BOOK OF ABSTRACTS 3RD INTERNATIONAL CONFERENCE ON SEAFLOOR LANDFORMS, PROCESSES AND EVOLUTION

Foreword

Welcome to Durban and the beautiful south coast of KwaZulu-Natal.

This book of abstracts represents a reduced volume from the original submissions, which numbered approximately 100. Given the uncertainties of global politics and the prevailing tensions in the Middle East, a number of withdrawals have unfortunately occurred over the past few weeks. This booklet therefore comprises approximately 60 remaining contributions from a diverse group of early-, mid- and late-career researchers representing countries and study sites from across the world.

The breadth of both "time" and "space" represented in these abstracts is particularly heartening, reflecting a collective growth in marine geoscience, and especially marine geomorphology, that is increasingly global and inclusive. It is especially satisfying to see such strong representation from the Global South, with approximately half of the contributions focusing on regions where significant logistical and scientific challenges to marine geomorphological research are routinely encountered.

To all the authors and their research teams, thank you for your steadfast commitment to this meeting, and for the opportunity to learn from one another, to share experiences, and to strengthen the collaborations that help us to better understand the ocean through the stories recorded on its seafloor.

A special thank you is extended to the Scientific Committee on Oceanic Research (SCOR), the University of KwaZulu-Natal, and the South African Institute for Aquatic Biodiversity for their generous sponsorship of African student attendance. We also gratefully acknowledge the KwaZulu-Natal Tourism and Film Authority for its generous support in helping us host this conference at the beautiful Pumula Beach Hotel.

May you enjoy your time here, and may you return to the shores of KwaZulu-Natal many times over.

Nkosi Sikelel' iAfrika (God Bless Africa)

Prof. Andy Green
University of KwaZulu-Natal, Durban, July, 2026

On behalf of the 3rd International Conference on Seafloor Landforms, Processes and Evolution Organising Committee

Geodiversity mapping based on geomorphometric modelling

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Technological advances in seabed mapping and classification, combined with Brazil's strategic goals for marine spatial planning and the growing demand for deep-sea research, understanding the spatial distribution of marine habitats is essential to support informed decision-making. The eastern Brazilian margin is characterized by high ecological and socio-economic complexity. This study is based on the premise that abiotic variables, particularly terrain attributes associated with geodiversity, play a fundamental role in structuring marine habitats and can be effectively applied to habitat classification. Bathymetry from the LEPLAC2021 grid (1-km resolution) was analysed in ArcGISPro to generate a geodiversity framework for habitat mapping. Morphometric modelling was performed using BRESS tool, applied separately across four depth-defined zones, enabling the classification of four landform types: flat, slope, ridge, and valley. The resulting geodiversity map was used to identify ecologically relevant areas, consistent with biodiversity patterns and the Marine Key Ecological Features concept. Results reveal pronounced geomorphological heterogeneity across the study area. The continental shelf is predominantly flat, although the spatial resolution limits smaller-scale features detection such as reefs, pockmarks, and incised valleys. In deeper regions, negative landforms associated with slope canyons were identified. The abyssal plain, while largely classified as flat, exhibits distinct positive and negative features related to channels, seamounts, salt diapirism, the Rio Grande Rise, and structures associated with the Mid-Atlantic Ridge. These findings highlight the seafloor geodiversity. The approach demonstrates strong potential to guide future sampling strategies and underscores the importance of integrating additional datasets to refine habitat classification and enhance methodological robustness.

Keywords: Bathymetry, Geomorphometry, marine spatial planning, geodiversity.

Submarine landslide distribution along the Cretan margin and tsunami relevance

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Crete is located along an active convergent margin in the eastern Mediterranean, characterized by high sedimentation rates, steep submarine slopes, and frequent seismicity. These conditions favor submarine mass-wasting processes, which pose a significant geohazard due to their potential to generate tsunamis and impact offshore infrastructure. Despite this, a systematic and region-wide inventory of hazard-related seafloor features along the Cretan margin remains limited.

Here, we present a comprehensive geomorphological map of the offshore region around Crete, based on high-resolution multibeam bathymetry and sub-bottom profiler data, primarily acquired during the R/V Maria S. Merian cruise MSM135. The analysis enables the identification and spatial classification of seafloor features, with a particular focus on landslide scars and blocky slope deposits.

Landslide scars are predominantly clustered in the southwestern and northeastern offshore areas of Crete, whereas channel systems are mainly concentrated along the northern to northwestern margin. To evaluate the tsunamigenic potential of selected submarine slope instabilities, different failure scenarios were simulated using the L-HySEA model. The simulations yield maximum coastal wave heights between 0.4 and 5.5 m, emphasizing the potential hazard associated with submarine slope failures along the Cretan margin.

Keywords: Eastern Mediterranean, Seafloor geomorphology, Gravity-driven sediment transport, Submarine geohazards, Tsunami modelling

Aspects of the geology and geomorphology of Lake Bangazi North: a palaeo-estuary to the Mkhuze River

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This research examines the geological evolution of Lake Bangazi North, on the east coast of northern KwaZulu-Natal, South Africa. Very little research has been conducted on this area and as a result the information provided in this paper will serve as the one of the first research pieces on the area. The geophysical and seismic stratigraphy, changing palaeo-environments relating to the change in contemporary geomorphology using bathymetry and satellite imagery are described for the area of Lake Bangazi. These data were collected and interpreted via geophysical and seismic reflection data, multibeam bathymetry and remote sensing. Geochemical analyses on a core sample taken from the lake provided a quantitative interpretation of the lake sediment, linking the recent development to the broader geological history.

The change in sea level following the Late Pleistocene and Holocene era had a significant effect on coastal systems. Lake Bangazi like other coastal systems along the east coast of KwaZulu-Natal such as St Lucia estuary, Kosi Bay and Lake Sibaya shows similar changes with the interaction of the Pleistocene dune barrier complex influencing the development of these systems. It is theorised that Lake Bangazi was once connected to the St Lucia estuary. Lake Bangazi has been isolated from the St Lucia estuary for a significant period of time where it has only been affected by prolonged periods of drought, thereby ensuring a high preservation potential allowing for an accurate geological evolution to be drawn from the stratigraphic record. An unexpected, yet interesting, aspect of this study shows the relationship that wildlife, specifically hippos, can have with waterbodies and the impact their role as bio-engineers play in the development of these waterbodies.

Keywords: Seismic Stratigraphy, Bio-engineering, Sea-level rise, Ground Penetrating Radar, Palaeo-estuary

Morphosedimentary evolution of a Late Pleistocene submerged coastal system on the sediment-starved western Sardinian shelf

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Coastal systems record the complex interplay between relative sea-level changes, sediment supply and hydrodynamic forcing. In the Mediterranean Sea, several studies have documented submerged coastal morphologies associated with the postglacial sea-level rise. However, most of these systems developed in mixed or delta-fed settings, where high sediment supply played a key role in terrace formation. In contrast, the western Sardinian shelf is wave-dominated and characterized by low fluvial input, offering an excellent natural laboratory to investigate how coastal systems responded to sea level variations in a sediment-starved continental shelf.

This study integrates high-resolution seismic and bathymetric data to: (i) identify the tectonic inheritance of the area through the recognition of a previously unmapped Pliocene normal fault; (ii) characterize four backstepping terraces interpreted as the preserved record of the Younger Dryas, reflecting stages of relative sea-level stabilization; and (iii) document two overstepping barrier systems formed in response to the rapid sea-level rise associated with Meltwater Pulses 1a and 1b. The absence of major fluvial sources and the dominance of Mistral windstorms further constrained coastal development during the Late Pleistocene.

These findings enable the reconstruction of the paleo-geography of the western Sardinian shelf, emphasizing the dominant role of inherited paleo-topography and wave dynamics on the evolution of a submerged coastal system in a sediment-starved continental shelf.

Keywords: submerged coastal system, Younger Dryas, Meltwater Pulses, sea-level rise, submarine depositional terraces

Sensing Turbidity Currents: A Comparison of Instrument Observations from the Monterey Canyon, California

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Turbidity currents are a globally significant process for transporting material and shaping submerged continental margins. These flows are difficult to monitor due to their speed and power; hence, few measurements have been made globally. Here, we compare observations of turbidity currents recorded by a unique multi-instrument array deployed in the Monterey Canyon, California, USA from November 2024 to April 2025. The array combined traditional turbidity current monitoring tools (moored Acoustic Doppler Current Profilers (ADCPs) and Conductivity-Temperature-Depth (CTD) sensors) with emerging acoustic and seismic approaches (hydrophones, ocean-bottom seismometers (OBSs), land-based seismometers, and distributed acoustic sensing (DAS) along a subsea cable). Moored instruments (CTDs, ADCPs, hydrophones) were placed in the canyon whereas the remaining sensors were deployed outside the canyon at distances of 100-450m for OBSs, >3000m for land seismometers, and 200-8000m for the DAS cable. Four turbidity currents with peak velocities of 3-8 m/s were observed by all instruments except the land seismometers and the DAS system. The ADCPs and CTDs provided the most direct, accurate constraints on local turbidity current arrival while hydrophones and seismometers detected events earlier by recording flow signals generated several kilometers upslope. The instruments also differed in their ability to capture different parts of the flows. ADCP data quality degraded due to high sediment concentrations at the flow front and base, while hydrophones and seismometers more clearly recorded these denser regions compared to the dilute flow tails. Our instrument comparison provides new insights into turbidity current behaviour and offers practical guidance for future monitoring strategies.

Keywords: Turbidity Currents, Submarine Canyons, Environmental Seismology

Seafloor landforms and habitats of a tropical inner shelf: integrated single-beam bathymetry and ROV exploration in the Pedra da Risca do Meio Marine Park, NE Brazil

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The continental shelf of northeastern Brazil preserves geomorphological features linked to late Quaternary sea-level fluctuations. The Pedra da Risca do Meio State Marine Park, located offshore Fortaleza (Ceará State), is situated on an outer marine stabilization surface formed during the Post-LGM transgression, characterized by submerged reefs, rocky bottoms, and bioclastic sedimentary accumulations. This study integrates bathymetry and Remotely Operated Vehicle (ROV) imagery to assess seafloor landforms and bottom types. Bathymetric data were used to generate a Digital Terrain Model (DTM), from which multiple bathymetric profiles were extracted to support morphological interpretation. ROV video surveys provided visual ground-truthing of substrates and geomorphological features. The DTM indicates depth variations between 15 and 28 m, clearly revealing submerged reef structures distributed across the area. Extracted profiles show contrasting morphologies, including reef alignments parallel to the present-day coastline, consistent with structurally controlled features. Other profiles display relatively flat sectors between 15 and 20 m depth, interpreted as areas of overlapping reef growth, bioencrustations and bioclastic sediment accumulation. Subaqueous ripples, predominantly composed of bioclastic material, were also identified. ROV imagery was analyzed using the BIIGLE platform, and substrates annotteted according to the EUNIS classification system, complemented by geomorphological elements observed along the profiles. The results effectively integrate sigle-beam bathymetry and ROV observations despite the positioning challenges encountered, and they highlight the heterogeneous nature of the seafloor on reef-dominated tropical shelves.

Keywords: Bathymetry, ROV imagery, Tropical continental shelf, Seafloor geomorphology

Early Holocene relative sea-level change revealed by shallow-water Chirp seismic geomorphology in the southeastern Levant

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Early Holocene relative sea-level (RSL) rise reshaped continental shelves, yet its geomorphic and stratigraphic expression in semi-enclosed basins such as the southeastern Levant remains poorly constrained. This study investigates Early Holocene sea-level change using ultra-high-resolution marine seismic data in very shallow water (3-20m).
Seismic imaging was conducted using an Exail Echoes Compact 10 kHz sub-bottom profiler. The Survey design employed variable grid resolution tailored to two complementary objectives. A dense grid with 1–2 m line spacing targeted detailed imaging of buried Neolithic village remains and associated anthropogenic surfaces, while a broader grid with 20-50 m spacing to resolve the geological architecture and spatial continuity of an expected Early Holocene marshland.
Chirp profiles show a brackish wetland surface interpreted to have been progressively transgressed by coastal sand bodies related to Early Holocene. Coring and dating of the sediment is planned next. Seismic facies analysis identifies features interpreted as drowned terrestrial surfaces, flooding unconformities, wetland–sand contacts, and a transgressive sand unit, possibly documenting episodic shoreline retreat and marine inundation. Initial results suggest feasible identification of archaeological remains within the upper meters of sediment in the Neolithic site, while marsh-related seismic facies define potential RSL index horizons suitable for dating and curve reconstruction. The close spatial association between these stratigraphic markers and the submerged settlement allows cautious evaluation of the relative timing between Early Holocene sea-level rise and human landscape use.
Results indicate Early Holocene transgression and demonstrate the value of shallow-water Chirp seismic geomorphology for sea-level reconstruction.

Keywords: Early Holocene; relative sea-level change; shallow-water seismic; seismic geomorphology; submerged landscapes; transgressive stratigraphy;

Innershelf Linear Sandridges Adjacent to a Delta

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A field of bedforms was identified adjacent to the submerged part of a wave-dominated coastal delta (Delta do Rio Doce, Brazil) and described as linear sand ridges. These sand ridges are oblique to the coast. These bedforms can be divided into two different groups in terms of size and sediment cover. The shallower bedforms occurs in depths of 25 to 35 m, showing an average length of 4.8 km, 1.3 km distance between their crests, and an average height of 1.37 m. The bedforms in deeper water occur from 35 to 50 m deep, showing an average length of 3.2 km, 1.25km distance between crests and average heights of 3 m. All the bedforms are aligned in a SE/NW direction. The deeper sand ridges are covered by carbonate gravel and rhodoliths, which apparently prevent their movement and probably preserve their height; the shallower ridges are covered by fine sands, with mud along the troughs. Using seismic data, we identified seismic stratigraphic units separated by an erosional surface. The upper unit is the actual progradational facies related to the submerged delta, and the unit linked to the bedforms apparently is a transgressive surface. Thus, the origin of these bedforms is probably linked to past sedimentary dynamics at a different sea level.

Keywords: Bedforms, Multibeam Echosounder, geomorphological mapping, sediment.

Integrated and multiproxy study of marine seepage systems in a hybrid volcanic-sedimentary basin of the Tyrrhenian Sea, Mediterranean region

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Active seeps have been described in a wide range of geological environments and geodynamic contexts. However, fluids seeping in hybrid volcanic-sedimentary basins have always received less attention. This contribution outlines surface expressions and sub-surface features related to fluid flow on the continental slope (500-800 m) of a hybrid volcanic-sedimentary basin (Paola Basin) located in the upper plate of the subduction zone that originated the Tyrrhenian back-arc basin (Mediterranean Sea).
The area is characterized by sites of vigorous hydrothermal venting of CO2 related to Pleistocene hydrothermal vent complexes fed by igneous intrusions and originating from Messinian units as imaged by multichannel seismic reflection data. Here, authigenic siderite, showing enrichment in δ13C and δ18O likely related to methanogenesis and intermittent venting of deep-sourced CO2, precipitate.
Pockmarks on top of mud diapirs controlled by normal faults and diapirism of the Messinian evaporites, as imaged by multichannel seismic reflection data are accompanied by methane-derived authigenic aragonite-calcite depleted in δ13C and slightly enriched in δ18O, which precipitated due to Anaerobic Oxidation of Methane in the Sulfate Reduction Zone, and chemoautotrophic symbiotic shelly mega fauna with associated chemoautotrophic symbiotic shelly mega fauna (e.g. Acharax sp. and Lucinoma kazani). The down-core trend of abundance and isotopic characteristics of clam beds, benthic and planktonic foraminifera show that these seep sites have remained geochemically optimal habitats over a period of more than 40,000 years chronologically constrained using biostratigraphy and tephrostratigraphy. Episodes of enhanced methane flux are also recorded and these have been constrained to specific ages.

Keywords: Pockmarks, hydrothermal vents, authigenic carbonates, multichannel seismic reflection, tephrostratigraphy, Paola Basin

Storm-wave-triggered submarine landslide on the shelf of Corvo Island (Azores): evidence, mechanisms, and hazard implications

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Recent high-resolution bathymetric surveys of the southern shelf of Corvo Island (Azores) revealed a previously undocumented submarine landslide that occurred between May 2018 and August 2019. This study documents the geometry, volume, timing, and triggering mechanisms of this mass-wasting event and evaluates its implications for coastal hazard assessment. The landslide affected a sandy clinoform structure, removing approximately 0.291 km² of seabed and mobilizing an estimated sediment volume of 0.0046 km³ through a rotational failure directed toward the SSW. Comparison of multibeam bathymetry acquired before and after the event, supported by legacy single-beam data, enabled accurate reconstruction of pre- and post-failure morphology. Seismic reflection data reveal a pre-existing basement depression beneath the landslide scar, suggesting repeated instability and the presence of a décollement surface that facilitated failure. Analysis of wave and seismic records indicates that the landslide was most likely triggered by intense storm-wave loading rather than seismic activity. In particular, a severe storm on 27 November 2018 generated wave heights exceeding 10 m and orbital velocities of ~1.4 m/s at the clinoform rollover depth (~45 m), sufficient to mobilize medium sands and induce cyclic pore-pressure buildup. The proximity of the landslide to Corvo's harbour highlights the vulnerability of shallow shelf clinoforms to storm-driven failure. Although the event was too small to generate a significant tsunami, the presence of multiple older scars indicates recurrent instability. These results emphasize the need for targeted geotechnical investigations and continuous monitoring of shelf environments near critical coastal infrastructure.

Keywords: Submarine landslide, storm waves, shelf clinoforms, Corvo Island, Azores, coastal hazard

Submerged beach ridges development between canyon heads and valleys in a narrow shelf, Eastern Brazilian Margin

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Drowned paleocoastal features on continental shelves are important indicators of sea-level changes in the Quaternary. Therefore, the objective of the study was to understand the main geomorphic characteristics of beach ridges located in a section of the Brazilian shelf. Multibeam echosounder survey was performed using an R2Sonic 2024 system in an area of 85km², providing detailed bathymetric dataset. The beach ridges stretch for ~12 km between the Comboios Valley and Watu North Canyon Head. The orientation of ridges follows the shelf break physiography, such as the influence of the canyon head of the Watu Sul on the orientations - NE-SW, NNE-SSW, and ENE-WSW. The ridges are concentrated (strandplain type) near Watu Sul and spaced and/or isolated in the rest of the area. The ridges' depths range, predominantly, between -56 to -60 m, reaching amplitudes (difference between the swale and crest) of up to ~4m. The beach ridges are bounded seaward by a cliff-like feature. These cliffs, regionally represented by the -60 m isobath (58-64), are up to 6 m high. The origin and formation of these beach ridges is interpreted based on the relationship between sea-level curves indicating the flooding of continental shelves (e.g., Lambeck curve) versus key events (e.g., MWPs). Considering the water depth, it is evident that the Younger Dryas sea-level slowstand could be the reason for the formation of the beach ridges and cliffs, while MWP1B (rapid sea level rise) would have drowned the ridges. Furthermore, the influence of older events (glacial/interglacial cycles) cannot be ruled out.

Keywords: Landforms, Submerged Strandplain, Slowstand/Stillstand, Shelf Flooding, Multibeam Bathymetry

Synthesis of the Late Quaternary Evolution and Morphology of the Abrolhos Reefs (Brazil)

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Submarine geomorphology is a main environmental driver defining the seascape and associated benthic habitat. In this sense, eustatic sea-level fluctuations played a major role in shaping the morphology of the seafloor. During the last deglaciation, changes in rates of sea-level rise led to moments of stillstand and rapid rise acceleration, forming and drowning distinct shelf geomorphological features. Here, we present and discuss the morphology and evolution related to submerged and emergent reefs along the Abrolhos shelf (western South Atlantic, Brazil). Unlike other carbonate platforms globally, the Abrolhos Shelf is a shallow and open carbonate shelf, comprising emergent and submerged reefs. Our aim is to provide a detailed description of the reef geomorphology variability and to discuss reef evolution and their responses to sea-level variations during the Late Quaternary. In this synthesis, in addition to the reef growth phases previously reported in the literature for Abrolhos, we observed that: (i) the coastal reef structures of Abrolhos ceased growth at different times during the Late Holocene, indicating spatial variability in paleotopographic control; (ii) pinnacle morphology transitions from chapeirões to tower-shaped pinnacles and reef banks with increasing water depth; (iii) pinnacles at the Abrolhos Parcel are composed of a reef-building organism distinct from the coralgal framework, namely bryozoans; (iv) full submerged or drowned reef were mapped in different water depths across the shelf, showing a distinct geomorphology. New reef stratigraphic data and geomorphological mapping provided a revised perspective on the evolution of the Abrolhos reefs, showing that different environmental and topographic controls may have acted spatially in distinct ways.

Keywords: Reef Morphology, Reef Evolution, Sea Level Changes, Marine Transgression, South Atlantic, Abrolhos Reefs.

Seamount Geodiversity along the Western South Atlantic

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The roadmap for a sustainable ocean and planet relies on ocean observation and exploration, requiring the investigation of different ocean basins to achieve a broad characterization of deep-sea ecosystems. Seamounts represent key geological features with high ecological relevance, acting as hotspots of benthic and pelagic biodiversity, vulnerable marine ecosystems, and potential targets for mineral resources. Their complex geomorphology contrasts with the surrounding flat, soft-sedimented ocean floor, providing suitable habitats for deep-sea corals, sponges, and diverse fauna. Physical processes associated with seamounts, such as upwelling, enhance biogeochemical processes, and contribute to primary productivity, carbon sequestration and ferromanganese or carbonate crusts formation. This study investigates the geomorphological distribution and classification of seamounts and ridges across the Brazilian Exclusive Economic Zone (EEZ) and adjacent areas. Global bathymetric grids and available multibeam bathymetric data were used to map and classify these features, with results compared to alternative mapping approaches based on SWOT-derived vertical gravity gradients. Results reveal high seamount geodiversity, including guyots, banks, cones, knolls, plateaus, and ridges. In the Brazilian EEZ, integration with multibeam data shows that many seamounts are significantly shallower than predicted by altimetric data, with summits often shallower than 50 m and bases exceeding 2500 m depth. Mapping seamount geodiversity is essential to improve habitat suitability models, understand geomorphological controls on biodiversity distribution, and highlight the importance of high-resolution mapping, given that seamounts can host habitats from neritic to abyssal zones.

Keywords: Seamounts, Geomorphometry, Marine Geodiversity, geomorphological mapping, South Atlantic, Brazil.

Marine geomorphological and geological maps to advance ecosystem mapping

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The South African National Biodiversity Institute has a mandate to assess and report on the state of biodiversity at a national scale, which includes the marine environment up to the outer bounds of the 200 NM Exclusive Economic Zone. We do so by characterising and delineating ecosystem types, aligned with the IUCN Global Ecosystem Typology. The ecosystem maps are used in a plethora of spatial planning, assessment, prioritization, reporting and policy streams relating to the management of South Africa's marine biodiversity. The difficulty and expense of accessing deepwater environments means that our knowledge of habitats and ecosystems is transformed as additional data reveal new features and environments that can be integrated into maps. Seafloor depth, geomorphology and seafloor substrate play important roles in determining biodiversity patterns, via their direct role in shaping habitats and via indirect influences of hydrodynamics at a variety of scales. As a result, we are working on national-scale maps that collate available data on bathymetry, geomorphological features, sediments and reef locations. Here we showcase the maps already completed, including an updated bathymetry map and South Africa's first map of submarine canyons. These have been valuable in understanding and delineating the underwater landscape. We also provide an overview of two other mapping efforts, namely collation of reef features in a national-scale map and to improve on the early marine sediment distribution maps produced in the1980s. Such efforts foster inter-disciplinary collaboration and highlight the relevance of geology and geomorphology in the mapping, assessment and management of marine biodiversity.

Keywords: ecosystem mapping, bathymetry, submarine canyons, sediments, reef outcrops

Plio-Quaternary shelf-edge delta system along a narrow uplifting continental shelf (Gulf of Orosei, Western Mediterranean sea)

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The stratigraphic architecture of the continental shelf and upper slope depositional system in the Gulf of Orosei (eastern Sardinian margin western Mediterranean Sea) has been investigated in relation to the area's recent tectonic evolution. This margin formed when the Tyrrhenian Sea opened up during the Miocene period. The continental shelf is narrow, with the heads of the submarine canyons located at depths of 50–80 metres. From the Upper Pliocene onwards, the margin and the subaerial sector have slowly risen. Reflection seismic data highlighted the presence of a thick seismic unit that outcrops at the seabed and displays characteristics of pelagic sedimentation in the distal sector along the continental slope, as well as prograding cliniforms in the proximal sector of the shelf. The seismic reflectors of this unit are clearly truncated by an erosion surface. The resulting sedimentary strata are visible at the seabed and can be clearly identified in the morphobathymetric data. This seismic unit has been attributed to the Lower Pliocene, in correlation with formations that outcrop in the adjacent coastal area. A prograding prism formed by several depositional sequences at the edge of the platform has been interpreted as a shelf-edge delta. The area's morphological and stratigraphic evolution is controlled by Pliocene–Quaternary tectonics and the oceanographic setting. This created space for the deposition of Lower Pliocene sediments, followed by the formation of extensive erosion surfaces due to margin uplift. During the Pleistocene, a shelf-edge delta was formed that is not directly connected to river mouths.

Keywords: Shelf-edge delta, Multibeam Echosounder, Reflection seismic, stratigraphy, tectonic uplift.

Integrating marine seismic and well data for offshore CO_2 storage assessment on a portion of the West Coast of South Africa

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Offshore CO2 storage represents one of the key technologies for the global reduction of greenhouse gases and a Just Transition whilst maintaining hydrocarbon exploitation. The offshore Orange Basin, on South Africa's west coast, is a frontier basin with no active hydrocarbon production, though nearby supermassive discoveries offshore Namibia suggest significant reserves. Despite the basin's hydrocarbon potential, assessing CO_2 storage capacity critically depends on detailed marine geophysics and subsurface mapping, which provide the foundation for integrating sedimentological architecture with quantitative evaluations. This study uses these techniques to characterise the sedimentological architecture of a portion of the Orange Basin and evaluate the CO_2 storage potential. Interpretation of legacy 2-D marine seismic reflection and well data revealed six seismic units (A–F), a depositional evolution from syn-rift, structurally controlled sedimentation to incipient ramp development and progradational shelf propagation, and three reservoir–seal intervals suitable for Carbon Capture Utilisation and Storage (CCUS). Well data provided lithological and petrophysical properties, and probabilistic volumetric methods quantified storage capacity. Probabilistic estimates indicate storage capacity of 178 Mt (P90) to 607 Mt (P10), with structural closures contributing 22–75 Mt. These findings offer an integrated framework to support future hydrocarbon exploration, assess basin-scale CO_2 storage, and demonstrate the potential for regional offshore carbon storage, advancing southern Africa's energy transition.

Keywords: CCUS, Just Transition, Orange Basin, depositional environments, marine seismic reflection,

The Changing Fortunes of a Mudbelt: Why Seafloor Mapping Matters

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The inner continental shelf along the southwest coast of South Africa has been described as a continuous mudbelt derived from southward transport of fine-grained sediment from the Orange River. However, despite its proposed importance as a potential blue carbon reservoir, the deposit has not previously been mapped using modern high-resolution geophysical methods.

Here, we integrate newly acquired ultra-high-resolution sub-bottom profiler data, vibracores, and multibeam bathymetry to reassess the stratigraphy and geomorphology of this sediment body. The results reveal a laterally extensive, clinoform-bearing sedimentary complex extending more than 200 km along the coast. Two prominent depocentres occur offshore of the Berg and Olifants Rivers, where laterally continuous sediment packages overlie a bedrock and gravel substrate. Core data indicate sand-dominated delta-front facies, while muddy sands and muds are restricted to the nearshore zone along the landward margin of a bedrock outcrop.

The geometry, facies distribution, and stratigraphic relationships indicate that these deposits represent modern subaqueous deltas associated with the Berg and Olifants Rivers, rather than a continuous Orange River–sourced mudbelt. High-energy wave conditions and northwesterly longshore drift have likely winnowed and redistributed much of the prodelta mud fraction northward, leaving a sand-rich, submerged relict morphology comparable to modern wave-dominated deltas.

We therefore propose reclassifying the so-called "mudbelt" as the Berg–Olifants subaqueous delta system, substantially refining current understanding of sediment dispersal and shelf evolution along the southwest South African margin.

Keywords: Sub-bottom Profiler, Multibeam Bathymetry, Vibracores, mudbelt, sub-aqueous delta, sediment distribution

Multidomain observations and geomorphological implications of internal wave-induced shelf-to-basin sediment transport.

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Shelf-to-basin sediment transport plays a key role in continental margin evolution and the carbon cycle, yet the mechanisms linking oceanographic forcing to sediment resuspension and redistribution remain poorly quantified. Intermediate nepheloid layers (INLs) are widely recognized as effective sediment conveyors, but their formation mechanisms, morphologic imprint, and spatio-temporal evolution remain elusive.

Here, we present multidomain observations from the Levant Basin (LB) that document the internal-wave-induced origin, seasonal recurrence, and associated seafloor expression of INLs. We integrate ultra-high-resolution (decimeter-scale) multichannel seismic oceanography (SO), high-resolution bathymetry, in situ conductivity-temperature-depth (CTD) profiles, oceanographic reanalysis products from the Copernicus Marine Service, and synthetic aperture radar (SAR) imagery to link water-column stratification, internal waves, sediment transport, and continental-slope morphology. These data sets span multiple years and capture comparable seasonal stratification regimes, allowing assessment of persistent processes rather than isolated events.

Our observations show that during periods of strong seasonal column stratification (i.e., Brunt-Väisälä frequencies N≈0.01 s-1), shoaling internal waves promote sediment resuspension from the shelf edge and basinward transport. Seismic profiles reveal continuous, gently inclined, low-amplitude reflections that detach from the seabed, interpreted as INLs flowing up to 10km from the continental slope. Co-located CTD measurements show aligned turbidity maxima ~10km offshore the resuspension zones. Calculated internal wave beam angles relative to local slopes show a correlation between transmissive (subcritical) zones, seafloor erosion, and sediment detachment, whereas reflective (supercritical) slopes are associated with sediment-wave patterns interpreted as upslope-migrating steps. These results demonstrate a recurring process that links seasonal internal wave dynamics and continental slope evolution.

A Global Scale Assessment of Hydrodynamics Effects on Biogenic Carbonate Distribution

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Many attempts have been made to understand the relationship between biogenic carbonate sediments and abiotic factors on a global scale, both in present-day settings and in the geological record. Although the majority of these studies focus on geochemical and large-scale oceanographic controls, the effects of hydrodynamics are often overlooked. While local-scale research confirms that hydrodynamic energy plays a crucial role in shaping coastal sedimentary environments, quantitative and standardized studies at a global scale remain scarce. The aim of this work is to address this gap in knowledge by expanding a global-scale database of biogenic carbonate sediments, utilizing AI-assisted literature research. By coupling this record with satellite-derived abiotic datasets, a standardized quantitative framework was established to correlate sediment components with environmental parameters globally. To isolate hydrodynamic variables, specifically current, wind, and tide parameters, findings of previous analyses were re-evaluated over the expanded dataset. While initial results indicate that fundamental patterns remain consistent despite the increased data volume, the implementation of this standardized approach facilitates the isolation of hydrodynamic drivers at a global scale, allowing for the observation of their distinct effects on biogenic carbonates distribution. This methodology clarifies the global dynamics of environmental factors over biogenic carbonate production, providing a robust baseline for assessing sediment response to hydrodynamic forcing in the context of climate change.

Keywords: Biogenic carbonate, abiotic factors, hydrodynamics, data-driven framework, satellite-based time series.

Characterizing Arctic cold seep habitats from shelf to slope (a case study in the Vestbakken province)

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Understanding methane seepage dynamics in Arctic cold seep systems is crucial for knowing the implications of their impact on the Arctic Ocean habitats. The Barents Sea, characterized by active sub-seafloor fluid flow, serves as an ideal setting for investigating the environmental factors that interact with seepage dynamics in Arctic cold seep habitats. This study presents a multidisciplinary investigation of cold seeps explored during the AKMA3 expedition along the Vestbakken shelf and slope (SW Barents Sea). The research combines (i) detailed visual analyses of seafloor imagery acquired by the ROV, (ii) sedimentological and biogeochemical analyses on three ROV-collected push cores and blade corers, and (iii) a preliminary assessment of living benthic foraminiferal communities. ROV video annotation allowed the identification and classification of multiple distinct microhabitats and cold seep indicators based on seafloor characteristics. A clear relationship between sediment type and the distribution of chemosynthetic communities is evident in ROV track analysis. Sedimentological and geochemical data provided quantitative evidence of seep-related processes, enabling a refined characterization of the substrate associated with each microhabitat type. Geochemical profiles revealed fine-scale lateral variability in sediment composition and porewater chemistry, reflecting the heterogeneous and dynamic nature of seepage in the area. The analysis of living foraminiferal assemblages revealed systematic differences between sites, indicating biological responses to seep-driven environmental gradients and variations in the depth of the SMTZ. Together, these multidisciplinary observations provide new insight into the significance of seafloor composition in controlling seepage dynamics near the sediment-water interface and, ultimately, shaping these habitats in the Arctic.

Keywords: Cold seep, Habitat Mapping, Foraminifera, Geochemistry, ROV, Methane Seepage

Sequence stratigraphic analysis of the Tugela Cone, Durban Basin, east coast South Africa: Defining the links between sedimentation and potential CO2 storage as an enabler for a Just Transition.

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Seismic and sequence stratigraphic analysis of offshore sedimentary basins represents a fundamental tool in our understanding of sedimentation and basin development. Globally such basins represent key repositories for hydrocarbons, as well as potential sites for CO2 storage or utilisation. Although having significant potential for both, South Africa's offshore remains a frontier region with limited exploration. Detailed analysis of these basins is, therefore, a priority to assist with the country's Just Transition and aid development in the hydrocarbon sector. The Durban Basin, located on South Africa's east coast represents a sheared-passive margin defined by a narrow shelf with a large constructional delta/fan complex, the Tugela Cone, developed offshore Durban. This study utilises single-channel 2D seismic reflection and well data to elucidate the sedimentary architecture of the Tugela Cone. Six seismic units (A-F) are resolved, separated by sequence boundaries. Depositional regimes range from syn-rift to upper slope and outer shelf with sedimentation occurring primarily under normal regressive conditions. These conditions allowed for the construction of the submarine delta which prograded into the basin during sea-level lowstands. The associated development of reservoir/seal pairs in shelf sands as well as basin-floor fan systems represent potential targets for future CO2 storage in the basin. This study suggests that the Tugela Cone hosts in the order of 1 Gigaton of storage potential in multiple sedimentary structures. Due to its proximity to major CO2 hubs inland, the Durban Basin represents a potential area for offshore CO2 storage as part of South Africa's Just Transition.

Keywords: Durban Basin; Tugela Cone; Sequence stratigraphy; CO2 Storage

The Submarine Landslides of Australia's K'gari Continental Margin: examples of basement geological control on landslide morphology and occurrence.

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Multichannel seismic reflection and sub-bottom profiles acquired in 2022 aboard the RV Investigator (IN2022-V05) enable the morphologic features of the submarine landslides presented on continental slope offshore east Australia's K'Gari (Fraser Island) to be characterized. This margin is particularly steep (5–10°), deeply dissected by straight and anastomosing canyons and presents numerous submarine landslides including several impressive 'whole-of-slope' slides.
Morphologic comparisons between the continental slope segments presenting the larger Wide Bay Slope, Inskip, and Noosa Staircase Slides with adjacent segments of continental slope indicates the role of basement geological structure in enabling and influencing submarine landslide occurrence. The larger submarine landslides are apparently developed on segments of the continental slope where the stronger sediment layers are inclined at a steeper angle or the geological basement blocks have subsided to deeper levels than is the case on the adjacent areas of continental slope.
Consolidated sediments were dredged from the landslide scarps during an earlier voyage aboard the RV Southern Surveyor in 2013. When the ages determined for these sediments are considered in the context of extensive erosional modification of the submarine landslide masses, it is possible to tentatively constrain the timing of large-scale failure on the margin to the late Pliocene or early Pleistocene time. This is apparently similar to the time of occurrence of other largescale submarine landslides elsewhere in the Eastern Australia, suggesting common causal conditions.

Keywords: Continental Margin, Submarine Landslides, Geomorphic Characteristics, Multichannel Seismic Profiles, South-Eastern Australia,

The Role of Basement Block Configuration in determining the morphologic style of South-Western Tasmania's Giant Submarine Landslides

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Multichannel seismic reflection acquired in 2023 aboard the RV Investigator (IN2023-V02) enable the morphologic characteristics of the giant submarine landslides presented on continental slope offshore southwestern Tasmania to be determined. This portion of the Australian seaboard is a subsided continental passive margin which formed at the transform-fault boundary that was extant between south-eastern Australia and Antarctica.
Plio-Pleistocene landslide scars and their associated well-developed, landslide debris fields and turbidite deposits are strikingly presented on the SW-Tasmainian margin which is moderately steep (3°-5). Here, a large circular slump slide is located adjacent to a similarly extensive planar slide. The co-location of these two slides is particularly intriguing when considered in the context of the absence of regionally extensive slope failures on the slopes of the nearby North-Western Tasmanian continental margin. Examination of seismic reflection profiles indicates the role of basement geological structure in determining the style of submarine landslide occurrence. From north to south the peaks of subsided basement blocks are located at different relative levels. The unfailed, NW-Tasmanian continental slope is associated with "shallowly subsided" basement blocks that present just beneath the present-day seafloor surface; the large circular slump failure is associated with deeply subsided basement; while the planar slide failure is associated with basement blocks that have subsided to intermediate levels. Failure style is therefore determined by "end-point basal control". High-standing basement provides a downslope berm that prevents failure, basement located at intermediate depths prevents deep circular failure.

Keywords: Continental Margin, Submarine Landslides, Geomorphic Characteristics, Multichannel Seismic Profiles, South-Eastern Australia,

Using multibeam echosounder to improve geospatial resolutions and information within and around the uThukela Banks Marine Protected Area, South Africa

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The need for high-resolution spatial data and understanding arises to inform, support and advance the policies and laws governing the proclamation of Marine Protected Areas (MPAs), as well as what biomes are being protected. However, of the 41 MPAs within South Africa's exclusive economic zone, none is covered entirely by multibeam echosounder (MBES) data. The use of MBESs at the foundation of MPA design may allow practitioners to better optimise regions of protection using physical metrics as a guide. The study encompasses 14 sites that were selected for hydroacoustic surveys based on 1) likely features identified in low-resolution regional datasets such as singlebeam echosounders, 2) being known recreational fishing areas (therefore likely reefs) and 3) their location relative to the uThukela Banks MPA management zones. The MBES data and its derivatives (slope and rugosity) describe seabed habitat in the highest possible detail. Improved accuracy and spatial resolution of the bathymetry maps revealing more information about our continental shelf seabed. Well-preserved record of sea-level indicators on Durban bight continental shelf exist within the - 40 to - 125 m below MSL (mesophotic zone), including the rare documentation of the -125 m palaeoshoreline. Shelf reef complexes relief and rugosity varies throughout the study area, providing varied niches for habitation. This contribution illustrates how geomorphological character is a significant driver of biodiversity distribution. However, further work is needed to understand the links between physical habitat and biodiversity, as well as the lateral extent of particular habitats along the continental shelf.

Keywords: Multibeam Echosounder, Marine Protected Areas, Biodiversity, Sustainability, Spatial understanding

Barrier overstepping as a dominant mechanism for shoreline retreat in coarse-clastic paraglacial coastlines: insights from Chedabucto Bay, Nova Scotia

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In Atlantic Canada, coastlines are dominantly paraglacial, meaning that their geomorphology and morphodynamics are largely governed by glacigenic deposits, a legacy of past glaciations. Detailed seabed mapping and sampling in Chedabucto Bay, Nova Scotia, have revealed uniquely preserved drowned barrier beach deposits dominated by coarse-clastic sediments. While many studies investigating barrier retreat have primarily focused on sandy systems, Chedabucto Bay offers the possibility of exploring barrier overstepping in a coarse-grained environment. In this study, we compare drowned beaches with modern barriers surveyed through ground-penetrating radar and LiDAR to investigate the environmental conditions that have led to their formation and preservation and to understand the differences observed between modern and ancient systems. We identified 62 individual relict paraglacial barriers, with glacio-isostatic-model-derived relative sea-level curves suggesting these systems formed between ~9,500 and ~5,500 yrs BP in a similar coastal configuration to that observed today. New radiocarbon ages support this regional model. Drift-aligned relict barriers are approximately three times more common than swash-aligned systems, which we attribute to a sedimentological preservation bias from longshore transport dynamics. From these findings, we suggest that barrier overstepping plays a dominant role in the coastal dynamics of coarse-clastic paraglacial systems and should be considered in models of long-term sediment budgets and shoreline retreat, particularly during periods of rapid sea-level rise.

Keywords: Drowned Barrier Beaches, Barrier Overstepping, Relative Sea-Level Rise, Sub-Bottom Profiling, Multibeam Echosounder Bathymetry, Paraglacial Coastline

The effects of lahars on a shallow water environment – St Vincent case study

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The Souifière volcano on St Vincent erupted explosively in April 2021 producing pyroclastic flows and significant amounts of ash fall. which fell over the island of St Vincent. The eruption was followed by intense rainfall which created several lahars which flowed downslope and into the ocean.
Lahars are fast-moving volcanic debris flows composed of a mixture of water, ash, volcanic rock fragments. They can travel long distances and at high velocity, along river channels and gullies destroying everything in its path. On land they can bury infrastructure, destroy ecosystems and cause significant loss of life. At sea they are thought to cause breakages in deepsea cables, but the behaviour of these processes near-shore is poorly known.
We will present two high-resolution coastal multibeam surveys on the west side of the volcano where pyroclastic flows and lahars both flowed into the ocean following the courses of two separate rivers. One survey was done 5 years before the eruption and a second survey done this year. Since the eruption there have been several significant rainfall events and causing more lahars.
We will show the consequence of the lahars, being a significant amount of erosion in the shallow water in some areas, whereas in other areas considerable amounts of deposition. Both areas are at the mouths of river channels, therefore requiring different explanations. Inbetween the river channels there is little or no change in water depths. Underwater photography shows the newly created environments, being considerably different from pre-eruption descriptions.

Keywords: Lahar, MultiBeam EchoSounder, Coastal erosion, Coastal deposition

Seafloor Geomorphology and Habitat Distribution of Seamounts and Guyots along the Salas y Gómez Ridge

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The Salas y Gómez Ridge is a volcanic chain over 2,000 km long in the southeastern Pacific Ocean, featuring hundreds of seamounts and guyots that rise from deep-sea environments and are separated by significant tectonic and oceanographic features. Although these structures are important for understanding volcanic formation, seafloor dynamics, and habitat diversity, their geomorphology, especially the flat-topped guyots,remains poorly studied. During the 2024 Schmidt Ocean Institute expedition, Unexplored Seamounts of the Salas y Gómez Ridge, selected seamounts and guyots were examined using high-resolution multibeam echosounder (MBES) mapping and targeted ROV dives. The MBES data were processed into detailed morpho-bathymetric and backscatter maps of six guyots and four seamounts. Quantitative analysis of terrain features and acoustic data was conducted with machine learning to classify landforms and infer sediment types and environments. Visual seabed observations from 22 ROV dives helped validate acoustic facies and explore relationships between morphology, substrate, and benthic megafauna distribution. The findings highlight significant morphological differences among the seamounts and guyots, influenced by volcanic growth, erosion, and sedimentary processes. This combined approach offers new insights into the evolution of volcanic seafloor features along the Salas y Gómez Ridge, with implications for deep-sea geomorphology, marine spatial planning, and conservation efforts.

Keywords: Seamounts, Guyots, Multibeam echosounder, Seafloor geomorphology, Deep-sea habitats

Seafloor mapping and geophysical characterization of potential seep environments of the central Agulhas Slide on the Southern Cape Margin

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The Agulhas Slide, situated off southeastern South Africa, is one of the world's largest submarine landslides and exerts a major influence on slope morphology, subsurface fluid migration, and benthic ecosystem development. This study focuses on the Kingklip Ridge, a prominent structural high along the slide's headscarp within the Port Elizabeth (PE) Corals Marine Protected Area. Integration of high-resolution multibeam bathymetry, backscatter, CHIRP sub-bottom, and 2D seismic reflection data with seabed samples reveals that faults and glide planes form a vertically connected network of fluid conduits. These structures channel methane-rich fluids toward the seabed, where they emerge as pockmarks, fluid pipes, and carbonate mounds. Ground-truthing confirms the presence of methane-derived authigenic carbonates (MDACs), phosphatic concretions, and fragments of the cold-water coral Solenosmilia variabilis, indicating ongoing anaerobic oxidation of methane (AOM) and carbonate precipitation. The co-occurrence of MDACs, coral frameworks, and seepage features demonstrates a dynamic coupling between slope failure architecture, methane venting, and reef growth. Methane likely derives from both thermogenic and biogenic sources and is episodically released through hydrate dissociation and fault-controlled advection. These findings establish that the Agulhas Slide remains an active geomorphic and biogeochemical system in which landslide structures sustain methane seepage and support Vulnerable Marine Ecosystems (VMEs) along the South African margin.

Keywords: Carbonates, phosphorites, Agulhas Slide, seep communities

Seafloor sub-surface imaging using Pinger-based acoustic sensing for marine infrastructure development of Algoa Bay, South Africa

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Acoustic sub-bottom profiling provides detailed seabed relief and marine sediment thickness. This information informs coastal infrastructure development in areas such as port facilities, submarine cable installation, navigation channels, and offshore wind farms. This study uses a Massa transducer pinger array to collect shallow-penetration seismic data across Algoa Bay as part of AEON's second marine geophysical survey in May 2025.

The pinger is mounted on a custom-built frame on the starboard side of the SAIAB RV-Observer. The system is powered by a GeoAcoustics Geopulse system operating at 4kHz center frequency. The NI-6221-BNC-USB converter and Hypack software are used to trigger and record seismic data in SEG-Y format. Onboard processing steps include swell filtering, stacking, water-column blanking, time-varying gain, and automatic sub-bottom tracking. Data is then processed at the CGS office in Gqeberha. Processing involves applying time-varying gain, bandpass filtering optimized between 2-8kHz, swell filtering, and manual seabed tracking. The method achieves a vertical resolution of 20cm and penetrates up to 10m below the seafloor, where Quaternary sediments are present.

Seven seismic profiles reveal strong, laterally continuous seabed reflectors underlain by subsurface features near the Sundays River. Reflector-1 forms the base of a thin, laterally continuous surficial sedimentary unit. Beneath this unit, a thicker sedimentary succession is observed, bounded at depth by Reflector-2. This succession is characterized by both stratified reflections and broad zones of chaotic seismic facies with poor reflector continuity. The chaotic facies extend laterally across the profiles for approximately 2km, suggesting heterogeneous subsurface conditions. Further interpretations are still underway.

Keywords: Pinger, Marine infrastructure development, Hypack, Seafloor Imaging, Seabed characterization

Detailed bedrock morphology and structural geology controls on diamond traps offshore Hottentot's Bay, Southern Namibia

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Offshore Hottentot's Bay, Namibia, Gariep Belt and Namaqua Metamorphic Province rocks crop out. Deformation produced a structurally complex morphological pattern that controls the distribution and accommodation of overlying gravel beds that are endowed with alluvial diamonds. The precise relationship between the underlying bedrock structures and diamond concentration is poorly understood, and this project aims to rigorously test this relationship using machine learning techniques.

Analyses of ultra-high resolution geophysical data involved manually digitising bedrock lineaments. Two structural domains occur; the proximal Gariep Belt and more distal Namaqua Metamorphic Province. Primary layering displays a N–S to NNW–SSE trend. The tectonic contact between the crustal terranes is the main thrust, inferred from differences in layer orientation and deformation intensity. Strike-slip faults parallel to the main fault, Riedel patterns, conjugate shears and ridges indicate sinistral transpression within the Gariep Belt with a horizontal regional maximum principal stress axis oriented ESE–WNW. Oblique collision between the Kalahari and Rio de la Plata cratons during the amalgamation of Gondwana resulted in this slip partitioning. These structures are likely associated with the D2 transpressional event, whereas dextral faulting and en-echelon tension fractures are related to D3 and post-D3 transtension. A dextral shear zone and clockwise rotation in proximity to the tectonic contact represents localised strain accommodation during fault reactivation.

A detailed prospectivity pattern will be modelled by coupling structural and borehole data using Python software. This will target structural zones with the highest diamond concentration, a first for southern African offshore placer resource estimation.

Keywords: Alluvial diamonds, Geophysical data, Python model, Resource estimation, Transpression, Structural traps

Seafloor geological mapping of False Bay using high resolution geophysical techniques

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The Council for Geoscience (CGS) has an integrated onshore – offshore geoscientific mapping programme. As part of the offshore mapping component, high-resolution geophysical and hydrographic data of the seabed and subsurface were collected within False Bay and supplemented by legacy sampling data. The integrated dataset helps to resolve known geological features in greater detail and reveal new bedrock and sedimentary features as well. This contributes to the programmes' broad objective of updating the seafloor geology of the bay. Higher resolution data further aids efforts to improve understanding of False Bay's geological evolution. Among the newly revealed features are extensive seafloor ridges with variable geomorphic characteristics across the northern shore of the bay. Their morphologies resemble palaeo-dunefields and coastal-spit systems and mimic similar systems observed along the contemporary coastline. Near the entrance of False Bay, the morphology of submerged features like Rocky Banks and Hangklip Ridge are better resolved. Planation surfaces backed by palaeo-cliffs of Table Mountain Group lithologies are observed at multiple depth positions. The surfaces are notched in outcrops in a step-like fashion and resemble contemporary wave-abraded platforms formed along the contemporary False Bay coast. These features may indicate erosive palaeoshoreline development and reoccupation across multiple sea-level cycles. The positions of these features conform to verified palaeoshorelines that have been identified elsewhere on the South African shelf. The exposed bedrock features provide valuable geological context for benthic habitat studies and can inform marine spatial planning frameworks in False Bay.

Keywords: Marine Geology, Seabed mapping, Geomorphology, Palaeoshoreline, Geophysics

Stratigraphic controls on sediment heterogeneity within the southern Namaqua Mudbelt, South Africa

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This study integrates high-resolution sub-bottom profiling, vibrocore sedimentology, and seabed mapping to characterise the stratigraphy and sediment distribution offshore the Olifants River and Doringbaai. Three principal stratigraphic units are recognised: (1) a rugged Precambrian acoustic basement (Unit A), (2) a discontinuous basal gravel unit (Unit B) interpreted as polycyclic transgressive–regressive deposits, and (3) a thin sediment sandy to muddy veneer (Unit C). The transition from coarse basal gravels to overlying mud records successive phases of sea-level rise and transgressive reworking during the late Pleistocene to Holocene, with the postglacial transgression responsible for the emplacement of sand-rich deposits.
Sediment thickness and facies variations are strongly influenced by antecedent basement morphology. Fine-grained sandy deposits are confined to topographic lows and coarse sands dominate the exposed highs points.

Bedrock highs have controlled the development of a nearshore submerged sediment body that has aligned with the prevailing longshore drift direction to the northwest.
Regional stratigraphic geometry reflects two major stillstands, at approximately -100 m and -70 m, corresponding to the Bølling-Allerød and Younger Dryas sea-level phases. A gravel tombolo likely formed during the latter and was preserved by the ensuing rapid rats of sea-level rise associated with Meltwater Pulse (MWP) 1A. The findings demonstrate that the southern "mudbelt" is not a uniform mud-rich deposit, but a heterogeneous, sand-dominated system shaped by inherited topography, episodic transgression, and limited terrigenous input. This study refines the sedimentary model for South Africa's west coast and provides new insights into continental shelf evolution during the late Quaternary.

Keywords: Continental shelf stratigraphy, Sub-bottom profiling, Late Quaternary seal-level change, Postglacial transgression

Shallow subsurface and seafloor morphology characterisation using ultra-high-resolution sparker-seismic reflection, Algoa Bay, Eastern Cape, South Africa

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Despite being South Africa's most monitored coastal marine region for biodiversity, Algoa Bay's seafloor and marine sediment characterisation remains limited. This study uses ultra-high-resolution sparker-seismic reflection profiles acquired aboard the SAIAB RV Observer during the collaborative AEON-Ifremer ALGOA-I cruise in April 2024. In total 13 sprofiles between 2 and 37 km long were aquired using a 150 m Geo Marine streamer with 48 hydrophones and an Applied Acoustic CSP-Nv 1200 source, sampled at 0.1 ms with a 275 ms interval. The dataset is processed with MATLAB and Solid QC.

Results show a relatively flat seafloor extending from the coastline to 60 m water depth. A linear and convex seafloor ramp occurs at 60-90 m water depth between Cape Recife and Bird Island, forming a transitional boundary between inshore and offshore environments.

An acoustic basement reflector separates unconsolidated sediments from bedrock. The basement reveals steeply dipping reflectors which are attributed to the Cape Fold Belt. The overlying basement-sediment contact is irregular with in places terraces and channel structures. Sediment thickness reaches a maximum of 20 to 25 m in the north-central part of the bay at 20-40 m water depth. Laboratory analysis of sediment grab samples collected during the survey shows a dominant medium-grained sand fraction and measured organic content is 3.84 % in average. These results show the predominant influence of erosion and sediment reworking in the studied region.

Keywords: ultra-high-resolution sparker-seismic, seafloor morphology, shallow subsurface characterisation

Geological evolution of the Algoa Basin during the opening of the Indian and Atlantic Oceans

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Reprocessing historical 2D reflection seismic profiles and borehole data from SOEKOR assist quantifying changes in sedimentation rates and subsidence of the South African margin since ~165 Ma. Eighteen seismic profiles, each 12 to 85 km long, with ~20 m vertical resolution, are integrated with four deep boreholes (2527–4142 m) across Algoa Bay using Kingdom Suite software.
Seismic stratigraphic terminations and major surfaces are traced throughout the entire dataset to ensure coherency. Results show a maximum sediment thickness of 7000 to 9000 m in the central part of the basin. 2 major sequences are identified: the upper D1 sequence (400–2000 m thick) with 4 subhorizontal units; and the underlying D2 sequence (1000–7000 m thick) with 7 tilted units. Based on previous studies, the angular unconformity separating the 2 sequences is Late Valanginian in age (~134 Ma).
Boreholes Hb-P1 and Hb-D1 in the central Algoa Basin show sequence D1 to comprise black shale (350 m) grading upward into grey claystone with limestone beds and then sandstone (~674m), indicating a progradation. Fossils within this interval covers the Hauterivian to Maastrichtian stages, yielding sedimentation rates >20m/Ma. Sequence D2 comprises an interval of conglomerate (385 m) overlain by mainly sandstone and siltstone with minor shale interbeds (2922 m) indicating aggradation. Fossils within this sequence reveal Tithonian to Late Valanginian ages, which translate to sedimentation rates >150 m/Ma.
Correlation with sea-level changes and uplift episodes linked to initiation of strike-slip movement along the Agulhas-Falkland Fracture Zone is in progress.

Keywords: Seismic stratigraphy, sedimentary basin modeling, South African continental margin, sedimentation rates

Circular depressions in microtidal estuary floors: seeps or keeps?

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Seabed depressions are common geomorphological features occurring in a range of continental margin settings. These depressions vary in shape, size and distribution patterns. The most commonly studied depressions are pockmarks which form due to the migration and seepage of fluids from the subsurface. However, circular depressions may also be linked to biological processes, being formed by vertebrates such as fish (Tilapia sp.), dolphins and porpoises.

High-resolution geophysical data (side scan sonar, multibeam bathymetry) and drone imagery (orthomosaic and terrain data) were collected significant low-water event in a microtidal estuary on the east coast of South Africa. The data reveal numerous (n > 2300) circular depressions occurring on the estuary floor. They are up to 1.5 m in diameter and > 40 cm in depth, with their regularity and circular shape strikingly similar to pockmarks associated with fluid seeps. Using software such as ArcGIS Pro, CoMMA_ descriptor and GA_SAMMT, parameters such as length, width, area, perimeter, aspect ratio, relief, and volume were extracted from the mapped depressions — allowing for comparison with similar depressions that may characterise shallow marine environments.

When compared to other depressions, these bear the strongest resemblance to nests of the Tilapia Oreochromis niloticus which are known to inhabit these estuaries and act as prominent eco-system engineers, forming depressions where they make their nests. The depressions predominantly occur on sand bars (in close association with areas of vegetation), often forming clusters or short chains, and are characterised by shallow profiles and slightly raised rims.

Given the prevalence of Oreochromis niloticus in coastal waterbodies of KwaZulu-Natal, and their extreme excavations for nest building, we consider the fate of blue or brown carbon in microtidal estuaries to be short lived. It appears that wherever these fish species occur, the associated system will be heavily bioturbated and thus not suitable as a long-term carbon storage site.

Keywords: Circular depressions, Pockmarks, Oreochromis niloticus, eco-system engineers, sandbars

Anomalous incisions along the outer shelf of southern Namibia: seismic evidence for coast-parallel valley formation on a sediment-starved passive margin

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Large, elongate depressions occur across the outer continental shelf of southern Namibia, where their origin has remained uncertain. High-resolution multibeam bathymetry and sub-bottom profiler data reveal a series of morphologically distinct, streamlined depressions characterised by rounded upwind margins, narrowing downwind geometries and associated erosional surfaces. Rather than representing fluvial or marine erosional features, their morphology and spatial organisation are consistent with large aeolian deflation basins that developed during periods of subaerial exposure associated with Quaternary sea-level lowstands.

The depressions occur in several stages of preservation and locally exhibit evidence of progressive deflation, erosion and partial infilling, suggesting repeated phases of landscape modification prior to marine inundation. Their preservation beneath the present-day seafloor provides rare insight into the morphology and evolution of ancient aeolian deflation systems preserved within the continental shelf stratigraphic record. These observations extend the known range of preserved aeolian landscapes offshore and demonstrate that submerged continental shelves can retain diagnostic geomorphic evidence of prolonged subaerial exposure. The study provides a new conceptual model for recognising preserved deflation basins in the marine geological record and highlights their significance for reconstructing Quaternary landscape evolution along sediment-starved continental margins.

Keywords: Deflation basins; submerged landscapes; aeolian geomorphology; Quaternary sea-level change; Namibian continental shelf.

Evaluation of CO2 storage potential in wells of the Bredasdorp Basin offshore South Coast of South Africa

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The tectono-sedimentary evolution of offshore basins exerts a primary control on reservoir architecture, fluid distribution, and long-term subsurface stability. The Bredasdorp Basin, offshore south coast of South Africa, is a structurally complex extensional basin containing depleted gas reservoirs hosted within shallow-marine to basin-floor turbidite sandstone units overlain by regional shale seals. With an increasing interest in offshore carbon capture, utilisation and storage (CCUS), it is essential to understand how basin evolution and structural configuration influence overall containment integrity. This study evaluates the static carbon dioxide (CO_2) storage potential of selected wells within the basin and examines the geological controls governing storage feasibility. Petrophysical analysis of well logs was integrated with static modelling to quantify porosity, water saturation, net-to-gross ratio, and pore volume. A compressibility-based volumetric method was applied to estimate storage capacity, and a sensitivity analysis was conducted to evaluate the influence of pore volume and fluid saturation on storage estimates. Results indicate fair to good quality sandstone reservoirs with adequate porosity and permeability, overlain by thick, laterally continuous shale units that provide effective sealing capacity. The estimated static storage capacity is approximately 0.64 Mt of CO_2. Storage potential is strongly influenced by pore architecture and residual water saturation, reflecting the basin's depositional history, burial evolution, and diagenetic modification. These findings demonstrate that offshore depleted reservoirs in the Bredasdorp Basin represent technically viable geological storage sites for long-term carbon sequestration. Integrating basin evolution, structural framework, and petrophysical characterisation is critical for evaluating long-term containment and assessing potential interactions with seafloor stability.

Keywords: CO2 storage, Bredasdorp Basin, characterisation, properties,

Reconstructing Paleoenvironmental Changes using Shallow Marine Sediment Cores in Algoa Bay, Eastern Cape, South Africa

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Algoa Bay is both ecologically and economically important as it supports a rich marine life and 2 industrial ports. This study uses sedimentology, geochemistry, and micropaleontology to investigate the sediment depositional history. In May 2025, 56 sediment cores were collected during the Algoa 2 cruise using a 1 m single-tube Ronenberg Corer, at depths between 20 and 120 m.
The dominant facies is dark olive grey, fine to medium-grained sand, with shell fragments. No sedimentary structures are visible apart from abundant bioturbation, indicating depositional processes dominated by high energy currents, sediment reworking, and storm waves. In proximity to the Sunday's River, coring intercepted an underlying unit of dark brown to grey clay, characteristics of river floodplain and estuary deposits. This indicates a paleo-sea level more than 30 m lower than present between 9,000 and 30,000 years ago.
The clay unit is truncated at the top by a marked erosional surface. The grain size distribution of this unit is 90% clay (<75 µm) and 10% silt (>75 µm). X-ray fluorescence results show that the predominant compounds present are: SiO2 (56%), Al2O3 (12%), Cl (11%), Fe (9%), Ca (4%) and K2O (4%). Traces include: MgO (3%), S (0,8%), Ti (0,5%), Br (0,2%), Sr (0,2%) and Mn (0,2%). In comparison, the overlaying unit of mixed sand and shell fragments are more enriched in Ca and depleted in Fe, Mn, Ti, K2O and Cl. Additional work is in progress to identify microfossil, spore and pollen, and measure stable isotope ratios in organic matter. This will help reconstruct environmental changes and links to marine habitats during the Quaternary.

Keywords: Algoa Bay, sedimentology, geochemistry, Ronenberg corer, microfossil

Seasonal Freeze–Thaw Processes Cause Rapid Expansion and Contraction of the sub-Arctic Seafloor

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Seafloor mapping in polar regions has increasingly revealed landforms linked to subsea permafrost processes. Yet, the role of seasonal freeze-thaw cycles in shaping the seafloor remains poorly documented. Despite growing evidence of rapid subsea permafrost degradation, observations of short term seafloor change are limited across the Arctic and sub-Arctic. Here, we use repeat multibeam bathymetry collected between 2021 and 2024, together with bottom water temperature records, to characterize the seasonal development and decay of small frost blisters (approximately 5 m wide and 20–50 cm high) produced by the formation of ice within surficial sediments in Coastal Labrador (eastern Canada). These features were absent or degraded in October 2021 at depths ≤25 m but were widespread by July 2023. They subsequently thawed between July and November 2023, reformed over the following winter, and were again observed in August 2024, demonstrating consistent seasonal cyclicity. Moored temperature sensors and sediment core analyses indicate that frost blister formation is driven by seasonal cooling of bottom water and is facilitated by freshened porewater within near surface sediments, which promotes ice growth even at relatively shallow freezing points. The subsequent degradation of frost blisters corresponds to warming of bottom-water during the fall, leading to thawing of ice. This study documents previously unrecognized seasonal expansion and contraction of the sub-Arctic seafloor driven by freeze–thaw cycles of freshened porewater. These findings highlight the dynamic nature of shallow Arctic shelves and demonstrate that small scale cryogenic processes can produce rapid, measurable changes to seabed morphology on annual timescales.

Keywords: Frost blisters, Permafrost, Timelapse multibeam bathymetry, Active layer, Submarine Groundwater Discharge

Marine Geohazards in Arctic and Sub-Arctic Settings: Insights from the Canadian North

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As the Arctic gains increased strategic importance due to climate-driven environmental change, increasing maritime activity, and growing international interest, understanding seafloor processes and marine geohazards in these high-latitude environments has become increasingly critical. Arctic and sub-Arctic continental margins host diverse hazards shaped by differing deglaciation histories and cryosphere–ocean interactions. In the Eastern Arctic, fjords with thick accumulations of glacigenic sediments mantle steep submarine slopes that are prone to failure. Such landslides threaten seafloor infrastructure and may generate displacement waves, paralleling events documented in fjords of Greenland, Svalbard, and northern Norway. Triggers include moderate seismicity, rapid sediment delivery and iceberg groundings. Additionally, glacial lake outburst floods (GLOFs) can inject high-energy sediment into fjords, producing turbidity currents and contributing to cascading geohazard sequences increasingly recognized across cryospheric landscapes. In contrast, the Western Canadian Arctic, particularly the Beaufort Sea shelf, exhibits hazards linked to submarine permafrost degradation following Holocene transgression. Resulting thermokarst depressions, retrogressive slope failures, and evolving seabed instability present challenges for long-term infrastructure planning. Together, these examples underscore the need for regionally tailored, process-based geohazard assessments across Arctic and sub-Arctic settings. Insights from Canada's northern margins advance broader understanding of seabed instability in a warming climate and support international efforts to enhance resilience and situational awareness in high-latitude marine environments.

Keywords: Marine geohazards, permafrost, Submarine landslides, Turbidity currents, Icebergs

On-going growth and collapse of ice cored submarine pingos

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A multipronged, 12-year study has revealed a complex, submarine morphology dotted with pingos, which are continually changing due to ongoing freezing and thawing of brackish groundwater seeping up from buried ancient permafrost. Multibeam mapping surveys on both sides of the Mackenzie Trough in the Canadian Beaufort Sea were repeated in 2025, 8 and 12 years after the initial mapping surveys. The difference between 1-m-scale AUV grids reveals that the tops of pingos experience up to 1.5 m of upwards growth between surveys, documenting the upwards growth of submarine pingos for the first time. Up to 6 m of collapse were also observed. ROV surveys revealed an ice layer exposed on the sides of a young (<8-year-old) crater. The exposed ice was sampled using a ROV deployed drill. This ice sample and gravity cores show segregated ice and ice bonded sediment exist at and just beneath the seafloor on these uplifted structures. Down-core freshening of pore waters from sediment cores taken on the tops of features also confirms that brackish water exists near the seafloor at these sites. ROV measurements show that the bottom water temperatures are <-1° C. At this temperature, fluctuating temperature and salinity cause the freezing and thawing of seeping brackish ground waters, resulting in ice-cored pingos growing or collapsing. ROV-based low altitude surveys using stereo cameras, multibeam, laser scanners, and Simultaneous Localization and Mapping (vision-based navigation), mapped sections of this dynamic morphology at sub-cm resolution providing extraordinary detail on the on-going seafloor deformation associated with submarine permafrost.

Keywords: Permafrost, AUV mapping, Photogrammetry, Simultaneous Localization and Mapping,

Sediment Transport Measured with Repeat Bathymetric Mapping Before and After Sediment Gravity Flows in Monterey Canyon During the SeismoSands Experiment

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SeismoSands is a multi-institutional study which investigated the seismic signatures associated with sediment gravity flows and quantified the resulting seabed morphological changes in Monterey Canyon. Between October 16, 2024 and March 4, 2025 the floor of the canyon was mapped monthly. Autonomous underwater vehicles (AUVs), carrying 400 kHz multibeam sonars, travelling 50 m above the seabed, mapped the canyon axis (200 -1360 mwd), at ~1 m grid resolution. To record gravity flows, eleven seismometers were deployed on benches above the canyon floor and two moorings, with downward looking current velocity profilers (ADCPs), were deployed in the canyon axis. During the experiment, three strong gravity flows were identified by these instruments, all continuing beyond the deepest sensor. Mapping surveys bracketed each of these flow events. Resulting seafloor changes were assessed by differencing successive mapping surveys. In all cases, crescent shaped bedforms migrated upcanyon during individual flow events for a large section of the surveyed area. The changes in the canyon axis as the cumulative result of all the sediment flows do not diminish with depth. Up to +/- 3 m of change was seen throughout the mapped section over the entire time span, indicating the crescent shaped bedforms in the canyon axis were mobilized at some point during the 2024-2025 winter. Linking these morphological changes with individual gravity flows recorded by the seismometers will enhance our ability to characterize flows in novel ways and demonstrate that one can passively detect and characterize gravity flows using seismometers placed out of harm's way.
Keywords: sediment gravity flows, AUV multibeam mapping, repeat surveys, seismometers, sediment gravity flow monitoring

High-resolution multibeam sonar bathymetry of the Southwest Addo Marine Protected Area

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High-resolution mapping using multibeam sonar has significantly improved seabed morphology characterization in coastal marine environments. This study presents a new map of 50km2 of the seafloor near the entrance of the Port of Coega in the southwestern region of the Addo Marine Protected Area in Algoa Bay, Eastern Cape, South Africa.
Bathymetric data were collected using RV Observer over a total of 7 days between 2024 and 2026. The survey was completed using a R2Sonic2026 multibeam echosounder operating at a frequency of 90-450kHz and combined with an SGB positioning and motion sensor system. Sound velocity profiles of the water column were obtained using a Valeport profiler and incorporated during data acquisition and processing. Survey acquisition and data processing are conducted in Qinsy and Qimera.
The new high-resolution bathymetric map covers water depths up to 35m surrounding St Croix and Brenton islands, and shallows to around 15m in proximity to the harbor wall and Jahleel Island. In total, four shipwrecks and two circular reefs are mapped. The bathymetry data reveals a 2-5m relief forming a SW-trending linear structure, or a series of ridges, in total 7km long extending southwestwards from St Croix Island. This ridge may represent beach deposits formed during lower sea level. Additional geophysical data including Sparker seismic and Pinger sub-bottom profiles are currently being interpreted to characterize the study area in more detail.

Keywords: multibeam sonar, bathymetry, seabed morphology, marine geophysics.

Last Deglacial to early Holocene changes in activity of the Levant Submarine Channel, Eastern Mediterranean Sea

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Submarine channels in the Levant Basin, eastern Mediterranean Sea, are key morphological features that record sedimentary processes and basin evolution. The most prominent is the >200 km-long Levant Channel (LC), originating offshore northern Sinai and formed by turbidity currents. Yet, its Late-Quaternary activity remains poorly constrained. This study addresses this gap, analyzing piston and box cores retrieved from two sites: a southern site ~60 km offshore Tel Aviv at ~1300 m water depth, and a northern site ~45 km farther down-channel at ~1500 m depth.

Sediment at both sites are predominantly non-laminated and clastic, yielding last-glacial radiocarbon ages, with basal sections exceeding the dating limit (>45 ka BP). The southern core displays age reversals, indicating sediment mixing most likely caused by repeated turbidity-current events. Above this section, a fine laminated sediment dated to ~9 ka BP, corresponding to Sapropel S1, is observed, reflecting undisturbed hemipelagic deposition.

Foraminiferal assemblages further support the age model and provide independent evidence for sediment mixing. Warm-water Globigerinoides ruber (pink) is restricted to Sapropel S1 and younger sediments, whereas cold-water Globorotalia scitula presence occurs only below S1. Their coexistence in the northern core is indicative of sediment mixing. Shelf-derived benthic foraminifera are abundant throughout the southern core but largely absent in the northern one, suggesting sustained transport of shallow-shelf material at least to the southern LC site.

Overall, the LC was active during the last glacial period, transporting shelf-derived turbidites, but became largely inactive during the Holocene, when hemipelagic conditions prevailed, reflecting the influence of postglacial sea-level rise and shelf widening on sediment transport.

Keywords: Submarine channels, Turbidity currents, Sediment cores, Micropaleontology, Last deglaciation, Eastern Mediterranean Sea

Geomorphological investigations of the Northwest Atlantic Mid-Ocean Channel, Labrador Sea

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The Northwest Atlantic Mid-Ocean Channel (NAMOC), situated between Greenland and Canada, is the longest known deep-sea channel, extending roughly 4,000 km—comparable to the world's longest rivers. It runs from offshore Hudson Strait through the Labrador Sea, loops around the Grand Banks of Newfoundland, and ends at the northern Sohm Abyssal Plain. Morphologically, NAMOC resembles river systems, featuring tributaries, meanders, levees, point bars, and a defined thalweg. However, it is unusual in that it is not linked to a river, did not form on a delta or deep-sea fan, and lacks a clear sediment source.

About 2,000 km of its northern section was mapped during RV Maria S. Merian Cruise MSM102. Here, the channel is flanked by well-developed levees that decrease in height away from the continental margin. Sinuosity is greatest where the channel is constrained by bedrock or tributary junctions, but remains low in unconstrained areas—many of which show significant wall collapse. This suggests levee instability may limit meander growth by periodically resetting channel shape.

Mass wasting also influences channel evolution. Acoustic data reveal stacked debris flows along the western flank, originating from the Canadian continental shelf. These flows can travel long distances parallel to the channel before breaching levees and entering the NAMOC itself.

Keywords: Submarine Channels, Multibeam Mapping, Channel-Levee System, Mass Wasting

Imaging shallow crustal structures of the Coega Fault using joint land-OBS ambient noise tomography, Eastern Cape.

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Algoa Bay, situated along South Africa's southeastern coast, is a tectonically and hydrogeologically significant coastal basin. Ambient noise tomography was applied across the land-ocean transition in support of the development of marine geophysics in the region.
Here, we present results from the first onshore-offshore passive seismic survey conducted near the Coega Fault during May 2025. Twenty land-based seismic stations and six ocean-bottom seismometers were deployed across an area of 30 km². Continuous ambient noise recordings were acquired over a
period of 30 days. Land stations were spaced at 1 km and sampled at 100 Hz, while OBS instruments were deployed at 1 km intervals and sampled at 250 Hz. The processing workflow included instrument response removal, spectral whitening, temporal normalisation, and cross-correlation of vertical-component waveforms in the 0.2–10 Hz frequency band. Probabilistic power spectral density analysis confirmed that both land and OBS stations recorded comparable, low-noise wavefields, with the secondary oceanic microseismic peak providing a coherent and persistent energy source for surface wave retrieval. Cross-correlations between adjacent station pairs yielded well-emergent Rayleigh wave empirical Green's functions with signal-to-noise ratios exceeding 11 in the 0.6 -1.0 s band. Frequency-time analysis yielded stable Rayleigh wave group velocity dispersion curves across the 0.2-1.0 s period band. Group velocities ranging from approximately 0.9 to 2.5 km/s were observed with sensitivity to depths corresponding to the Table Mountain and Uitenhage Groups.
Variations in group velocity between station pairs indicate lateral variability throughout the study area and reflect differences in geological and hydrogeological structures. The successful recovery of coherent surface-wave signals from both land and ocean-bottom stations demonstrates that passive seismic methods can be applied in the coastal marine environments to investigate shallow crustal structures.

Keywords: Marine passive seismic, Cross-correlations, Rayleigh waves, Group velocity, Empirical Green's function, surface waves.

Combining multibeam bathymetry and side-scan sonar data in shallow water mapping applications

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The efficient mapping of shallow water seafloor environments remains challenging due to limitations in acoustic survey techniques. This study presents an integrated approach combining multibeam echosounder (MBES) bathymetry and backscatter data and towed side-scan sonar (SSS) data to optimize survey efficiency and data completeness. MBES systems provide high-density bathymetric measurements and co-registered backscatter databut their fixed swath angle results in reduced coverage in shallow water. In contrast, towed SSS systems operate on a fixed scan range, coverage is independent of depth. This method produces high-resolution acoustic imagery suitable for detailed seabed characterization; however, a data gap is present in the nadir of the SSS swath. Optimizing the features from both systems enables an increase in the rate of seafloor coverage for mapping projects. Case studies are presented from the Council for Geoscience's integrated multidisciplinary mapping programme (IMMP) where MBES and SSS lines are run concurrently, utilizing the wider line spacing of the SSS. MBES backscatter data are then integrated to fill the nadir gap in the SSS data. This integrated approach improves survey efficiency and enhances the quality and continuity of seafloor datasets, which enables more detailed geological interpretation in shallow marine environments.

Keywords: Multibeam bathymetry, side-scan sonar, shallow water

Geospatial knowledge for South Africa's blue economy: A Council for Geoscience perspective

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South Africa's blue economy is spearheaded by the Operation Phakisa initiative, which aims to accelerate sustainable economic growth and job creation by leveraging the nation's extensive coastline and rich Exclusive Economic Zone (EEZ) resources. The initiatives' primary objective is to make a substantial contribution to the national Gross Domestic Product (GDP) by 2033, with a strategic focus on key sectors including marine transport and infrastructure development, offshore oil and gas exploration, aquaculture, ocean governance, and the development of small harbours.

The Council for Geoscience (CGS) plays a pivotal role in advancing the objectives of Operation Phakisa through comprehensive offshore geoscientific mapping which includes the collection of multibeam bathymetry, side-scan sonar and sub-bottom profiling data for seafloor mapping. By collecting, interpreting, and disseminating these vital marine geoscience datasets, the CGS supports the unlocking of South Africa's offshore potential with data driven decision making and stakeholder collaboration. The CGS offshore mapping programme is aligned with strategies which can contribute to the fast-tracking of initiatives which include marine spatial planning, marine governance, offshore infrastructure, coastal vulnerability studies, renewable energy and mineral exploration, aimed at maximizing the socioeconomic benefits of South Africa's blue economy.

Keywords: Energy Security, Geohazards, Mineral Exploration, Offshore Mapping, Blue Economy, Exclusive Economic Zone

Portable Distributed Acoustic Sensing for high-resolution monitoring of dynamic processes in submarine canyons

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Monitoring dynamic seafloor processes such as submarine landslides and turbidity currents remains challenging because most available instruments provide measurements only at discrete locations. Permanent observatories, on the other hand, are sparse and geographically restricted. Distributed Acoustic Sensing (DAS) offers dense spatial sampling along optical fibers, but marine applications commonly depend on telecommunication cables that rarely cross the sites of greatest geomorphic interest.

Here we present Geo-Sense, a portable and autonomous DAS system designed for rapid, targeted seafloor deployment without reliance on existing cable infrastructure. The system integrates a low-power interrogator, pressure-rated battery housings and a 1 km steel-armoured sensing cable. Geo-Sense was deployed for eight days at 380 m water depth on the flank of Monterey Canyon, California, where strong tidal currents and active sediment-transport processes provide an ideal natural test site.

The system detected all catalogued earthquakes recorded within 150 km during the deployment and also identified additional uncatalogued seismic and hydroacoustic events. DAS-derived magnitudes agree closely with catalogue magnitudes, and P-S arrival times yield source-receiver distances consistent with independent earthquake locations. Beyond impulsive events, the DAS record shows persistent environmental forcing. Broadband amplitude in the 4-30 Hz band correlates with near-bottom tidal current velocities measured by a colocated Acoustic Doppler Current Profiler, while lower-frequency wave and microseism bands display semidiurnal and diurnal modulation.

These results demonstrate that portable DAS can provide spatially distributed, high-resolution monitoring of dynamic submarine canyon processes and offers strong potential for future detection and characterization of related hazards.

Keywords: Distributed Acoustic Sensing, seafloor monitoring, submarine canyon, microseismicity

The Mesophotic Dimension of Magoodhoo Reef, Maldives: Geomorphic Structure and Benthic Community Patterns

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Mesophotic coral reef environments remain considerably less investigated than shallow reef areas, which are more readily accessible to conventional remote-sensing techniques. This knowledge gap concerns both their high-resolution geomorphological structure and the spatial organization of associated benthic habitats. Moreover, datasets providing continuous coverage from shallow reef flats to deeper mesophotic zones are still uncommon, limiting our ability to understand how reef morphology, sedimentary processes, and benthic communities vary across the entire reef system.

In this study, we investigated Magoodhoo Reef, located along the discontinuous southwestern marginal rim of Faafu Atoll in the Maldivian archipelago, using an integrated multiscale dataset. Satellite-derived bathymetry, three-dimensional optical models generated through photogrammetric processing of UAV imagery, and multibeam bathymetry were combined to obtain continuous elevation data across the island, reef flat, backreef, lagoon, and deeper submerged sectors. Remote observations were complemented by photo-transects across the reef flat and observational ROV surveys along the forereef and within the lagoon.

The resulting geomorphological and habitat map extends from the shallowest reef zones to approximately 120 m water depth along the oceanic margin and 60 m along the lagoon-facing margin. The oceanward slope is characterized by steep, terraced morphologies, interpreted as the expression of reef development under late Pleistocene and Holocene sea-level fluctuations. These terraces define distinct depth-related geomorphic sectors and support benthic habitats with contrasting spatial distributions and community patterns. Within the lagoon, patch reefs and reef-associated sedimentary landforms increase seafloor heterogeneity and provide evidence of sediment transport pathways and processes linked to reef and island evolution.

Our results highlight the value of continuous, high-resolution shallow-to-deep mapping for characterizing the mesophotic dimension of coral reefs and improving our understanding of their ecological functioning, geomorphic development, and potential contribution to reef resilience.

Keywords: Coral reef, geomorphological mapping, habitat mapping, mesophotic habitats, Maldives

Gravel and sand barrier preservation at geological (Cenozoic) timescales: observations from the southern Namibia continental shelf

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Attention has recently been drawn to the dichotomy between modern coastal barrier facies and morphology and barrier-associated sediments preserved in the geological record. These differences have been attributed to geological timescale processes not observable in contemporary barriers. Studies of barrier preservation at a Cenozoic scale help bridge this conceptual gap by considering both barrier-forming processes and the effects of repeated cycles of transgression and regression within a specific topographic and sediment-supply context. Here we examine four temporally discrete barrier sequences with composite, progradational, aggradational multistacked, and retrogradational internal patterns preserved on the southern Namibian shelf. Seismic stratigraphy and borehole data reveal four extensive barrier complexes (three gravel and one sand) developed on lower-than-present shorelines (−50 to −70 m).

Initial gravel barrier development occurred in the lee of bedrock highs during the Miocene. Subsequent gravel deposition during repeated Quaternary regressions and transgressions produced a sequence of prograding barrier spits, downstepping barriers, and mixed sand–gravel shorefaces that partly overlie and abut one another. Variable preservation at geological timescales reflects a combination of:
(i) accommodation controlling initial sediment accumulation;
(ii) bedrock irregularities promoting nucleation of incipient barriers;
(iii) sediment texture and supply governing progradational, aggradational, and transgressive styles;
(iv) rates of sea-level change influencing barrier development and overstepping or progradation; and
(v) combined bedrock and antecedent seabed morphology influencing preservation during repeated wave ravinement and subaerial erosion.
These factors have determined whether only subtidal (shoreface/lagoon) facies, only emergent barrier facies, or complete barrier systems are preserved. Changes in accommodation, controlled by antecedent bedrock topography and sea-level state together with sediment supply, produce preservation styles that vary far more than previously recognised.

Keywords: Long-term barrier preservation, submerged shorelines, overstepping, rollover, Namibia

Structural and bathymetric conditioning of postglacial depositional systems: Interactions between sea-level rise and delta development on the Richards Bay shelf, South Africa

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This study presents a high-resolution seismic and geomorphological investigation of the Richards Bay continental shelf, along South Africa's high-energy, wave-dominated eastern coast. Sub-bottom seismic reflection data reveal two prominent deltaic sequences seaward of a modern river system with limited sediment supply. These delta lobes extend across the mid-shelf, overlying an incised valley network and lagoonal/back-barrier deposits, whose distribution is structurally constrained by Cenozoic faulted bedrock. The deltas record two phases of progradation, interrupted by backstepping, consistent with punctuated rises in relative sea level. In the nearshore, deltaic deposits are absent, having been eroded by wave ravinement, while overlying relict shelf ridges indicate later shoreline progradation in the absence of significant fluvial input, preserved by a subsequent rapid sea-level rise. Collectively, the stratigraphic architecture of the Richards Bay shelf illustrates a tightly coupled interplay between fluvial supply, marine processes, and sea-level fluctuations. Crucially, the positions, preservation, and progradational patterns of deltaic deposits are fundamentally dictated by antecedent bedrock morphology, which establishes preferential accommodation and exerts a persistent control on sediment routing. Steep inner-shelf gradients promoted sediment bypass and wave ravinement, whereas the flat mid-shelf platform acted as a long-lived sediment trap, preserving multi-phase deltaic lobes that record progradation, backstepping, and abandonment during punctuated rises in relative sea level. These findings underscore the primacy of structural inheritance in governing delta evolution on wave-dominated continental shelves, providing a framework to anticipate how structural inheritance modulates delta construction and resilience to accelerating sea-level rise.

Keywords: submerged deltas; sea-level rise; antecedent topography; continental shelf geomorphology

High-Resolution Seafloor Grain Size Classification and Mapping Using Multibeam Backscatter Data and Geostatistical Interpolation Methods

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Grain size distribution along continental shelves is essential for understanding benthic habitats, supporting environmental management, and guiding coastal infrastructure planning. This study presents the results from the first phase of a project analyzing grain size distribution on a continental shelf using integrated acoustic and geostatistical methods. Backscatter data were collected during annual monitoring programs (2017–2023) using multibeam sonar aboard the R/V Bat-Galim. The data underwent angular response corrections (ARA) and were validated against field-collected sediment samples to ensure accuracy. Normalization and validation processing focused on flat, homogeneous seafloors. Optimal correction values, achieved with muddy sand (Phi 3.3), produced highly accurate classifications for grain sizes ranging from medium silt (Phi 5.5) to medium sand (Phi 1.5), with an error margin of less than 1 Phi value across water depths from 10 m to 100 m. Seafloor classification revealed clear transitions in grain size, including shifts from fine to very fine sand and from coarse to medium silt at specific depth ranges. Hard substrates, such as platforms and ridges, were identified using both bathymetry and backscatter data, with strong acoustic returns offering distinct signatures. Areas with hard substrates surrounded by softer sediments were excluded from interpolation due to their artifact effect on surrounding values. In regions where hard substrates were widely distributed, their values were included in the interpolation process. The resolution and accuracy of the interpolated maps were closely linked to data density and spatial distribution. Kriging, leveraging spatial autocorrelation, produced the most reliable results, balancing data density and resolution at a 250 m grid scale maps. The results highlight the value of combining normalized backscatter with geostatistical tools for cost-effective, precise seabed classification, offering valuable insights into sediment dynamics and supporting broader applications in marine spatial planning and environmental monitoring.

Keywords: Continental shelf; Multibeam backscatter; Seafloor sediment classification; Grain size distribution; Kriging interpolation; Marine spatial planning