that the average total REE content in the offshore sediments of Hainan Island is  $157.00 \times 10^{-6}$  ppm, the composition and distribution patterns of REEs vary significantly across different sea areas and are closely related to the material sources in the land areas of Hainan Island and the depositional environmental conditions in the offshore waters. By comparing the data with existing regional geological characteristics and oceanographic process studies, the offshore waters of Hainan Island are divided into four sediment geochemical zones: the modern fine-grained sediment zone on the inner continental shelf, the coarse-grained sediment zone under high-energy conditions on the inner continental shelf, the reworked sediment zone on the outer continental shelf, and the fine-grained sediment zone on the outer continental shelf. This study successfully establishes a link between sediment geochemical characteristics and their material sources and depositional environments. It provides new methods and valuable scientific basis for understanding material transport and depositional evolution in the nearshore areas of Hainan Island and is of great significance for coastal geoscience and environmental evolution research.

**Keywords:** Rare earth elements; Sediments; Provenance indication; Depositional environment; Offshore of Hainan Island.

## **Scientific Session Two: River Mouth Systems and Urban Seas**

# **River Mouth Systems and Urban Seas in the Baltic Region: Sources-to-Sink Dynamics and Anthropogenic Pressures**

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## **Abstract:**

River mouth systems in the Baltic region represent highly dynamic interfaces between continental drainage basins and semi-enclosed marginal seas, where natural processes and intense anthropogenic pressures converge. In countries such as Lithuania, Latvia, and Estonia, major rivers including the Nemunas, Daugava, and Narva deliver sediments, nutrients, and pollutants into urbanized estuaries and coastal seas. These transitional zones are increasingly influenced by rapid urban development, industrial activity, eutrophication, and the impacts of climate change, notably rising sea levels, altered hydrological regimes, and ice-cover variability. This study synthesizes recent findings on sediment transport pathways, nutrient fluxes, and contamination loads across selected Baltic river mouth systems, applying a sources-to-sink perspective to assess their role in shaping coastal geomorphology and ecosystem health. Results underscore the vulnerability of Baltic urban seas to cumulative pressures, including hypoxia, saline intrusion, and biodiversity loss, while also revealing their resilience through deltaic sedimentation and habitat regeneration. The research highlights the urgent need for integrated coastal zone management that links upstream catchment processes with downstream marine dynamics. Understanding these coupled systems is critical to ensuring the ecological and socio-economic sustainability of river mouth–urban sea complexes in the Baltic under accelerating climate and anthropogenic change.

**Keywords:** Baltic Sea; River mouth systems; Urban seas; Nemunas Delta; Daugava; Narva; Sediment transport; Eutrophication; Coastal geomorphology; Climate change; Integrated coastal zone management.

# Coastline Changes on the Polish Baltic Coast During the Last Millennium in Light of Dating Submerged Forests

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## Abstract:

Among the paleogeographic data useful for retrodicting changes in the shoreline's position, particularly valuable are outcrops of organic sediment layers (peats, fossil soils), and especially fossil tree trunks found in their natural position in the beach zone developed on the edges of sandy barriers. Outcrops of this type of sediment in the coastal zone of the southern Baltic have been known for a long time, but only the results of radiocarbon dating allow, in some cases, an estimated assessment of shoreline movements, as indicated by Bogusław Rosa (1984). On the beaches of the Polish Baltic coast, peat outcrops with tree butts, underlain by lagoon sediments, have been found in several locations. This situation supports the assumption that the entire complex of lagoon and marsh sediments formed in the onshore zone of the barrier. Therefore, if these sediments are currently located in the beach zone, it means that the entire barrier has moved landward. Analysis of the results of age determinations of peat layers and tree trunks in their natural position found in the contemporary beach zone, combined with the geomorphological situation (including the width of the barriers and the extent of the coastal dune sediment accumulation belt), enabled an estimate of the rate of southward movement of the barrier coasts. In the western part of the Polish coast, between the mouths of the Dziwna and Parsęta rivers, the average annual erosion rate of the barrier coasts ranges from 0.35 to 0.73 m/year. This means that over the last 1,000 years, the seashore has moved from approximately 350 to 730 m southward. Slightly larger changes were recorded only east of the mouth of the Łupawa River, where the

rate of erosion of the Łebsko Spit coasts may have reached as much as 0.9 m/year. Such significant southward shifts of the shorelines developed in the spit zones are consistent with the rate of erosion of cliffs undercutting the moraine plateaus, as indicated by historical data from the Trzęsacz area (Hartnack 1926; Kostrzewski et al. 2021). When analyzing the magnitude of shoreline shifts in the southern Baltic, it is also important to consider that on the seabed, north of the modern cliff and dune shores, there are numerous fossil depressions filled with lacustrine and marsh sediments that were accumulated in the period preceding the Littorina transgression. This geomorphological situation significantly facilitated the rapid ingress of the sea onto low-lying land areas. The numerous presences of such depressions filled with biogenic sediments is documented both by direct data from underwater drilling and indirect data, including in particular the occurrence of large peat bogs and detritus gyttjas, as well as lacustrine mud deposits containing freshwater malacofauna.

**Keywords:** Southern Baltic coasts; Submerged forests; Shoreline changes; C<sup>14</sup> dating, Sea level; Erosion.

# **A Comparative Study of Bayhead Delta Evolution under Wave-Dominated and Tide-Dominated Estuarine Settings: Case Studies from Southeastern Australia and the Pearl River Estuary, China**

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## **Abstract:**

This study compares the morphodynamic evolution of bayhead deltas in two contrasting estuarine systems: the wave-dominated coast, SE Australia and the tide-dominated estuary in China's Pearl River Estuary. Through analysis of bathymetric data, sediment cores, and numerical modeling, we identify fundamentally different evolutionary pathways controlled by distinct hydrodynamic, sediment transport processes and their driving forces.

In wave-dominated coast of Lake Illawarra, delta evolution is characterized by seaward progradation shaped by the balance between fluvial sediment supply and wave energy. Waves redistribute river-derived sediments along the shoreline, creating a classic wave-influenced delta front whose morphology reflects the prevailing wind-wave climate. This system exhibits high sensitivity to sea-level changes and sediment flux variations, with the delta progressively infilling the estuarine basin under wave modulation.

In contrast, the tide-dominated Lingding Bay displays lateral sediment transport as the dominant process. Northwestern river-mouth shoals show systematic eastward extension and clockwise deflection, primarily driven by tidal currents with secondary Coriolis influence. The critical control is the angle between river outflow and tidal flow direction, where acute angles lead to tidal dominance in bifurcation evolution. This

results in an exponentially converging, funnel-shaped estuary morphology reflecting landward tidal energy decay.

The comparison reveals that wave-dominated deltas evolve through seaward progradation controlled by wave-river interactions, while tide-dominated systems develop through lateral accretion governed by tidal asymmetry and river-tide momentum balance. These distinct evolutionary patterns provide diagnostic criteria for interpreting ancient estuarine deposits and crucial insights for predicting estuarine response to environmental changes.

**Keywords:** Bayhead Delta; Estuarine Morphodynamics; Wave-Dominated; Tide-Dominated; Comparative Analysis; Sediment Transport.

# **Coastal lagoons as a transitional zone between land and sea: insight from heavy metals and modern biological communities in surface sediments**

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## **Abstract:**

Coastal lagoons, as dynamic interfaces between terrestrial and marine systems, are particularly sensitive to land-sea interactions. In this study, we examined heavy metals (HMs) and biological communities, including ostracods and foraminiferas in 39 coastal lagoons in the South of China. We also took a detailed spatial survey on above parameters within a typical coastal lagoon, Pingqing Lagoon. We these polluted lagoons are commonly characterized by intensive anthropogenic disturbance, especially fishing activities. Spatial analysis revealed an obvious declining gradient of pollution risk from land to sea in half of the researched lagoons, highlighting the terrestrial sources of HMs and the role of sea water exchange in pollutant dilution. Systematic comparison with other water bodies in southern China revealed the following contamination gradient: urban lakes > reservoirs > rivers > coastal lagoons > continental shelf. The two gradients indicating that coastal lagoons form a transitional zone of HMs pollution between land and sea suggest that coastal lagoons sensitively record interactions between human activities and sea-land. Biological communities in those lagoons also exhibits significant difference between sampling sites close to land and sea. Our findings provide essential insights into the pollution patterns and biological distribution

of coastal lagoons and are also significant for environmental management and ecological restoration of coastal zones.

**Keywords:** Coastal lagoon; Sediment; Sea-land interaction; Trace element; Tidal exchange.

## Progress in Defining Urban Sea Systems – A Marginal Seas Exercise

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### **Abstract:**

Urban Sea Systems are major **Ports** and port cities and towns, Trade **Hubs** (Transshipment depots), a **Nexus** of tourism, Communication **Nodes** (marine cables/satellite transmission points), Cultural/Educational **Centers, Sites** of major industries, **Source** of major employment, and **Drivers** of national **Economies**. They also have tremendous **Appetites** for **Energy** and **Suffer** from human concentration, Climate change and sea level rise, Ecological degradation, and Natural and anthropogenic impacts. These ports, hubs, nexuses, nodes, centers, sites, and drivers can be characterized by 1) Physiography/Tectonic Settings, 2) Climate/Geography, 3) Size/Age, 4) Population/Culture, 5) Natural and Anthropogenic Impacts, 6) Economic viability/Self-Sufficiency, 7) Ecological Status, and 8) Significance. Many marginal seas are Urban Seas and can be characterized in the same way as Urban Sea Systems as both are influenced by their location and processes within distinct watersheds. The Salish Sea of the Pacific Northwest of the U.S. is an example of an Urban Sea, a nearly enclosed marginal sea, an inland sea, that has two primary connections to the global Pacific Ocean. We will briefly describe each of the eight characterizations listed above with emphases on 1, 2, 5, and 7 along with the next steps of constructing a digital twin for each of the characterizations listed.

**Keywords:** Urban Sea Systems; Marginal seas; Inland seas; Characterization.

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### Urban Sea Systems and why they are important: A preliminary characterization

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# **The Vistula River Mouth Area: Holocene Development of the Sea Coast in the Gdańsk Area**

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## **Abstract:**

The Vistula River, discharging into the Baltic Sea, has formed an extensive delta with an area of approximately 2,400 km<sup>2</sup>. At present, nearly 30% of this area is submerged beneath the waters of the Gulf of Gdańsk (Southern Baltic Sea). The submerged part of the delta extends from several to about 20 km offshore, reaching depths of 60–65 m.

The partial submergence of the delta occurred during the Littorina Sea Transgression, one of the key stages in the evolution of the Baltic Sea. The present coastline marks the boundary between the inland delta plain (Żuławy) and its submerged continuation, with the Vistula Spit forming along this transitional zone. While the palaeodepositional surface and geological structure of the onshore delta are relatively well studied, the offshore sector remains less thoroughly investigated.

The current morphology of the southern Gulf of Gdańsk coast has been shaped by the evolution of distributary channels within the Vistula Delta under conditions of Holocene sea-level rise, combined with later anthropogenic modifications. Geological research carried out since the early 21<sup>st</sup> century has significantly improved our understanding of the Holocene evolution of the Baltic coast in the Gdańsk region.

For centuries, the Gulf of Gdańsk has also been known as the “Amber Coast,” owing to the occurrence of Baltic amber (succinite). Despite their localized and scattered nature, which complicates prospection and exploitation, Holocene amber

accumulations within the Vistula Delta have been successfully exploited for hundreds of years.

**Keywords:** Baltic Sea; Gulf of Gdańsk; Holocene; Paleogeography; Vistula Delta.

# **Paleogeographic numerical modeling of marginal seas – Baltic Sea case study**

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## **Abstract:**

Paleogeographic evolution of marginal seas is being driven by various global, regional and local driving forces. Application of conceptual Relative Sea Level (RSL) equation allowed to generate a set of paleogeographic scenarios; corresponding to evolution of Baltic Sea throughout Holocene with 500 years' time interval; by combination of global eustatic sea level changes, vertical crust movements (GIA - glacio-istostatic adjustment) as well as regional sediment thickness model and performing grid-based calculations on present-day Digital Elevation Model (DEM). Obtained paleo-DEMs were positively validated by comparison with field-based reconstructions of RSL and successfully evidenced the connection/disconnection events between the Baltic Sea and the North Sea during the transitions between lake and sea phases. This study required generation of regional Holocene sediment thickness map, which was obtained by synthesis of various local datasets and application of 2 different extrapolation methods to cover the undersampled areas. Noteworthy is, that eustatic water level curve considered the disconnection of paleo-North Sea and the Baltic freshwater body during the Ancylus Lake stage, inferring independent water level from the global data. This study represents a further step towards a consistent methodology to reconstruct the formation of marginal seas during transgression/regression cycles including not only tropic and subtropic climate zones but also polar and subpolar marginal seas impacted by the regional dynamics of ice sheets.

**Keywords:** Baltic Sea; Marginal seas; Paleogeographic modeling; Holocene.

# Past Efforts and Future Challenges in Safeguarding the Straits of Malacca

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## **Abstract:**

The Straits of Malacca, one of the world's busiest and most ecologically significant marginal seas, has received growing attention in recent years through both conservation initiatives and scientific research. Numerous studies have documented sediment quality, water mass conditions, and heavy metal contamination, enhancing baseline knowledge for management along the Straits. However, detailed sediment profile distributions along the Straits and high-resolution seabed mapping have yet to be systematically revisited. Nevertheless, there are achievement in the biological conservation effort including the gazettelement of Pulau Payar as a marine park, the recent establishment of a marine park in Malacca, and the designation of Ecologically or Biologically Significant Areas (EBSAs) encompassing the Matang mangroves, Pangkor, and Pulau Jarak. These measures reflect Malaysia's efforts to safeguard critical habitats and maintain ecosystem resilience in the face of increasing pressures. Moving forward, the Straits face mounting challenges from both climate- and human-driven changes. Sea-level rise is already affecting major shipping ports through coastal inundation, while land reclamation in Malacca and Penang continues to transform natural coastlines. At the same time, the Straits remain vital for food security, with the highest national catch-per-unit effort reported in Perak, and for human well-being, as Malaysia's most densely populated coastal communities are concentrated along its west coast. These realities highlight the urgent need to strengthen ecosystem protection, adaptive management, and climate resilience strategies to secure the Straits of Malacca for future generations.

**Keywords:** Straits of Malacca; Marginal Sea; Marine parks; Ecologically or Biologically Significant Areas (EBSAs); Oceanography; Sediment distribution.

# **Multidisciplinary study of the northern Ionian Sea: from fluid seepage to environmental change**

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## **Abstract:**

Marginal seas are partially landlocked, typically have shallower depths than the open ocean and their water quality circulation are often influenced by the nearby landmass, river runoff, climate, human activity and pollution. Inside the Mediterranean Sea, which at times can be regarded as a large-scale marginal sea, the Gulf of Taranto is the northern tip of the Ionian Sea entirely surrounded by land masses with large coastal industrial sites, has a peculiar ocean circulation, hosts part of an accretionary wedge and faces the plate boundary between Eurasia and Africa.

This presentation focuses on the preliminary results of an interdisciplinary oceanographic cruise conducted in late 2023-early 2024 on board the Cnr vessel Gaia Blu in different study areas located in the Gulf of Taranto, using a multidisciplinary and multiproxy approach which combines different marine geophysical and geological data and disciplines including seismo-stratigraphy, sedimentology, biostratigraphy, geochemistry and paleoceanography. The goal is to reconstruct, at different spatial and temporal scales, the main factors that determined the stratal architecture, sedimentary and geochemical heterogeneity and contamination background: i) offshore Crotona, where we deeply investigate a recently discovered mud volcano; ii) offshore Gallipoli, where we characterize, for the first time, a contourite depositional system and iii) offshore Taranto, where we reconstruct background values and Anthropocene trends of classic and emergent contaminants.

These contrasting settings highlight how vertical fluid migration, sediment supply, accommodation space and bottom-current dynamics, acting with different intensities

and across multiple scales, may operate either independently or in interplay to shape the architecture of sedimentary successions at active continental margins. Beyond their stratigraphic implications, this project underscores the importance of sedimentary and bio-geochemical events, illustrating how geological archives provide a key to decoding both past environmental changes and present-day processes in complex marine settings.

**Keywords:** Seepage; Sediment drift; Microplastic; Mediterranean Sea; Plio-Quaternary.

# Evaluation of Ecological and Geological Vulnerability of China's Coastal Zone

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## Abstract:

The coastal zone is the most biodiverse and economically developed region in China. However, rapid urbanization and industrial development, along with the impacts of climate change, have exacerbated the degradation of coastal ecosystems and geological structures. This study aims to quantitatively assess the eco-geological vulnerability of China's coastal zones, providing scientific guidance for ecological restoration and conservation efforts in these areas. The Coastal Vulnerability Index (CVI) is utilized for the assessment of eco-geological vulnerability in coastal zones. This index introduces key indicators that contribute to eco-geological issues in coastal areas into the evaluation system. The assessment is conducted in a zoned and categorized manner. Additionally, the study discusses the characteristics of population distribution in areas with varying degrees of vulnerability and the distribution of vulnerability among different types of shorelines. The eco-geological vulnerability level of China's coastal zones is generally good. Areas that are extremely vulnerable and highly vulnerable account for approximately 11% of the total area of China's coastal zones and about 31% of the total length of the coastline, affecting around 0.64 billion people (excluding data from Hong Kong, Macao, and Taiwan). The areas with higher eco-geological vulnerability in China's coastal zones are mainly located in the tops of the bays of the Bohai Sea, along the shore of the Yangtze River Delta, and other key bays and deltas. The affected population is primarily distributed in the Beijing-Tianjin-Hebei region, the Yangtze River Delta, and the Guangdong-Hong Kong-Macao Greater

Bay Area. There is an urgent need to carry out ecological restoration and disaster prevention and mitigation work in these regions to enhance the ecological resilience of the coastal zones.

**Keywords:** China's Coastal Zone; Ecological Geology; Vulnerability Assessment; CVI.

# Late-Holocene compound flood records in southern China:

## Implications for subtropical coastal hazards

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### Abstract:

Compound flood poses great threats to both coastal environments and human societies. To improve understanding of the sedimentary characteristics and underlying mechanisms of palaeo-compound floods in subtropical region, this study was conducted at the Zhangjiang Estuary, southern China, a site that frequently suffered from mega-typhoon hazards. In this study, sediment grain size, bulk organic  $\delta C$ , C/N, and major and trace elements using an XRF core scanner were analyzed for a percussion core taken from the estuary. AMS  $^{14}C$  dating indicates that the core spans approximately 4300-500 cal. yr BP, with an average sedimentation rate of 0.21 - 1.94 mm/yr. Grain size analysis helps identify at least six major compound flooding events from the core that is predominantly composed of silt and clay sediment (50-75%), interspersed with frequent sandy depositional layers where sand content ranges from 25% to 50%. The combined grain size and the elemental and isotopic signature from these sandy deposits suggest these sandy layers may come from a mix of fluvial/terrestrial and coastal/marine sources. Therefore, these sandy depositional sediments represent compound flooding events, a result from both fluvial flooding and

storm surges, rather than being attributed to solely storm surges or fluvial flooding. Furthermore, typhoons could be the primary driving mechanisms for the compound flood events identified in this study. Because typhoons tend to produce severe rainfall-driven fluvial floods and strong wind-driven storm surges This explanation is further supported by the similar recurrence period of 400 - 700 years between compound floods and severe typhoon activities in the region, and their occurrence times are highly synchronized. This study provides a detailed record of typhoon-induced compound flooding and offers insights into their sedimentary features and periodicity. Findings of this study are crucial for risk assessment and mitigation strategies in subtropical coastal regions under the background of global warming.

**Keywords:** Compound flood; Typhoon; Geochemical record; Global warming; Sea level change.

# **Mangrove monitoring using Landsat data and AlphaEarth data in Pearl River Estuary (China)**

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## **Abstract:**

Accurate and efficient mapping of mangrove forests is essential for understanding coastal ecosystem dynamics. This study compares mangrove classification results derived from traditional Landsat data with those obtained from AlphaEarth imagery in the Pearl River Estuary, China. While the Landsat-based analysis requires the relatively complex steps of data preprocessing and classification, AlphaEarth data achieve comparable accuracy through a much simpler workflow. The results demonstrate that AlphaEarth provides reliable information for small-scale land cover mapping and highlights its strong potential for rapid mangrove monitoring in coastal environments in the case study.

**Keywords:** AlphaEarth; Landsat data; Mangrove; Pearl River estuary.

# **Provenance and Transport Patterns of Particulate Organic carbon in the Turbidity Maximum Zone of the Jiulong River Estuary, Southern China**

Yanren Zhou<sup>1,2,4\*</sup>, Fengling Yu<sup>1,2,4</sup>, Yuze Liu<sup>1,2,4</sup>, Jiaying Li<sup>1,2,4</sup>, Yishu Hou<sup>1,2,4</sup>, Muyi Zhang<sup>1,2,4</sup>,  
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## **Abstract:**

The estuarine turbidity maximum (ETM) is a critical hub for the transport of particulate organic carbon (POC) from estuaries to the ocean. To investigate the provenance and transport mechanisms of POC within the ETM, this study takes the Jiulong River ETM as a research site. Hourly-resolved hydrological parameters, horizontally transported POC (collected via filtration), and vertically settling POC (collected using sediment traps) were systematically sampled from the ETM for two tidal cycles during the dry season in 2018. POCs were analyzed for organic carbon isotopes, and the Monte Carlo end-member model was employed to analyze the relative contribution of different endmembers. Then the empirical orthogonal function (EOF) analysis was applied to examine and discuss the transport patterns and their driving mechanisms of POC within the ETM. The results revealed significant spatiotemporal variations in POC sources: surface POC was primarily of riverine origin (35.5%), while bottom POC was dominated by sedimentary sources (35.1%). Settling POC was also mainly derived from sedimentary sources, reaching up to 65% in high-flow flood tide periods. POC concentrations ( $0.8 \sim 8.4 \text{ mg}\cdot\text{L}^{-1}$ ) showed a significant positive correlation with tidal current velocity ( $0.6 \sim 0.9 \text{ m}\cdot\text{s}^{-1}$ ). The peak settling flux

of particles ( $227.1 \text{ mg}\cdot\text{cm}^{-2}\cdot\text{h}^{-1}$ ) occurred during low-flow periods ( $< 0.2 \text{ m}\cdot\text{s}^{-1}$ ). Based on the correlation between tidal current velocity and POC concentration in the ETM during different tidal phases, three patterns of POC transport within the ETM were summarized: During flood tide, high tidal current velocity triggers sediment resuspension, leading to an initial increase followed by a decrease in POC concentration, which remains trapped near the bottom due to stratification, with sediment-derived POC dominating. At slack tide, as tidal current velocity decreases, sediment resuspension weakens, reducing the contribution of sedimentary POC. POC concentration continues to decline, while the relative proportion of riverine or marine POC increases. During ebb tide, as ebb current velocity intensifies, riverine POC dominates in the surface layer, while sedimentary POC remains predominant in the bottom layer, though its proportion is lower than during the flood tide phase. These findings provide important insights for further understanding the source-to-sink processes of POC within the ETM.

**Keywords:** Estuarine turbidity maximum (ETM); Particulate organic carbon (POC); Tidal current velocity; Resuspension; Tide-dominated estuary; Jiulong River Estuary.

**Scientific Session Three: Biogeography - biostratigraphy from Deep-  
time among marginal seas**

# **Paleosalinity Reconstruction in the Taiwan Strait and its Implications for Minjiang River Flooding and Climate Change over the Past 330 Years**

Min Chen<sup>1,2</sup>, Xuan Liu<sup>1</sup>, Shuqin Tao<sup>1,2</sup>, Shunling Wu<sup>1</sup>, Aijun Wang<sup>1,2</sup>, Hongshuai Qi<sup>1\*</sup>

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## **Abstract:**

Based on diatom records from surface sediments and two core samples from the northern Taiwan Strait and the Minjiang River Estuary, we established a diatom-salinity transfer function and reconstructed the paleosalinity changes in the study area over the past 330 years in combination with the age framework established by 210Pb analysis. The results revealed five large low-salt events during 1691-1882 AD and four small low-salt events since 1882 AD. These large low-salt events resulted from the superposition of several smaller ones. Combined with the historical flood frequency and flood intensity data from the Minjiang River, the diatom accumulation effects from high-frequency floods are more readily preserved in marine sedimentary records outside the estuary than those from singular floods. The magnitude of a low-salt event often indicates not only the flood size but also its frequency. The paleosalinity record revealed that the freshwater flow and flood frequency of the Minjiang River differed overall before and after 1882 AD, which may represent a key climatic turning point in the study area. Furthermore, the paleosalinity corresponds well with the stalagmite records from Dongge Cave in South China and Yuhua Cave in Fujian, and the salinity corresponds to climatic events such as the weakening of the summer monsoon and the conversion of monsoon circulation. The low-salt event also corresponds to the wet stage recorded in two tree rings in Fujian Province. Overall, these findings suggest that

paleosalinity changes in the study area are influenced by both global and regional environmental shifts.

**Keywords:** Taiwan Strait; Paleosalinity; Ancient flood; Paleoclimate.

# **Sedimentary Diatoms and Paleoenvironmental Significance Since the Last Glacial Period in the Northern South China Sea**

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## **Abstract:**

Due to the unique geographical location between western Pacific and southeast Asian continent, the South China Sea (NSCS) is sensitive to global climate change and sea-level fluctuations, which makes it a critical region for reconstructing low-latitude paleoclimatic evolution, that related to strong terrigenous input and land-sea interaction. Utilizing sediment Core TTK2022-D15 (119°39'23.012"E, 20°12'47.777"N, a 420 cm length) from the NSCS slope at 3,208 m water depth, we operated measurement on AMS14C dating, grain-size, biogenic component of biosilica content and total organic carbon, and diatom to the sediments, in order to reconstruct the sedimentary environment and paleoclimatic evolution processes in the NSCS since the Last Glacial Maximum (LGM).

A total of 249 diatom species belonging to 62 genera were identified from this core. Core TTK2022-D15 reveals a low-sedimentation-rate (13.08 cm/kyr), and silt-dominated (>84%) distal low-energy sedimentary environment during the LGM, with dominant diatom species indicative of upwelling and the western Pacific boundary currents.

In the late deglaciation, the sedimentation rate increased to 19.12 cm/kyr and the sand content rose to 16.50%, reflecting an increase in proximal materials input caused by continental shelf submergence. The biosilica content depletion (~11.38%) and fluctuation of diatom abundance (3,393–14,622 valves/g) reflect the Younger Dryas (YD) event.

The content of *Coscinodiscus radiatus* decreased sharply in the Early Holocene, showing a systematic upwelling decline led by intensified ocean stratification. The diatom community restructured into coastal species, representing an ecological transition driven by terrigenous nutrient input.

The high proportion of tropical diatom species (exceeded 25%) in the middle Holocene presented an environmental pattern characterized by tropical water mass dominance, monsoon-modulated upwelling, and saturated terrigenous flux. The sediments in the Late Holocene showed an abrupt increase in terrigenous coarse-grained materials (with a peak sand content of 38.47%) and organic matter, indicating a significant anthropogenic perturbation.

This study established a high-resolution sedimentary-climatic evolution sequence in the NSCS since the LGM through an integrated approach combining chronology, sedimentology, geochemistry, and micropaleontology. It revealed the synergistic response mechanism of "sedimentary dynamics-primary productivity-biocoenosis" to glacial-interglacial cycle, advancing our understanding of paleoclimate and paleoenvironment evolution in marginal seas.

**Keywords:** LGM; Holocene; Paleoclimate; Paleoenvironment; South China Sea; Diatoms.

# **From a Green Sahara to the Present Desert: Example of Holocene Lacustrine Sedimentation at Hassi Manda (Erg Er Raoui, Tabelbala, Algerian Sahara)**

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## **Abstract:**

A humid and green Sahara between approximately 11,000 BP and 5,000 BP represents one of the most remarkable manifestations of global climate change over the last millennia. At that time, numerous lakes and rivers, together with herbaceous and woody vegetation and a diverse fauna, ensured the subsistence of Neolithic populations who succeeded the Paleolithic inhabitants in the heart of the Sahara. Based on lacustrine sediments at the margin of the Erg Er Raoui (Hassi Manda, Tabelbala region) and supported by different archives and biogenic remains, a paleo-hydrological and paleoclimatic (paleoenvironmental) reconstruction is attempted.

Quantitative and qualitative diatom analyses from the Hassi Manda sediment in Algerian Sahara lakes were used to evaluate the environmental development of the lake and climate change during the late Holocene. 67 samples were analyzed, taken from

lake on the border of Erg Er Raoui. A total of 46 diatom species and varieties were identified from one core obtained from the lake. The analysis based on calcareous diatomite collected from this outcrop allowed us to distinguish several ecological groups, reflecting variations in water salinity, lake levels, and trophic states. These changes are mainly associated with climatic variations during the Holocene. The diatom flora includes brackish and epiphytic species like *Epithemia argus*, along with some freshwater and planktonic species, primarily *Stephanocyclus meneghinianus*.

The results provide evidence of Holocene lacustrine conditions linked to the African Humid Period. Shallow-water conditions with wide littoral zones and evaporation periods quickly emerged during this time. High salt concentrations in warm, alkaline waters were linked to these conditions, suggesting marshy habitats.

As a result of generally drier circumstances, the climate also experienced brackish and alkaline conditions along with a drop in lake water levels.

**Keywords:** Holocene; Sahara; Paleoenvironment; Diatoms; Lacustrine sediments; Erg Er Raoui; Hassi Manda; Climate change.

# The Application and Development of Diatom Conversion Function in the Study of Coastal Environmental Evolution

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## **Abstract:**

This study develops and applies diatom-based transfer functions to quantitatively reconstruct late Holocene coastal environmental changes in the Zhangjiang estuary, southeastern China. By establishing both diatom–salinity transfer functions (DSTFs) and diatom–elevation transfer functions (DETFs) using modern surface sediment datasets, we achieve robust reconstructions of paleosalinity and paleoelevation. Transfer functions between diatoms and environmental parameters was established using the Weighted Averaging Partial Least Squares (WA-PLS) model. WA-PLS models demonstrate strong predictive performance, with high correlation coefficients and low root mean square errors. Application to sediment core K5 reveals a long-term trend of decreasing salinity (from ~32 to ~29 psu) and lowering elevation fluctuated basically between -0.1 and 0.4 mYSD, that is, remained near the modern sea level. from 4364 to 279 cal. yr BP, reflecting a gradual coastal regression. Superimposed on this trend, short-term fluctuations and anomalous sand layers correspond to extreme hydrological events, such as storm surges and floods, driven by climatic variability and coastal hazards. The combined application of DSTFs and DETFs enhances reconstruction precision, validates independent proxies, and allows for more detailed interpretations of the interplay between sea-level dynamics, hydrological variability, and human activity. These results provide high-resolution geological evidence for Holocene coastal evolution and demonstrate the advantages of integrating multiple transfer functions in paleoenvironmental studies.

**Key words:** Diatom transfer function; Late Holocene; Coastal paleoenvironment; Sea-level change; Southern Fujian coastal area.

# Primary productivity variations in the Southern Bay of Bengal since the last glaciation: evidence from coccolithophores

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## Abstract:

Marine primary productivity (PP) plays a pivotal role in the global carbon cycle through the function of the biological pump. Coccolithophore, a unicellular calcifying phytoplankton in global ocean, provides an essential proxy for reconstructing past PP dynamics. However, PP variability in the northeastern Indian Ocean remains debated, with some studies indicating markedly lower values compared to the Arabian Sea, while others suggest comparable levels in the southern Bay of Bengal (BoB), underscoring the necessity for region-specific reconstructions. This study presents a high-resolution record of PP over the last 53 kyr, based on quantitative analysis of coccolithophore assemblages from a sediment core recovered from the ninety-east ridge in the southern BoB. Coccoliths are abundant and preserved well throughout all samples, with an average absolute abundance of  $9.55 \times 10^9$  n/g. Assemblages are dominated by *Florisphaera profunda*, *Gephyrocapsa oceanica* and *Emiliana huxleyi*. The PP records reconstructed based on coccolith percentages show low values during the LGM, a gradual rise through the deglaciation, and a peak in the Early Holocene. This trend is consistent with the PP records from the equatorial and western Indian Ocean, which is influenced by monsoon winds variations, sea level fluctuations, and nutrient fluxes input.

**Keywords:** Coccolithophores; Primary productivity; Indian Summer Monsoon; Last Glacial Maximum; Nutrient.

# **Messinian diatom assemblages of diatomites in the Lower Chelif basin (northwestern Algeria)**

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## **Abstract:**

This study, using variations in diatomic assemblages, is a contribution to the characterization of paleoceanographic changes that affected the Mediterranean during the transition from open marine conditions that prevailed during the Messinian and before the salinity crisis. This biological marker was selected because diatomites from the Lower Chelif Basin constitute a dominant sedimentary component of this interval, classically known as the Tripoli Formation.

A detailed analysis of diatoms was carried out on five (05) outcrops selected according to different paleogeographic positions: marginal basin of platform type (Murdjadjo); platform-basin transition zone (Sig); and in a deep basin context (Abdelmalek Ramdane, Ouled Bettahar and Djebel Bent Zouda).

The diatomites, which includes a variety of facies in addition to diatomites s.l., has been subdivided into two (02) lithostratigraphic units or members. Variations in the composition of the siliceous microflora, consisting of 103 species of diatoms and 03 of the most abundant species of silicoflagellates and incidentally radiolarians, make it possible to distinguish two (02) main ecological groups (ecozones) which correspond to the lithological units defined by lithostratigraphical and sedimentological criteria.

This diatom microflora reflects different ecological characteristics: littoral planktonic, neritic-oceanic and oceanic planktonic, benthic, marine to brackish marine,

and even fresh water. Oceanic planktonic forms dominate the microflora of member 1, although there is evidence of coastal influence due to the presence of littoral forms, which are much more abundant in member 2. This would suggest a relatively deep marine environment open to the ocean. Cold forms are predominant here; they are replaced in Member 2 by warmer forms, where sub-littoral populations (littoral and benthic planktonic species) are much more prominent. In certain areas, the latter would indicate the proximity of a reef-type carbonate platform complex. Others suggest a marine environment that may be subject to desalination.

The diatom assemblages characterize the permanence of opened marine environment, the impulse of cold waters from Atlantic origin, a general decrease in bathymetry in the Messinian diatomites, are subject to littoral influences and sometimes even to fresh water contributions. The predominance of the species *Thalassionema nitzschioides* and/or *Thalassiothrix longissima* indicates periods of strong productivity that can be associated to upwelling systems.

A major change is observed at the top of member 2 of the Abdelmalek Ramdane and Douar Bettahar outcrops, those are characterized by sapropelic deposits (sapropelic intervals) rich in spemularia-type radiolarians and diatomic assemblages of cold and warm waters. This accumulation of sapropel was probably controlled by a combination of several factors: warmer sea surface temperatures, primary productivity (river runoff), increased stratification of the water column, and periods of blooms accompanying possible upwellings.

**Keywords:** Diatoms; Paleoenvironments; Messinian; Diatomites; Sapropel; Algeria; Lower Chelif basin.

## Bubble mediated assembly of viral matter

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### **Abstract:**

It was discovered that bubbles rising in sea water may generate a single or double-spiraling motion that arises from separation and acceleration of ionic hydrates on bubble boundaries. Experiments indicated that single stranded motion refers to cationic hydrates while bi-spiraled motion refers to cationic and cationic/anionic motion. Structure of single stranded motion display feature of RNA while bi-stranded reminds architecture of DNA. This suggests that both viral like polymers can be assembled by rising bubbles in saline water. Experiments indicated that stranded forms of rotation are more abundantly assembled in water of 30-40oC temperature range under low salinity of 9 g/kg. That particular result suggests that the RNA viruses and capsid forms of coronaviruses may be synthesized in warmer surface water due to climate warming. Next, the produced variants of viruses may be incorporated to aerosol jet droplets and form capsid like forms of coronaviruses. These may return back to the sea during precipitation or dry deposition and infect bacteria causing their high death and sedimentation. This directly suggests that marine bacteria may be an immediate indicator for the appearance of new variants of viruses that could potentially spread to all biota. We assume that especially warming of the surface coastal water occurring in shallow marginal seas may be responsible for assembly of new RNA that may impact biota in the coastal oceans. Considering that the warmest waters are shallow coastal compartments in the tropics of the Pacific Northwest during summers and autumns it is expected that in their enhanced production of RNA viruses take place, but especially during the tropical rains in the South China Sea. It is thus, suggested to establish a group of multidisciplinary researchers that will conduct pilot investigations and try to develop

a strategy for monitoring of viral matter composition and concentration in waterborne bacteria and uppermost sediments in the coastal water of the South China Sea.

**Keywords:** Spiraling motions of bubbles; Production of RNA; Assembly of capsid viruses; Water warming in tropical marginal seas.

## Silicolagellates as the “canary in the coal mine”

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### **Abstract:**

The four major marine skeleton protist groups in paleontology are, in no particular order, the calcareous nannoplankton, foraminifera, diatoms and radiolarians. The fifth group, still major but generally with much lower abundance and diversity, are the silicoflagellates. In my forty years of silicoflagellates study, I have learned and documented many things:

1) silicoflagellates skeletons, made of a latticework of siliceous hollow rods, within a species are generally quite similar in both fossil and modern populations, but can on occasion exhibit astonishing variability. This has created much confusion within and between fossil and modern taxonomies.

2) the cause of this unusual variability is that skeletal design is influenced by a mathematical optimization: minimization of apical area for a given internal volume within the domal skeletal shape. This minimization may determine skeletal design as much as the genetics of the organism.

3) The shape with absolute minimal surface area to volume is a sphere, which silicoflagellates skeletal designs closely approximate as double skeletons formed and separated during mitosis. Such double skeletons have only fairly recently seen detailed study, which suggests how much remains to be learned of this group.

4) While the exact environmental factors that influence the skeletal shape are unknown, throughout the 100 million years of their evolutionary history, simpler silicoflagellates skeletal designs predominate in warmer latitudes while more complicated morphologies occur in colder waters. For the present, four-sided skeletal morphologies with an apical bridge (*Dictyocha*) occur near the equator, while six-sided

*Stephanocha* are more prevalent in polar waters.

5) Silicoflagellates variability occurs in two quite different types. While skeletons in stable environments are quite similar, populations in some environments such as coastal regions show greater skeletal variability, which may include teratoid skeletons. This is presumed to be due to changes among the mix of environmental factors that influence skeletal design.

6) A vastly different variability, known as plexus events or episodes, is sometimes observed in fossil populations. Here, observed silicoflagellates skeletons are far more abundant than the usual, perhaps being more common than all diatoms combined, and can have a wide range of skeletal variants. Such occurrences strongly suggest severe environmental stress.

7) The phrase “canary in the coal mine” is from American regions of coal production, where the canary’s song delighted coal miners. The canaries were more susceptible than humans to harmful gases and the canary’s death, quickly determined by the music’s end, told the miners to make a quick exit.

8) Silicoflagellates are not well studied, as the four more significant groups have far more species. However, silicoflagellates may well be the oceanic “canary in the coal mine”. There are numerous occurrences in the geological record where plexus events, shown by extreme abundance and unusual silicoflagellates skeletal morphologies, result from environmental stress. Marine microscopists should be looking for these in the modern ocean.

**Keywords:**

# Unveiling *Halampora* sp. from Balekambang Beach, Malang Regency, Indonesia: Morphological and Molecular Insights

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## Abstract:

The diatom is one of the most diverse microorganisms in ecosystems and has a crucial ecological role in primary production and biogeochemical cycling. In this study, a diatom belonging to the species *Halampora* sp. was isolated from Balekambang Beach in the southern Java region of Indonesia, specifically within the waters of the Indian Ocean. The molecular identification analysis was performed using the *rbcL* gene marker, which revealed the strain to be similar to *Halampora yongxingensis* with 99.85% similarity index. Morphological observations revealed distinctive valve features, including shape, size, and striation pattern, that are consistent with those of *Halampora* but show variations compared to previously described species. These findings represent the report of *Halampora* at Balekambang Beach and contribute to the documentation of diatom diversity in Indonesian coastal ecosystems.

**Keywords:** *Halampora*; East Java; Indonesia; *rbcL*.

# **Indonesian Biogeography of the Incidence of Imposex in Marine Gastropods as Bioindicator of Pollution**

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## **Abstract:**

Indonesia, is home to a rich marine ecosystem, offering invaluable ecological services and resources to its coastal communities. However, this precious environment faces threats from various anthropogenic activities, including industrialization and urbanization, particularly in Java, which can result in pollution of coastal waters. Java is the most populous island in the world. Rapid industrialization, urbanization, and economic development have taken a toll on the island's marine ecosystems. Among the various environmental concerns in the region, ecotoxicological studies have gained prominence due to their relevance in preserving and safeguarding marine life. Gastropods are excellent biogeographical indicators because they have limited dispersal, clear habitat preferences, and are sensitive to pollutants. Imposex is the superimposition of male sexual traits onto female gastropods, mainly caused by exposure to organotin compounds (especially tributyltin, TBT) from antifouling paints and some heavy metals. The incidence of imposex in Indonesia varies across regions depending on shipping intensity, coastal industrialization, pollution regulation, and biological susceptibility of local species. Imposex is not randomly distributed but follows biogeographic patterns of species' sensitivity, habitat distribution, and human pollution pressures.

**Keywords:** Anthropogenic activity; Pollution; Imposex mapping; Gastropod.

# **Restoration of Coastal Ecosystems as an Approach to the integrated Mangrove Ecosystem Management and Mitigation and Adaptation to Climate Changes in North Coast of East Java**

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## **Abstract:**

Climate change is very basic and appears on earth. Climate change has become an issue that must be faced by humans today and in the future. One of the impacts of climate change can be found in coastal areas. Tsunamis and tidal floods repeatedly occur in coastal areas. One of the efforts to overcome sea level rise that causes tsunamis, erosion, and tidal flooding is mangrove forests. This study aims to determine public awareness of the occurrence of tidal flooding and tsunami and to find an easy and inexpensive way to overcome it. This research is integrated using the partial least square (PLS) approach and the coastal vulnerability index (CVI) approach to mangrove forests. The results showed that the awareness and assessment of the community to carry out mangrove forest restoration to overcome disasters caused by climate change must be managed and handled with a co-management approach.

**Keywords:** Climate Changes; Mangrove; Restoration; PLS; CVI; Mitigation; Adaptation.

## ***Halamphora* diversity in Turkish coasts**

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### **Abstract:**

Türkiye is surrounded by different seas on three sides: the Black Sea in the North, the Aegean Sea in the West and Mediterranean Sea in the South. Also, the Marmarean Sea is an inland sea connecting the Black Sea and Aegean Sea. Among them, the salinity values range from 17 PSU in the Black Sea to 34 PSU in the Mediterranean Sea. So, each sea has its own current dynamics and physico-chemical properties. In this study, the samples were collected from three stations from Kırklareli, Sinop and Rize in the Black Sea; İstanbul in the Marmarean Sea; Balıkesir, İzmir and Muğla in Aegean Sea; Antalya, Antakya and Cyprus in the Mediterranean Sea. The results showed that only *Halamphora coffeiformis* exists in Aegean and Mediterranean Seas while, there are some undescribed taxa exist in the different seas. As a result, there is a high *Halamphora* diversity in Turkish coasts.

**Keywords:** Diatom; Biodiversity; Turkey; *Halamphora*.

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# Microplastics provided habitats for benthic microalgae in Fujian coastal waters of China

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## Abstract:

Epimicroplastic microalgae (EMP-MA) refers to microalgae adhering to microplastics (MPs), their characteristics of species and taxonomy are still poorly understood. Our investigation in three bays in Fujian showed that EMP-MA communities were mainly composed of diatoms and dinoflagellates, their community structure was significantly different from planktonic microalgae (PM) communities. Above all, the relative abundance of benthic microalgae in EMP-MA communities were significantly higher than that in PM communities, and all dominant species in EMP-MA communities were benthic species, indicating that MPs mainly provide habitats for benthic microalgae and may change their vertical distribution. Environmental variables had less impacts on EMP-MA than PM, which may be attributed to the buffering effect of biofilm on environmental changes. This study highlights the prevalence of benthic microalgae on MPs and their change in vertical distribution, which are new discoveries in algal ecology and may have significant implications for marine primary productivity and marine food webs.

**Keywords:** Benthic microalgae; Microplastics; Epimicroplastic microalgae; Adhesion; Community structure.

# Calcareous Nannoplankton Response to the Cenomanian–Turonian Oceanic Anoxic Event (OAE 2) in the eastern Tethys: evidence from southern Tibet

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## Abstract:

The Oceanic Anoxic Event encompassing the Cenomanian-Turonian (C-T) boundary interval, commonly termed OAE2, represents the most pronounced Cretaceous episode of widespread marine anoxia and carbon-cycle disruption. We present a detailed record of calcareous nannofossil assemblages from the middle-upper Lengqingre and lower Gambacunkou formations exposed at the Qiangdong section, Gamba (southern Tibet, China). This section occupied an inner shelf setting of the eastern Tethys Ocean during the Late Cretaceous. Abundant, well-preserved calcareous nannofossils dominated by *Watznaueria barnesiae*, *Discorhabdus ignotus*, *Biscutum constans*, *Zeugrhabdotus* spp. (<4 μm), and *Eiffellithus turriseiffelii* constitute >50% of the assemblages. Biostratigraphy places the section within Upper Cretaceous (UC) biozones UC1–UC7 and pinpoints the C-T boundary—and thus OAE 2—in the upper Lengqingre Formation. The consistently modest proportion of *Watznaueria barnesiae* (mean 17%, always < 40%) indicates minimal diagenetic overprint and faithful preservation of the primary ecological signal. Quantitative analyses reveal persistently high-fertility surface waters throughout most of the OAE 2 interval, consistent with enhanced nutrient delivery and elevated primary productivity. Calculated nutrient and temperature indices based on nannofossil species with preferred ecologies reveal

significant oceanographic changes across OAE 2, suggesting dynamic coupling between productivity, water-column structure, and anoxia on the eastern Tethyan shelf. These results refine the regional expression of OAE 2 and provide a robust palaeoecological framework for assessing productivity-anoxia feedbacks in marginal seas.

**Keywords:** Calcareous nannofossils; Oceanic Anoxic Event 2; Cenomanian–Turonian boundary; Paleoproductivity; Eastern Tethys; Southern Tibet.

# Diverse deep-sea trace fossils from the Crocker Formation, northwestern Borneo, Malaysia

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## Abstract:

The study of trace fossils offers valuable indicator of paleoenvironmental reconstruction and associated paleoecological changes in deepwater deposits. Here this research provides present a comprehensive ichnofabric analysis for sand-rich deepwater Crocker fan on the onshore Sabah of the southern margins of South China Sea. A total of 14 ichnogenera and 19 ichnospecies have been identified within the Oligocene–Lower Miocene West Crocker Formation in northeastern Borneo, Malaysia. These ichnofacies are dominated by horizontal grazing, farming and feeding traces, representing various behavioral patterns of trace makers. The trace fossil suite include various pre-depositional graphoglyptids and post-depositional forms, reflecting colonization within the mudstone and sandstone/siltstone intervals. Four distinct trace fossil assemblages are recognized: *Helminthopsis-Megagraption-Paleodictyon*, *Ophiomorpha annulata*, *Paleodictyon-Ubinia-Cosmorhaphe*, *Spirophycus-Paleodictyon*. The first assemblage, primarily comprising pre-depositional graphoglyptids, suggests the low-oxygen, deep-water environment enriched in organic matter, indicating long-term sedimentary hiatus. The second assemblage, commonly found on lobe and sheet sandstone surface, implies relatively rapid sedimentation rate. Moreover, the most abundant and diverse trace fossils and bioturbation occur within interbedded of mudstone and sandstone intervals in mid-fan lobe and sheet turbidite in

the medium–upper parts of West Crocker Formation. Network-shaped trace fossils are present along the submarine fan margins, while few trace fossils occur in the outer fan of the lower part of West Crocker Formation. These findings highlight the complexity of palaeoceanographic conditions and benthic environments in foredeep turbidite systems compared to distal hemipelagic and pelagic settings. The temporal interplay between trace fossil assemblages and turbidity current events plays a crucial role in shaping the sedimentological regime of depositional sites and subsequently influencing ichnofaunal communities in foredeep margins.

**Keywords:** Trace fossil; Ichnofabric analysis; Turbidity current events; Crocker fan; South China Sea.

# **Biogeographic Patterns and Paleoenvironmental Reconstruction of Coastal Lagoons of South China: Insights from Ostracods and Foraminifera**

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## **Abstract:**

Coastal lagoons in South China form dynamic land–ocean interfaces and provide sensitive archives of ecological and environmental change. However, long-term biogeographic and biostratigraphic studies remain limited. Here we present an integrated analysis of 39 lagoons, focusing on ostracods and foraminifera as microfaunal indicators. From surface sediments, we identified diverse assemblages that exhibited strong spatial heterogeneity, primarily influenced by geomorphology, salinity, water depth, and heavy metal input. Statistical analyses revealed salinity and water depth as the dominant drivers, and quantitative transfer functions demonstrated reliable potential for reconstructing past environmental conditions. Sediment core records from Pingqing Lagoon further revealed ecological responses over the past 150 years, showing a transition from an open marine bay to a semi-enclosed lagoon with three distinct phases: natural evolution prior to the 1970s, barrier-bar formation and biodiversity decline during the 1970s–2000s, and post-2000s eutrophication with pollution-tolerant assemblages. Our findings highlight the complementary value of ostracods and foraminifera as biostratigraphic indicators in marginal seas. By linking modern ecological gradients with fossil records, this study provides robust tools for paleoenvironmental reconstruction and contributes to improved understanding of lagoon evolution, coastal management, and biodiversity conservation.

**Keywords:** South China; Costal Lagoons; Biogeography; Environmental evolution;

## Deep-Time diatomaceous ooze -- biogeography and biostratigraphy

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### Abstract:

Diatoms are siliceous heterokont microalgae found in fresh and brackish to saline waters, as an important preliminary productivity, playing a crucial role to drive climate change through carbon, oxygen and silicon biogeochemical cycles. Diatom blooms and suitable environmental conditions, can create diatomaceous ooze and diatomite to a unique depositional unit of biogenic accumulation in continental and oceanic strata. In marine environments, diatomaceous ooze is a widely distributed type of sediment composed of siliceous diatom frustules that is deposited on deep sea floor usually, especially below the Calcium Carbonate Compensation Depth (CCD). To understand factors that have influence on diatomaceous ooze, from the genesis, to biostratigraphy, and paleoceanography interpretation, requires greater study. On a Deep-time scale, the big-data analysis is a valuable clue to compile and discover the knowledge for this sediment type that occur in both deep ocean and coastal regions.

Though big-data analysis, we collect diatomaceous ooze documents from public literatures, and using the materials from IODP Cruise 371 to record the species presence and abundance in known diatomite. We obtain preliminary results, that, 1) there is strong diversity of diatom ooze types, and a new one is observed by our work team; 2)

the diatomaceous ooze formations date back to Late Cretaceous at least in marine sediments; 3) biostratigraphy change with biogeography is obviously differentiated open oceans and marginal seas; 4) although most diatomaceous oozes were recorded in open ocean with deep water depth, diatomaceous ooze are also observed in marginal seas from polar to middle even lower latitude nearshore regions; 5) the diatomaceous ooze from giant *Ethmodiscus* is one of dominated types in Quaternary scale, which was recorded not only in glacial stage but also in interglacial stage with a complicated formation genesis; 6) in the Last Glacial Cycle, the marginal seas, except of polar region, e.g., Gulf of California, Shelf of West Africa, Mediterranean Sea, etc., has diatomaceous ooze with different dominate species, showing strong diversity within different oceanographic realms.

**Keywords:** Fossil diatom; Diatomaceous ooze; Eco-diversity; Paleoceanography

We appreciate support from KCC, Kochi, Japan and IODP Expedition 371 cruise.

## Others

# Reconstruction of Ocean Wave Spectrum Based on Deep Learning

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## Abstract:

As a core physical quantity characterizing the distribution of wave energy in the frequency-direction domain, the accurate reconstruction of wave spectra holds significant scientific value and application significance for the optimization of marine engineering design, the analysis of marine dynamic processes, and marine environmental forecasting. Based on Wave Watch III (WW3) model data, this study explores the application of deep learning methods in wave spectrum reconstruction and conducts a comparative study with traditional methods.

The traditional reconstruction method relies on spectral integral parameters (including wave direction, wave height, wave spreading, and peak wave period). It calculates the frequency component using the Jonswap spectrum model, constructs the directional component by coupling with the directional distribution function, and finally synthesizes the complete wave spectrum. Although this method has clear physical interpretability, it is limited by complex calculation procedures, high time-efficiency costs, and relatively low accuracy.

In recent years, deep learning has provided an innovative technical approach for the field of wave spectrum simulation, thanks to its excellent nonlinear mapping capability and high-dimensional data processing efficiency. For this purpose, this study constructs a fully connected neural network with skip connections (WaveSpectrumNet). Taking the spectral integral parameters of 4 partitions as inputs, the network realizes the reconstruction of local wave spectra through the weighted fusion of the main network and multi-scale skip branches. The complete wave spectrum is obtained by superimposing the results after independent training of each partition.

The study conducts verification from four dimensions: correlation coefficient (R),

root mean square error (RMSE), bias, and spectral shape distribution characteristics. The results show that the proposed deep learning method significantly reduces the computational cost while maintaining high reconstruction accuracy, and thus can serve as an effective solution for efficient wave spectrum reconstruction. Future research will further introduce advanced deep learning frameworks to optimize the model structure, aiming to enhance the reconstruction performance.

**Keywords:** Wave spectrum reconstruction; Wave Watch III; Deep learning; Fully connected neural network; Skip connection.

# **Research on water depth Inversion method based on Substrate zoning around island's reef via remote sensing**

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## **Abstract:**

The bathymetric information around coral reef is out of vessel's investigation results in usually. Using the remote sensing image data to abstract water depth is a valuable selection for shallow water survey. This study selects Yongxing island in Xisha islands, northwest South China Sea to study a remote sensing inversion method which could suitable for obtaining the water depth data around that coral reef. As experiment, GF-1 and Landsat 8 remote sensing image data are carried out through using the chart depth data. Firstly, an optimal inversion model is determined. After practicing that optimal inversion model, water depth inversion results of single source images are obtained according to substrate zoning results. Then, to merge the results from medium and high-resolution single source images inversion, are basing on the decision-making level classification fusion rules via fuzzy membership. After comparison on results of root mean square error and average relative error from the overall and water depth segmentation inversion results respectively, the experimental results show that:

1) the remote sensing inversion water depth results based on sediment zoning are better than those without sediment zoning;

2) accuracy of multi-source remote sensing inversion water depth fusion results based on seafloor substrate zoning is better than that of single source remote sensing inversion water depth results based on sediment zoning.

**Keywords:** Coral reef, Water depth retrieval, Remote sending data, Data fusion, Substrate zoning, South China Sea.

# **Blue-Economy Geopolitics in the South China Sea: Interdependence, Risk and Opportunities for Cooperation**

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## **Abstract:**

Marginal seas are an increasingly important arena where economic development, ecological sustainability, and geopolitical interests intersect. The South China Sea exemplifies these tensions, with overlapping Exclusive Economic Zone (EEZ) claims, intensifying fisheries exploitation, and rapid port expansion. At the regional level, negotiations between ASEAN and China on the Code of Conduct (CoC) have progressed slowly, while at the bilateral level, recent Indonesia - China joint agreements show greater potential for cooperation. This paper examines the blue-economy geopolitics of the region using publicly available datasets to map patterns of overlapping resource use and environmental pressure, and by reviewing existing policies, ongoing ASEAN - China negotiations, and bilateral arrangements. It identifies governance gaps and explores policy options to improve coordination and support sustainable blue-economy outcomes.

**Keywords:** South China Sea; Blue economy; Geopolitics; ASEAN; Indonesia–China; Governance.

# **Characteristics and influencing factors of planktonic communities in the waters surrounding Jiangmu Island in Honghai Bay, South China**

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## **Abstract:**

To explore the characteristics and influencing factors of plankton around the utilization of islands, this study conducted water quality monitoring and plankton surveys in the waters around Jiangmu Island, Honghai Bay, South China, in September 2022. The results show that the water quality around Jiangmu Island is good, meeting Class I to Class II water quality standards; A total of 106 species of phytoplankton were detected, with diatoms dominating and an abundance of up to 92.1%. The mean values of Shannon diversity index, richness index, and evenness index are 3.93, 2.696, and 0.776, respectively; A total of 45 species of Zooplankton were detected, with copepods dominating at 44.4%. The mean values of Shannon diversity index, richness index, and evenness index are 2.732, 1.948, and 0.628, respectively. Pearson analysis shows that the diversity index of phytoplankton is significantly negatively correlated with mercury; The diversity index and total density of Zooplankton are significantly negatively correlated with heavy metal or nitrogen concentrations. The study revealed the negative impact of utilization activities on plankton, providing a scientific basis for the protective utilization of islands.

**Keywords:** Jiangmu Island; Phytoplankton; Zooplankton; Environmental factors; Diversity index.

# **A Comparative Study of Deep-Sea Equipment: Application Scenarios and Key Technologies**

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## **Abstract:**

The deep sea, characterized by its vastness, high pressure, and strategic importance, has become a key area for international scientific and technological efforts. Recent developments in deep-sea equipment emphasize unmanned operation, intelligence, and global deployment, supporting applications such as seabed mapping, resource exploration, and ocean monitoring. Leading countries in this field include China, the United States, Russia, Japan, Norway, and France. Trends show increasing system diversity and international collaboration. However, progress is limited by challenges in navigation accuracy, underwater communication, and system integration. Conducting a systematic comparative analysis of equipment types, key technologies, and application scenarios provides a foundation for formulating development plans for China's deep-sea equipment.

**Keywords:** Deep-Sea Equipment Classification; Application Scenarios; Critical Technologies; Deep-sea Equipment Development.

# Open-domain Geoscience Data Discovery, Association and Intelligent Recommendation

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## Abstract:

The proliferation of open-domain geoscience data across heterogeneous and distributed repositories poses significant challenges to efficient data discovery, association and recommendation. To bridge this gap, we present DataExpo—a one-stop platform that leverages deep learning techniques to systematically integrate global geoscience resources, including “dark data” and long-tail datasets from the Internet. DataExpo supports multi-modal data exploration through keyword search and map search, automated metadata extraction from unstructured webpages, and cross-dataset association analysis. By incorporating AutoFAIR as an evaluation framework, the platform ensures that datasets align with the FAIR principles (Findable, Accessible, Interoperable, and Reusable), thereby enhancing their scientific value and reusability. Furthermore, DataExpo has been augmented with an intelligent recommendation technique, which identifies and structures high-impact “gold data” from publications in Cell, Nature, and Science, delivering FAIR-compliant dataset recommendations to researchers. This integration underscores DataExpo’s capacity to support both large-scale geoscience data services and high-value interdisciplinary applications, offering a scalable and intelligent framework for open-domain data discovery, association, and recommendation.

**Keywords:** Data Discovery; Data Association; Data Recommendation; DataExpo; FAIR Principles.

# **Mechanism Analysis and Application Research of Clear-Sky Low-Level Wind Field Variations in the typical Regions in the Guangdong-Hong Kong-Macao Greater Bay Area (Pearl River Delta urban agglomeration)**

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## **Abstract:**

This study focuses on the impact of the complex heterogeneous land surface processes on low-level (<300m) wind field in the typical Regions in the Guangdong-Hong Kong-Macao Greater Bay Area (Pearl River Delta (PRD) urban agglomeration). Based on the high-precision observation data and Terrain Data, a newly developed numerical model (Multi-Scale Urban Canopy Model, MSUCM) is established to simulate high resolution (hundred-Meter to Meter Scale) low-level wind field in PRD urban agglomeration and analysis the temporal and spatial characteristics of urban low-level wind field. The research focuses on the surface and low-level wind shear, clear-air turbulence as well as the generation mechanisms of wind channels and wind shear at different levels in the low-altitude airspace of the PRD urban agglomeration. The main contents are as follows: (1) Generate a surface complex aerodynamic resistance map based on high-precision topographic data of PRD urban agglomeration. (2) Using MSUCM model, we generate high resolution complex heterogeneous low-level wind field in PRD urban area, and perform fusion and correction of wind field based on multi-source meteorological data in PRD areas. (3) Establish a database of historical clear-air wind shear variation cases on the surface in PRD and conduct research on the numerical simulation of low-altitude wind shear, especially clear-air wind shear,

identify the spatiotemporal variation characteristics of regional wind shear in RPD.(4)Carry out risk early warning and risk assessment of low-altitude wind shear for the PRD urban agglomeration, and provide risk early warning and risk assessment for multi-layers (low-speed channel(90-150m), medium-speed channel(150-210m) and high-speed channels(210-300m)) from the land surface to the low-altitude airspace. (5) Analysis the characteristics of the low-level wind field and wind shear in the river or coastal zones of PRD urban agglomeration.

**Keywords:** Low-altitude airspace, Wind shear, Clear-air turbulence (CAT), Aerodynamic impedance, Heterogeneous wind field.

# **A Study on the Kinetics of Carbon Dioxide Hydrate Formation in a Clay Environment and under the Influence of Different Promoters**

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## **Abstract:**

Hydrate-based CO<sub>2</sub> sequestration (HBCS) is a cutting-edge technology for achieving the goal of "carbon neutrality." Marine sediments, especially formations rich in clay minerals like montmorillonite, are ideal sequestration sites, but their complex physicochemical properties pose challenges to the rapid formation of hydrates. To investigate the formation kinetics of carbon dioxide hydrate in a clay environment, this study compared the formation characteristics of CO<sub>2</sub> hydrates under three conditions in a high-pressure reactor simulating marine sediments: without a promoter, with the addition of L-tryptophan (an environmentally friendly amino acid), and with the addition of 1,3-dioxolane (DIOX). The experiment systematically examined key kinetic parameters such as induction time, gas consumption, formation rate, and final gas storage capacity. We found that in the clay environment, the overall promotion ability of the three systems for CO<sub>2</sub> hydrate formation followed the order: 1,3-dioxolane > L-tryptophan > no promoter. This study confirms the necessity of applying chemical promoters in clay environments and highlights the great potential of 1,3-dioxolane for efficient carbon dioxide hydrate sequestration in clay-rich sediments, providing a theoretical basis and data support for the practical application of this technology.

**Keywords:** Carbon dioxide hydrate, Carbon dioxide sequestration, Montmorillonite, Kinetic promoter.

# Origin analysis of overpressure s and quantitative assessment in the Dongfang area, Yinggehai Basin

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## **Abstract:**

Analysis of overpressure origins serves as the foundation for pressure prediction and hydrocarbon accumulation studies. Overpressure is widely distributed in the Dongfang area of the Yinggehai Basin, demonstrating a close yet complex relationship with hydrocarbon accumulation. It is imperative to conduct in-depth research on the origins of overpressure and perform quantitative evaluation. Analysis utilizing well log combinations, loading-unloading curves, and acoustic velocity-density crossplots was conducted to investigate the origins of overpressure in the Dongfang area, Yinggehai Basin. Research results indicate that two-stage overpressure is widely developed in the Dongfang area of the Yinggehai Basin. The first overpressure zone occurs in strata above the mid-lower Yinggehai Formation at 1000-1500m depth, with a pressure coefficient over 1.3; the second segment is located in the Huangliu Formation below 2400m, with a pressure coefficient exceeding 1.5. Acoustic time difference, density, and resistivity logging curves exhibit significant responses to overpressure, manifesting as reversals to varying degrees. Integrated analysis with multiple methods indicates that the overpressure in the Dongfang area of the Yinggehai Basin is primarily caused by a combination of hydrocarbon-generation pressurization and undercompaction. The magnitude of hydrocarbon-generated overpressure primarily ranges from 5 to 20 MPa, contributing 40% to 75% of the total overpressure.

**Keywords:** Yinggehai basin; Overpressure genesis; Hydrocarbon-generating pressurization; Quantitative evaluation.

# Sound velocity structure of deep-water sediments in the West

## Philippine Sea

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### Abstract:

The sound velocity of deep-sea sediment is fundamental in constructing the sound field of the marine environment. In this study, we measured sound velocity, wet density, porosity, water content, and the mean grain size of 11 sedimentary cores obtained from the 4818-6630 m deep water area of the West Philippine Sea. We describe the basic characteristics and vertical variation in the acoustic and physical parameters of the seabed sediment in the study area, explore the relationship between physical parameters and sound velocity, and compare measured data with predicted values from empirical equations. We then use this information to develop a seabed sediment acoustic model for the study area. The sound velocity of sediment ranges from 1460 to 1674 m/s, the porosity ranges from 62.07% to 69.54%, the density ranges from 1.34 to 1.62 g/cm<sup>3</sup>, and the mean grain size ( $\varphi$ ) ranges from 7.75 to 8.40. The test results are similar to the acoustic properties of other ocean sediments worldwide. The parameters of sediment vary with depth, and the density has a greater impact on the sound velocity than the porosity and the mean grain size in the study area. A comparison between the measured and the empirical values indicates that even though there are still certain errors, the empirical formula reflects the vertical acoustic characteristics changes of seafloor sediments to some extent. We also measured significant differences between the acoustic characteristics and the geoaoustic models of the seabed sediments in the

northern (A zone) and southern (B zone) regions of the Central Rift Zone. High acoustic velocity sediment stratification mainly dominates Zone A, while Zone B is mainly dominated by low acoustic velocity sediment unstratified models. This difference is the result of the influence and control of the seabed sediment types, the sedimentary environments, and the sediment microstructure.

**Keywords:** Sound velocity characteristics; Sound velocity structure; Physical parameters; Deep-sea sediment; West Philippine Sea; Sedimentary cores.