https://doi.org/10.3301/ABSGI.2019.02

21-22 febbraio 2019 - Roma

# ABSTRACT BOOK

a cura della Società Geologica Italiana

## Terzo Convegno dei geologi marini italiani

# La geologia marina in Italia

CoNISMa
Consorzio Nazionale Interuniversitario per le Scienze del Mare

ISTITUTO NAZIONALE DI GEOFISICA E VULCANOLOGIA

ISPRA
Istituto Superiore per la Protezione e la Ricerca Ambientale

OGS

SOCIETÀ GEOLOGICA ITALIANA
MENTE ET MALLEO
1881

Come citare gli abstract:
COGNOME, INZIALE DEL NOME (2019) - Titolo dell'abstract. In: Chiocci F.L., Budillon F., Ceramicola S., Gamberi F., Senatore M.R., Sulli A. (eds) - Abstract Book della Società Geologica Italiana, "La geologia marina in Italia, Terzo Convegno dei geologi marini italiani - Roma, 21-22 febbraio 2019", numero di pagina. https://doi.org/10.3301/ABSGI.2019.02.

Il convegno è sotto l'egida del *Consiglio Nazionale delle Ricerche (CNR)*, del *Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa)*, dell'*Istituto Nazionale di Geofisica e Vulcanologia (INGV)*, dell'*Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS)*, dell'*Istituto Superiore per la Protezione e la Ricerca Ambientale (ISPRA)* e della *Società Geologica Italiana (SGI)*.

Si ringraziano *Codevintec Italiana srl, Fugro Italy Spa, GBT Offshore e Idrosfera* per aver supportato il Terzo convegno dei geologi marini Italiani.

# INDEX

# Prefazione

E siamo arrivati al terzo convegno;

sta andando sempre meglio, abbiamo un numero di iscrizioni, di lavori sottomessi, perfino di sponsor, ancora più alto delle scorse edizioni, nonostante il 2019 sia un anno denso di congressi di interesse per la geologia marina (SIPM-SGI, IAS, CIESM, MetroSea…). Questo fatto prova, ancora prima dello svolgimento del convegno, la vivacità della comunità scientifica dei geologi marini italiani e l'opportunità della formula delle presentazioni con poster digitali che stimola discussioni approfondite sui dati per una reale crescita di coesione, di conoscenza e di competenza, con particolare beneficio specie per i più giovani tra noi. Anche quest'anno le tematiche proposte coprono tutti i campi in cui si articola la geologia marina, con interessanti interazioni anche con le altre scienze del mare (in primis l'oceanografia e la biologia marina), proseguendo la feconda disseminazione delle tecniche e conoscenze geologiche anche in discipline dove una volta il fondo del mare era solo la base cartografica sulla quale illustrare i dati. Questa evoluzione, iniziata già con il progetto Ritmare, è essenziale per rinnovare le nostre ricerche ed aprire nuove prospettive di studio e di progettualità, in tempi in cui la geologia "dura e pura" stenta (a mare come a terra) ad essere finanziata e riconosciuta socialmente come elemento indispensabile per la gestione del territorio.

Purtroppo questo terzo convegno arriva in un momento di estrema difficoltà per le scienze del mare nel loro insieme e per la geologia marina in particolare, dovuta alla carenza di mezzi navali. Siamo una comunità "spiaggiata" nel vero senso del termine e non abbiamo navi per svolgere il compito di ricerca scientifica che ci è proprio. Al momento il CNR non ha una vera nave da ricerca di tipo regionale, l'OGS ha una nave molto anziana ed in procinto di essere dismessa, l'Università ha da tempo perduto l'ambizione di gestire un proprio mezzo navale; restano due piccole navi del CNR e dell'ISPRA, del tutto insufficienti per ricerche non diciamo di punta ma almeno dignitose, specie nel campo della geologia, dove è necessario mettere a mare strumentazioni impegnative o svolgere ricerche anche lontano da costa. Quindi, in questo momento storico, crediamo che la comunità abbia il dovere di riflettere bene su sé stessa e far sentire la sua voce, al di là dell'appartenenza a questa o a quella istituzione. Ogni Ente ha le sue politiche, le sue contingenze, le sue ambizioni ed i suoi vincoli ma è forse giunto il momento di rivolgerci direttamente alle autorità di governo della ricerca scientifica per far presente che un paese con 7.500 km di coste ed una superficie sommersa quasi doppia di quella emersa, non può fare a meno di una infrastruttura importante come le navi per la ricerca scientifica e di una organizzazione che assicuri in maniera stabile la gestione dei mezzi navali, con strumentazione scientifica di avanguardia e tecnici in grado di operala ed attribuzione del tempo nave in base al merito scientifico delle proposte. Perché tutto questo ci suona come un sogno? Questa è la banale quotidianità in tutti i paesi economicamente sviluppati. Per questo motivo quest'anno il convegno ospita una tavola rotonda con i principali gestori di flotte nazionali ed europee per iniziare a discuterne seriamente, aspettando l'arcobaleno che viene sempre dopo il piovasco.

Gli organizzatori

# Geo-Archaeological Targets for the interpretation of the variation of the coastline in the Gulf of Naples

Avilia F.[1] & Santanastasio R.[2]

[1] Dipartimento Studi Umanistici, Università IULM di Milano, Italy.
[2] Struttura specialistica Marenostrum, Archeoclub d'Italia, Italy.

*Corresponding author email:* segretariogenerale@archeoclubitalia.org

*Keywords :* Sea.Re.N., Parthenope, Castel dell'Ovo.

The study of variations of the coastline associated with the phenomenon of anthropization can not be separated from a close connection between geological analysis and archeology. The multidisciplinary appeared already clear to Maiuri and Scherillo, in the study of variations of the coast line in the Phlegraean Fields, only close contact between the two figures of scholars can understand a complex phenomenon such as geological phenomena and human factors. The Sea.Re.N. project funded by the IULM University of Milan, both in the historical-archaeological aspects as well as in the geological surveys, confirming that the two aspects are indispensable, especially in an area like the one in Campania. The dives, taken in October 2017, continued in the underwater geo-archaeological survey, discovering another gallery and above all, detecting submerged artefacts in front of the cliff of Via Partenope, practically a channel that leads into a circular basin, still to be understood in its origin, and a cut in the tuff bank with traces of wagons. The complex of galleries and artefacts in front of Via Partenope can most probably be connected to port infrastructures of the primitive Cumana colony of Palepoli / Parthenope. The dating for now can be generically attributed between the VI / V sec. B.C. also for comparisons with the side galleries of the cave of the c.d. Sibilla in Cuma. The research clearly continues as the context to be analyzed is broader, including the tip of Castel dell'Ovo and the area of Santa Lucia.

# New geophysical evidence from Edisto Inlet fjord, Cape Hallett (Ross Sea, Antarctica)

Battaglia F.[1,2], Baradello L.[1], De Santis L.[1], Sauli C.[1], Gordini E.[1], Kovacevic V.[1], Morelli D.[3], Langone L.[4], Bohm G.[1], Colleoni F.[1], Colizza E.[3], Rebesco M.[1], Accetella D.[1] & Ursella L.[1]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] Department of Science and Management of Climate Change, Cà Foscari University, Venice, Italy,.
[3] Dipartiemnto di Matematica e Scienze della Terra, Università di Trieste, Italy.
[4] Istituto di Scienze Marine, Bologna (ISMAR), Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* fbattaglia@inogs.it

*Keywords:* Stratigraphy, Sediment drift, Fjord, Ross Sea, Antarctic Climate Evolution.

Edisto Inlet, located along the northern Victoria Land coast, is a small fjord about 15 km long and 4 km wide, carved by glacial processes and separated by a sill from the larger Moubray Bay.

The bathymetry shows a reversed slope and ranges from 670 m in the innermost sector of the bay to 100 m near the entrance of the bay.

The Edisto Inlet is seldom accessible due the presence of persistent sea ice but in 2017 during the PNRA (Programma Nazionale delle Ricerche in Antartide) OGS Explora expedition, exceptional sea-ice free conditions allowed for the first time the acquisition of a wealth of data (including sub-bottom chirp profiles, multibeam swath bathymetry, Acoustic Doppler Current Profiler measurements as well as two gravity cores) inside the fjord.

The geophysical dataset combined with previous echo-sounding data collected in the outer sector of the fjord reveal the presence of sediment drifts that hypothetically formed under the influence of bottom currents. The sediment drifts are characterized by a very high sedimentation rate and are potential excellent paleoclimatic archives.

Paleoclimate records are crucial for understanding current changes taking place in the Antarctica; However, paleoclimate and oceanographic reconstructions, especially from the Antarctic fjords, as well as the circulation and processes impacting their exchange with the shelf and wider ocean, are scarce.

Here we present the first report of the integrated analysis of all geophysical dataset aimed to understand relationship between the seabed morphology and present day velocity and direction of the currents. Moreover, the evolution over the late deglaciation phase can be inferred by comparing the results with the stratigraphic information from existing sediment cores.

The comparison of all data and observations with the numerical simulation of ocean dynamics, will permit to understand the climatic evolution of the fjord. Link with the climatic evolution of the Victoria Land coast and with other Antarctic sectors of the same area will allow to understand the interaction between East and West Antarctica.

# WestMedFlux cruises: first interpretations of the relationships between salt deformation and heat flow in the Western Mediterranean Sea

Bellucci M.[1,2,3,4], Poort J.[5], Rabineau M.[1], Del Ben A.[4], Lucazeau F.[6], Camerlenghi A.[2], Leroux E.[3], Gorini C.[5], Moulin M.[3] & Aslanian D.

[1] Laboratoire Géosciences Océan, UMR 6538 IUEM - CNRS, Brest, France.
[2] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[3] IFREMER, Géosciences Marines, Plouzané, France.
[4] Dipartimento di Matematica e Geoscienze, Università di Trieste, Italy.
[5] Sorbonne-Universités, UPMC Univ. Paris 06, CNRS, Institut des Sciences de la Terre de Paris, Paris, France.
[6] Institut de Physique du Globe de Paris, IPGP, Paris, France.

*Corresponding author email:* massimo.bellucci@univ-brest.fr

*Keywords:* Salt tectonics, heat flow, Western Mediterranean, Messinian.

The Messinian salt deposition in Western Mediterranean Sea has undergone deformations generally associated to the gliding gravity and sedimentation loading tectonics. However, most of this salt has been deposited in already formed deep basins, leaving little space for gliding. Moreover, there is a coincidence between its morphology and the crustal nature of substratum (and its segmentation). Although the coincidence is not taken into account, the salt deformation also depends to the temperature in a non-linear way. The crustal nature, associated to a characteristic thermal field, could therefore have an important control to the deformation and the resulting geometries of salt morphology.

The WestMedFlux surveys (WMF1, 2016 and WMF2, 2018) allowed to enrich of about 190 new heat flow measurements in Western Mediterranean Sea. Most of these measurements are located and aligned with seismic profiles, both on the Liguro-Provençal and Algerian basins, in order to cover the conjugated margins. The context of the Western Mediterranean Sea, its recent age, its atypical crust and the variability of its OCT make it an ideal zone to constrain the deep thermal regime and to test different thermomechanical models. In addition, recent studies carried out on the Liguro-Provençal basin (Leroux et al., 2015; Bellucci, M2 thesis), on the Atlantic margins (Angola and Santos basins) and on Gulf of Mexico show a coincidence between the salt morphologies and the change of substratum nature. The work presented will focus on the first part of interpretation of WestMedFlux data, the corrections of heat flow measures and especially the relationship between the deep thermal field and the salt deformation. Salt has a thermal conductivity higher than the sedimentary rocks; indeed, the conductivity of halite is between 4.8 and 6.5 W/m/K *(*Clauser and Huenges, 1995*)*. Therefore, the salt structures act as a transport of heat which will be disturbed to the surface. The objective of this study is to constrain the effect of salt on the temperature measured at the surface in order to better understand this influence and to test the hypothesis of a thermal influence on the salt deformation. The heat flows punctual analysis, associated with the chrono-stratigraphic interpretation and the thermo-kinematic modelling of the margins will help us to differentiate the sedimentation local effects on the surface temperature, including the refraction of salt, and the deep thermal signal, related to the crustal nature of the substratum.

*References:*

Bellucci M. (2017) - Interpretation of seismic profiles in Western Mediterranean Sea. Unpublished Master thesis. Università di Trieste, 125 pp.

Clauser C. & Huenges E. (1995) - Thermal Conductivity of Rocks and Minerals, in: Rock Physics & Phase Relations. American Geophysical Union, pp. 105-126. doi: 10.1029/RF003p0105.

Leroux E. et al. (2015) - Sedimentary markers in the Provençal Basin (western Mediterranean): a window into deep geodynamic processes. Terra Nova, 27, 122-129.

# Sedimentological and micropaleontological analysis of prodeltaic deposits offshore Mazzarrà Fiumara (NE Sicily)

Bonaventura F.[1], Bove C.[1], Casalbore D.[1,2], Chiocci F.L.[1,2], Di Bella L.[1], Frezza V.[1], Gaglianone G.[1], Milli S.[1,2], Pierdomenico M.[2], Ridente D.[2] & Tuscolano C.[1]

[1] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Italy.
[2] Istituto di Geologia Ambientale e Geoingegneria (IGAG), Roma, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* daniele.casalbore@uniroma1.it

*Keywords:* prodelta, hyperpycnal flows, foraminiferal assemblages, Sicily.

Multibeam bathymetry and high-resolution seismic profiles recently collected in the Gulf of Patti (NE Sicily) allowed us to characterize a wide submarine deltaic system linked to the Mazzarrà Fiumara (Casalbore et al., 2017). This system developed during the post glacial sea level and can be divided into different seismic units that can be related to the transgressive and highstand system tracts. This deltaic system is morphologically dominated by different type of seafloor waveforms trending overall along strike and incised by cross-strike gullies. These bedforms were tentatively related to the interaction of hyperpycnal flows with the seafloor and some of them could be indicative of upper-flow regime conditions (Kostic et al., 2019). The generation of flash-flood hyperpycnal at the mouth of Mazzarrà Fiumara is, in fact, favored by its small and steep drainage basin as well as by its torrential regime. In order to constraint the role of hyperpycnal-flows in controlling the formation of these bedforms, in this work we present the first results of an integrated sedimentological and micropaleontological analysis performed on several grabs and 4-m long gravity cores realized on the prodeltaic deposits and upper continental slopes. The results indicate the presence of different units with erosive base and fining-upward trend, having a sandy layer at the base passing upward to silty sediment that can be interpreted as the product of waning and depletive flows. These units generally decrease in thickness, frequency and grain-size moving from the shallow to the distal part of the prodelta. Differently, an opposite trend seems to occur in the upper slope, likely in relation to the re-acceleration of the sedimentary gravity at the shelf break due to a marked increase of slope gradients. This inference is also supported by the larger and deeper incision of the gullies in the outer shelf/upper slope with respect to the inner-middle shelf.

The micropaleontological analyses carried out on living foraminiferal assemblages highlighted that, at the present time, their distribution is controlled both by depth gradient and seasonally organic matter supply coming from the Mazzarrà Fiumara. Preliminary observations along the gravity cores allow us to assert that the same driving forces also acted in the past too. Consequently, foraminiferal assemblage changes resulted a useful proxy for the paleoenvironmental reconstruction in the prodeltaic successions.

*References:*

Casalbore D., Ridente D., Bosman A. & Chiocci F.L. (2017) - Depositional and erosional bedforms in Late Pleistocene-Holocene pro-delta deposits of the Gulf of Patti (southern Tyrrhenian margin, Italy). Mar. Geol. 385, 216-227.

Kostic S., Casalbore D., Chiocci F., Lang J. & Winsemann, J. (2019) - Role of Upper-Flow-Regime Bedforms Emplaced by Sediment Gravity Flows in the Evolution of Deltas. Journal of Marine Science and Engineering, 7(1), 5.

# Geological and geomorphological characterization from swim surveys of the Monte Pellegrino coastal area (Gulf of Palermo, south-western Tyrrhenian Sea)

Caldareri F.[1], Agate M.[1], Sulli A.[1], Furlani S.[2], Antonioli F.[3], Gasparo Morticelli M.[1]

[1]Dipartimento di Scienze della Terra e del Mare, Università degli Studi di Palermo, Italy.
[2] Dipartimento di Matematica e Geoscienze, Università of Trieste, Italy.
[3]Agenzia Nazionale per le Nuove Tecnologie, l'Energia e lo Sviluppo Economico Sostenibile (ENEA), Dipartimento Sostenibilità dei Sistemi Produttivi e Territoriali, MET-CLIM, Roma, Italy.

*Corresponding author email:* francesco.caldareri@unipa.it

*Keywords:* rock coasts, geomorphology, sea level change, swim survey.

The Italian peninsula is surrounded by about 7500 km of coastline. ISTAT data shows that 30% of the population lives permanently in coastal districts, on a territory of 43000 km$^2$, that is about the 13% of the national territory. These data suggest the logistical/economic importance of this territory and, for this reason, in the last decades it has been highly urbanized and exploited for touristic purposes.

The coastal area is affected by marine erosional processes, slope instability and, in the longer term, by relative sea level changes due to the interplay between eustatic, isostatic and tectonic movements. At the same time, tectonic processes acted inducing intense fracture on carbonatic rocks that also influenced the sea caves genesis.

This work deals with the geological and geomorphological characterization of the coastal area in front of Monte Pellegrino, in the western sector of the Gulf of Palermo (south-western Tyrrhenian Sea). The coastal analysis was carried out both in the emerged and in the submerged part of the coastal area, starting from a swim survey within the Geoswim project.

Field survey highlighted recent and paleo coastal forms, allowing the Late Quaternary geological deposits and geomorphological features to be mapped and ongoing coastal process to be recognized.

In the study area we identified several traces of the latest-Quaternary relative sea level changes. In particular, tidal notches and *Lithophaga lithophaga* holes were detected at altitudes ranging between 3 and 7 m asl, that indicates definitely recent changes of the shorelines. A particular attention was paid to littoral deposits accumulated during the geochronological subunit MIS 5.5 occurred between 133-115 ka BP, when the global sea-level rose-up to a higher level than the current one,

The analysis of the wave motion trends and its relationship with the different exposure of the different sectors of the coast, helped us to understand the different aspects of the geomorphological and morphosedimentary evolution of the area.

CTD data collected during the swim survey, allowed to localize and map freshwater springs along the littoral, which have a primary role in the evolution of the coastal sectors, enhancing erosions processes, which are responsible for tidal notches and sea caves expansion.

The studied coastline is highly affected by direct and indirect anthropic activity. The presence of small harbours for recreation boats and the accumulation of hardfills, have modified the coastline in several points, determining favorable conditions for the development of small beaches and plunging cliffs carved on anthropic landfills.

# Seismic imaging in support of scientific drilling in the Mediterranean Salt Giant

Camerlenghi A.[1], Bertoni C.[2], Brancatelli G.[1], Del Ben A.[3], Facchin L.[1], Forlin E.[1], Geletti R.[1], Huebscher C.[4], Lofi J.[5], Madof A.[6], Micallef A.[7], Picotti S.[1] & Tinivella U.[1]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] University of Oxford, UK.
[3] Dipartimento di Matematica e Geoscienze, Università di Trieste, Italy.
[4] University of Hamburg, Germany.
[5] Géosciences Montpellier, Université de Montpellier, France.
[6] Chevron - Energy Technology Company, Houston, USA.
[7] Department of Geosciences, University of Malta.

*Corresponding author email:* acamerlenghi@inogs.it

*Keywords:* Scientific Drilling, Messinian, Salt Giant, Evaporites, Seismic reflection.

Scientific drilling through IODP/ICDP may provide a fundamental, perhaps final, contribution to the understanding of the Messinian Salinity Crisis (MSC). The key to the success of the proposal writing phase designed within the MEDSALT network (https://medsalt.eu) is two-fold: i) to address the Mediterranean Salt Giant as a global event with a cross-disciplinary approach; ii) to obtain an improved imaging of the Messinian formations in the deep and marginal Mediterranean basins in order to locate accurately drilling sites targeting different objectives. The strategy is to obtain high-quality depth seismic sections through advanced Imaging procedures, particularly useful in the presence of important changes of the velocity field, the use of 3D seismics when available, and the combination of deep penetration and high-resolution data to resolve fine-scale structures especially in the upper Messinian formations. Where possible, ad-hoc seismic site surveys have been run to fill gaps in the historical, at times vintage seismic coverage.

Improved seismic images have resulted particularly effective in resolving the true image of salt structures and formation thickness (e.g. Dal Cin et al., 2016) (thus improving the drilling plans), resolving fine-scale fluid migration paths (e.g. Bertoni and Cartwright 2015), the fine-scale salt gravitational deformation and the fine-scale spatial change of the seismic facies (Camerlenghi et al., in preparation), the nature of the Upper Unit, in which the deep-water expression of the "Lago Mare" formations may be hidden (Madof et al., 2019), and the occurrence of chaotic deposits inferred to represent the flooding of the Mediterranean at the Messinian/Zanclean transition (Micallef et al., 2018).

*References:*

Bertoni C. & Cartwright J. (2015) - Messinian evaporites and fluid flow. Marine and Petroleum Geology 66, 165-176.

Camerlenghi, A., Del Ben A., Huebscher, C, Forlin E., Geletti R., Brancatelli G., Micallef A., Saule M. & Facchin, L. in preparation. Seismic markers of the Messinian Salinity Crisis in the deep Ionian basin.

Dal Cin M., Del Ben A., Mocnik A., Accaino F., Geletti R., Wardell N., Zgur F. & Camerlenghi A. (2016) - Seismic imaging of Late Miocene (Messinian) evaporites from Western Mediterranean back-arc basins. Petr. Geosci. 22, 297-308.

Madof A.S., Bertoni, C. & Lofi, J. (2019) - Discovery of vast fluvial deposits provides evidence for drawdown during the late Miocene Messinian salinity crisis. Geology, 47, 1-4.

Micallef A., Camerlenghi A., Garcia-Castellanos D., Otero D.C., Gutscher M.-A., Barreca G., Spatola D., Facchin L., Geletti R., Krastel S., Gross F. & Urlaub M. (2018) - Evidence of the Zanclean megaflood in the eastern Mediterranean Basin. Sci. Rep. 8, 1078.

# Plio-Quaternary mass movements along the Ionian Calabrian margin, Southern Italy

Candoni O.[1,2], Ceramicola S.[2], Praeg D.[3,4], Zecchin M.[2], Brancatelli G.[2], Gorini C.[5], Bohrmann G.[6] & Cova A.[2]

[1] Dipartimento di Matematica e Geoscienze, Università degli Studi di Trieste, Italy.
[2] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[3] Instituto do Petróleo e dos Recursos Naturais (IPR).
[4] Géoazur.
[5] Université Pierre et Marie Curie (UPMC).
[6] Marum - University of Bremen, Germany.

*Corresponding author email:* ocandoni@inogs.it

*Keywords:* mass movements, Crotone Spartivento forearc basin, Neogene tectonics, uplift, slope steepening.

We here present the occurrence and characterization of mass movements along the shelves and slopes of the Calabrian Ionian continental margin in the Crotone Spartivento forearc basin (Ionian Sea, Italy) since Middle Pleistocene times and relate them to the major episodes of the Calabrian continental margin evolution.

Recent studies provided evidence of recurrent mass movements along the inner continental slope of the Ionian Calabrian margin, mainly based on high-resolution bathymetry and shallow subsurface data in the framework of the MAGIC project.

This new study allowed to better characterize the mass movements already identified at higher (up to 5x5 grid size) and lower (50x50 grid size) bathymetric resolution and enabled to link their occurrence to the Calabrian margin evolution since Middle Pleistocene times. The study is based on the interpretation of more than 3500 km of multichannel seismic reflection data with different resolution and more than 10000 km of sub-bottom profiles, acquired in the framework of the RITMARE project as well as thanks to international collaborations (on board of the German RV Meteor and Italian RV OGS Explora). These dataset served to integrate vintage (VIDEPI and MS and CRPOP lines) seismic and well data.

Results allowed characterizing three main types of mass movements, named as: 1) isolated submarine landslides, 2) headwall and sidewall canyon slides and 3) slow sliding complexes. Isolated submarine landslides are characterized by slide scars up to 10 km long and occur on the open and steeper (>5°) slopes. Headwall and sidewall canyon slides are characterized by hundreds of meters long slide scars and are mainly located on the canyon headwalls and sidewalls slopes. Slow sliding complexes are characterized by fields of slope parallel undulations on the gentle (<3°) slopes. Evidence of repeated failures events in form of stacked mass transport deposits (MTDs) have been found, mostly at the base of the slopes. Stratigraphic analysis led to the recognition of three main regional unconformities related to Neogene cyclic episodes of uplift and subsidence of the Crotone Spartivento forearc basin. According to the stratigraphic distribution of the MTDs on the Crotone-Spartivento basin, they occur above a Middle Pleistocene unconformity, tentatively dated around 1 Ma. We infer that the onset of the mass movements are related to the rapid km-scale differential uplift of Calabria over the last 1 Ma, which has driven a seaward tilting of the Ionian Calabrian margin, thus leading to the generation of different types of mass movements. In particular, slope steepening associated to the differential uplift is inferred to be the main cause of mass movements initiation.

# New insights into submarine hydrothermal system phenomena revealed by acoustic monitoring technologies

Caruso C.[1], Lazzaro G.[1], Longo M.[1], Romano D.[1], Scirè Scappuzzo S.[1] & Italiano F.[1,2]

[1] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Palermo, Italy.
[2] EMSO Western Ionian Regional Team.

*Corresponding author email:* cinzia.caruso@ingv.it

*Keywords:* seafloor observatory, acoustic analysis, geological processes

The need to gather a better insight on the processes developing in the oceans, including episodic or rather rapid events, makes it difficult to plan periodic expedition to collect multidisciplinary data. Therefore, the collection of long time-series at variable sampling frequencies provides the opportunity for backing out trends related to various processes. An observatory cabled to a surface buoy has been deployed off the coast of the volcanic island of Panarea which hosts the most active submarine hydrothermal system of the Mediterranean sea. Extreme environmental conditions such as high $CO_2$ flow rate, temperatures up to 140°C, pH less than 3 and electrical conductivity higher than the normal sea-water, make the island of Panarea a natural laboratory for multidisciplinary seafloor observation. The observatory working off Panarea is able to operate down to a water depth of 4000 m in extreme marine environment although it was deployed at shallow depth (24 m). It collects data from a wide range of probes including acoustics, dissolved $CO_2$, Ox, $H_2S$ and $CH_4$, T°C, pressure, EC, pH. Particular attention was given to the hydroacoustics , thus the observatory was set to collect hydroacoustic signals three times per hour along with 20 seconds of recording in order to reduce the power consumption and data transmission issues. The main aim to collect acoustic data was to gain a better insight in the submarine degassing process by studying changes in the bubbling frequencies that are related to the gas flow rate of the hydrothermal vents. The collected data (geochemical and acoustic) showed how the submarine vents are affected by seasonal trends and changes due to tides and other natural forces. After filtering for the periodicity, the frequency ranges of the acoustic signals were analyzed and grouped into two classes on the basis of the spectral content and signature representing the occurrence of different processes: 1) range between 1 Hz and 50 Hz associated to possible conduits vibration sources due to hydrothermal fluids uprising; 2) range between 70 Hz and 2 kHz, related to changes of the gas flow rate from the hydrothermal vents namely to changes of the total submarine gas output.

# The volcanic field offshore southwestern Sicily (Italy) investigated through high-resolution seafloor mapping and ROV images

Cavallaro D. & Coltelli M.

Istituto Nazionale di Geofisica e Vulcanologia (INGV), Osservatorio Etneo (Catania), Italy.

*Corresponding author email:* danilo.cavallaro@ingv.it

*Keywords:* volcanic field, batymetric data, tephra cones, monogenic volcanism, ROV images.

Using high-resolution bathymetric data (Coltelli et al., 2016) and ROV images, a volcanic field, located 35-50 km offshore southwestern Sicily (Italy), has been characterized in detail.

It is composed of at least 10 cones, which are aligned along a N-S trending and 12 km long belt. The volcanic field represents a peculiarity, since it took place within a tectonic transfer zone, outside of the typical geodynamic settings, such as subduction and rift zones, of other fields worldwide and far from long-lived volcanic systems.

The field includes the Graham Bank, formed by two volcanic cones, the smallest of which is the relict of the short-lived "Ferdinandea Island" created during the well-documented 1831 Surtseyan-type eruption.

The present-day morphology of the cones is the result of the interplay between constructive (volcanic and depositional activity) and destructive (wave and currents erosion, mass-wasting and subsidence) processes, acting, together with tectonics and sea-level fluctuations, in both subaerial and submarine environments.

The main dimensions of the cones and morphometric associated parameters have been measured, allowing a morphologic classification on a shape basis. They show a pointy or flat-topped shape and are made of consolidated tephra and lava layers lying between 150 to 250 m bsl. Their heights range between 100 to 200 m, while the tops lie between 35 to 125 m bsl (except for the Ferdinandea shoal, that is 9 m bsl) and are often characterized by knolls as displayed through ROV images.

The cones are the remnants of Late Pleistocene to Holocene monogenetic submarine volcanism. Time constraints are inferred throw the analysis of morphological parameters (i.e. depth of the tops, level of erosive dismantlement, presence and depth of abrasion and depositional terraces) in relationship with sea-level fluctuations, taking also into account analogies with the post-eruptive morphological evolution of volcanic seamounts worldwide.

The distribution and shape of the cones within the volcanic field as well as the alignment of their vents provide important insights into the interaction between magmatism and tectonics. The cones are, in fact, aligned along two preferred directions, NW-SE and N-S, following, respectively, the trend of the Sicily Channel rifting and an active transfer lineament (Civile et al., 2018).

Finally, numerous mass transport deposits and pockmarks were identified within the volcanic field, suggesting the occurrence of slope failures and diffuse fluid releases.

*References:*

Civile D., Lodolo E., Accaino F., Geletti R., Schiattarella M., Giustiniani M., Fedorik J., Zecchin M. & Zampa L. (2018) - Capo Granitola-Sciacca Fault Zone (Sicilian Channel, Central Mediterranean): Structure vs magmatism Mar. Pet. Geol., 96, 627-644.

Coltelli M., Cavallaro D., D'Anna G., D'Alessandro A., Grassa F., Mangano, G. Patanè, D. & Gresta, S. (2016) - Exploring the submarine Graham Bank in the Sicily Channel. Ann. Geophys., 59(2), S0208.

# Archivio di Studi Adriatici: from a miscellaneous historical heritage to a Open Access digital repository of multidisciplinary data

Ceregato A.[1], Armeli Minicante S.[2], Maggiore F.[2], Donnici S.[2], De Lazzari A.[2] & Capotondi L.[1]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Istituto di Scienze Marine (ISMAR), Venezia, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* alessandro.ceregato@ve.ismar.cnr.it

*Keywords:* scientific collections; repository; open access; data management; biodiversity.

The Archivio di Studi Adriatici (ASA) is a repository of the Institute of Marine Sciences (ISMAR-CNR), completely open source and open access. It was developed in collaboration with the IRCRES CNR of Turin with the aims to preserve and make accessible natural collections, heritage books, documents, and maps of the Institute of Marine Sciences. Initially created by ISMAR to house the digitization of the historical library of the ISMAR headquarters in Venice, it was then developed following the discovery of a historical algal collection at the Biblioteca Storica di Studi Adriatici (BSA) of Venice (Armeli Minicante et al., 2017). This collection, after having been catalogued, has been digitized with a digital planetary scanner. In the meantime, the recovery of the related publications and of original correspondences and documents by the authors within the BSA allowed to rebuild the history of this collection and its original purposes. This work suggested to implement the repository in order to upload also living and fossil marine invertebrate *s.l.* collections and the available metadata, and make them publicly accessible. Recently, a first section devoted to foraminifera collections has been established and soon it will contain relevant datasets including SEM images, complete metadata and links to related papers and external databases. Further scheduled uploads will include both fossil and recent marine macroinvertebrates. Digitized specimens and metadata, compiled using Dublin Core and Simple Darwin Core formats, are preserved into a Fedora Repository, public accessed by Islandora framework and reachable through the website www.archiviostudiadriatici.it completely reachable by a CC-by Open Access License (Armeli Minicante et al., 2017; Maggiore et al., 2018).

The reorganization of the Institute of Marine Sciences offers the opportunity to further expand the archive to new collections and new contributors interested in the project. At a time when the infrastructures for marine sampling are limited, such a platform is a valuable tool that offers the possibility of accessing multidisciplinary data (datasets, maps, geological and biological collections) still unpublished or underused for (palaeo) biodiversity, time series, environmental studies.

*References*:

Armeli Minicante S., Birello G., Sigovini M., Minuzzo T., Perin A. & Ceregato A. (2017) - Building a Natural and Cultural Heritage Repository for the Storage and Dissemination of Knowledge: The Algarium Veneticum and the Archivio di Studi Adriatici Case Study, Journal of Library Metadata, 17:2, 111-125.

Maggiore F., Armeli Minicante S., Donnici S., De Lazzari A., Ceregato A. & Socal G. (2018) - Le collezioni naturalistiche dell'Istituto di Scienze Marine : dalla conservazione alla digitalizzazione, Technical Report n. 1, Aprile 2018, 32p.

# High resolution characterization of Sapropel 1 in the Central Mediterranean (Adriatic Sea) through planktonic foraminifera, geochemistry and XRF analysis

Checa H.[1,2], Margaritelli G.[1], Pena L.D.[2], Cacho I.[2], Pérez-Asensio J.N.[2], Frigola J.[2], Lirer F.[3] & Rettori R.[1]

[1] Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, Italy.
[2] GRC Geociències Marines, Departament de Dinàmica de la Terra i de l'Oceà, Universitat de Barcelona, Barcelona, Spain.
[3] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* aneleh_checa@hotmail.com

*Keywords:* Sapropel event (S1), Adriatic Sea, Planktonic foraminifera, U/Mn, XRF elements.

The Mediterranean Sea is a semi-enclosed sea where regional climates exert control on the formation of deep water masses at its two basins (eastern and western). At present, there are four major intermediate and deep water convection cells: Levantine Basin (intermediate), Aegean Sea (deep) and Adriatic Sea (deep) on the eastern basin, and Gulf of Lions (deep) on the western basin. These cells are interconnected and act as a driving engine of the Mediterranean thermohaline circulation (MedTHC).

Major changes on the MedTHC occurred during the Early-Middle Holocene (9.5 - 6.5Kyr), when the Mediterranean Sea was characterized by an asynchronous oceanographic pattern between its two sub-basins. On the western, there was a major strengthening in the deep overturning cell, meanwhile, on the eastern started one of its major phases of stagnation, resulting in the Sapropel 1 event (S1). Sapropels are caused by complex interactions between climatic and biogeochemical processes and are considered diagnostic of periods with anoxic deep-waters.

We present new results obtained from the South Adriatic Sea, at a location where deep waters are connected to the waters of the Ionian Sea through the Otranto Strait. This site is well suited to investigate Holocene climatic changes due to its unusually high sedimentation rate and the proximity to the Adriatic deep water convection cell. We have focused on high resolution analysis of the S1 interval of the core ND14M-bis (655m water depth).

Changes in surface water properties were reconstructed based on the ecological interpretation of planktonic foraminiferal assemblages. This information is also complemented with stable isotopes ($\delta^{18}O$, $\delta^{13}C$) data of *Globigerina bulloides*. Additionally, variations in deep water properties were reconstructed in base of the geochemical analyses of the U/Mn ratio measured in planktonic foraminiferal coatings, as well as the paleoecological interpretation of benthic foraminiferal assemblages. All this information is combined with XRF elemental data from the bulk sediment.

The results allowed us to clearly define the S1 and its interruption phase. Our new data suggest the onset of surface waters stratification prior to the beginning of sapropel S1. The increase of the abundance of *Globigerinoides ruber* white, and decrease of *Neogloboquadrina pachyderma, Globorotalia scitula* and *Globorotalia truncatulinoides* support surface ocean stratification. The deposition of the sapropel is shown by the increase in deep water nutrient content, represented in our data as an increment of XRF Ba and *Globigerinoides ruber* pink. The U/Mn data and the benthic foraminiferal assemblages further support the occurrence of highly dysoxic waters during both phases of S1, and a rapid re-oxygenation event during the interruption, also marked by *Globigerinoides ruber* pink and *Globorotalia inflata*. We finally propose a sequence of events for the occurrence of S1 in the South Adriatic Sea.

# Comparative analysis and genetic interpretation of erosive-depositional bedforms in Mazzarrà (northeastern Sicily) and Rhis-Nekor (northern Morocco) pro-deltaic systems

Clementucci R.[1,4], Lafosse M.[2,5], Casalbore D.[3,4], Chiocci F.L.[4], Gorini C.[5], Ridente D.[3], d'Acremont E.[5] & Rabaute A.[5]

[1] Dipartimento di Scienze, Università Roma Tre, Italy.
[2] Department of Earth Sciences, Utrecht University.
[3] Istituto di Geologia Ambientale e Geoingeneria (IGAG), Roma,. Consiglio Nazionale delle Ricerche, Italy.
[4] Dipartimento di Scienze della Terra, Università Sapienza di Roma.
[5] Institut des Sciences de la Terre de Paris, Sorbonne Universités.

*Corresponding author email:* romano.clementucci@uniroma3.it

*Keywords:* Pro-deltaic systems, Undulations, Gullies, Multibeam bathymetry, Geostatistics

Multibeam bathymetry and high-resolution seismic profiles have been analysed to characterize the main depositional and erosional dynamics recorded in pro-deltaic deposits, located in Gulf of Patti (southern Tyrrhenian Sea), and in Al-Hoceima Bay (Northern Morocco). These two Mediterranean pro-deltaic systems share similar geological-structural and oceanographic settings as well as morphologies. Particularly, fields of submarine undulations and gullies are widespread from the inner shelf to the shelf break in both prodeltaic systems (Casalbore et al., 2017; Lafosse et al., 2018). The coexistence of erosional and depositional bedforms on the shelf, represent a peculiar feature of these systems, uncommon in other Mediterranean pro-deltaic environments.

The gullies are interpreted as the products of hyperpycnal flows generated at the river mouths. More complex is the definition of the genetic processes responsible for the formation of seafloor undulations (Urgeles et al., 2011); in fact, they can be interpreted as the result of sediment deformations (sin-sedimentary creep) or sedimentary structures induced by oceanographic dynamics (i.e. internal waves) or hyperpycnal flows. Morphometric and geostatistical analysis (Principal Component Analysis and Clustering) on the main parameters (height, wavelength, lateral length, asymmetry, aspect ratio and slope) of the seafloor undulations were performed to study their spatial distribution, and by this try to constrain their genesis. Seismic profiles were instead used to evaluate the evolution during time of these erosive-depositional bedforms.

*References:*

Casalbore D., Ridente D., Bosman A. & Chiocci F.L. (2017) - Depositional and erosional bedforms in Late Pleistocene-Holocene pro-delta deposits of the Gulf of Patti (southern Tyrrhenian margin, Italy). Marine Geology, 385, 216-227.

Lafosse M., Gorini C., Le Roy P., Alonso B., d'Acremont E., Ercilla G., Rabineau M., Vazquez J. T., Rabaute A. & Ammar A. (2018) - Late Pleistocene-Holocene history of a tectonically active segment of the continental margin (Nekor basin, Western Mediterranean, Morocco). Marine and Petroleum Geology, 97, 370-389.

Urgeles R., Cattaneo A., Puig P., Liquete C., De Mol B., Amblàs D., Sultan N. & Trincardi F. (2011) - A review of undulated sediment features on Mediterranean prodeltas: distinguishing sediment transport structures from sediment deformation. Marine Geophysical Research, 32(1-2), 49-69.

# The Odyssea Contourite Depositional System (Ross Sea, Antarctica)

Conte R.[1], Rebesco M.[2], Gales J.[3], De Santis L.[2], Zgur F.[2], Kim S.[4], Accettella D.[2], Battaglia F.[1], Olivo E.[2], Sauli C.[2], Kovacevic V.[2], Bergamasco A.[5], De Steur L.[6], Florindo-Lopez C.[7], Bensi M.[2], Viezzoli D.[2], Ursella L.[2], Lucchi R.G.[2], Caburlotto A.[2] & Colleoni F.[2]

[1] Dipartimento di Scienze Ambientali Informatica e Statistica, Università Ca' Foscari, Venezia, Italy.
[2] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy
[3] School of Biological & Marine Sciences, Plymouth University, UK.
[4] Korea Polar Research Institute (KOPRI), Yeonsu-gu, Incheon, South Korea.
[5] Istituto Scienze Marine (ismar), Venezia, Consiglio Nazionale Ricerche, Italy.
[6] Norwegian Polar Institute, Tromsø, Norway.
[7] National Oceanography Centre (NOC), Southampton, UK.

*Corresponding author email:* rconte@inogs.it

*Keywords:* Ross Sea, Sediment Drifts, Mass Transport Deposits, Seismic Interpretation.

The linear east-west direction of Ross Sea continental margin is interrupted only by the presence of the Iselin Bank. The latter protrudes northward for about 150 km from the Ross Sea continental shelf and its top lies at depths between 400-1000m. Therefore the Antarctic Slope Current (ASC), flowing westward along the continental margin, is forced to deviate northwards by the Iselin Bank. At the same time the presence of Hillary Canyon to the west of the Iselin Bank favours downslope flows of dense bottom waters forming on the Ross Sea continental shelf and upslope flow of ASC into the Ross Sea.

The Odyssea Contourite Depositional System situated between the Iselin Bank and the Hillary Canyon represents an archive of the past changes in terms of sediment availability and interplay between along slope and down slope processes.

Integrated interpretation of morphobathymetric and seismic reflection data allowed the identification of seven seismic units. The three lower seismic units have thicknesses strongly dependent on the basement morphology while the upper units have more frequent thickness variations resulting in mounds interpreted as sediment drifts. These mounds produce reliefs in the bathymetry elongated in a SW-NE direction, from 2 to 5 km wide and between 50 and 200 m high.

The shape of the sediment drifts is modified by landslides, identified both as detachment scars on the sea bed and as mass transport deposits. Indeed sedimentary record in the central part of the Contourite Depositional System is dominated by a mass transport deposit about 300 m thick and 750 km$^2$ wide.

This demonstrates that there is a dominant interplay between gravity driven processes and bottom currents in the deposition of available sediments.

The integration of data from IODP 374 expedition will allow for a better connection of the depositional history of the area and dynamics of the ice sheet.

# 3D Architecture and Plio-Quaternary evolution of the Paola Basin: Insights into the Fore-arc of the Tyrrhenian-Ionian Subduction System

Corradino M.[1], Pepe F.[1], Bertotti G.[2], Picotti V.[3], Monaco C.[4] & Nicolich R.[5]

[1] Dipartimento di Scienze della Terra e del Mare, Università di Palermo, Italy.
[2] Faculty of Civil Engineering and Geosciences, Delft University of Technology, Netherlands.
[3] ETH Geologisches Institut, Zürich, Switzerland.
[4] Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università di Catania, Italy.
[5] Via Rossetti,83 34141 Trieste, Italy.

*Corresponding author email:* marta.corradino@unipa.it

*Keywords:* Calabrian Arc, Ionian Sea, Fore-arc basin, Lithospheric buckling, Longshore current.

Fore-arc basins are segments of fore-arc regions that form structurally in response to a variety of subduction zone processes. The sedimentary infill records the complex tectono-stratigraphic evolution of basin associated with subduction system, and thus, allows deciphering the formation mechanisms of basins developed in compressional intraplate settings. We analyse these processes in the Paola Basin, a fore-arc basin of the Tyrrhenian-Ionian subduction system, by using reflection seismic profiles and bathymetric data. The Paola Basin is a NNW-SSE trending asymmetric syncline, bounded by the offshore sector of the Coastal Chain to the East and by the regional-scale Paola Anticline to the West. It hosts up to 5.5 km thick Plio-Quaternary deposits, most of them showing eastward-dipping clinoforms. These latter are associated to shelfal progradation, supplied from the north *via* longshore currents, dispersing sediments from unknown Apenninic/Sila entry points. A local circulation of longshore currents flowed southwards and dispersed sediments from unknown Apenninic/Sila entry points. An aggradational internal geometry characterizes the uppermost part of the sedimentary infill with a thickness decreasing westwards, suggesting a sediment supply from the Coastal Chain. In the Early Pliocene, the proto Paola Basin extended from the Paola Anticline up to the western flank of the Sila Massif. Since ~ 3.5 Ma, the uplift of the Coastal Chain shortened the proto Paola Basin, leading to the separation of the basin from the Crati basin. Short wavelength (~ 80 km) lithospheric buckling, caused by a ENE-WSW oriented, arc-normal paleo-stress field, is the most likely mechanism that explains the pattern of tectonic subsidence of the Paola Basin, the uplift of the Paola Anticline and part of the uplift experienced by Sila Massif during the Plio-Quaternary. Kilometre-scale, strike-slip restraining and releasing bends are widely spread over the hinge zone of the Paola Anticline, defining the Paola Ridge. Their formation is compatible with an NW-SE oriented maximum stress axis meanwhile strike-slip fault accommodates the arc-parallel component of the plate motion. The change in direction from ENE-WSW to NW-SE of the maximum stress axis in the fore-arc region is a consequence of the transition from orthogonal to oblique subduction, associated to the bending of the Northern Calabria Arc. Regional uplift and folding of the Northern Calabrian Arc induced tensile stress resulting in the formation of N-S trending normal faults in the extrados of the Sila Massif anticline. In this context, the Paola Basin can be defined as a “Neutral Accretionary-type” forearc basin.

# Integrated geophysical high resolution marine survey for multidisciplinary applications: case study for definition of Mar Grande of Taranto geological features (southern Italy)

De Giosa F.[1], Demonte P.[2], Scardino G.[3], Piscitelli A.[1], Barracane G.[1], Locuratolo G.[1], Milella M.[1], Moretti M.[3], Tursi A.[4] & Mastronuzzi G.[3]

[1] Environmental Surveys S.r.l. - Via Dario Lupo 65, Taranto, Italy.
[2] Consorzio Nazionale Interuniversitario per le Scienze del Mare (CoNISMa), Roma, Italy.
[3] Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari "Aldo Moro", Bari, Italy.
[4] Dipartimento di Biologia, Università degli Studi di Bari "Aldo Moro", Italy.

*Corresponding author email:* francescodegiosa@ensu.it

*Keywords:* marine geophysics, reflection seismic, seismic facies, Mar Grande, Taranto.

"Area Vasta - Mar Grande" project funded by the Italian Environment Ministry- *Commissario Straordinario per gli Interventi urgenti di bonifica, ambientalizzazione e riqualificazione di Taranto* involved several technique for definition of environmental issues, in order to plan a remediation framework of the Taranto area.

A marine geophysics high resolution data-set acquired in the *Mar Grande* marine area to define sea bottom surface features, throughout a multibeam echo sounder and side scan sonar.

Moreover, for a definition of subsurface, marine reflection seismic has been performed through two different techniques: sub bottom profiler and sparker source system.

Channel seismic profiles obtained have been calibrated with long cores sampled on the *Mar Piccolo* and *Mar Grande,* throughout a stratigraphic correlation (Mastronuzzi *et al.*, 2012), discriminating different seismic facies.

The acoustic basement can be ascribed to the *Calcare di Altamura Fm* and *Calcarenite di Gravina Fm*, throughout long cores sampled in surrounding area, while the immediately upper unit can be referred to informal stratigraphic unit of *argille subappennine*, as observed in cores sampled in *Mar Piccolo* (Valenzano *et al.*, 2018) and *Mar Grande* (Mastronuzzi *et al.*, 2012).

Main Holocene units are made by soft clay and sandy muds with the presence of a tephra layer at 27-32 meters depth m.s.l.

This geophysical dataset, in combination with literature works (Mastronuzzi & Sansò, 1998; Mastronuzzi *et al.*, 2012; Amorosi *et al.*, 2014; Negri *et al.,* 2016), reveals that *Mar Grande* basin evolution can be interpreted as:

- 116/76 ky - marine terraced deposition in combination with cooling of the Last Interglacial;
- 76/20 ky - beginning of fluvial incision with polyphasic lowering of sea-level;
- 20 ky - ending of marine regression up to -130/150 m and formation of *Mar Grande* incised valley;
- 12-10 ky - beginning of marine transgression with rapid sea-level rise in *Mar Grande* basin;
- 7/8 ky to present day - slowing-down of the sea-level rise, erosion of the coastal portions and contemporaneous deposition in low energy conditions.

*References:*

Amorosi A. et al. (2014) - The Middle-Late Quaternary Fronte Section (Taranto, Italy): an exceptionally preserved marine record of the Last Interglacial. Global and Planetary Change, 119, 23-38.

Mastronuzzi G. et al. (2012) - Underwater surveys in the reconstruction of Upper Pleistocene - Holocene sea level changes in the Taranto seas. Rend. Online Soc. Geol. It., 21 , 1176-1178.

Mastronuzzi G. & Sanso' P. (1998) - Morfologia e genesi delle Isole Chéradi e del Mar Grande (Taranto, Puglia, Italia). Geogr. Fis. Din. Quat., 21, 131-138.

Negri A. et al. (2016) - The Fronte candidate section for the Upper Pleistocene GSSP: a short report. Alpine and Mediterranean Quaternary, 29(2), 137 - 142.

Valenzano E. et al. (2018) - Holocene morpho-sedimentary evolution of the Mar Piccolo basin (Taranto, southern Italy). Geografia Fisica e Dinamica Quaternaria 41, 119-135.

# Volcanism along lateral slab-edge: the Diamante-Enotrio-Ovidio complex (Southern Tyrrhenian Sea)

De Ritis R.[1], Pepe F.[2], Orecchio B.[3], Casalbore D.[4,5], Bosman A.[4], Chiappini M.[1], Chiocci F.[5], Corradino M.[2], Nicolich R., Martorelli E.[4], Monaco C.[6], Presti D.[3] & Totaro C.[3]

[1] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy.
[2] Dipartimento di Scienze della Terra e del Mare, Università di Palermo, Italy.
[3] Dipartimento di Scienze Matematiche e Informatiche, Scienze Fisiche e della Terra, Università di Messina, Italy.
[4] Istituto di Geologia Ambientale e Geoingegneria (IGAG), Consiglio Nazionale delle Ricerche, Roma, Italy.
[5] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Italy.
[6] Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università di Catania, Italy.

*Corresponding author email:* fabrizio.pepe@unipa.it

*Keywords:* Volcano-intrusive complex, Calabrian Arc, Subduction-induced mantle flow, Slab edges.

We investigate a formerly unknown large volcano-intrusive complex developed East of the ~ 90 km-long Palinuro Volcanic Chain (southern Tyrrhenian Sea) using the integration of different geophysical data: a) multibeam bathymetry; b) high-penetration multichannel seismic-reflection data; c) magnetometric data; d) seismological data. The study area lies in the northern offshore of the Calabrian Arc, and comprises the Diamante, Enotrio and Ovidio seamounts. The volcanic edifices extend above magma feeding system corresponding to an area characterized by low Vp/Vs ratios. Magmatic intrusions, chimneys, lava flows and laccoliths are observed in the area beneath and surrounding the volcanoes. The emplacement and cooling of the magma occurred during the Brunhes Chron. Presently, the volcanoes are not active even if small magma ascents are observable. The volcanic complex can be subdivided in a western domain where strike-slip transpressional faults deform the volcanic edifices and control the seafloor landscape (Diamante and Enotrio chains), and an eastern domain (Ovidio volcanic complex) characterized by flat-topped volcanic edifices. The flat-topped morphology is the result of the interplay between volcanism, erosion, sedimentation and sea-level change. The Ovidio volcanic complex formed in an area that experienced at least 60 m of tectonic subsidence. The magma responsible for formation of the Diamante-Enotrio-Ovidio complex is originated by the decompression melting occurred at the northern edge of the Ionian slab whereas a roughly E-W trending, STEP fault exerted a direct control on the magma uprising. Data and interpretation we present on volcano-intrusive complex provide new insights on the evolution of subduction-induced mantle flow around the slab edges.

# Geophysical exploration of the West Sardinian continental margin and Sardo-Provençal oceanic basin (West Mediterranean Sea)

Del Ben A.[1], Geletti R.[2], Zgur F.[2], Bellucci M.[1,2,3], Brancatelli G.[2], Camerlenghi A.[2], Dal Cin M.[2], Fais S.[4], Forlin E.[2], Lanzoni A.[1], Romeo R.[2] & Travan G.[1,2,5]

[1] Dipartimento di Matematica e Geoscienze, Università di Trieste, Italy.
[2] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[3] IUEM Ifremer and University of Brest, France.
[4] Dipartimento di Ingegneria Civile,Ambientale e Architettura, Università di Cagliari, Italy.
[5] Laboratoire d'Oceanologie et Geosciences, Université de Lille, *Centre National de la Recherche Scientifique* France.

*Corresponding author email:* delbenan@units.it

*Keywords:* West-Sardinian margin, Sardo-Provençal Basin, Seismic reflection, Messinian, Evaporites.

The Sardo-Provençal Basin and its eastern continental West Sardinian margin represents one of the less explored Italian sea. During the year 2010 the OGS-Explora acquired a new dataset (W-Sardinia_2010) represented by seismic reflection and CHIRP profiles, Multibeam swath bathymetry and Magnetic data. The acquisition was designed on the base of results provided by previous profiles of the MS (Mediterranean Sea), CROP (CROsta Profonda) and ViDEPI (Visibility of Petroleum Exploration Data) projects.

Integration of all the different dataset allowed us to interpret the main geological structures produced during the Upper Oligocene-Lower Miocene, when the rifting phase was followed by the oceanic opening of the West Mediterranean Sea.

On the continental margin exploration reaches the whole sedimentary sequence, down to the geological basement showing the horst and graben system produced by the extensional tectonics (Geletti et al., 2014).

On the oceanic abyssal plain the MS and CROP profiles depicted some deep reflectors, generally ascribed to the top of the basaltic basement. The new W-Sardinia_2010 dataset, due to its higher resolution, highlights very clearly the Messinian evaporate sequence, characterized by the typical Messinian trilogy (Rehault et al., 2004).

The evaporate sequence is represented by *i)* a high amplitude stratified upper unit (UU, mainly gypsum lithology), *ii)* a transparent salt unit (MU, characterized by strong halokinetic tectonics), and *iii)* a stratified lower unit (LU, also represented by gypsum). This trilogy onlaps the lower continental slope, disappearing toward east, substituted by the erosional truncation (MES, for Margin Erosional Surface: Lofi et al., 2011) locally evident also in the Sardinia onshore.

The Plio-Quaternary sequence was highly deformed, especially during the Lower Pliocene, by halokinetics. In some local conditions this process is still active, producing some circular structures in the sea bottom, well imaged in detail by the CHIRP and multibeam data.

The different resolution of the available data represents the best condition to study the whole sedimentary sequence and to correlate deep structures with their local effect on shallow youngest sediments.

*References:*

Geletti R., Zgur F., Del Ben A., Buriola F., Fais S., Fedi M., Forte E., Mocnik A., Paoletti V., Pipan M., Ramella R., Romeo R. & Romi A. (2014) - The Messinian Salinity Crisis: new seismic evidence in the West-Sardinian Margin and Eastern Sardo-Provençal Basin (West Mediterranean Sea). Marine Geology, 351, 76-90.

Lofi J., Deverchère J., Gaullier V., Gillet H., Gorini C., Guennoc P., Loncke L., Maillard A., Sage F. & Thinon I. (2011) - Atlas of the Messinian seismic markers in the Mediterranean and Black Seas. Memoir Societe Geologique de France n.s. 179 and World Geological Map Commission (72 pp.).

Rehault J.P., Boillot G. & Mauffret A. (1984) - The Western Mediterranean Basin geological evolution. Marine Geology 55, 447-477.

# Potential tsunami from submarine landslides in the Bay of Naples and Salerno - Southern Tyrrhenian Sea, Italy: 3D modeling example

Di Fiore V.[1], Alberico I.[1], Budillon F.[1], Cavuoto G.[1], Pelosi N.[1], Punzo M.[1] & Tarallo D.[1]

[1] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy

*Corresponding author email:* vincenzo.difiore@cnr.it

*Keywords:* 3D Tsunami simulation, Gulf of Naples and Salerno, submarine landslides.

In this study we propose a 3D numerical modeling of tsunami waves generated by submarine landslides which might occur in the continental slope of the Napoli and Salerno gulfs. These areas are characterized by a high susceptibility to slope failures, as testified by the large number of landslide scars identified on the open slope and along the canyons' walls. Recent studies however evidenced that only four scars over about 470 surveyed could have been potentially tsunamigenic (Alberico et al., 2018) and therefore their morphometric parameters and depth were used to implement the numerical simulations of tsunami propagation.

The tsunami waves modeling was carried out by using the numerical Open Source Software *Geowave* (Watts, 2009) which requires as input the landslide characteristics and local bathymetry. The algorithms simulate the tsunami waves generation (Okal et al., 2003) and propagation (Grilli et al., 1999; Watts, 2009) by using: i) fourth order fully nonlinear equations, ii) fully dispersive Boussinesq with multiple wave dissipation mechanisms, iii) wave breaking, and dry land overflow. In our simulation, thanks to a detailed bathymetry (D'Argenio et al., 2004), we have taken properly into account the decreasing nearshore tsunami wavelength through a system of nested grids. The performed simulations consider both single and simultaneous mass failures and paid attention to the waves interference, in the latter case.

The outcome of the numerical analysis evidenced a maximum wave height at the shoreline, which in some cases reaches few meters.

*References:*

Alberico I., Budillon F., Casalbore D., Di Fiore V., Iavarone R. (2018) - A critical review of potential tsunamigenic sources as first step towards the tsunami hazard assessment for the Napoli Gulf (Southern Italy) highly populated area. Nat Hazards, https://doi.org/10.1007/s11069-018-3191-5.

D'Argenio B., Aiello G., de Alteriis G., Milia A., Sacchi M., Tonielli R., Budillon F., Chiocci F.L., Conforti A., De Lauro M., d'Isanto C., Esposito E., Ferraro L., Insinga D., Iorio M., Marsella E., Molisso F., Morra V., Passaro S., Pelosi N., Porfido S., Raspini A., Ruggieri S., Terranova C., Vilardo G. & Violante C. (2004) - Digital elevation model of the Naples Bay and adjacent areas, eastern Tyrrhenian Sea. Atlas Italian Geologic Mapping, 32 IGC, Firenze, August 2004.

Grilli S.T. & Watts, P. (1999) - Modeling of waves generated by a moving submerged body: Applications to underwater landslides, Engrg. Analysis with Boundary Elements, 23, 8, 645-656.

Okal E.O. & Synolakis C.E. (2003) - A Theoretical Comparison of Tsunamis from Dislocations and Landslides, PURE AND APPLIED GEOPHYSICS, 160, (10/11), 2177-2188.

Watts P. (2009) - Geowave tutorial 1.1, Applied Fluids Engineering, Inc. 5710 E. 7th Street, Long Beach, CA, USA.

# XRF fluorescence facility at CNR-Ismar, Bologna (Italy): a case study of tephra and cryptotephra identification in marine sediments from the Ross Sea (Antarctica)

Di Roberto A.[1], Colizza E.[2], Del Carlo P.[1], Gallerani A.[3], Giglio F.[3] & Miserocchi S.[3]

[1] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Pisa, Italy.
[2] Dipartimento di Matematica e Geoscienze, Università degli Studi di Trieste, Italy.
[3] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* stefano.miserocchi@cnr.it

*Keywords:* Tephra, Ross Sea, marine sediment, XRF Core Scanner, magnetic susceptibility.

Marine sediment sequences may contain deposits produced during large explosive volcanic eruptions i.e. tephra. These materials usually dispersed over regional to continental-scale areas, are isochronous marker horizons and can provide important time-stratigraphic information if geochemically fingerprinted and tied to a known, dated eruption, or used as cross-correlated time horizons between natural records, offering an accuracy difficult to achieve with other methods. Usually macroscopic/visible tephra are recognizable during the visual description of the sediment sequences by variation in sediment color or texture.

Sometimes volcanic ash is dispersed in the sediment records and does not form a continuous distinct horizon. These deposits known as cryptotephra, occur as layers of very fine ash (tens of μm) and offer the opportunity to register also smaller eruptions, and eruptions from more distal sources.

Cryptotephra could be identified using several different methods, most of which are time-consuming and sample destructive. Here we present an application of rapid, and nondestructive scanning techniques (XRF core scanning and Magnetic Susceptibility), in order to recognize cryptotephra in marine distal sediment sequences, from the continental shelf of the Ross Sea (Antarctica). Sediments gravity cores has been collected in the framework of Italian PNRA TRACERS Project (TephRochronology and mArker events for the CorrElation of natural archives in the Ross Sea, Antarctica) that aims to identify, characterize in detail (sedimentological characteristics, texture, mineral phases, geochemical fingerprint) tephra as potential regional markers.

Victoria Land has been the site of intense and recurrent volcanic activity since 500 ka which resulted in the deposition of several discrete tephra in sediment sequences from Drygalski basin off the Victoria Land coast. The volcanoes of the Melbourne Volcanic Province are considered the most likely sources for these tephra layers on the basis of volcanological, geochemical and age constraints.

High resolution Magnetic susceptibility and XRF scan of sediment cores allowed us to recognize for the first time cryptotephra layers also in more distal basin (Joides Basin). Sediment cores (ca 6-8 m long) were run through the Avaatech XRF (3rd generation) core scanner at the CNR-Ismar infrastructure with a sample spacing of 1 cm, at 10, 30 and 50 kV to obtain semi-quantitative geochemical composition. Magnetic Susceptibility was measured with 2cm of resolution, using a Bartington MS2 system with loop sensor to acquire the concentration of ferromagnetic component.

In particular, the ratios of light elements (Fe/K, Ti/K, Ti/Ca, Mn/Ca, Cu/K and Si/Ca) proved to be the most useful to mark the cryptotephra.

# Onshore-offshore correlation of regional unconformities and tectonic lineaments in the late Miocene-Holocene sedimentary succession of the southern portion of the Hyblean foreland

Distefano S.[1], Tortorici G.[1], Gamberi F.[2], Pavano F.[1], Romagnoli G.[1], Catalano S.[1] & Di Stefano A.[1]

[1] Dipartimento di Scienze Biologiche, Geologiche ed Ambientali, Università di Catania, Italy.
[2] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* salvodist82@unict.it

*Keywords:* seismo-stratigraphic interpretation, morpho-structural investigations, Hyblean foreland.

The offshore seismo-stratigraphic interpretation of seismic profiles acquired along the southeastern coastline of Sicily together to onshore geological and morpho-structural investigations along the south-western borders of the Hyblean Plateau, allow us to improve the knowledge about the stratigraphic and structural context in the area connecting the Gela-Catania foredeep to the Hyblean foreland.

In particular, two goals have motivated this study: i) understanding the offshore areal distribution of the late Miocene-Holocene sedimentary succession through the identification of the main regional unconformities based on the available on-land geological data; ii) defining the offshore continuation of the main tectonic lineaments recognized in the hinterland (Scicli Line, Comiso-Chiaramonte fault system and Pozzallo-Ispica-Rosolini System).

A new stratigraphic-structural setting of the study area is proposed and compared with preexisting models derived from the literature. It is characterized by a NE-SW to NNE-SSW trending extensional fault systems, with horst and graben setting, affecting late Miocene to early Pleistocene deposits. The seismic profiles display tectonic structures probably connected to the Comiso-Chiaramonte fault system, to the north, and to the Marina di Ragusa Graben, to the south, which is strictly related to the polyphase kinematic evolution of the Scicli Line (Grasso et al., 2000; Catalano et al., 2008).

Furthermore, we identify three main regional unconformities: the lower one shows the marked erosional features interpreted as the Messinian horizon (M-reflector), the middle surface separates the evaporitic succession from the overlying Trubi formation and the upper unconformity represents the base of the youngest depositional units. The Gessoso-Solfifera formation is confined within the tectonic depressions and in the channelized areas, while the Trubi formation is widely extended in the studied area. The acoustic features of the undeformed deposits have permitted the identification of several seismic units that reflect the synchronous depositional evolution of the nearby Gela foredeep. According to the onshore geological data, this succession would represent the middle Pleistocene-Holocene deposits that conceal the tectonic structures.

*References:*

Catalano S., De Guidi G., Romagnoli G., Torrisi S., Tortorici G. & Tortorici L. (2008b) - The migration of plate boundaries in SE Sicily: influence on the large-scale kinematic model of the African promontory in southern Italy. Tectonophysics, 449, 41-62.

Grasso M., Pedley H.M., Maniscalco R. & Ruggieri R. (2000) - Geological context and explanatory notes of the Carta geologica del settore centro-meridionale dell'altopiano Ibleo. Mem. Soc. Geol. It, 55, 45-52.

# Enhancing the value of public vintage seismic data in the Italian offshore

Diviacco P.[1], Firetto Carlino M.[2] & Busato A.[1]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo (Catania), Italy.

*Corresponding author email:* pdiviacco@inogs.it

*Keywords:* Data access, SNAP database, Italian offshore, seismic data, vintage data.

Despite the antiquated acquisition methods and processing tools, vintage geophysical data represent a huge heritage for the whole scientific community, especially because they are generally characterized by high penetration and wide regional extension and also because large-scale projects are very difficult to take place nowadays, considering environmental, geopolitical, and funding issues.

Italian offshore areas have been widely investigated by a dense network of multichannel seismic reflection profiles, acquired by AGIP at the beginning of the 1970s for mineral prospecting, following the Italian law n. 613, 21 July 1967. This asset of data, known as "sismica riconoscitiva delle zone marine", represents big part of the ViDEPI database (Visibilità dei Dati afferenti all'attività di Esplorazione Petrolifera in Italia), whose main limitation is that seismic profiles are here available only as raster images, with gross information on positioning. It is therefore almost impossible to use these data in modern practices and software, heavily limiting their impact on the scientific community and stakeholders.

To address the above-mentioned drawbacks, Istituto Nazionale di Oceanografia e di Geofisica Sperimentale undertook an internal project aimed at converting this large dataset into an easily usable one. The main objectives of this project were to convert the dataset from raster images to SEG-Y seismic data, to fix the issues related to incorrect positioning, to enhance the signal-to-noise ratio using advanced reprocessing methodologies and to further valorize this dataset in terms of easy accessibility.

All the products of data restoration and reprocessing were submitted to a web-based geophysical data system named "SNAP" (Seismic database Network Access Point, Diviacco et al., 2018) (http://snap.ogs.trieste.it), that Istituto Nazionale di Oceanografia e di Geofisica Sperimentale is hosting and continuously developing, extending, and updating.

This work provides to the geoscience community the possibility to access a large (over 65.000 km) and important asset of vintage seismic lines offshore Italy; this dataset can now be used with modern processing and interpretation softwares.

*References:*

Diviacco P., Firetto Carlino M. & Busato A. (2018) - Enhancing the value of public vintage seismic data in the Italian offshore. Geosci Data J. 2018;00:1-10.

# Sedimentological, geochemical and biogeochemical facies of Central and Southern Adriatic Sea

Droghini E.[1], Dinelli E.[2], Tramontana M.[1], De Marco R.[3], Baldelli G.[1], Pappafico G.[1] & Spagnoli F.[3]

[1] Dipartimenti di Scienze Pure e Applicate (DiSPeA), Università degli Studi di Urbino Carlo Bo, Italy.
[2] Dipartimento di Scienze Biologiche, Geologiche e Ambientali (BiGeA) Università degli Studi di Bologna, Italy.
[3] Istituto per le Risorse Biologiche e le Biotecnologie Marine (IRBIM), Ancona, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* e.droghini@campus.uniurb.it

*Keywords:* sedimentology, geochemistry, factor analysis, facies, Adriatic Sea.

The Adriatic Sea is a basin oriented in the NW-SE direction, which represents the result of filling the Apennine and Dinaric-Hellenic chain foredeep. The present surface sediment distribution is controlled by basin evolution, different sediment source areas and processes. The aims of this work were to identify sedimentary facies based on grain-size, geochemical and biogeochemical features and to describe their spatial distribution, to recognize regional patterns of sediment dispersal, geochemical signals for provenance and eventual local features.

Grain-size, geochemical (major and trace elements) and biogeochemical (organic carbon) analysis (Droghini, 2017) carried out on 107 samples, collected by box-corer during the PERTRE cruise (Spagnoli, 2016). These data were elaborated with a Q-mode factor analysis to identify the sedimentary facies (Spagnoli et al., 2014). In particular the statistical processing of sediment properties highlighted 5 factors, which allowed characterizing different facies and to evaluate their provenance and surface distribution. In particular were identified: 1) Clayey facies, made up of clayey and clayey-silty sediments, originated from the contribution of the Po River and the Apennine rivers, and that are redistributed by the Adriatic circulation in a SE direction; 2) sandy facies, made up of sandy-silty sediments with silicate minerals and enriched in Magnesium; this facies is more abundant along the Italian coasts; 3) coarse carbonatic facies, made up of sandy-gravel sediments; this facies is more abundant in the outer areas of the Adriatic Basin, coinciding with the depositional areas of the relict sands; 4) silty facies with heavy minerals, characterized by silty sediments enriched in heavy minerals resulting from the action of waves and coastal currents; 5) sediment provenance, useful to identify the origin of sediments. This component shows high values in different areas mainly located offshore of northern Gargano Promontory and is due to sediment features mainly controlled by geochemistry rather than grain-size.

The characterization and distribution of the above described facies allowed understanding in more detail the present hydrodynamic, sedimentological, geochemical and biogeochemical processes occurring in the Central and Southern Adriatic Sea, and to identify the main sediment source areas.

*References:*

Droghini E. (2017) - Caratteri Sedimentologici e Geochimici dei sedimenti dell'Adriatico Centro-Meridionale. Tesi di laurea, Università degli studi di Urbino Carlo Bo.

Spagnoli F., Caccamo G., De Marco R., Leonetti M., Fossile E., Baldelli S., Manzotti E. & Castelli A. (2016) - Campagna oceanografica PERTRE. Rapporto finale di crociera M/N G. Dallaporta, 16 settembre - 4 ottobre 2016. 35 pp.

Spagnoli F., Dinelli E., Giordano P., Marcaccio M., Zaffagnini F. & Frascari F. (2014) - Sedimentological, biogeochemical and mineralogical facies of Northern and Central Western Adriatic Sea. Journal of Marine Systems, 183-203.

# Coasts, ports, inland waters, ponds…: hydrographic surveys by drone help the management of hydrogeological instability

Faccioli A.[1] & Fumanti M.[1]

[1] Codevintec Italiana, Milano, Italy.

*Corresponding author email:* andrea.faccioli@codevintec.it

*Keywords:* ASV, USV, Unmanned, Multibeam, SBP.

A portable, completely autonomous and remotely controllable ASV -Autonomous Surface Vessel- developed for hydrographic and geophysical surveying applications.

Rivers, ports, quarries, dams, sewage treatment plants, contaminated lakes...: detailed surveys of inaccessible areas are getting more and more strategic for the scientific knowledge of the environment and its management, risk assessment and disasters prevention.

The multi-role Hydrographic Drone features great portability, even with a large payload capacity which includes most of the marine geophysics instrumentation normally installed on traditional vessels: Single and Multibeam Echosounders (Beamformer or Interferometric), Sub Bottom Profilers, ADCP , LiDAR, Multiparametric Profiling Probes, Magnetometers, etc ....

*References:*

Faccioli (2018) - Rilevare le parti immerse di strutture e infrastrutture. Strade & Autostrade. It., 2-2018, 198-200.

# Benthic foraminifera as indicators of environmental changes and human impact in the coastal marine system

Ferraro L.[1], Bergamin L.[2], Capotondi L.[5], Di Bella L.[3], Frontalini F.[4] & Romano E.[2]

[1] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy.
[2] Istituto Superiore per la Protezione e la Ricerca Ambientale, Roma, Italy.
[3] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Italy.
[4] Dipartimento di Scienze Pure e Applicate, Università degli Studi di Urbino "Carlo Bo", Italy.
[5] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* ferraro.luciana@cnr.it

*Keywords:* Benthic foraminifera, Biomonitoring, Marine Environment, Italy.

Benthic foraminifera are a meiofaunal group of microorganisms that are particularly abundant in marine sediments. Their occurrence and distribution reflect environmental conditions in the bottom water and sediment surface layers (Murray, 2006 *and references therein*). Hence, this group has been recently proposed as a biomonitoring proxy to determine the Ecological Quality Status (Alve et al., 2009) both in Mediterranean and extra-Mediterranean areas (Bouchet et al., 2018 *and references therein*). In addition, their small shells are well preserved along the sediment record allowing us to reconstruct the historical evolution of particular areas, and thereby, to obtain insight into the baseline conditions preceding the present period of anthropogenic impact (Francescangeli et al., 2016; Romano et al., 2016). This unique foraminifera feature represents a clear advantage compared to (other) meiofaunal and/or macrofaunal organisms that are currently used in marine biomonitoring studies.

Over the last decades, the use of these organisms in marine biomonitoring has largely increased. The interest in benthic foraminifera has partly been driven by government policies and programs aimed at developing suitable, non-invasive bioindicators of marine environmental quality. Here, we report some field-based research carried out along the Italian coasts.

*References:*

Alve E., Lepland A., Magnusson J. & Backer-Owe K. (2009) - Monitoring strategies for reestablishment of ecological reference conditions: possibilities and limitations. Mar. Pollut. Bull. 59, 297-310.

Murray J.W. (2006) - In: Ecology and Applications of Benthic Foraminifera. Cambridge University Press, Cambridge, pp. 426.

Bouchet V.M.P., Goberville E. & Frontalini F. (2018) - Benthic foraminifera to assess the Ecological Quality Status of Italian transitional waters. Ecol. Ind. 84, 130-139.

Francescangeli F., Armynot du Chatelet E., Billon G. et al. (2016) - Palaeo-ecological quality status based on foraminifera of Boulogne-sur-Mer harbour (Pas-de-Calais, Northeastern France) over the last 200 years. Mar. Environ. Res. 117, 32-43.

Romano E., Bergamin L., Ausili A. et al. (2016) - Evolution of the anthropogenic impact in the Augusta Harbor (Eastern Sicily, Italy) in the last decades: benthic foraminifera as indicators of environmental status. Environ. Sci. Pollut. Res. 23, 10514-10528.

# Time and space scattered volcanism in the Mt. Etna area driven by strike-slip tectonics

Firetto Carlino M.[1], Cavallaro D.[1], Coltelli M.[1], Cocchi L.[2], Patanè D.[1] & Zgur F.[3]

[1] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Osservatorio Etneo (Catania), Italy.
[2] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy.
[3] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.

*Corresponding author email:* marco.firettocarlino@ingv.it

*Keywords:* Mt. Etna, strike-slip tectonics, seismic reflection profiles, magnetic data, gravity data.

Although Mt. Etna area (eastern Sicily, Italy) represents one of the most intricate and studied example of magmatism at the front of a collisional belt, its origin and spatial-temporal evolution are still object of debate. New high-resolution seismic reflection, magnetic and gravity data were acquired offshore Mt. Etna, during the TOMO-ETNA experiment (FP7 Project MED-SUV"; Coltelli et al., 2016; Ibanez, et al., 2016), to shed light on the relation between tectonics and volcanism. The present study focuses on the continental margin offshore southeastern Mt. Etna coast, where the oldest (ca 500 ka) volcanic products were found (Branca et al., 2011). Seismic and bathymetric data highlights the high degree of tectonic deformation involving the area, which is dominated by a 75 $km^2$, rhomboidal morpho-structural high, the Timpe Plateau, pertaining to the Hyblean foreland and bounded by inherited NNW-SSE and NE-SW lineaments.

Timpe Plateau and its continental slope, down to the bathyal plain, are strongly affected by strike-slip tectonics, highlighted by a large, wedge-shaped, roughly symmetric push-up, which is developed along WNW-ESE to NW-SE faults, producing an overall remarkable shortening. Splay faults bound basinal areas, showing local evidence of positive tectonic inversion, suggesting a former distensive phase. This latter favored the emplacement of scattered Plio-Quaternary volcanics and deep magmatic intrusive bodies, as resulting by a joint model of seismic, magnetic and gravity data.

This structural asset suggests the occurrence of a former transtensive phase, favoring volcanism through pull-apart structures. The ongoing strike-slip tectonics led to the development of a transpressive regime, hampering magma ascent, and a migration of transtensive structures, causing the shifting of magmatism toward the eastern Valle del Bove and then to the central-type volcanic centers (< ca 110 ka).

*References:*

Branca S., Coltelli M., Groppelli G. & Lentini, F. (2011) - Geological map of Etna volcano, 1:50,000 scale. Ital.J.Geosci. (Boll.Soc.Geol.It.), Vol. 130, No. 3, pp. 265-291.

Coltelli M. et alii (2016) - The marine activities performed within the TOMO-ETNA experiment. Annals of Geophysics, 59, 4, S0428.

Ibáñez J.M., Prudencio J., Díaz-Moreno A., Patanè D., Puglisi G., Lühr B. G., Carrión F., Dañobeitia J.J., Coltelli M., Bianco F., Del Pezzo E., Dahm T., Willmott V. & Mazauric V. (2016) - The TOMO-ETNA experiment: an imaging active campaign at Mt. Etna volcano. Context, main objectives, working-plans and involved research projects. Annals of Geophysics, 59, 4, S0426.

# Mass failures on the eastern flank of the Marsili submarine volcano and consequent tsunami generation

Gallotti G.[1], Tinti S.[1], Zaniboni F.[1], Pagnoni G.[1], Romagnoli C.[2], Gamberi F.[3] & Marani M.[3]

[1] Dipartimento di Fisica e Astronomia (DIFA), Settore Geofisica, Università di Bologna, Italy.
[2] Dipartimento di Scienze Biologiche Geologiche e Ambientali (BiGeA), Università di Bologna, Italy.
[3] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* glauco.gallotti2@unibo.it

*Keywords:* Marsili, Submarine Volcano, Tyrrhenian Sea, Mass Failures, Tsunami.

The Marsili Seamount (MS) is the biggest submarine volcano in Europe, located in the southern part of the Tyrrhenian Sea, about 120 km north of Sicily and 370 km west of Calabria. The volcanic edifice, NNE-SSW elongated, is 70 km long, 30 km wide and rises from the deep Marsili basin at 3500 m to a depth of only 450 m b.s.l. It represents the axial, superinflated spreading ridge of the Marsili back-arc basin (Marani and Trua, 2002; Cocchi et al., 2009). It is presently the seat of hydrothermal activity and of explosive eruptive activity, in historical times (Iezzi et al., 2014). A strong eruption, or seismic activity in connection with volcanic processes could eventually led to mass movements that in turn could induce tsunami waves. With this in mind, in this work we present a series of scenarios of possible mass failures occurring on the eastern flank of the MS, covering a broad range of volumes. The landslides are simulated by means of the UBO-Block numerical model, based on the partition of the landslide into a matrix of blocks whose dynamics is computed through a Lagrangian approach. The mass failures modelled for the Marsili have the potential to be tsunamigenic and hence our study represents a significant contribution to tsunami hazard assessment in the peri-Tyrrhenian region. With this goal, we compute the associated tsunami scenarios through the numerical code UBO-TSUFD, solving the shallow water equations via a finite difference technique, and show that the hypothesized largest mass failure could trigger waves impacting the eastern coasts of the Tyrrhenian sea with height even larger than 20 m.

*References:*

Cocchi L., Caratori Tontini F., Muccini F., Marani M.P., Bortoluzzi G. & Carmisciano C. (2009) - Chronology of the transition from a spreading ridge to an accretional seamount in the Marsili backarc basin (Tyrrhenian Sea). Terra Nova, 21, 369-374.

Iezzi G., Caso C., Ventura G., Vallefuoco M., Cavallo A., Behrens H., Mollo S., Paltrineri D., Signanini P. & Vetere F. (2014) - First documented deep submarine explosive eruptions at the Marsili seamount (Tyrrhenian Sea, Italy): A case of historical volcanism in the Mediterranean Sea. Gondwana Res. 25, 764-774.

Marani M.P. & Trua T. (2002) - Thermal constriction and slab tearing at the origin of a superinflated spreading ridge: Marsili volcano (Tyrrhenian Sea). JGR Solid Earth, doi: 10.1029/2001JB000285.

# Extensive mass transport deposition in the Capo d'Orlando Basin: location, 3-D geometry, facies and possible genetic processes

Gamberi F.[1], Scacchia E.[2], Dalla Valle G.[1], Di Stefano S.[3], Gallerani A.[1], Leidi E.[1], Mercorella A.[1] & Savelli F.[1]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Dipartimento di Fisica e Astronomia (DIFA), Università di Bologna, Italy.
[3] Dipartimento di Scienze Biologiche, Geologiche ed Ambientali, Università degli studi di Catania, Italy.

*Corresponding author email:* fabiano.gamberi@bo.ismar.cnr.it

*Keywords:* mass transport deposits, debris flow deposits, slumps, channel-levee wedge, shelf-edge.

Downslope sedimentary processes move material over the seafloor and resediment it into deeper water; they are characterized by a large variety of magnitude, type of transport and deposition, and frequency. In the recent sedimentary succession of the Capo d'Orlando Basin, a remarkable variety of MTDs is present and is illustrated in this work. Our analysis focusses on: the location of the evacuation and depositional areas of the MTDs; the characterization of the surface geomorphology of the MTDs; the evaluation of the thickness and 3-D geometry of the MTDs; the determination of the MTDs facies. The MTDs evacuation areas are mainly restricted to the slope, but some of them propagate upslope to affect the shelf-edge. The largest MTD occupies the whole eastern part of the basin plain with a total volume of approximately 12 $Km^3$. It is a frontally unconfined slump with often an erosional base and a ramp geometry in its frontal area. Intermediate-sized MTDs form an apron at the base- of-slope and do not reach the basin plain. They have their evacuation areas in the channel-levee wedges that consequently are experiencing a major destructional phase. Smaller scale debris flow deposits with generally an axial channel and lateral and distal blocky "wings" are present in the upper slope. Also, larger MTDs are however present in the upper slope of the western basin portion; they have a blocky surface and their evacuation area involves the shelf edge and is probably controlled by tectonic structures. The shelf edge is affected by sediment failure also in the eastern part of the basin, where landslide results in the retrogradation of canyon heads in the coastal areas. They can be triggered by rapid events of high sedimentation at the shelf edge, possibly connected with hyperpycnal flows or oceanographic processes, and originate flows that flush the canyons. The basin-plain MTD and the base-of-slope MTDs result from a single failure event or from almost synchronous multiple events indicating a major pulse of widespread instability in the basin margin. The common occurrence of MTDs in the upper stratigraphy of the Capo d'Orlando Basin points to a recent intensification of sediment collapse that has probably its roots in the tectonic setting of the northern Sicilian margin characterized by active faulting, tilting, vertical movements and seismicity. The Capo d'Orlando basin MTDs show a large variety of surface texture, shape, thickness, facies, source area, that afford the presentation of a classification of the different mass transport deposits in the study area. Our classification, linking source area character with the nature of the final deposits can serve as a template for the interpretation of MTD's history in succession, where successive geological processes obliterate the original environment. In addition, our study provides a useful case-study for the advancement of our understanding of geohazards in area affected by repeated and diverse collapse events.

# Benthic foraminiferal fauna from anoxic sediments in the Kveithola Trough, northwest Barents Sea (Arctic region)

Gamboa Sojo V.M.[1,2], Morigi C.[1,3], Lucchi R.G.[4], Caridi F.[5], Sabbatini A.[5]
and the Scientific Party of BURSTER cruise

[1] Dipartimento di Scienze della Terra, Università di Pisa, Italy.
[2] Dipartimento di Scienze della Terra, Università di Firenze, Italy.
[3] Stratigraphy Department, Geological Survey of Denmark and Greenland, Copenhagen, Denmark.
[4] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[5] Dipartimento di Scienze della Vita e dell'Ambiente, Università Politecnica delle Marche, Ancona, Italy.

*Corresponding author email:* vivianamaria.gambaosojo@unifi.it

*Keywords:* Foraminifera, sediments, Arctic, Kveithola Trough, climatic changes.

The recent sedimentary records preserve the imprint of the climatic changes in the last decades. One of the most sensitive region to these changes is the Arctic region, as it responds more rapidly to global warming than most of the other areas on our planet.

The Kveithola Trough, in the NW Barents Sea, represents an important repository of the history of the past climatic changes affecting the local oceanographic configuration and ice sheet evolution. Indeed this zone is characterized by the interaction of two main water masses: the cold, fresh Arctic Water coming from the north and the warm, salty Atlantic Water flowing from the south.

During the oceanographic cruise EUROFLEETS2-BURSTER (June 2016), seven multi-cores were collected from three sampling sites in the Kveithola Trough area. The aim of this study is to analyze three of these cores focusing on dead and living benthic foraminiferal assemblages and sedimentological parameters, in order to study the past variability and present conditions of the water masses, the organic matter flux and oxygen concentration to the sea floor during the last decades.

A total of 77 dead benthic species (calcareous perforated, miliolids and agglutinated) and 78 living (50 species of calcareous perforated, miliolids and agglutinated, plus 28 species of soft-shelled) foraminiferal species were identified. The dominant (live and dead) foraminiferal species are *Globobulimina auriculata*, *Globobulimina arctica*, *Nonionellina labradorica*, *Cassidulina laevigata*, and *Cassidulina neoteretis*, present in different percentages at each site. Benthic foraminiferal assemblages allow to distinguish different (palaeo)-environmental conditions along the study area.

The preliminary results shows that during the last 200 years until present, the deeper part of the Kveithola trough has been a highly dynamic environment. The inner part is a stressful environment with low oxygen concentrations and high superficial phytodetritus influx, likely influenced by methane seepage. A higher influence of warm water masses, North Atlantic Water Currents, is reflected by the presence of warm taxa (such as *Melonis barleeanus*, *Cassidulina neoteretis, Cassidulina laevigata*) during the last decades. During the same time, the high percentage of *Nonionellina labradorica, Globobulimina auriculata*, *Globobulimina arctica*, shows a low oxygen concentration along the Kveithola Trough area.

These preliminary results need further research to be confirmed by multidisciplinary analysis, including oceanographic, biological, sedimentological and chemical data.

*Acknowledgement*: the work was funded by the Italian project PNRA 14_00039 "AXED" Project (PI: C. Morigi).

# A micropaleontological focus on two piston cores from the Edisto Inlet, Ross Sea, Antarctica

Gariboldi K.[1], Gazzurra G.[1], Morigi C.[1], Torricella F.[1,2], Tesi T.[3], Belt S.[4], Smik L.[4], Muschitiello F.[5], Colizza E.[2], Giglio F.[3], Giordano P.[3], Finocchiaro F.[2], Capotondi L.[3], Gallerani A.[3] & Langone L.[3]

[1] Dipartimento di Scienze della Terra, Università di Pisa, Italy.
[2] Dipartimento di Matematica e Geoscienze, Università di Trieste, Italy.
[3] Istituto di Scienze Marine (ISMAR),Bologna, Consiglio Nazionale delle Ricerche, Italy.
[4] School of Geography, Earth and Environmental Sciences, Univ. of Plymouth, Plymouth, United Kingdom.
[5] Dept. Geog., Univ. of Cambridge, Cambridge, United Kingdom.

*Corresponding author email:* karengariboldi@gmail.com

*Keywords:* micropaleontology, diatom laminations, last 3ka, Ross Sea, sea-ice dynamics.

In the frame of the PNRA-Holoferne Project (see Tesi et al., 2019), detailed micropaleontological analyses on two gravity cores, HLF16_01 (11.4 m long) and HLF17_01 (14.6 m long), collected in the same site into the Edisto Inlet (Ross Sea, Antarctica), have been conducted. The high biosiliceous sedimentation characterising the Edisto Inlet (accumulation rates are as fast as 0.5 cm $a^{-1}$, core HLF17_01 covering ca. the last 2800 years) together with its geomorphology, allowed the formation of diatom laminations, as well as their preservation in the sediment record. Therefore, studies on diatom assemblages are being conducted both on homogenized sediments (samples taken each 5 cm without considering whether one or more laminae were being collected) along the whole HLF17_01 core and on distinct laminae from section III of the same core. Preliminary results show that while diatom assemblages characterising single laminae give information on the paleo sea-ice dynamics within the inlet, whereas the whole-core-analysis is displaying the regional climate evolution in the last 3 ka of the Ross Sea. As diatom assemblages are representative of sea surface waters conditions, information such as bottom oxygenation levels and organic matter fluxes are gained from benthic foraminiferal assemblages in the twin core HLF16_01. As the two cores are visually correlated by means of laminae, we will be soon able to compare surface paleoprimary production conditions with changes in the benthic foraminiferal fossil record. Environmental investigation on the paleo sea-bottom conditions will be further enriched throughout the study of brittle stars (Class: Ophiuroidea) vertebral-arm-ossicles-accumulation-levels found in core HLF16_01. Observations of ossicles have been conducted by means of the Hitachi TM3030 Tabletop Microscope, available at the Earth Sciences Department, University of Pisa.

*References*

Tesi T., Gariboldi K., Belt S., Smik L., Muschitiello F., Colizza E., Giglio F., Giordano P., Finocchiaro F., Morigi C., Capotondi L., Gallerani A., Torricella F., Gazzurra G. & Langone L., (2019) - Sea-ice reconstruction over the last 3ka in the Ross Sea (Antarctica). This volume.

# A fleet of autonomous surface vehicles for the geological / geophysical study of submerged environments

Gasperini L.[1], Stanghellini G.[1], Del Bianco F.[2] & Ferrante V.[2]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Consorzio Proambiente, Bologna, Italy.

*Corresponding author email:* luca.gasperini@ismar.cnr.it

*Keywords:* Autonomous Surface Vehicles (ASV), marine geophysical surveys, NAIADI Project (Nuovi sistemi Autonomi/AutomaticI per lo stuDio e il monitoraggio degli ambienti acquatici).

Natural or artificial shallow-water environments, such as ports, coastal areas, waterways, lakes and lagoons, are particularly affected by anthropogenic pressures. For this reason, they would require periodic monitoring to mitigate the effects of environmental crises caused by human activity or natural processes. However, to date, geophysical studies in shallow-water areas (shallower than 5 m) are not a consolidated practice for various reasons, including the following: 1) they present difficult access even by small boats in absence of accurate bathymetric maps; 2) shallow water is an efficient waveguide for acoustic and ultrasonic noises that limit penetration of the signals into the substrate; 3) the effect of noise due to propellers or other natural and artificial causes is amplified; 4) the rapidity of environmental changes would require repeated investigations (4D), which are not economically viable with conventional methods (Gasperini, 2005). The economic and social importance of shallow-water environments, therefore, calls for the development of new technologies and methods that could open their study to a wider range of researchers and environmental protection agencies; progresses and developments in the field of marine robotics could be an interesting opportunity for this purpose. In fact, the relatively recent availability of miniaturized although accurate sensors, as well as innovative hardware architectures (Arduino, Raspberry, etc.) simplify the design and development of Autonomous Surface Vehicles (ASV), which can operate in a variety of aquatic environments. This is the case of SWAP (Shallow-WAter Prospector) developed by ISMAR-CNR and by the Proambiente Consortium (Tecnopoli dell'Emilia Romagna), a small highly flexible vehicle to be used with different payloads, that has been developed as part of the POR-FESR project NAIADI (New autonomous /automatic systems for the study and monitoring of aquatic environments). The intensive use of "open" technologies and software packages for data acquisition and processing (Gasperini and Stanghellini, 2009), and their low-cost, have the potential to extend the use of these techniques and methods to a growing public of Earth scientists studying geological processes in these rapidly changing environments.

*References:*

Gasperini L. (2005) - Extremely Shallow-Water Morphobathymetric Surveys: The Valle Fattibello (Comacchio, Italy) Testcase. Marine Geophysical Researches, 26, 7-107.

Gasperini L. & Stanghellini G. (2009) - SeisPrho: an interactive computer program for processing and interpretation of high-resolution seismic reflection profiles, Computers and Geosciences. 35,1497-1504.

# Seismic depth imaging of fluid flow plumbing system and bottom simulating reflectors in the Circum-Antarctic seas

Geletti R.[1], Mocnik A.[2], Brancatelli G.[1], Forlin E.[1], Busetti M.[1], Civile D.[1] & Del Ben A.[2]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] Dipartimento di Matematica e Geoscienze, Università di Trieste, Italy.

*Corresponding author email:* rgeletti@inogs.it

*Keywords:*BSRs, seismic reflection, depth migration, Antarctica, gas seeps, gas hydrate.

In the Antarctic region, several Bottom Simulating Reflectors (BSRs) have been observed in different offshore crustal domains. Some types of BSRs are related to the presence of gas hydrate (methane) below the sea floor. The relationship between ocean warming and escape of methane from the seabed is a crucial problem and therefore it is important to identify fluid flow plumbing system linked to reservoirs of gas hydrates. This phenomenon is undoubtedly related to climate change, but also depend on geological factors such as tectonics. For these reasons, it is important to have a good seismic image in depth to characterize the deep geological features. In this work, we show new seismic images of several BSRs in Circum-Antarctic seas using the multichannel seismic lines acquired by the OGS since 1988 with the R/V OGS-Explora in the framework of the Italian Programma Nazionale di Ricerche in Antartide (PNRA). We used different techniques of true amplitude seismic processing in order to characterize the BSRs: spectrum velocity analysis, seismic instantaneous attributes and Amplitude Versus Offset. These different approaches have been integrated by the Pre-Stack Depth Migration (PSDM) of the seismic profiles to define the real geometry in depth of seismic horizons. In particular, the velocity fields for the PSDM have been obtained using different, integrated approach: 2D grid tomography, horizon-based tomography and residual velocity analysis performed on Common Image Gathers. The seismic depth images obtained and the geological information of the explored sedimentary layers allow us to identify some new BSRs as well as those already known in literature. In particular (i) fossil-diagenetic BSRs have been observed in the Scotia Sea, while (ii) methane hydrate BSRs have been observed in the Ross Sea (Geletti & Busetti, 2011), on the South Shetland Margin (Lodolo et al., 1993; Tinivella et al., 1998), on the some areas of the Scotia Sea. The fault systems generally represent a preferred pathway for fluids migration and often this process produces mud volcanoes and pockmarks on the sea floor such as in the Ross Sea (Geletti & Busetti, 2011) and Scotia Sea. This analysis aims to improve the general understanding of BSRs formation in the Antarctic region and suggests that integrated use of all the seismic data can give important information on the fluid flow upward migration linked to the gas hydrate reservoirs and fault systems.

*References:*

Geletti, R. & Busetti, M. (2011) - A double bottom simulating reflector in the western Ross Sea, Antarctica. J. Geophys. Res. 115.

Lodolo et a. (1993) - A bottom simulating reflector on the South Shetland margin, Antarctic Peninsula. Antarct. Sci. 5 (2).

Tinivella et al. (1998) - Seismic tomography study of a bottom simulating reflector of the South Shetland Islands (Antarctica). In: Henriet, J. P., Mienert, J. (eds.), Gas hydrate: relevance to world margin stability and climate change. Geol. Soc. Spec. Publ. 137.

# New comparative mapping around Lampedusa, Linosa and Lampione, Pelagie Archipelago (Sicily Channel)

Innangi S.[1], Tonielli R.[1], Di Martino G.[1], Innangi M.[3] & Romagnoli C.[2]

[1] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy
[2] Dipartimento di Scienze Biologiche, Geologiche ed Ambientali (BiGeA), Università di Bologna, Italy
[3]Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università degli Studi della Campania "Luigi Vanvitelli", Napoli, Italy

*Corresponding author email:* sara.innangi@cnr.it

*Keywords:* Seafloor mapping, multibeam bathymetry, multibeam backscatter, automatic classification, ground-truth data.

In the course of three years, the CNR-ISMAR of Naples carried out the surveys ("*Lampedusa 2015"*, *"Linosa 2016"* and "*BioGeoLin 2017*") with the aim of studying the seabed of the insular shelf of Lampedusa, Linosa and Lampione, the three islands belonging to the Pelagie Archipelago. A common feature of all three surveys was the use of the multibeam Teledyne Reson SeaBat 7125 400 kHz (Innangi et al., 2018; Innangi et al., 2019), providing sub-centimetric resolution in the bathymetric data at that depth range between 5 to 180 m. Furthermore, the vessels employed were equipped with the same auxiliary instruments, i.e. an Ominstar DGPS (for position data), an IxSea Octans 3000 (for attitude data), and a Valeport mini-SVS sound velocity probe installed near the transducer (for beam steering). For all surveys, the snippet data was logged (as backscatter information) with the same Absorption and Spread acquisition parameters. Also the data processing was the same, e.g. the snippet data was processed using FMGeocoder Toolbox (FMGT) in Fledermaus 7.6 version (QPS, 2016) to produce mosaic images with the same amplitude range, from -60 dB (lighter tones, corresponding to low backscatter) to -25 dB (dark grey tones, corresponding to high backscatter). Furthermore, ground-truth information, in the form of video-investigation (for all islands) and grab samples (only for Linosa and Lampione), were collected during the surveys. These characteristics made it possible to analyse all islands with RSOBIA (*Remote Sensing Object Based Image Analysis*) with the integrated information derived from backscatter data and bathy-morphological features, validated by ground-truth data (Innangi et al., 2018; Innangi et al., 2019) to produce three seabed maps, including seagrass distribution and benthoscape classification (according to Lacharité et al., 2017), and comparable to each other. Finally, it must be emphasized that the maps provided the first indication of the occurrence of rhodolith and maërl habitats at Lampione and Linosa, which are among the most important ecosystems in the Mediterranean Sea, while for Lampedusa further ground-truth data are necessary to better characterize the acoustic facies pattern of the island (Innangi et al., 2018; Innangi et al., 2019).

*References:*

Innangi S., Tonielli R., Romagnoli C., Budillon F., Di Martino G., Innangi M., Laterza R., Le Bas T. & Lo Iacono C. (2018) - Seabed mapping in the Pelagie Islands marine protected area (Sicily Channel, southern Mediterranean) using Remote Sensing Object Based Image Analysis (RSOBIA). Mar. Geophys. Res., pp. 1-23, https://doi.org/10.1007/s11001-018-9371-6.

Innangi S., Di Martino G., Romagnoli C. & Tonielli R. (2019) - Seabed classification around Lampione Islet, Pelagie Islands Marine Protected Area, Sicily Channl, Mediterranean Sea. Journal of Maps., in press. https://doi.org/10.1080/17445647.2019.1567401.

Lacharité M., Brown C. J. & Gazzola, V. (2017) - Multisource multibeam backscatter data: developing a strategy for the production of benthic habitat maps using semi-automated seafloor classification methods. Mar. Geophys. Res, 0(0), 1-16. https://doi.org/10.1007/s11001-017-9331-6.

# The ~4 ka-2 ka tephra record in the Central Mediterranean: tracing ash dispersal and new potential isochrones for high-resolution stratigraphy

Insinga D.D.[1], Petrosino P. [2], Alberico I.[1], de Lange G.J.[3], Lubritto C.[4], Molisso F.[1], Sacchi M.[1], Sulpizio R.[5], Wu J.[6] & Lirer F.[1]

[1] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale deele Ricerche, Italy.
[2] Dipartimento di Scienze della Terra dell'Ambiente e delle Risorse (DiSTAR) Università degli Studi "Federico II" di Napoli, Italy.
[3] Department of Earth Sciences-Geochemistry, Utrecht University, The Netherlands.
[4] Dipartimento di Scienze e Tecnologie Ambientali, Biologiche e Farmaceutiche, Università della Campania "Luigi Vanvitelli", Caserta, Italy.
[5] Dipartimento di Scienze della Terra e Geoambientali, Università di Bari, Italy.
[6] State Key Laboratory of Marine Geology, Tongji Univerisity, Shanghai-China.

*Corresponding author email:* donatelladomenica.insinga@cnr.it

*Keywords:* cryptotephra, Mediterranean, Italian volcanism, high-resolution stratigraphy, ash dispersal

Tephra and cryptotephra analysis is a main challenge in Quaternary studies because it has the potential to address a wide range of scientific questions dealing with volcanology, paleoclimate and geoarcheology research, for instance. The central Mediterranean is a favourable study area in this context due to the occurrence of the active and productive Italian volcanic vents and the downwind position of some marine basins characterized by expanded sedimentary sequences which are suitable for high- and ultrahigh-resolution stratigraphic studies. In this work we report some preliminary results on tephra deposits (mostly cryptotephra) found in a number of marine cores raised in the southern Tyrrhenian, southern Adriatic and Ionian seas, including the Taranto Bay, from the shelf to the deep basin. The cryptotephras were recognized through magnetic susceptibility means, elemental composition on bulk sediments and optical observation of samples prepared for micropaleontological purposes. The characterization in terms of major element composition, obtained through SEM-EDS technique, along with robust age constraints for each core, allowed to relate the analysed deposits to the Somma-Vesuvius, Ischia, Campi Flegrei, Aeolian arc (Lipari and Vulcano) and Mt. Etna activity occurred during the ~4 ka- ~2 ka time window. According to the tephrostratigraphic framework built for this research, the 79 CE tephra occurs in most of the investigated sites thus applying as a powerful tool to link and synchronise sedimentary archives at ~2 ka BP. In southern Tyrrhenian, the 79 CE phonolitic population is often found mixed with the trachyphonolitic glasses of Cretaio eruption (Ischia, CE) whereas in the Taranto Bay it is closely spaced in time with Lipari HKCA rhyolites. Cryptotephras sourced by Mt. Etna characterize the investigated stratigraphic intervals in the southern Tyrrhenian and in the whole Ionian Sea and this study allowed to document them for the first time in the marine settings. They occur in cores at ~ 4 cal ka associated to a Campi Flegrei related population (offshore Santa Maria di Leuca-eastern Taranto Bay), at ~2.2 cal ka (southern Ionian), at ~2.1 cal ka (margin of the Libyan shelf) and might be correlated to the terrestrial FS (~4 cal ka), FF (44 BC) and FG (122BC) tephras respectively, which represent regional markers on land. We can include also the FL (~3.4 cal ka) deposits found in the Taranto Bay and already documented up to the Balkans. In order to establish a distinctive proximal-distal correlation, however, a database of single glass chemistry compiled for those Mt. Etna deposits is required since data relies largely on bulk composition. The results presented here are part of a work in progress which aims to give a contribution to high-resolution stratigraphic studies and also to provide new insights on ash dispersal from active Italian volcanoes.

# Particle transfer along the modern dispersal system of the Adriatic Sea by down-core sediment-bound metal distributions

Langone L.[1], Lopes da Rocha M.[2,3], Miserocchi S.[1], Giordano P.[1], Pellegrini C.[1], Tesi T.[1] & Guerra R.[3,4]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Departamento de Química-Física, Facultad de Ciencias del Mar y Ambientales, Universidad de Cádiz, Spain.
[3] Centro Interdipartimentale di Ricerca per le Scienze Ambientali (CIRSA), Ravenna, Università di Bologna, Italy.
[4] Dipartimento di Fisica e Astronomia, Università di Bologna, Italy.

*Corresponding author email:* leonardo.langone@cnr.it

*Keywords:* trace metals, deep sea sediments, marine sedimentary record, off shelf transfer, Adriatic Sea.

In the marine environment, anthropogenic contaminants are mostly adsorbed onto the particulate matter, which mainly accumulates close to the source areas. Their concentrations and inventories gradually decline with increasing distance from the inputs.

In many sedimentary systems, such as the Adriatic Sea, the magnitude of along-shelf particulate transport is much greater than the corresponding across-shelf component. In these systems, the river-borne contaminated material follows the dispersion pattern controlled by the main currents and accumulates when and where the energy of water mass decreases. Thus, the study of the contaminant fate can contribute to elucidate the depositional processes of river-borne material from the riverine source to the basinal sink into the sedimentary record.

High Zn and Pb concentrations have been previously found in the northern Adriatic sector and related to anthropogenic influences. In this study, we used the vertical profiles of Pb and Zn, measured in $^{210}$Pb-dated sediment cores collected along the modern mud wedge of the western Adriatic Sea, to reconstruct their historical evolution during the last century.

The temporal trends of trace metals in the Adriatic sediments coincided with the industrial production activities and their past use. Our results showed that Zn and Pb concentrations started to increase from the World War I. The increasing contamination signal of these trace metals propagated southward as far as 450 km with a growing delay. A reduction of trace metals from mid-1980s was also observed, related to the implementation of stricter environmental regulations on chemical wastewaters.

Based on the delay of propagation of the signal of the onset and decreasing shift of Zn and Pb recorded in sediment cores collected along the Po River dispersal system, a first estimate of ~10 years is provided for the mean transfer time of particles travelling from the Po River mouth to the Gargano subaqueous delta.

# Released submarine volcanic gases revealed by COSMO-SkyMed satellite images: the exceptional case of Paleochori Bay (Milos Is., Greece)

Loreto M.F.[1], Nirchio F.[2], Grieco G.[3], Nimikou P.[4] & Ligi M.[1]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Agenzia Spaziale Italiana (ASI), Matera, Italy.
[3] Koninklijk Nederlands Meteorologisch Instituut (KNMI), De Bilt, Nederland.
[4] National and Kapodistrian University of Athens (NKUA), Panepistimioupoli Athens, Greece.

*Corresponding author email:* filomena.loreto@bo.ismar.cnr.it

*Keywords:* Satellite radar, hydrothermal gas, submarine volcanoes, sea surface reflectivity.

High-hazard volcanoes forming islands, often located within territorial water of several European countries, are a favoured tourist destination, a factor that increases the risk. Consequently, the knowledge of volcanic dynamics through time are crucial for risk assessment and mitigation in coastal areas. Gas vents, black smokers, chimneys and any other form of gas emissions are directly connected to the dynamic behaviour of volcanoes, accordingly, intensity variation of gas-released in hydrothermal systems would provide clues on volcanic activity changes, monitoring of which can be crucial for eruption forecasting. In this study we explored the possibility of detecting any submarine volcanic activity from satellite synthetic aperture radar (SAR) images part of the Cosmo-SkyMed mission operated by the Italian Space Agency. Three test sites have been analysed: 1) the hydrothermal system offshore Nea Kameni and Palea Kameni that are part of the Santorini volcanic group (Aegean Sea); 2) the intense and stationary submarine vents within the Paleochori Bay south to Milos Is. (Aegean Sea); and 3) the Panarea hydrothermal system including the Basiluzzo's "smoking land" (South East Tyrrhenian Sea). Visual analysis of all StripMap HIMAGEs, integrated with the wind model maps (produced by ECMWF ERA5), acquired over the selected sites since 2007 have not allowed the detection of any features associable with gas-sea surface interaction, for all the analysed sites. Instead, Radar Cross Section measurements, performed by internally-developed software, revealed an increased averaged reflectivity over the areas interested by the submarine gas emissions respect to similar sites. Particularly in Nea Kameni and Palea Kameni bays the difference is of 0.233 dB and in Paleochori Bay it is of 0.808 dB. The Normalized Radar Cross Section (NRCS) in Panarea and Basiluzzo was practically not different from nearby sites, here the average difference in reflectivity is close to zero (-0.002 dB). Results give confirmation that only intense and continuous emissions of gas can be detected by Satellite radar. Indeed, sites of Panarea/Basiluzzo and even Santorini are not suitable for this kind of monitoring, at least in the current status, while in Paleochori Bay the vents are continuous and enough intense to create a perturbation of sea surface reflectivity to be recorded by Satellite radar. Amongst all investigated sites Paleochori Bay is the most suitable one for future combined Satellite acquisition and fieldwork survey with underwater systems as ROV, which can give additional valuable elements to the high-risk submarine volcanic systems assessment and to the monitoring protocol definition.

# Preliminary data on recent benthic foraminiferal assemblages from shallow water hydrothermal environment in the Aeolian Arc (Tyrrhenian Sea)

Louvari M.A.[1], Auriemma R.[3], Bigi S.[2], Caruso C.[5], Conti A.[2], De Vittor C.[3], Esposito V.[3], Frezza V.[2], Gaglioti M.[4], Gambi M.C.[4], Italiano F.[5], Longo M.[5], Munari M., Ruggiero L.[2] & Di Bella L.[2]

[1] Department of Historical Geology & Paleontology, Faculty of Geology & Geoenvironment, School of Earth Sciences, National & Kapodistrian University of Athens, Panepistimiopolis, Zografou, Greece.
[2] Dipartimento di Scienze della Terra, Sapienza Università di Roma.
[3] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[4] Stazione Zoologica Anton Dohrn, Napoli, Dipartimento di Ecologia Marina Integrata, Villa Dohrn- Ecologia del benthos, Ischia, Italy.
[5] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Palermo, Italy.

*Corresponding author email:* letizia.dibella@uniroma1.it

*Keywords:* benthic foraminifera, hydrothermal vent, seagrass, Panarea Island.

During the Scientific Diving Summer School, that is annually held since 2016 on Panarea Island (Aeolian Archipelago) at the ECCSEL NatLab-Italy laboratory (established by the National Institute of Oceanography & Experimental Geophysics and the Sapienza University, Rome), a series of bottom sediment sampling (syringe technique) is being conducted at the NE coasts of the island, in order to investigate the effects of the $CO_2$ vents on the shallow marine benthic ecosystems. This area is considered as a natural laboratory and it is a much-promising study site for multidisciplinary marine research (carbon capture and storage, geochemistry of hydrothermal fluids and ocean acidification vs benthic and pelagic organisms). Previous studies on benthic foraminiferal assemblages in Mediterranean areas characterized by underwater hydrothermal vents and $CO_2$ fluid emissions, have indicated biodiversity loss, decrease in faunal density and variations in the test-type abundances (agglutinated, porcelaneous, hyaline) (Panieri et al., 2005; Di Bella et al., 2016). However, the relationships between the environmental parameters (e.g. pH, temperature, salinity, $CO_2$,) and foraminiferal distribution in such environments are yet poorly studied. In this perspective, the aim of this research is to present the preliminary results as yielded by the study of foraminiferal assemblages in shallow hot/cold spots (10-12 m depth) of Panarea Island, characterized by a patchy meadow of *Posidonia oceanica* seagrass. All spots are affected by gas emissions and hot fluids (even up to 60 °C). The preliminary observations have highlighted the absence of living or dead foraminifera in the sediments. Only diatoms and partly dissolved carbonate tests (serpulids, ostracods and foraminifers) are found in the bottom samples. Foraminifera and other carbonate epiphytic organisms are present only on the *P. oceanica* leaves and rhizomes. The cold sites can be distinguished from hot ones by the fact of the absence of miliolids. The absence of carbonate micro and meiofauna in the bottom samples could be attributed to multiple hypotheses such as: the dissolution of the tests caused by the widespread $CO_2$ vent, the presence of active shore currents, the grainsize of the sediments that are mainly composed of coarse sands which luck of the necessary amount of organic matter, for the benthic foraminifera to survive.

*References:*

Di Bella L., Ingrassia M., Frezza V., Chiocci F.L. & Martorelli E. (2016) - The response of benthic meiofauna to hydrothermal emissions in the Pontine Archipelago, Tyrrhenian Sea (central Mediterranean Basin). Jour. Mar. Sys., 164, 53-66.

Panieri G., Gamberi F., Marani M. & Barbieri R. (2005) - Benthic foraminifera from a recent, shallow-water hydrothermal environment in the Aeolian Arc (Tyrrhenian Sea). Mar. Geol. 218, 207-229.

# Paleoclimatic significance of laminated sediments on the NW Barents Sea continental margin (Arctic)

Lucchi R.G.[1], Musco M.E.[1,2], Caricchi C.[3], Sagnotti L.[3], Caburlotto A.[1], Morigi C.[4,5], Princivalle F.[6], Giorgetti G.[2], Husum K.[7] & Laberg J.S.[8]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] Dipartimento di Scienze Fisiche, della Terra e dell'Ambiente, Università di Siena, Italy.
[3] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy.
[4] Dipartimento di Scienze della Terra, Università di Pisa, Italy.
[5] Geological Survey of Denmark and Greenland, Copenhagen, Denmark.
[6] Diparimento di Matematica e Geoscienze, Università di Trieste, Italy.
[7] Norwegian Polar Institute, Tromsø, Norway.
[8] UIT - the Arctic University of Norway in Tromsø, Norway.

*Corresponding author email:* rglucchi@inogs.it

*Keywords:* Arctic, Barents Sea, Meltwater Pulses, Heinrich Events, ice-sheet

The recent depositional architecture of the north-western Barents Sea continental margin derives from past climate changes with alternating deposition of highly consolidated glacigenic diamicton and debris flows associated to shelf-edge glaciations, and low-density biogenic-rich sediments deposited during interglacial conditions. Sub-bottom records indicate the presence of acoustically laminated deposits locally having thickness exceeding 10 m, which lithofacies characteristics indicate deposition from turbid meltwaters (*plumites*) during short-living, phases of glacial retreat (meltwater pulses, MWP). One of the youngest stratigraphic intervals recognized along the NW Barents Sea margin was related to the MWP-1a that was responsible for the deposition of about 1.1 x $10^{11}$ tonnes of sediments on the upper slope of the Storfjorden-Kveithola TMFs (south of Svalbard) (Lucchi et al., 2015). New compositional analyses of such *plumites* revealed a distinct signature that allow us to distinguish deposition from glacial melting form that related to the ice-sheet sub-glacial erosion and transport to the edge of margins. Sediment facies and compositional analyses lead to a new climate-related interpretation of the laminated deposits recognized during Marine Isotopic Stages 3 and 2 on the NW margin of the Barents Sea, including Heinrich Event H2.

*References:*

Lucchi et al. (2015) - Marine sedimentary record of Meltwater Pulse 1a in the NW Barents Sea continental margin. arktos 1:7 https://doi.org/10.1007/s41063-015-0008-6.

# Submarine depression trails driven by upslope migrating sediment waves and the roles of fluid escape

Maestrelli D.[1], Garone R.[2], Maselli V.[3], Chiarella D.[4], Jovane L.[5] & Iacopini D.[6]

[1] Istituto di Geoscienze e Georisorse (IGAG), Firenze, Consiglio Nazionale delle Ricerche, Italy.
[2] Next Geosolution.
[3] Department of Earth Sciences, Life Sciences Centre, Dalhousie University, 1355 Oxford Street, Halifax, Nova Scotia, B3H 4R2, Canada.
[4] Department of Earth Sciences, Royal Holloway, University of London, Egham Hill, TW20, 0EX ,UK.
[5] Instituto Oceanográfico, Universidade de São Paulo, Praça do Oceanográfico, 191, 05508-120, São Paulo, Brazil.
[6] School of Geoscience, University of Aberdeen, King's college, Aberdeen AB24 3DS, UK.

*Corresponding author email:* d.iacopini@abdn.ac.uk

*Keywords:* Sediment waves, fluid migration, turbidity currents, 3D seismic geomorphology, Brazil.

The study of fluid migration in marine sediments has attracted a large community of geoscientists due to their importance in predicting the presence of deep-seated hydrocarbon reservoirs, and in understanding the seal capacity and the physical properties of specific stratigraphic intervals (Hovland 2003). Circular to elliptical topographic depressions, isolated or organized in trails, have been observed on the modern sea floor in different contexts and water depths, and often linked to fluid escape from subsurface sediments. After the seminal works performed on the Pacific margin offshore California (Fildani et al., 2006), several studies have highlighted how turbidity currents showing streamwise alternations between sub- and super-critical flow regimes may generate circular to elliptical topographic features at the sea floor through erosion, deposition or a combination of both (Cartigny et al., 2011; Symons et al., 2016). In this study, we propose a new mechanism for the formation of sea floor depression features considering the interplay between turbidity currents and seafloor topography. By using high-resolution 3D seismic data from offshore Ceará State (Brazil), we show how vertically stacked and upslope migrating sediment waves generated by unconfined turbidity currents may promote the formation of coarse-grained intervals that may facilitate the fluid flow towards the sea floor. In some case persisting fluid migration favours the maintenance of a topographic depression at the sea floor, in turn affecting the behaviour (or flow regime) of the turbidity currents flowing down the slope. The result of this study indicates how the shaping of submarine landscapes may be controlled by a dynamic interaction between gravity-driven flows, seafloor topography and fluid migration.

*References:*

Cartigny M.J.B., Postma G., van den Berg,J.H. & Mastbergen D.R. (2011) - A comparative study of sediment waves and cyclic steps based on geometries, internal structure and numerical modelling. Marine Geology 280, 40-56. https://doi.org/10.1016/j.margeo.2010.11.006.

Fildani A., Normark W.R., Kostic S. & Parker G. (2006) - Channel formation by flow stripping: Large-scale scour features along the Monterey East Channel and their relation to sediment waves. Sedimentology, 53(6), 1265-1287. https://doi.org/10.1111/j.1365-3091.2006.00812.x.

Hovland M. (2003) - Geomorphological, geophysical, and geochemical evidence of fluid flow through the seabed. J. Geochem. Exploration, 78-79, 287-291. https://doi.org/10.1016/S0375-6742(03)00091-8.

Symons W.O., Sumner E.J., Talling P.J., Cartigny M.J.B. & Clare M.A. (2016) - Large-scale sediment waves and scours on the modern seafloor and their implications for the prevalence of supercritical flows. Marine Geology, 371, 130-148. https://doi.org/10.1016/j.margeo.2015.11.009.

# Enigmatic volcano deformation at the base of the Northern Calabrian continental slope

Marani M.[1], Freundt A.[2], Rosi M.[3], Dalla Valle G.[1] & Mercorella A.[1]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionela delle Ricerche, Italy.
[2] GEOMAR Helmholtz Centre for Ocean Research, Kiel, Germany.
[3] Dipartimento di Scienze della Terra, Universita di Pisa.

*Corresponding author email:* michael.marani@cnr.it

*Keywords:* Submarine volcano, volcano deformation, degassing.

Alcione is a 1000 m-high conical volcano rising from a water depth of about 2 km on the northern Calabria continental slope. The volcano is emplaced on a low-lying, 5 km-wide bench at the base of slope, delimited basin-wards by a 200 m-high escarpment. Dredge hauls indicate a calc-alkaline basaltic composition for the seamount. A distinctive feature of Alcione volcano is its dissection by a NNW-SSE trending, 150 m relief arcuate scarp that displaces downwards the western (seaward) half of the edifice. The scarp has maximum relief at the summit and tapers downward to terminate at the volcano base. The resulting morphology at the top of the volcano are two summit areas: a western 'regular' conical top situated at 940 m bsl, about 60 m below and 500 m distance from an eastern summit, elongated along the scarp trend that reaches its shallowest depth (880 m bsl). Three different mechanisms can explain the morphological peculiarity of Alcione, although with the available data we cannot identify which with certainty. Differential flank creep and flank spreading due to gravitational instability provide two different scenarios (i) at a lesser degree of instability, a simple displacement of the western half of Alcione basinwards and thus towards the unbutressed portion of the volcano. This would be followed by a minor cone building phase to develop the conical western summit. (ii) a massive sector collapse of a previous conical volcano towards the west (basinward) resulting in a remnant volcano flank and a deep collapse scar. Disruption and/or depressurization of the magmatic system sustain the growth of a new cone in the collapse zone, against the collapse scar. Growth of the cone fills the collapse void reaching the present morphology close to the previous volcano rim. (iii) A tectonic trigger due to the basement fault (re) activation beneath the volcanic edifice. Analogue models show that fault traces take on a curvilinear direction at intersections with volcanic edifices. A series of scarps surrounding Alcione are evidence of fault activity that may have destabilised the volcano. A final point to consider and another, as yet not fully comprehended event, is the recent identification of strong gas emissions deriving from the summit portion of the scarp and from the conical summit. The data derive from the water column record of the multibeam system on board the GEOMAR R/V Poseidon in April 2018. Previous studies of $^{3}He$ anomaly relative to background on Alcione yielded negligible results. The $^{3}He$ data was acquired by a single tow, so was the degassing undetected at the time (2007) or is it a more recent event?

# Warm signature of the Roman period in Mediterranean Sea surface temperatures

Margaritelli G.[1], Cacho I.[1], Català A.[1], Bellucci L.[2], Lubritto C.[3], Rettori R.[4] & Lirer F.[5]

[1] GRC Geociències Marines, Dept. de Dinàmica de la Terra i de l'Oceà, Facultat de Geologia, Universitat de Barcelona, Barcelona, Spain.
[2] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[3] Dipartimento di Scienze e Tecnologie Ambientali Biologiche e Farmaceutiche (DiSTABiF), Seconda Università di Napoli, Caserta, Italy.
[4] Dipartimento di Fisica e Geologia, Università di Perugia, Italy.
[5] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* giuliamargaritelli@hotmail.it

*Keywords:* Sea surface temperature reconstruction (SST), Mg/Ca, Roman Period, Mediterranean Sea.

Sea surface temperature reconstruction (SST) over the last millennia in the Mediterranean area represent an important challenges to document the possible link of past climate variability on the rise and fall of ancient civilizations. In addition, the last report of the Intergovernmental Panel on Climate Change (IPCC 2018) underlines the requirement to assess climate feedbacks during past episodes of moderately warmer (1.5ºC-2°C) conditions. Within this framework, we present the reconstruction of the SST anomaly over the last five millennia based on the Mg/Ca ratios measured in the planktonic foraminifer *Globigerinoides ruber* from the sediment core SW104-ND11 extracted in the western part of Sicily Channel (water depth 475 m, central Mediterranean Sea). This new generated SST record is compared with previous published SST records reconstructed from Alboran Sea, Minorca Basin, Aegean Sea and from a north Hemisphere temperature reconstruction. This exercise brings the basses to discuss the regional impact of the most recent episode of apparently warmer conditions than present in the social-economical development of the Mediterranean region.

According to the Mg/Ca $_{G.ruber}$ SST record, the Late Holocene maximum temperatures (22.7°C) were reached at ca. 424 CE during the Roman period, after an overall warming trend that started at ca. 3300 BCE and was punctuated by several abrupt short term oscillation. After the Roman period, the Mg/Ca $_{G.ruber}$ SST record shows a cooling trend reaching the minimum temperature (18.2°C) at ca. 1673 CE, during the Little Ice Age. During the last three centuries the Mg/Ca $_{G.ruber}$ SST record shows warming trend to present day (20.3°C). The comparison of the studied record with other SST records based in both Mg/Ca and alkenone proxies from several areas of the Mediterranean basin, supports homogeneous warm conditions at regional scale between from 100 BCE to 500 CE, and documents the occurrence of a distinct warming phase of ca. 2°C at the beginning of the Roman Period that led to the so called "Roman Climatic Optimum". This period corresponded to an important demographic increase during the Roman Empire. At ca. 600 CE a cooling phase is recorded, which age corresponds to the Late Antique Little Ice Age (LALIA) event; after this event, the SST Mg/Ca$_{G.ruber}$ reconstruction documents the onset, at ca. 1180 CE, of the well-known Medieval Warm Period. The cooling associated to the Little Ice Age event occurred between 1320 CE and ca. 1850 CE with an anomaly of ca. 2°C *vs* negative values. The studied record of Sicily Channel ends with a turnover from ca. 1850 CE to 2014 CE *vs* a warming phase of ca. 1°C probably associated to the onset of the Industrial Period/Modern Warm Period.

This research has been financially supported by Italian Project of Strategic Interest NEXTDATA (www.nextdataproject.it) and by ERC-TIMED project 525 (683237).

# Vertical deformation of the Campi Flegrei caldera during the Holocene through analysis of seismostratigraphical and geomorphological sea-level markers in the Pozzuoli Bay

Marino C.[1], Ferranti L.[1], Natale J.[1] & Sacchi M.[2]

[1] Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse (DiSTAR), Università "Federico II", Napoli, Italy.
[2] Istituto per l'Ambiente Marino Costiero (IAMC), Napoli, Consiglio Nazionale delle Ricerche (CNR), Italy.

*Corresponding author email:* camillamarino9@gmail.com

*Keywords:* Campi Flegrei caldera, seismic profile interpretation, seismostratigraphic analysis, sea-level markers, volcano-tectonic evolution.

A seismic stratigraphic analysis of very high-resolution single-channel seismic profiles provided insights into the last ~10-12 ky volcano-tectonic vertical ground deformation in the Pozzuoli Bay, which represents the submerged part of the Campi Flegrei resurgent caldera. The collapse of the central part of the Campi Flegrei is associated with the eruption of the Neapolitan Yellow Tuff (NYT) at ~15 ky BP and was followed by phases of intra-caldera volcanic activity associated to resurgence and subsidence.

Interpretation of the dataset acquired during the oceanographic survey SEISTEC_2013, calibrated by up to 6 m deep gravity cores, allowed us to identify key seismic horizons characterized as tephras spanning between the Monte Nuovo1538 AD and ~3.9 ky eruptions.

Seismic stratigraphic interpretation reveals the occurrence during the last ~12 ky of several generations of Infralittoral Prograding Wedges (IPW). IPW's edges, can be considered as proxies for the position of the past sea-level and used to reconstruct the evolution of vertical deformation. Correction of the observed depth of each IPW for the paleo-bathymetric estimate and for the sea-level change, allowed to reconstruct differential RSL curves for the western, central and eastern sectors.

Analysis revealed different trajectories of the IPW edge and four types of stacking pattern: a) a descending trajectory, documenting a prevalence of uplift over the sea-level rise; b) a flat edge trajectory, indicating progradation during a RSL still-stand, which suggests that uplift kept pace with sea-level rise; c) an ascending trajectory with prograding/aggrading bodies, indicating a prevalence of sea-level rise over positive ground motion; d) aggrading bodies indicative of creation of accumulation space because of dominant sea-level rise over coupled to subsidence.

Whereas IPW's edge pattern (a) and (b) are correlated to peaks of ground deformation episodes during phases of volcanic unrests, pattern (c) likely developed at the end or at the beginning of an unrest phase. Pattern (d) is correlated to periods of minor volcanic activity.

Significant uplift is documented between ~10-8.5 ky and ~5.5-3.9 ky. Negligible deformation occurred between ~8.5 and ~5.5 ky. Whereas the periods of sea-floor uplifts temporally correspond to known phases of volcanic unrests, the interleaved stability period is correlated to an interval of volcanic quiescence or minor activity in the tephro-stratigraphic record. A differential behavior emerges between the central resurgent dome sector and the peripheral sectors between ~3.8-2.5 ky. Whereas the central sector is affected to a marked subsidence related to large post-resurgence collapse, the more stable peripheral sec tors are less subsiding. After ~2.5 ky, all sectors underwent a similar slower subsidence which likely reflects a regional subsiding trend, supported by analysis of submerged archaeological sea-level markers off the Bay of Pozzuoli (Napoli and Procida Island).

# Geomorphological seabed characterization of the Wadden Sea tidal inlets (North Sea, Germany)

Mascioli F.[1], Gasprino D.[2], Kunde T.[1], Cerrone F.[2], Piattelli V.[2] & Miccadei E.[2]

[1] NLWKN-Coastal Research Station/Forschungsstelle Küste, Norderney, Germany.
[2] Dipartimento di Ingegneria e Geologia, Università degli Studi "G. d'Annunzio" Chieti-Pescara, Italy.

*Corresponding author email:* enrico.miccadei@unich.it

*Keywords:* Geomorphological mapping, tidal inlets, bathymetry, backscatter, Wadden Sea.

The seafloors mapping at European level is the subject of several mapping programs aimed to the implementation of the HD 1992/43/EEC, WFD 2000/60/EC and MSFD 2008/56/EC Directives. The long-term monitoring purposes on the habitats and marine environment conservation strongly encouraged the scientific interests on innovative survey and mapping methods, aimed to produce accurate and reproducible results (Mascioli et al., 2017).

Within the mapping program of subtidal habitats in the Lower Saxony marine and coastal waters, carried out by NLWKN, this study provides a methodological contribution to the geological and gomorphological mapping. Investigated area is the German Wadden Sea, one of the world's largest intertidal systems encompassing a multitude of transitional zones between land, marine and estuarine environments. Since 2009 it belongs to the UNESCO world heritage and is protected in the framework of the Trilateral Wadden Sea Plan, which entails policies, measures, projects and actions agreed upon by The Netherlands, Germany and Denmark (Vorberg et al., 2017).

Swath bathymetry systems have been used to collect high-resolution bathymetry and acoustic backscatter data. The simultaneous availability of bathymetry and reflectivity, in conjunction with validation samples, allowed a consistent processing of acoustic data for producing high-quality acoustic imagery, corrected for morphological and water column effects. Bathymetrical and seabed imagery have been interpreted using geomorphometric and object-based image analysis, by means of ArcGIS® tools.

Acoustic data, combined to grain-size analysis, show a prevalence of unconsolidated sandy sediments, mainly made of fine-medium sands, referred to the Upper Pleistocene-Holocene transgressive sequence and associated to medium to very large sand waves. Locally, Upper Pleistocene medium sands are also present, mainly located in the deepest parts of the tidal channels. Hard-substrates consist on the Holocene basal peat, which generally outcrops on narrow steep erosive scarps, located on the tidal channel slopes.

In conclusion, the study provides a detailed geological-geomorphological seabed characterization of a very dynamic coastal area, using repeatable and objective methods. The combination of different datasets and tools allowed the quantitative analyse of the complex subtidal morphology of tidal inlets, the correlation of bedforms and substrates, the characterization of abiotic features according to the main habitat classification schemes.

*References:*

Mascioli F., Bremm G., Bruckert P., Tants R., Dirks H. & Wurpts A. (2017) - The contribution of geomorphometry to the study of tidal inlets. Z. Geomorphol. Supp. 61/2, 179-197.

Vorberg R., Glorius S., Mascioli F., Nielsen P., Reimers H.-C., Ricklefs K. & Troost K. (2017) - Subtidal habitats. In: Wadden Sea Quality Status Report 2017. Eds.: Kloepper S. et al., Common Wadden Sea Secretariat, Wilhelmshaven, Germany.

# Monitoring tuff rock deformations at Coroglio coastal cliff, Naples Bay, Italy

Matano F.[1] & Sacchi M.[1]

[1] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* fabio.matano@cnr.it

*Keywords:* coastal cliff, tuff blocks, monitoring, Naples.

Along the coastline of the Campi Flegrei volcanic district, near Naples (Italy), severe retreat processes affect a large part of the coastal cliffs, mainly made of fractured volcanic tuff and pyroclastic deposits. Opening of fractures and deformation of rock blocks can lead to potentially hazardous rock failures on coastal cliffs. Here we present a monitoring system (MoSys) designed to analyze the stability of selected tuff blocks along the Coroglio coastal cliff near the city of Naples. The system is coupled with a total weather station, measuring rain, temperature, wind and atmospheric pressure since late December 2013 to date, located near the top of the cliff.

The Coroglio cliff is 140 m high and 250 m wide, and is exposed towards the SW, facing the Pozzuoli Bay (Tyrrhenian Sea). The cliff rockface is represented by fractured welded tuff (Neapolitan Yellow Tuff fm.), and includes several rock fronts exceeding 50 m in height.

Measurements were acquired along fractures and stratal discontinuities bounding the selected unstable tuff blocks, in order to assess the pattern and magnitude of block deformations (fracture opening and block rotational or translational slides) and their evolution through time. The monitoring system is composed of 8 crackmeters and 2 tiltmeters equipped with internal thermometers, that have been set with a sampling rate of one measurement each 30 minutes, resulting in 48 measurements per day.

The time series record of measurements covers a 4-year time span (Dec 2014-Oct 2018). The most striking evidence is represented by the deformation of the tuff rocks under changing temperature, that is recorded by cyclic, sinusoidal variation in the opening of fractures and rock face rotations of tuff blocks, as a result of daily, seasonal and annual temperature fluctuations. In addition to the "elastic" component of the rock deformation, some trends of cumulative multi-annual changes have been also recognized.

*References:*

Matano F., Caccavale M., Esposito G., Grimaldi G.M., Minardo A., Scepi G., Zeni G., Zeni L., Caputo T., Somma R., Troise C., De Natale G. & Sacchi M. (2016) - An integrated approach for rock slope failure monitoring: the case study of Coroglio tuff cliff (Naples, Italy) - preliminary results. Proceedings of 1st IMEKO TC-4 International Workshop on Metrology for Geotechnics Benevento, Italy, March 17-18, 2016, 242-247.

Sacchi M., Caccavale M., Matano F., Esposito G., Caputo T., Somma R., Troise C., De Natale G., Minardo A., Zeni G. & Zeni L. (2016) - Application of an integrated monitoring system for rock failures in the Coroglio tuff cliff (Naples, Italy). In: Aversa S., Cascini L., Picarelli L., Scavia C. (eds.), Landslides and Engineered Slopes. Experience, Theory and Practice, CRC press/Balkema, Leiden, The Netherlands, 1775-1782.

# Late Quaternary paleoenvironment and paleoclimate of the northern Drygalski Basin (Ross Sea, Antarctica) using microrganism assemblages and sediment characteristics: preliminary results

Melis R.[1], Torricella F.[1,2], Colizza E.[1], Di Roberto A.[3], Gallerani A.[4] & Giglio F.[4]

[1] Dipartimento di Matematica e Geoscienze, Università degli Studi di Trieste, Italy.
[2] Dipartimento di Scienze della Terra, Università degli Studi di Pisa, Italy.
[3] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Pisa, Italy.
[4] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* melis@units.it

*Keywords:* Ross Sea, Sediments, Diatoms, Foraminifers.

Diatoms are one of the major phytoplankton groups blooming in cold, nutrient rich regions, such as Antarctica, where silica contribution is not limited. High diatom productivity together with good preservation in Antarctica marine sediments, allow using diatoms to study the late Quaternary paleoceanographic and paleoclimate changes. Foraminifers too, are known as useful tools to interpret palaeoenvironmental changes related to the glacial history in Antarctic areas.

We present the first data on diatom and foraminifer assemblages associated to the sedimentological and compositional characteristics of two piston cores collected in the northern Drygalski Basin (TR17_03 and TR17_04PC), Western Ross Sea, collected in the framework of the PNRA-Project TRACERS (TephRochronology and mArker events for the Correlation of natural archives in the Ross Sea), Antarctica.

Core TR17_03PC (207 cm length) is characterized by alternating muddy sand and sandy mud with some levels containing abundant foraminifers. Two distinct tephra layers are present along this core. Core TR17_04PC (268 cm length) is characterized by sandy silt alternating with clayey silt. Four tephra layers have been described in the sediment sequence.

Preliminary data on microorganisms and abiotic data allowed recognizing three different facies. Facies 1 is a glaciomarine diamicton present at the bottom of both cores. Facies 2, which represents a transition from glacial to open sea environments, is recorded in core TR1703_PC, only. Facies 3, recognized at the top of both cores, represents open water environmental conditions with evidences of seasonal sea ice, as suggested by the significant presence of *Fragilariopsis curta* and *Actinocyclus actinochilius*, subordinately. The benthic foraminifer distribution suggests a repetitive variation from sub-ice-shelf and grounding-zone proximal settings conditions, culminating with the ice-shelf collapse.

Physical (magnetic susceptibility) and chemical-geochemical (organic and total carbon, major and trace elements) analyses support the results based on microfossils assemblages and sedimentological data. Radiocarbon dating and tephra layers will be used to correlates the studied sedimentary records with other sediment cores collected in the same area during previous cruises.

# Seabed characterization off the Bradano river mouth (North-western Ionian Sea) by acoustic investigations and sampling

Meo A.[1], Russo B.[3], Budillon F.[2], Ferraro L.[2] & Senatore M.R.[1]

[1]Dipartimento di Scienze e Tecnologie, Università degli Studi del Sannio, Benevento.
[2]Consiglio Nazionale delle Ricerche–Istituto per l'Ambiente Marino Costiero, Napoli.
[3]Dipartimento di Scienze della Terra, dell'Ambiente e delle Risorse, Università Federico II, Napoli.

*Corresponding author:* agomeo@unisannio.it

*Keywords:* patchy acoustic facies, side scan sonar, *Cymodocea nodosa* meadows, Ionian Sea.

The continental shelf edge in the north-western sector of the Ionian sea has been undergoing progressive retreat due to the entrenchment of the Taranto canyon upper reach (Meo et al., 2017) and, more recently, the coastline has been withdrawing as well, owing to a reduced sediment yield from the main rivers. Off the Bradano river mouth - a Site of Community Importance since 2014 - the break in slope is at about -30 m, less than 2 km from the shoreline. Along such a narrow and unsteady infralittoral strip, a surprisingly wide meadow of *Cymodocea nodosa (Ucria) Asch.* has been reported by Appolloni et al. (2013) through scuba diving. *C. nodosa* is one of the most common phanerogams in the Mediterranean Sea, colonizing the low-energy sandy/muddy seabed, between the 5-20 m depth range and it is considered a pioneer species (D'Angelo and Fiorentino, 2012). Despite its common occurrence, few descriptions of the acoustic facies by side scan sonar investigations are available in literature. The aim of this work is to describe the outstanding aspect of the seabed in the area colonized by the *C. nodosa* meadows by means of acoustic investigations and sedimentological data. The meadows consist of two wide fields, north and south the Bradano River mouth, 4 and 2 km$^2$ wide, respectively, about 1 km far from the coastline, from -5 m to -20 m. The Side Sonar Sonar images show hundreds of dark circular patches, ranging between 10 m and 60 m in diameter, with a high contrasting backscatter against the weak acoustic response of the soft fine-grained sediment of estuarine origin. The spotty trait of the seabed is accounted for by the patches of *C. nodosa* in proximity of the lower limit. At lower depths, between -5 m and -9 m, a dark belt with a high backscatter is detected indicating that, in this case, the *C. nodosa* forms the characteristic meadow habitat, with a remarkable density according to the visual inspections (Appolloni et al., 2013). The sediment collected by means of Shipek bucket (Belfiore et al., 1981) show a muddy seabed with the benthic foraminiferal assemblages mainly characterized by the euryhaline species *Ammonia beccarii, Aubignyna perlucida, Nonion depressulum, Protelphidium granosum* and *Quinqueloculina seminulum*, which testify the influence of brackish waters. The preservation of *C. nodosa* meadows in the submerged sectors of the Bradano river mouth is of overriding importance for the protection of the habitat in the SIC area and to mitigate the retreat of the coastline.

*References:*

Appolloni et al. (2013) - Carta degli habitat marini dell'area prospiciente i SIC ionici della Basilicata, 14° Conf. It. Utenti ESRI, 17-18 aprile 2013, Roma.

Belfiore A. et al. (1981) - La sedimentazione recente del Golfo di Taranto (Alto Ionio, Italia). Ann. Ist. Univ. Navale, Napoli, 49-50 (3), 1-196.

D'Angelo S. & Fiorentino A. (2012) - Phanerogam Meadows: A Characteristic Habitat of the Mediterranean Shelf-Examples from the Tyrrhenian Sea. In: Seafloor Geomorphology as Benthic Habitat - GeoHAB Atlas of Seafloor Geomorphic Features and Benthic Habitats, Elsevier, 159-168.

Meo A. et al. (2017) - Morphometric measures to assess the maturity of the submerged drainage basins. The case of the Taranto Canyon upper reach, Inter. Conf. MetroSea, Proceedings IMEKO, pp. 133-137.

# The Whales Deep Basin - Houtz and Hayes Bank system: Late Pleistocene slope processes and depositional model of Southeastern Ross Sea (Antarctica)

Olivo E.[1], De Santis L.[1], Bart P.J.[2], Bergamasco A.[3], Gales J.[4], Bohm G.[1], Wardell N.[1], Colleoni F.[1], Kovacevic V.[1], Bensi M.[1], Rebesco M.[1], Forlin E.[1] & Viezzoli D.[1]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] Louisiana State University, Baton Rouge, LA, United States.
[3] Istituto di Scienze Marin (ISMAR), Venezia, Consiglio Nazionale delle Ricerche, Italy.
[4] School of Biological & Marine Sciences, Drake Circus, Plymouth University, UK.

*Corresponding author email:* eolivo@inogs.it

*Keywords:* Antarctica, Ross Sea, slope processes, geomorphology, depositional model.

The Eastern Ross Sea outer shelf and slope are key areas to study the interactions between oceanic and ice sheet dynamics on a high latitude continental margin. We present a multidisciplinary study integrating preexisting and new geological, geophysical and oceanographic datasets, in order to reconstruct the slope processes and propose a depositional model of the margin evolution.

The area of study covers the outer shelf and continental slope and is located between Houtz and Hayes Bank, at the mouth of the Whales Deep Basin.

The oceanographic dataset suggest that currently in this area, Antarctic Bottom Water formation occurs because of mixing between the cold and dense Ross Sea Bottom Water and the relatively warm Circumpolar Deep Water (which encroaches the continental shelf).

The analysis of geological and geophysical data collected during the OGS Explora cruise in spring 2017 reveals different morphological structures, including gullies, canyons, channels, mounds, ridges, slide scars, iceberg scours and mega-scale glacial lineations, that can be associated with ice-sheet dynamics on the shelf as well as preferential pathways for ice-sheet meltwater and oceanic bottom currents.

The analysis of the seismic units, correlated to the DSDP271 sediment core lithostratigraphy, suggests that the margin recorded at least four main episodes of ice sheet advance and retreat, during the past 650 kyrs. These episodes are highlighted by erosional surfaces, chaotic facies sequences, small-scale incisions and channels. Thickness and distribution of those units vary, suggesting a relocation through time of the main sediments depocenters presumably indicative of changes in the mechanisms at the origin of sediment supply.

Along the slope, in front of the central part of the basin, the current shelf edge presents a convex shape and the thickness of the most recent seismic unit is maximum. The slope gradient is 5-10° degrees and multibeam and seismic data highlight the presence of slide scars and a lobed-shaped deposit. We interpret this geomorphological arrangement as expression of glacial deposit, resulting from an ice stream activity that occurred in front of the central part of the Whales Deep and was affected by gravitational instability after its deposition along the slope.

In the slope areas located in front of both lateral extremities of the basin, the current shelf edge appears concave and the thickness of the most recent seismic unit is minimal. In those areas, dominated by erosion, the slope gradient is >10° and the multibeam reveals more incised structures on the seabed, with well-developed gullies at the shelf edge. The lateral depressed areas can be expression of different processes that prevented the accumulation or removed sediments: 1) preferential route for the melt water, discharged into the sea during the ice retreat that flowed along the Whales Deep at the end of the LGM; 2) corridors for the cold and dense waters formed in the Ross Sea discharge.

# Hazard from tsunamis triggered by submarine landslides along the coast of southern Italy: Gela and Capo Rizzuto case studies

Pagnoni G.[1], Zaniboni F.[1], Paparo M.A.[1], Armigliato A.[1], Tinti S.[1], Argnani A.[2], Rovere M.[2] & Gauchery T.[2]

[1] Dipartimento di Fisica e Astronomia (DIFA), Università di Bologna, Italy.
[2] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* andrea.argnani@ismar.cnr.it

*Keywords:* submarine landslides, tsunamis, geologic hazard, southern Italy seas.

Morpho-bathymetric data allow to identify mass transport deposits along the submarine slopes close to the Italian coasts. Two areas were considered of interest to address the hazard related to tsunamis generated by submarine landslides: the Gulf of Gela and Capo Rizzuto offshore. For these two areas we have developed three tsunami scenarios.

In the Gela basin several slide headscarps have been identified along the steep slope that borders the basin. For one of these landslide deposits (Northern Twin Slides, Minisini et al., 2007), located about 30 km south of the coast and with a volume just below 0.5 km$^3$, the tsunami hazard has been assessed. The second scenario addresses a landslide with a volume of about 1.5 km$^3$, located in the southernmost part of the basin, about 40 km north of the island of Gozo. Offshore Capo Rizzuto the analysis of seismic profiles and of the morphology of the seabed allowed to infer the possible occurrence of a large slide with a mass of about 25 km$^3$.

The tsunami scenarios have been built in steps. First, the landslide body and pre-event morphology were reconstructed, and the stability of the slope was calculated (e.g., Paparo & Tinti, 2017). Subsequently, the landslide motion was simulated (e.g., Tinti et al., 1997; Zaniboni et al., 2016), and the tsunami propagation computed (e.g., Tinti & Tonini, 2013). The result is given by hazard maps based on the maximum heights reached by the waves along the coast.

The study of the hazard on the coasts of southern Sicily shows that the basin bathymetry strongly affects the concentration of the tsunami energy on some parts of the coast. The tsunamigenic massive landslide that might have occurred off Cape Rizzuto could have produced a tsunami with extremely high-impact on a local scale.

This study is part of the activities in the SPOT project (MISE) (Di Bucci et al., 2017).

*References:*

Di Bucci D. et al. (2017) - The SPOT project (potentially triggerable offshore seismicity and tsunamis): a first appraisal of the possible impact of oil and gas platforms on the seismic and tsunami risks along the Italian coasts. Geoingegneria Ambientale e Mineraria, 152, 3, 132-138.

Minisini D. et al. (2007) - Morphologic variability of exposedmass-transport deposits on the eastern slope of Gela Basin (Sicily channel). Basin Research 19, 217-240.

Paparo M.A. & Tinti S. (2017) - Analysis of Seismic-Driven Instability of Mt. Nuovo in the Ischia Island, Italy. Bull. Seism. Soc. Am., 107, 750-759.

Tinti S., Bortolucci E. & Vannini C. (1997) - A block-based theoretical model suited to gravitational sliding. Nat. Hazards, 16, 1-28.

Tinti S. & Tonini R. (2013) - The UBO-TSUFD tsunami inundation model: validation and application to a tsunami case study focused on the city of Catania, Italy. Nat. Hazards Earth Syst. Sci., 13, 1795-1816.

Zaniboni F., Armigliato A. & Tinti S. (2016) - A numerical investigation of the 1783 landslide-induced catastrophic tsunami in Scilla, Italy. Nat. Hazards 84:S455-S470.

# A first study of the Arkhangeleskij and Doldrums transform systems (equatorial Atlantic)

Palmiotto C.[1], Sanfilippo A.[2], Ligi M.[1], Bonatti E.[1,3], Cuffaro M.[4], Gasperini L.[1], Skolotnev S.[5], Peyve A.[5] & Moroz E.[5]

[1] Istituto di Scienze Marine (ISMAR), Bologna,.Consiglio Nazionale delle Ricerche, Italy.
[2] Dipartimento di Scienze della Terra e dell'Ambiente, Università di Pavia, Italy.
[3] Lamont Doherty Earth Observatory , Columbia University, New York, USA.
[4] Istituto di Geologia Ambientale e Geoingeneria, Roma, Consiglio Nazionale delle Ricerche, Italy.
[5] Geological Institute, Russian Academy of Sciences, Moscow, Russia.

*Corresponding author email:* camilla.palmiotto@bo.ismar.cnr.it

*Keywords:* Oceanic transforms, intra-transform centers, equatorial Atlantic.

Mid-ocean ridges systems are not continuous accretional margins; rather, they consist of a series of ridge segments offset by transform faults. The ridge segments lie nearly perpendicular to the spreading direction, whereas the transform fault lie parallel to the spreading direction. The morphology of an oceanic transform fault is generally characterized by a narrow and elongated valley, flanked by steep slopes towards the valley and gentle slopes outwards (Fox & Gallo, 1984); it is continuous also in the fossil zones, where seismicity is not recorded (Sykes, 1967).

An example of "classic"oceanic transform is the Arkhangeleskij, located at 9° N of latitude in the equatorial Atlantic. This transform offsets the Mid-Atlantic Ridge (MAR) by ~ 110 km, and the maximum width of the area of deformation is ~ 25 km. To the South of the Arkhangeleskij, the Doldrums transform system (7°-8° of latitude) offsets the MAR by about 620 km. It includes four-right transform faults and three intra-transform spreading centers (ITRs). The width of the area of deformation is ~ 120 km and the age offset is > 30 Ma. Given these features, we include the Doldrums transform system in the class of oceanic plate boundaries called Megatransforms (Ligi et al., 2002). These transforms are characterized by broad complex multifault zones of deformation, similar to some continental strike-slip systems such as the St. Andrea and the North Anatolian faults, in California and Turkey, respectively. Examples of modern megatransforms are the Romanche transform along Mid-Atlantic Ridge and the Andrew Bain along Southwest Indian Ridge. In particular, the Doldrums transform system displays features similar to those of the St Paul system (equatorial zone) suggesting that the birth of intra-transform spreading centres in this part of the MAR may represent an evolutionary stage of mega-transforms.

Geological and geophysical data from the Arkhangeleskij and Doldrums transforms have been acquired during the Oceanographic cruises "leg 6" and "leg 9" aboard the R/V Nikolay Strakhov of the Russian Academy of Science, in 1986-1987 and 1990. A new oceanographic cuise is planned this year within an Italian-Russian project. The aim of this cruise is carry out multibeam, gravity, magnetics, reflection seismic and rock dredging surveys along the Doldrums transform system, a region of the MAR still poorly known and utmost importance to understand the evolution of megatransforms.

*References:*

Fox J.P. & Gallo D. (1984) - A tectonic model for Ridge - Transform - Ridge plate boundaries: implications for the structure of oceanic lithosphere. Tectonophysics, 104, 205-242.

Ligi M., Bonatti E., Gasperini L. & Poliakov A.N.B. (2002) - Oceanic broad multifault transform plate boundaries. Geology, 30, 11-14.

Sykes L.R. (1967) - Mechanism of earthquakes and nature of faulting on the Mid-Atlantic Ridge. J. Geoph. Res., 72, 2131-2153.

# Marine Geology at ISMAR 2.0 (CNR): A "*Journey Through the Past*". And the future?

Passaro S.[1], Gasperini L.[2], Polonia A.[2], Sacchi M.[1], Rizzetto F.[3] & ISMAR Geology Group*

*Aiello G.[1], Alberico I.[1], Alvisi F.[2], Angeletti L.[2], Asioli A.[2], Bonatti, E.[2]; Budillon F.[1], Caccavale M.[1], Capotondi L.[2], Ceregato A.[2], de Alteriis G.[1], Di Fiore V.[1], Di Martino G.[1], Donnici S.[3], Ferraro L.[1], Giuliani S.[2], Insinga D.D.[1], Iorio M.[1], Lirer F.[1], Loreto M.F.[2], Matano F.[1], Milia A.[1], Molisso F.[1], Palmiotto C.[2], Remia, A.[2], Romano S.[2], Rovere M.[2], Stanghellini, G.[2]; Tamburrino S.[1], Taviani M.[2], Tonielli R.[1], Tosi L.[3], Vallefuoco M.[1], Vigliotti L.[2], Violante C.[1], Zaggia L.[3] & Zitellini N.[2]

[1] Istituto di Scienze Marine - CNR-ISMAR, Napoli.
[2] Istituto di Scienze Marine - CNR-ISMAR, Bologna.
[3] Istituto di Scienze Marine - CNR-ISMAR, Venezia.

*Corresponding author email:* salvatore.passaro@cnr.it

*Keywords:* CNR-ISMAR; Marine Geology; Research Vessel.

The recent re-organization of the CNR research network led to the formation of 4 new Research Institutes operating in the field of marine sciences, namely ISMAR (*Institute of Marine Sciences*), IRBIM (*Institute of Marine Biological Resources and Biotechnologies*), IAS (*Institute for the study of Anthropic Impacts and Sustainability in the Marine Environment*), and IGAG (*Institute of Environmental Geology and Geoengineering*). The new CNR-ISMAR was constituted in September 2018 by joining several sections that operate in the field of oceanographic science. In particular, three of these sections inherited significant expertise in the field of Marine Geology, i.e. the former IAMC-Napoli, the ISMAR headquarters (Venezia) and the section of Bologna. The newly-formed marine geology community benefits from a wide experience in surveying, monitoring, mapping and modeling of natural geologic processes in a variety geodynamic and oceanographic settings, from the modern and fossil record.

Research activity carried out in the Mediterranean and worldwide by ISMAR scientists over the last decades has brought a significant advances in understanding fundamental geological processes, including: 1) Formation and destruction of oceanic lithosphere; 2) Earthquake and tsunami hazards; 3) Volcanic risk and geothermal resources; 4) Sediment dynamics from the coastal plain-continental shelf to slope-deep basins and its response to global forcing; 5) Submarine landslides; 6) coastal hazards (landslide, erosion, subsidence, flood and pollution) 7) Facies analysis and paleoenvironmental reconstruction of stratigraphic intervals (Mesozoic to Quaternary) of the peri-Mediterranean area; 8) Stratigraphic architecture of Neogene-Quaternary continental basins, and lakes; 9) Physical and ecosystemic response to geological and climatic forcers.

Overall, such variegated research proved to be strategic in promoting the CNR participation to relevant national and international projects, and the best outcome has been published in many high ranked international, journals. Admittedly, the fundamental pre-requisite in achieving this result, was the availability of suitable offshore research vessels operating in support of the marine CNR scientific community up to 2017. The unfortunate situation is that all the experience gained through the years and the future of the marine geological investigation are currently at risk because of the present lack of any adequate research ships. This situation is obviously in urgent need to be reversed to maintain not only viable the marine scientific research at CNR, but also to continue and expand the offshore research at competitive levels.

We present here a summary of results of relevant studies conducted over the last decades by researchers of the CNR-ISMAR Geology Group as a selection of "Greatest Hits" in Marine Research.

# Earthquake Potential of Active Faults using offshore Geological and Morphological Indicators project: preliminary results

Pepe F.[1]*, Kanari M.[2]*, Burrato P.[3], Corradino M.[1], De Ritis R.[3], Duarte H.[4], Faraci C.[5], Ferranti L.[6], Ketter T.[2], Monaco C.[7], Parrino N.[1], Sacchi M.[8], Sulli A.[1] & Tibor G.[2]

[1] Dipartimento di Scienze della Terra e del Mare, University of Palermo, Italy.
[2] Israel Oceanographic & Limnological Research, Haifa, Israel.
[3] Istituto Nazionale di Geofisica e Vulcanologia di Roma, Italy.
[4] Geosurveys Consultants in Geophysics, Aveiro, Portugal.
[5] Dipartimento di Ingegneria, University of Messina, Italy.
[6] Dipartimento di Scienze della Terra, delle Risorse e dell'Ambiente, University of Naples "Federico II", Italy.
[7] Dipartimento di Scienze Biologiche, Geologiche e Ambientali, University of Catania, Italy.
[8] Istituto per l'Ambiente Marino e Costiero, CNR-IAMC, Naples, Italy.
* Principal Investigator

*Corresponding author email:* fabrizio.pepe@unipa.it

*Keywords:* Seismogenic fault, Deformation model, Lowstand Infralittoral Prograding Wedge, Southern Tyrrhenian Sea.

We present the preliminary results of the "Earthquake Potential of Active Faults using offshore Geological and Morphological Indicators" (EPAF) project, which was founded by the Ministry of Foreign Affairs and International Cooperation - Italy and the Ministry of Science, Technology and Space of the State of Israel, in the frame of the Scientific and Technological Cooperation (Scientific Track 2017).

The aim of the project is the development of 1) a novel, timesaving, multidisciplinary, low-cost method to identify and trace the geometry of offshore active faults or fault systems using geophysical dataset, and 2) a novel method to measure and reconstruct the history of fault movements through radiocarbon dating of benchmarks identified on gravity cores and ultra-high-resolution seismic profiles. This is accomplished by: a) the development of a GIS-based database of the present-day depth of the edges of Lowstand Infralittoral Prograding Wedges (IPWs) and associated abrasion platforms along the shelf and slope area of the southern Tyrrhenian Sea and Levant Basin; b) the identification of the geological/oceanographic factors that control the depth of the rollover of IPWs through analog modeling; c) the estimation of the magnitude and rate of vertical tectonic movements on the basis of the present-day depth of IPWs formed during the last glacial maximum; d) the identification of offshore active fault; e) the development of paleoseismological procedure on offshore faults for the calculation of average long-term slip rate, recurrence interval, displacement per event, and elapsed time since the last event along the fault plane.

The area chosen for testing the methodology, the S. Eufemia Gulf (Tyrrhenian side of the Calabrian Arc, Italy), hosts the debated seismogenic fault of the Mw 7.0, September 8th, 1905 earthquake that produced devastating effects and induced also a tsunami wave. In the study area, we acquired a grid of ultra-high-resolution seismic data by using an innovative dual sources, multi-Tip Sparker System coupled with a slanted, multichannel (48ch) streamer and a high-precision, differential global positioning (DGPS) system. In addition, gravity core data were collected. The dataset was acquired during a geophysical cruise on board the research vessel "Atlante".

The expected outcome of the project is to help at developing innovative geophysical methodologies to identify and characterize offshore seismogenic sources that could be applied within Collaborative Project for the updating of active and seismogenic sources databases, like the "European Database of Seismogenic Faults" (EDSF, http://diss.rm.ingv.en/share-EDSF/), and the Italian "Database of Individual Seismogenic Sources (DISS, http://diss.rm.ingv.it/diss/)", that traditionally have many shortcomings in terms of completeness of the geometry of the source model in the offshore, and for producing geological models in target areas where critical offshore facilities are located.

# Coralligenous and maërl habitats distribution along the Latium continental shelf

Pierdomenico M.[1], Ingrassia M.[1], Adami C.[1], Argenti L.[2], Bonifazi A.[3], Casalbore F.[1], Chiocci F.L.[4], Falese F.G.[1], Martorelli E.[1] & Sañé E.[4]

[1] Istituto di Geologia Ambientale e Geoingegneria (IGAG), Roma; Consiglio Nazionale delle Ricerche, Italy.
[2] Via Clarice Tartufari 161, 00128 Roma.
[3] Dipartimento di Biologia, Università di Roma Tor Vergata.
[4] Dipartimento di Scienze della Terra, Università Sapienza di Roma.

*Corresponding author:* martina.pierdomenico@uniroma1.it

*Keywords:* Red algae build-up, coralligenous, maërl beds, habitat mapping, Latium continental shelf.

Coralline red algae build-ups such as coralligenous outcrops and maërl beds are typical underwater seascapes of the Mediterranean Sea. Due to their high level of biological diversity and productivity they are ranked among the most relevant habitats in the Mediterranean, considered of critical importance for ecosystems conservation.

An extensive study was performed along the Latium continental shelf, aimed at defining and mapping the distribution of coralligenous and maërl habitats and at assessing their health status in 6 different study areas. The study areas were selected based on the possible occurrence of the habitats of interest, suggested by previous observations, literature data or geomorphological seafloor characteristics. Furthermore, the study areas were chosen to be representative of the variability of environmental conditions (in terms of sedimentation rates, hydrodynamism, water transparency) occurring along the Latium region, and subjected to different potential levels of human pressure. For each area, a large dataset was collected, including multibeam bathymetry, side scan sonar data, ROV videos and grab samples.

The analysis of bathymetric data and backscatter mosaics allowed to identify the morpho-acoustic facies potentially indicative of coralligenous outcrops/maërl beds. ROV video transects were then carried out to confirm the presence of these habitats, enabling us to extrapolate results over larger areas. In parallel, a quantitative analysis of ROV video transects was carried out, in order to characterize the megabenthic communities associated with coralligenous and maërl habitats, in terms of species composition, abundance, health status of structural species, and to evaluate the abundance of marine litter.

The results showed a large variability in the characteristics of coralligenous bioconstructions and maërl beds along the Latium continental shelf, likely reflecting the different environmental conditions and human pressure in the different areas. Coralligenous outcrops were reported from all the investigated areas, hosting a rich and varied associated fauna with dense gorgonian meadows, also featuring species of relevance for conservation such as *Corallium rubrum*. Conversely, the presence of wide maërl beds was only observed in the southern sector of the Latium shelf, especially on the seafloor around the Pontine island, where associated fauna also included species of commercial interest. Such distribution, together with the paucity of marine litter, suggest a low level of anthropogenic impact in this area. This is not the case of the other study areas, where a rather significant amount of marine litter was observed in correspondence of the coralligenous outcrops, mostly represented by fishing-related material. In several cases, fishing lines and nets caused entanglement of sessile species, especially gorgonians and sponges, arising concerns about the conservation status of this fragile and relevant habitat.

# The environmental effects of the 2017 Casamicciola earthquake for the seismic hazard assessment of the Ischia island (Tyrrhenian Sea)

Porfido S.[1,2], Alessio G.[2], Gaudiosi G.[2] & Nappi R.[2]

[1] Istituto di Scienze dell'Alimentazione, Avellino.Consiglio Nazionale delle Ricerche, Italy.
[2] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Osservatorio Vesuviano (Napoli), Italy.

*Corresponding author email:* sabina.porfido@cnr.it

*Keywords:* Ischia island, volcano-tectonic earthquake, ground effects, seismic hazard.

The Ischia island is located on the northwest side of the Gulf of Naples. In historical times it was characterized by strong seismic events and tsunami correlated to mass instability related to the volcano-tectonic dynamics of the island itself. In particular the Casamicciola Terme village, in the northern area of the island, was heavily hit by strong earthquakes, the most important occurred in 1762, 1796, 1828, 1881, 1883 (Alessio et al., 1996), which allowed to recognize an active seismogenic area along the northern slope of the Mt. Epomeo resurgent block. Most of these earthquakes show parameters comparable with the August 21, 2017 seismic event, both for the epicentral zone, and for the macroseismic and environmental effects.

On August 21, 2017 a shallow earthquake of Md 4.0 struck the Casamicciola village and the neighboring localities, causing 2 fatalities and about 40 people injured. Although the 2017 Casamicciola earthquake was a moderate size volcano-tectonic event, we observed several ground effects both primary (surface ruptures), and secondary (landslides, hydrological variations etc.). The main earthquake-induced effects detected during dedicated field surveys were: ruptures, fractures, landslides, variations in fumarolic activity and collapse of drywalls.

The pattern of primary coseismic ground effects is represented over all by 62% of ruptures and 17% of fractures; the secondary effects consisted in 14% of drywall collapses; 6% of landslides phenomena; 5% of steam variations in the fumaroles. Considering the distribution of the primary and secondary coseismic effects we have assessed an epicentral intensity of VII degree ESI-07, taking into account the total length of the fault segment, about 2 km, as well as the area affected by other secondary coseismic effects, which is only of a few km$^2$ (Nappi et al., 2018, Porfido et al., 2018).

The study of the environmental seismic effects is fundamental both for the seismic hazard evaluation of Ischia, one of the most crowded touristic destinations worldwide, and also for the recostruction of coastal and inland villages after the earthquake.

*References:*

Alessio G., Esposito E., Ferranti L., Mastrolorenzo G. & Porfido S. (1996)-Correlazione tra sismicità ed elementi strutturali nell'isola d'ischia. Il Quaternario, 9, 1, 303-308.

Nappi R., Alessio G., Gaudiosi G., Nave., R., Marotta R. E., Siniscalchi V., Civico R., Pizzimenti L., Peluso R, Belviso P., &. Porfido S. (2018) - The 21 August 2017 Md 4.0 Casamicciola earthquake: First evidence of coseismic normal surface faulting at the Ischia volcanic island. Seism. Res. Lett., 89, 4, 1323-1334.

Porfido S., Alessio G., Gaudiosi G. &. Nappi R. (2018) - Macroseismic intensities assessment of the August 21,2017 Casamicciola earthquake at the Ischia volcanic Island (southern Italy). Proc. 9th Inter. INQUA Meeting on Paleoseismology, Active Tectonics and Archeoseismology (PATA),25-27June 2018, Possidi, Greece, 223-226.

# Snapshots of past Holocene lagoons: an archive of paleo tidal inlets of the northern Adriatic shelf

Ronchi L.[1], Fontana A.[1] & Correggiari A.[2]

[1] Dipartimento di Geoscienze, Università degli Studi di Padova.
[2] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* livio.ronchi@gmail.com

*Keywords:* Paleo tidal inlets, Holocene, CHIRP, marine transgression.

A series of abandoned and filled incised channels located in the north-western Adriatic shelf have been recently detected and characterized. The analysis of such features led to identify almost 100 fillings of paleo tidal inlets formed during the transgression that followed the LGM and led to the submersion of the shelf. The presence of filled incised channels and tidal inlets has been known since a long time (cf. Storms et al., 2008; Trincardi et al., 2011 and reference therein), but this is the first time that a comprehensive and widespread analysis is attempt on these features. This work has been possible through the re-analysis of over 7000 km of high-resolution CHIRP profiles, ground-truthed by tens of stratigraphic cores, carried out in the area during the last 30 years by the CNR-ISMAR of Bologna.

The presence of transgressive paleo tidal inlets is not common in the geologic record as they are usually almost completely erased by the wave ravinement processes. Indeed, only few examples of such features, usually restricted to low-gradients shelves, can be found in literature.

Paleo tidal inlets would represent ideal proxies in the reconstruction of timing and modes of the marine transgression as they act as geographical and chronological snapshots from the past. For instance, their presence marks the location of paleo coast lines, their morphometry allows to estimate the dimension and characteristics of the paleo lagoon systems and, through the appropriate evaluations, they can be used as relative paleo sea-level markers.

A wide range of dimensions characterize the tidal inlets identified in the northern Adriatic shelf, which, in some cases, reach a thickness up to 20 m (Ronchi et al., 2018). The architecture of the fillings suggests a scarce or even absent lateral and landward migration for these features, pointing toward the lagoon overstepping as a key mechanism for the deactivation of the barrier-lagoon systems.

By comparing the depth of the upper portion of the considered tidal inlets it was possible to notice a non-homogeneous distribution along the shelf slope, with the presence of some preferential depth ranges in which a high number of inlets can be found. This allows to infer the position of a series of paleo coastlines and suggests the occurrence of periods of stasis of the relative sea-level rise, which fostered the formation of such inlets.

This research offers new perspectives on the evolution of the northern Adriatic Sea during the post-LGM transgression and on the response of lagoon systems to high rates of relative sea-level rise. Moreover, this work provides a novel approach to the topic that may be exported to other low-gradient shelf settings.

*References:*

Ronchi L., Fontana A., Correggiari A. & Asioli A. (2018) - Late Quaternary incised and infilled landforms in the shelf of the northern Adriatic Sea (Italy). Mar. Geol., 405, 47-67.

Storms J.E.A., Weltje G.J., Terra G.J., Cattaneo A. & Trincardi A. (2008) - Coastal dynamics under conditions of rapid sea-level rise: Late Pleistocene to Early Holocene evolution of barrier-lagoon systems on the northern Adriatic shelf (Italy). Quaternary Sci. Rev., 27, 1107-1123.

Trincardi F., Argnani A. & Correggiari A. (2011) - Note illustrative della Carta Geologica d'Italia alla scala 1:250,000 - Foglio NL33-7 "Venezia", ISPRA - Servizio Geologico d'Italia.

# Cost-effective and relocatable monitoring of natural hydrocarbon seepages in the Italian offshore

Rovere M.[1], Mercorella A.[1], Spagnoli F.[2], Funari V.[1,6], Frapiccini E.[2], Pellegrini C.[1], Ciccone F.[1,3], Antoncecchi I.[3,4], Bonetti A.S.[3,5], Dell'Orso M.[3], Tassetti N.[2], Giuliano G.[2], De Marco R.[2] & Fabi G.[2]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Istituto per le Risorse Biologiche e le Biotecnologie Marine, Ancona, Consiglio Nazionale delle Ricerche, Italy.
[3] Divisione V della DGS UNMIG Ministero dello Sviluppo Economico, Roma, Italy.
[4] Ricerca sul Sistema Energetico - Sicurezza e sostenibilità delle fonti energetiche, Milano, Italy.
[5] ENVIRONMENT PARK S.P.A. Parco Scientifico Tecnologico per l'Ambiente, Torino, Italy.
[6] Dipartimento di Scienze Biologiche, Geologiche eAmbeintali (BiGeA), Università di Bologna, Italy.

*Corresponding author email:* m.rovere@ismar.cnr.it

*Keywords:* biogenic gas, Adriatic Sea, pockmark, water column reflectivity, biogeochemistry, offshore exploration.

Hydrocarbon seepage is overlooked in the marine environment, mostly due to lack of marine exploration data, especially over the continental shelf and upper slope, where data may be available but not at adequate resolution. Shallow marine environments, such as the north and the central Adriatic Sea, are ideal for the formation of hydrocarbons, because organic matter sinks to the sea bottom where undergoes rapid burial and anaerobic degradation. On the other hand, deeply-trapped hydrocarbons tend to migrate to shallower sedimentary horizons, they may pierce the seabed, giving rise to peculiar seafloor morphology, and, under particular conditions, fluids escape the seabed to form gas plumes in the water column. The latter can be accurately detected by modern multibeam sonar systems as 3D density anomalies, which sometimes can reach high at the sea surface.

This contribution is about the geophysical and geochemical investigation of two seepage sites on the shelf of the Adriatic Sea. The study areas are represented by: an oil spill off Civitanova Marche, at water depth of 10 m; scattered biogenic seeps offshore Mt. Conero, at water depth of 84 m. Dissolved benthic fluxes of nutrients, metals and DIC have been measured by in situ deployment of a benthic chamber equipped with an automatic water sampler and a multi-parameter probe. Geochemical analysis was performed to identify the presence of and characterize hydrocarbons in the water samples and provide insights into the origins of the organic matter. Concentration of Polycyclic Aromatic Hydrocarbons and major and trace elements was analyzed to provide an estimate of hydrocarbon contamination in the surrounding sediment.

We conducted these research activities under the umbrella of a technical agreement between ISMAR-CNR and the Italian Ministry of Economic Development, Directorate General for Safety - National Mining Office for Hydrocarbons and Georesources, within the Clypea Innovation Network, which seeks to increase the safety, also in terms of environmental protection, of offshore oil & gas exploration and exploitation, using innovative approaches.

This study aims at: i) establishing a cost-effective and relocatable geochemical and geophysical monitoring system for natural hydrocarbon seepage to mitigate the adverse effects of hydrocarbon spill and discharge, especially if located near the coast or nearby human activities; ii) delivering a better understanding of the characteristics and origins of the petroleum system, adding a valuable layer of information to more conventional offshore exploration data; iii) to unravel the relationship of fluid seepage with geohazards, notably soft-sediment deformation, and sea level changes as triggering mechanism.

# Latest Pleistocene-Holocene evolution of the Volturno coastal plain-delta system (South Italy) at the turnaround of the Last Glacial Maximum

Ruberti D.[1], Sacchi M.[2], Pepe F.[3] & Vigliotti M.[1]

[1] Dipartimento di Ingegneria, Università degli Studi della Campania "Luigi Vanvitelli", Napoli, Italy.
[2] Istituto per le Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy.
[3] Dipartimento di Scienze della Terra e del Mare (DiSTeM), Università di Palermo, Italy.

*Corresponding author email:* daniela.ruberti@unicampania.it

*Keywords:* Campania Plain, Volturno River, Last Glacial Maximum, incised valley, Latest-Pleistocene-Holocene evolution.

This study presents a paleo-environmental reconstruction of the mixed siliciclastic-volcaniclastic depositional system of the Volturno delta plain and buried incised valley (IV) across the coastal region of the northern Campania Plain, South Italy, since the onset of the last glacial cycle. The research was based on integrated sets of onland borehole data and offshore reflection profiles and was addressed to the interpretation of the Volturno IV, as an example of a highly dynamic stratigraphic system dominated by volcanic activity during rapid climatic changes.

The onset of the paleo-Volturno IV takes place during the relatively long period of forced progradation of coastal depositional systems following the eustatic lowering of the sea level that occurred between the Marine Isotopic Stage (MIS) 5 (ca, 120 ka BP) and the Last Glacial Maximum (LGM, ca. 20 ka BP).

Above this erosional morphology and associated sediments follow the volcaniclastic deposits originated by the Campi Flegrei caldera eruption at 39 ka BP (Campania Grey Tuff - CGT), that form the substrate for the early post-glacial, Holocene and recent sedimentation.

The digital terrain model reconstructed for the upper CGT surface shows a 15-20 km wide Late Quaternary paleovalley incised by the Volturno River into the thick ignimbritic unit. The asymmetry of the southern valley flanks was shaped by the occurrence of an ancient river (Clanio River), reclaimed during the XVI century, that resulted in the enlargement of the valley and the formation of a complex deltaic system in the southern part.

Correlation of stratigraphic data from the subsurface of the Volturno Plain with sequence stratigraphic interpretation of high-resolution (1kJ sparker) single channel reflection seismic profile offshore the Volturno river mouth indicates that the Volturno buried paleo-valley was likely incised throughout the Late Pleistocene - early Holocene, during the Last Glacial eustatic cycle. The boundary between the substrate of the paleo-Volturno valley and its sedimentary fill is marked by a well-developed unconformity and associated stratigraphic gap that separates the older Quaternary alluvial deposits and the CGT from the overlying uppermost Pleistocene-Holocene coastal prism entrenching the IV. The onset of the sea-level rise, that followed the climax of the LGM since ca. 15 ka BP, caused marine ingression deep into the Volturno IV and was associated with rapid backstepping and landward shift of depositional systems. Maximum marine flooding conditions are documented at 7,0-6,5 ka BP by the occurrence of prodelta deposit, that have been cored between 18 and 25 m beneath the surface. Since the middle Holocene, a progressive lowering of the Post Glacial sea-level rise created conditions favorable to early aggradation (6,5 -4,5 ka BP) and late stage progradation (< 4,5 ka), accompanied by seaward shift of depositional systems. This caused, in turn, a rapid filling of the accommodation space over the former IV, with the formation of the modern Volturno alluvial Plain, coastal lagoon and beach barrier system.

# Amino acids in sediment samples from a hydrothermal vent offshore Zannone Island (Western Mediterranean Sea)

Sañé E.[1], Ingrassia M.[2], Chiocci F.L.[1] & Martorelli E.[2]

[1] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Italy.
[2] Istituto di Geologia Ambientale e Geoingegneria (IGAG), Roma, Consiglio Nazionale delle Ricerche, Italy.

*Corresponding author email:* esaneschepisi@gmail.com

*Keywords:* hydrothermal vent, Mediterranean Sea, sediment, amino acids.

This study shows preliminary results from amino acid analysis of seafloor sediment sampled between 83 and 129 m depth within an active hydrothermal field located off Zannone Island and identified by multibeam and ROV data (Ingrassia et al., 2015; Martorelli et al., 2016). The total hydrolysable amino acid (THAA) content was determined at 12 stations, together with sediment grain size and percentages of nitrogen, carbon, hydrogen and sulphur. At all stations, the percentage of sand was ~75% or higher. Carbon percentage was lower in samples located within the main hydrothermal depression (i.e., the Zannone Giant Pockmark, ZGP) than in stations located in the surrounding seafloor. THAA concentration ranged between 2 and 11 nmol $mg^{-1}$ DW and was comparable to the low THAA concentrations measured in deep water regions of the Mediterranean Sea not affected by hydrothermal activity. Lowest THAA concentrations were found at stations located within the ZGP. At all stations, the most abundant amino acids were Gly, Asx, Ala, Ser, Glx and Thr. No differences were found in the percentage of polar (Asx, Glx, Ser, His, Arg, Thr and Lys) and hydrophobic (Ala, Val, Ile, Leu and Phe) amino acids between the stations located inside and outside the ZGP. Moreover, we found higher concentrations of neutral (Gly, Ala, Ile, Val, Leu, Phe, Pro, Ser, Thr, Tyr) amino acids than acidic (Asp and Glu) and basic (Lys, His and Arg) amino acids. Thus, our observations support the idea that the adsorption mechanism of amino acids is regulated by electrostatic interactions. The concentration of neutral amino acids was lower inside than outside the ZGP. Within the ZGP, we also found the lowest concentration of biogenic silica (Ser, Gly and Thr) and carbonate (Arg and Glx) amino acids. The Dauwe degradation index (DI) was also calculated to assess the quality of the organic matter. High DI values were found at stations located inside the ZGP.

Our results evidence differences in the sedimentary organic matter among stations differently affected by hydrothermal activity. In particular, they suggest the potential use of THAA as biomarkers of hydrothermal activity, being their total concentration and composition variable at the different sampling stations.

*References:*

Ingrassia M., Martorelli E., Bosman A., Macelloni L., Sposato A. & Chiocci F.L. (2015) - The Zannone Giant Pockmark: first evidence of a giant complex seeping structure in shallow-water, central Mediterranean Sea, Italy. Marine Geology, 363, 28-51.

Martorelli E., Italiano F., Ingrassia M., Macelloni L., Bosman A., Conte A.M., Beaubien S.E., Graziani S., Sposato A. & Chiocci F.L. (2016) - Evidence of a shallow water submarine hydrothermal field off Zannone Island from morphological and geochemical characterization: implications for Tyrrhenian Sea Quaternary volcanism. Journal of Geophysical Research Solid Earth, 121, 8396-8414.

# Shallow gas migration pathways imaged as discrete features in seismic data: a case study from the Malta Plateau (Sicily Channel)

Savini A.[1], Pinson S.[2], Bistacchi A.[1], Etiope G.[3,4] & Holland C.W.[5]

[1] Dipartimento di Scienze dell'Ambiente e della Terra, Università degli Studi di Milano-Bicocca, Italy.
[2] SHOM, 29228 Brest Cedex 2, France.
[3] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy.
[4] Faculty of Environmental Science and Engineering, Babes-Bolyai University, Cluj-Napoca, Romania.
[5] Pennsylvania State University, Applied Research Lab., State College, PA.

*Corresponding author email:* alessandra.savini@unimib.it

*Keywords:* Scattering, gas bubble slugs, shallow mud volcanoes, AUV, Malta plateau.

The analysis of seismic data aimed at imaging discrete features, rather than the geometry of sedimentary layers (Pinson and Holland, 2016), is a more recent and less common technique, only recently adopted to investigate the sub-seafloor in a seep system (Savini et al., 2018). Discrete features can be defined as heterogeneities with aspect ratios in the neighbourhood of unity, instead of layers (i.e. sedimentary layering), which have an extremely high aspect ratio (the ratio between the horizontal and vertical scale of a feature).

In our work, data acquired by an Autonomous Underwater Vehicle (AUV) towing a source (1600 Hz - 3500 Hz) and an horizontal array of hydrophones, about 20 m above the seabed, are analysed. An algorithm based on a semblance function was applied to the acoustic data, to generate images that highlight scattering features rather than interface reflections, in order to investigate shallow fluid migration pathways within a mud volcanoes province in the NW of the Malta Plateau (Holland et al., 2003; Savini et al., 2009) hydrocarbon plumbing system. The analysis of these detected scatterers, integrated with existing seafloor mapping data (i.e., multibeam bathymetry and high frequency side-scan sonar data), allowed the identification of fluid pathways which appear as made up by gas bubbles slugs (i.e. discontinuous gas columns) and clarified published assumptions on the role of fault zones as a preferential path for gas/fluid migration. The data showed, in particular, that gas bubble slugs, rise through Plio-quaternary sediments along a complex system of conduits terminating at the surface into quiescent mud volcanoes. The gas flux is facilitated by the regional stress field that results in dilatant conditions on the mapped fault zones.

The adopted survey design and the scatterers imaging approach proved to be a highly adeptness method to investigate seeping phenomena in the underlying sediment. Although conventional seismic methods remain instrumental to define the stratigraphic framework of all those regions affected by seabed fluid-flow, our technique seems to be promising to better detect and characterize the shape and size of both subseafloor (e.g. gas chimneys, pipes, etc) and water column (i.e gas plume) seepage-related features.

*References:*

Holland C.W., Etiope G., Milkov A.V., Michelozzi E. & Favali P. (2003) - Mud volcanoes discovered offshore Sicily. Marine Geology 199, 1-6.

Pinson S. & Holland C.W. (2016) - Seafloor sound-speed profile characterization with non-parallel layering by the image source method: Application to CLUTTER'09 campaign data. J. Acoust. Soc. Am. 140(2), EL154-158. http://dx.doi.org/10.1121/1.4959769.

Savini A., Malinverno E., Etiope G., Tessarolo C. & Corselli C. (2009) - Shallow seep-related seafloor features along the Malta Plateau (Sicily channel-Mediterranean Sea): morphologies and geo-environmental control of their distribution. Marine and Petroleum Geology 26, 1831-1848.

Savini A., Pinson S., Bistacchi A., Etiope G. & Holland C.W. (2018) - Imaging shallow gas migration pathways in a mud-volcano province using an Autonomous Underwater Vehicle (Malta Plateau, Mediterranean Sea). Near Surface Geophysics. doi: 10.1002/nsg.12017.

# Multi-proxy study in Augusta Bay (Eastern Sicily, Italy) expands understanding of offshore tsunami deposits

Smedile A.[1], Molisso F.[2], Chagué C.[3], Iorio M.[2], De Martini P.M.[1], Pinzi S.[1], Collins P.E.F.[4], Sagnotti L.[1] & Pantosti D.[1]

[1] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy.
[2] Istituto di Scienze Marine (ISMAR), Napoli, Italy.
[3] UNSW, Sydney, Australia.
[4] Brunel University, London, UK.

*Corresponding author email:* alessandra.smedile@ingv.it

*Keywords:* Eastern Sicily, offshore coring, tsunami deposits.

Tsunami deposits are important archives for understanding tsunami histories and dynamics. While most research has focused on onshore preserved remains, offshore deposits have received less attention, although considered to offer a very high potential in terms of preservation and spatial coverage.

In 2009, during a coring campaign with the Italian Navy *Magnaghi*, four 1 m long gravity cores (MG cores) were sampled from the northern part of Augusta Bay in south-east Sicily, along a transect in 60-110 m water depth, in the same area where a core (MS06) was collected in 2007, about 2.3 km offshore Augusta at 72 m bsl (Smedile et al., 2011). Core MS06 consisted of a 6.7 m long sequence that included 12 anomalous intervals interpreted as the primary effect of tsunami backwash waves in the last 4500 years. In the presented study (Smedile et al., 2019), tsunami deposits were identified, based on sedimentology and displaced benthic foraminifera (as for core MS06) reinforced by ITRAX X-ray fluorescence (XRF) data. Two erosional surfaces (L1 and L2) were recognized coupled with grain size increase, abundant *Posidonia oceanica* seagrass remains and a significant amount of *Nubecularia lucifuga,* an epiphytic sessile benthic foraminifera considered to be transported from the inner shelf. The occurrence of Ti/Ca and Ti/Sr increments, coinciding with peaks in organic content (Mo inc/coh) suggest terrestrial run-off. Units L1 and L2 were potentially attributed to two distinct historical tsunamis (AD 1542 and AD 1693) by age-estimation methods using $^{210}$Pb profiles and the comparison of Volume Magnetic Susceptibility data between MG and MS06 cores. One most recent bioturbated horizon (Bh), despite not matching the above listed interpretative features, recorded an important palaeoenvironmental change that might correspond to the AD 1908 tsunami.

Amongst all the techniques applied, sedimentology and micropalaeontology (displaced benthic foraminifera) remained the most informative, corroborated by the XRF results. The compared study of multiple cores collected at different depths along the shelf provided important insights about the dynamics of tsunami backwash and its imprint in the offshore stratigraphic sequence not easily gained from a single core. This work adds to previous studies in highlighting the growing potential of offshore investigations for reconstructing palaeotsunami histories of critical relevance to contribute and test probabilistic tsunami hazard assessment and scenarios.

*References:*

Smedile A., De Martini P.M., Pantosti D., Bellucci L.G., Del Carlo P., Gasperini L., Pirrotta C., Polonia A. & Boschi E. (2011) - Possible tsunami signatures from an integrated study in the Augusta Bay offshore (Eastern Sicily-Italy). Mar. Geol., 281, 1-13.

Smedile A., Molisso F., Chagué C., Iorio M., De Martini P.M., Pinzi S., Collins P., Sagnotti L. & Pantosti D. (2019) - New coring study in Augusta Bay expands understanding of offshore tsunami deposits (Eastern Sicily, Italy). Sedimentology, in press.

# Imprints of the Messinian Salinity Crisis on the geomorphology of the Malta Escarpment (Mediterranean Sea)

Spatola D.[1], Micallef A.[1], Camerlenghi A.[2], Georgiopoulou A.[3,4], Garcia-Castellanos D.[5], Gutscher M.A.[6], Lo Iacono C.[7], Huvenne V.A.I.[7], Mountjoy J.[8], Paull C.K.[9], Le Bas T.[7], Facchin L.[2] & Accettella D.[2]

[1] Marine Geology and Seafloor Surveying, Department of Geosciences, University of Malta, Msida, Malta.
[2] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[3] UCD School of Earth Sciences, University College Dublin, Dublin, Ireland.
[4] UCD Earth Institute, University College Dublin, Dublin, Ireland.
[5] Instituto de Ciencias de la Tierra Jaume Almera, CSIC, Barcelona, Spain.
[6] Laboratoire Géosciences Océan, University of Brest/CNRS, IUEM, Pl. N. Copernic, Plouzané, 29280, France.
[7] Marine Geoscience, National Oceanography Centre, University of Southampton Waterfront Campus, European Way, Southampton, UK.
[8] National Institute of Water and Atmospheric Research, Wellington, New Zealand.
[9] Monterey Bay Aquarium Research Institute, Moss Landing, CA, USA.

*Corresponding author email:* daniele.spatola@um.edu.mt

*Keywords:* Malta Escarpment, Geomorphic evolution, Submarine canyon, Palaeoshoreline, Messinian salinity crisis.

During the Messinian salinity crisis (MSC), between 5.97 and 5.33 Ma, the Mediterranean Sea became disconnected from the world's oceans and a fast and continuous evaporation generated its partial desiccation, resulting in the deposition of more than one million cubic kilometres of salt. In the central Mediterranean sea, the extent of the evaporative drawdown phases associated to the MSC remain poorly constrained. In this study we investigate the geomorphology of the Malta Escarpment to provide answers to these questions using multibeam, seismic reflection data, and gravity cores. We identify more than two hundred linear to arcuate scars and more than two hundred canyons. The largest of the canyons - Noto, Cumecs, and Heron Canyons - are up to 100 km long and 39 km wide. We also identify concave breaks of slopes and terraces, the most extensive of which are located in the northern Malta Escarpment and are 70 km long and 2478 m deep, and 25 km long and 2545 m deep. Along most of the base of the northern Malta Escarpment, the western Ionian Basin seafloor is also characterised by a series of ridges that are up to 8 km long, have an average height of 30 m and are spaced 2-3 km apart. Seismic reflection profiles from the western Ionian Basin show the occurrence of lenses of intermediate amplitude and sub-parallel reflectors, which are up to 0.2 s (TWTT) thick and 8 km wide, downslope of the large canyon mouths and beneath the evaporite sequence. Gravity cores from the large submarine canyons feature sandy turbidites and debrites. We propose that during the MSC, base level fall, fluvial erosion formed a dense network of canyons across the Malta Escarpment whilst coastal erosion developed extensive palaeoshorelines and shore platforms. We carry out an isostatic restoration of the palaeoshorelines and shore platforms on the northern Malta Escarpment to infer an evaporative drawdown of 1800 - 2000 m in the eastern Mediterranean Sea during the MSC. We interpret the occurrence of pre-evaporite sedimentary lobes (Facies F) in the western Ionian Basin as suggesting that either evaporative drawdown and canyon formation occurred predominantly before salt deposition, or that only the latest salt deposition at the basin margin occurred after the formation of the sedimentary lobes. After the MSC, the drivers of geomorphic evolution of the Malta Escarpment included: (i) canyon erosion by submarine gravity flows, with the most recent activity taking place <2600 cal BP; (ii) deposition by bottom currents across the entire depth range of the Malta Escarpment; (iii) widespread, small-scale sedimentary slope failures triggered by oversteepening and loss of support due to canyon erosion.

# Skewness analysis of Pacific Plate Magnetic Anomalies 22r-22n-21r, and possible implications for the formation of the Hawaiian-Emperor Bend and True Polar Wander

Staro A.[1], Gaastra K.[2], Zheng L.[2] & Gordon R.[2]

[1] Dipartimento di Scienze della Terra, Università di Milano.
[2] Department of Earth, Environment and Planetary Science, Rice University of Houston, USA.

*Corresponding author email:* alice.staro@studenti.unimi.it

*Keywords:* marine magnetic anomalies, Pacific plate, skewness analysis, Hawaiian hotspot paleolatitude, true polar wander.

The time interval from 50 Ma to 47 Ma, is a critical one in the evolution of the Pacific plate and Pacific hotspots, corresponding to the approximate age of the bend in the Hawaiian-Emperor seamount chain.

The paleolatitude of the Hawiian hotspot is well constrained during the formation of the Hawaiian chain from 48 -12 Ma at 22ºN (Woodworth and Gordon), and the Emperor chain from 80-56 Ma at 30ºN.

This shift in Hawiian hotspot paleolatitude southward by 8° is constrained to ~11 Ma.

In this study we aim to reconstruct the paleopole position for Chron 22 and Chron 21, and to provide better constraint both on the time and on the rate of shifting.

Here we apply the method first proposed by Schouten and Cande (1976) to analyze the skewness of marine magnetic anomalies 22r-22n-21r.

With this preliminary result we confirm that our pole suggests a transitional paleolatitude between Emperor and Hawiian locations. This result is roughly coeval with the Koko seamount, registering the southward shifting of the hotspot chain in the Late Eocene.

Our pole falls along a track that displays an apparent near reversal of Pacific plate APW.

Lastly, our time averaged location of the spin axis falls between the averaged position during Hawaiian time and Emperor time, capturing a possible episode of true polar wander.

*References:*

Schouten H. & Cande S.C. (1976) - Palaeomagnetic poles from marine magnetic anomalies. Geophysical Journal International, 44(3), 567-575.

Woodworth D. & Gordon R.G. (2018) - Paleolatitude of the Hawaiian Hot Spot Since 48 Ma: Evidence for a Mid-Cenozoic True Polar Stillstand Followed by Late Cenozoic True Polar Wander Coincident With Northern Hemisphere Glaciation. Geophysical Research Letters, 45(21), 11-632.

Zheng L., Gordon R.G. & Woodworth D. (2018) - Pacific Plate Apparent Polar Wander, Hotspot Fixity, and True Polar Wander During the Formation of the Hawaiian Island and Seamount Chain from an Analysis of the Skewness of Magnetic Anomaly 20r (44 Ma). Tectonics.

# Sea-ice reconstruction over the last 3ka in the Ross Sea (Antarctica)

Tesi T.[1], Gariboldi K.[2], Belt S.[3], Smik L.[3], Muschitiello F.[4], Colizza E.[5], Giglio F.[1], Giordano P.[1], Finocchiaro F.[5], Morigi C.[2], Capotondi L.[1], Gallerani A.[1], Torricella F.[2,5], Gazzurra G.[2] & Langone L.[1]

[1] Istituto di Scienze Marine (ISMAR), Bologna, Consiglio Nazionale delle Ricerche, Italy.
[2] Dipartimento di Scienze della Terra, Università di Pisa, Italy.
[3] School of Geography, Earth and Environmental Sciences, Univ. of Plymouth, Plymouth, United Kingdom.
[4] Dept. Geog., Univ. of Cambridge, Cambridge, United Kingdom.
[5] Dipartimento di Matematica & Geoscienze, Università di Trieste, Italy.

*Corresponding author email:* leonardo.langone@cnr.it

*Keywords:* paleorecords, sea-ice reconstruction, expanded sedimentary section, Late Holocene, Ross Sea.

The aim of the project Holoferne was to obtain a continuous and highly resolved record of sea ice dynamics and other environmental parameters during the late Holocene. With this goal in mind, we collected a laminated sediment core (14.6 m long) in the Edisto inlet (Ross Sea, Antarctica). The coring site was chosen in the inner bay, where the Holocene unit is particularly expanded (>60 m thick). By means of AMS $^{14}C$ datings of the acid insoluble organic fraction, the expanded record covers the last *ca.* 2800 years indicating an average sedimentation rate of ca. 0.5 cm $y^{-1}$. X-ray radiographs and visual inspections show well-preserved laminated sediments dominated by alternating dark- and light-brown diatom oozes. In this study, we present XRF core scanning data, diatom assemblages, high-resolution bulk organic matter geochemistry (stable isotopes and contents of organic carbon and total nitrogen), opal, grain size and lipid biomarker results with focus on the new IPSO25 proxy (di-unsaturated highly branched isoprenoid) of landfast sea ice.

A sub-sample of well-defined dark and light laminae (n=33) exhibited a statistically different (t-test) composition in terms of stable carbon isotopes, IPSO25, relative percentage of same the diatoms such as Corethron pennatum, as well as porosity. Dark laminae are likely indicative of spring blooms when $d^{13}C$ signature and IPSO25 concentration are higher, whereas porosity is comparatively low. The heavy $d^{13}C$ signature and high IPSO25 values are consistent with deposition of sea-ice diatoms grown in reduced availability of dissolved inorganic carbon typical of sea-ice matrix and released in the water column during the sea ice melting season. By contrast, the IPSO25 in light laminae decreases by up to three-orders of magnitude together with a marked decrease of $d^{13}C$. We interpret these trends to reflect a protracted opening of the bay later in summer and a greater availability of carbon for photosynthesis. Under these conditions, the greater *Corethron pennatum* concentration in the light-brown laminae might indicate a different environment likely associated with open sea conditions. In addition, the relatively higher abundance of *Corethron pennatum* resulted in a "sponge-like" matrix, which explains the marked difference in porosity between light and dark laminae.

If confirmed, this interpretation allows some inferences on the Late Holocene temporal variability of the regional wind pattern, which in turn exerts first-order control on the landfast sea ice dynamics and diatom ecology in the Edisto Inlet, and in general along the western coast of the Ross Sea.

# Evaluation of disturbance induced on soft offshore sediments by different sampling techniques

Tommasi P.[1], Avalle A.[1], Budillon F.[2], Romeo R.[3], Caburlotto A.[3], Conforti A.[4], Di Martino G.[2], Pagliaroli A.[5], Magagnoli M.[6], Urgeles R.[7], Llopart J.[7] & Camerlenghi A.[3]

[1] Istituto di Geologia Ambientale e Geo-Ingegneria (IGAG), Roma, Consiglio Nazionale delle Ricerche Italy.
[2] ISMAR-CNR- Istituto per le Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy
[3] Istituto Nazionale di Oceanografia e Geofisica Sperimentale (OGS), Trieste, Italy
[4] Istituto per l'impatto Antropico e la Sostenibilità dell'Ambiente Marino (IAS), Oristano, Consiglio Nazionale delle Ricerche, Italy
[5] Università degli Studi "G. d'Annunzio" di Chieti Pescara, Pescara, Italy
[6] Carmacoring S.r.l., San Lazzaro di Savena, Bologna, Italy
[7] Departament de Geociències Marines, Institut de Ciències del Mar (CSIC), Barcelona, Spain

*Corresponding author email:* paolo.tommasi@uniroma1.it

*Keywords:* sample disturbance, geotechnical properties, laboratory tests, seabed sampling, magnetic susceptibility.

Sample disturbance is still a key point in offshore investigations, especially when logistic and financial limitations do not allow the use of drilling equipment controlled on board. In fact many geotechnical, geological and geophysical analyses require knowledge of physical and mechanical properties, e.g. undrained shear strength, strength parameters in effective stresses, stiffness and damping parameters. These parameters are affected by soil disturbance induced by the sampling procedure, which in most offshore projects is particularly significant.

This presentation focuses on the comparison between the disturbance induced by a conventional free fall piston corer (FF) and a modified piston corer (AD) equipped with a velocity control (Angel Descent method). Twin core samples were retrieved in two successions of pelitic sediments with a prevailing non-clayey fraction and a non-negligible sandy fraction. Seafloor sampling was performed in 2014 during the SAOS (Stability Assessment of an Open Slope) cruise onboard R/V Urania (CNR) within the national research project RITMARE. The cruise was jointly organized by the IAMC (now ISMAR) and IGAG institutes of the CNR and by OGS, in the South Tyrrhenian Sea (Southeastern Italy). At three of the ten coring locations during the SAOS cruise, sampling was duplicated using a standard piston corer and a piston corer employing the Angel Descent® method described in Magagnoli (2017). Two pair of cores were collected in the unfailed sedimentary section just up-slope of the Licosa Landslide crown scarp in about 250 m water depth (Sammartini et al., 2018). One pair of cores was collected from an intra-slope basin in 673 m water depth. Comparison was based on different acquisition, physical and mechanical parameters ranging from accelerometer data to magnetic susceptibility logs and geotechnical parameters from laboratory investigations, including oedometer compression tests and cyclic simple shear tests. Accelerometer data highlighted the sharp reduction in velocity obtained for AD samples. Magnetic susceptibility logs, characterized by a pattern of peaks induced by volcaniclastic levels interspersed in the succession, indicated that the AD method significantly reduces core shortening. Among geotechnical investigations, cyclic shear tests provided small-strain shear moduli always higher in AD samples, whilst the response of oedometer compression tests was non-univocal, being influenced by the prevailing non-clayey fraction, as it has been pointed out in the very recent technical literature.

*References:*

Magagnoli M. (2017) - A new coring method in deep water. Marine Georesources and Geotechnology, 35/4, 496-503.

Sammartini M. et al. (2018) - Open-slope, translational submarine landslide in a tectonically active volcanic continental margin (Licosa submarine landslide, southern Tyrrhenian Sea). *Geological Society, London, Special Publications*, 477, 24 May 2018, https://doi.org/10.1144/SP477.34.

# New insights on the evolution of the Linosa volcano (Sicily Channel) from the study of its submarine portions

Tonielli R.[1], Innangi S.[1], Di Martino G.[1], Romagnoli C.[2], Belvisi V.[2], Grasselli F.[2] & Romagnoli B.[2]

[1] Istituto di Scienze Marine (ISMAR), Napoli, Consiglio Nazionale delle Ricerche, Italy.
[2] Dipartimento di Scienze Biologiche, Geologiche ed Ambientali (BiGeA), Università di Bologna, Italy.

*Corresponding author email:* claudia.romagnoli@unibo.it

*Keywords:* Submarine volcanic edifice, multibeam bathymetry, seismic profiles, eruptive cones, morphometry.

Linosa Island represents the emergent tip of a mostly submarine volcanic edifice, with at least 96% of its areal extent lying below sea level. Its morphology is the result of volcanic subaerial activity dated from ~1.06 Ma to 0.5 Ma (Rossi et al., 1996). Until now, the scant knowledge on its submarine extension led to consider this volcanic edifice as extinct. Marine geological surveys carried out by ISMAR CNR of Naples in 2016 and 2017 allowed to reconstruct the submarine portions of Linosa down to a depth of 1000 m, indicating a much wider submarine extension than expected. The new multibeam data, integrated by seismic profiles and ROV inspections, provided new insights on the evolution and biological colonization of this little-explored volcanic edifice. Overall, it extends for about 20 km in the NW-SE direction, evidencing a tectonic control from the main structural system of the Sicily Channel, as already suggested for the subaerial portions (Rossi et al., 1996). Along the same direction, also a marked tectonic lineament and a field of pockmarks can be observed at the base of the W/SW flanks, respectively. The shallow-water SE and NW portions of the volcanic edifice show wide insular shelves, giving evidence on the original extent of the early eruptive centres at the time of emersion stage, prior to their erosion during late-Quaternary sea-level fluctuations (Romagnoli, 2004). These areas are the seat of a very rich ecosystem with a pristine coralligenous habitat. Where insular shelves are lacking, canyons and gullies develop with a radial pattern from shallow water down to the base of the submarine flanks. A number of volcanic features such as lava fields, lava flows and are recognized on the submarine flanks, which appear punctuated by several eruptive centres. A specific morphometric investigation of the volcanic cones mapped on the Linosa submarine flanks was carried out, pointing out a strong similarity with the Pantelleria volcano, especially for what regards the distribution and morphometric characteristics of eruptive cones occurring in the submarine portions (Calarco et al. 2011).

The study of the submarine extension of Linosa suggests that the growth and evolution of the volcanic edifice has likely been more complex than what inferred from its subaerial volcanism, and gives new insights on the development of volcanism in the Sicily Channel and on related potential hazard.

*References:*

Calarco M. (2011) - "Integrated analyses of the submarine volcanic structures offshore Pantelleria". Unpublished PhD Thesis, "La Sapienza" University of Roma, 195 pp.

Romagnoli C. (2004) - Terrazzi deposizionali sommersi nell'isola di Linosa (Canale di Sicilia). Mem. Descr. Carta Geol. D'It. 58,133-140.

Rossi P.L., Tranne C.A., Calanchi N. & Lanti E. (1996) - Geology, stratigraphy and volcanological evolution of the island of Linosa (Sicily Channel). Acta Vulc., 8, 73-90.

# Preliminary results of a micropaleontological study of a sediment core collected on the Bellsund Drift (Svalbard): the last 10 ka

Torricella F.[1,2], Battolla G.[1], Gariboldi K.[1], Gamboa Sojo V.M.[1,3], Caffau M.[4], Caricchi C.[4], Musco M.E.[4], Rebesco M.[4], Lucchi R.G.[4] & Morigi C.[1,5]

[1] Dipartimento di Scienze della Terra, Università degli Studi di Pisa, Italy.
[2] Dipartimento di Matematica e Geoscienze, Università degli Studi di Trieste, Italy.
[3] Dipartimento di Scienze della Terra, Università degli Studi di Firenze, Italy.
[4] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[5] Geological Survey of Denmark and Greenland (GEUS), Denmark.

*Corresponding author email:* fiorenza.torricella@phd.unipi.it

*Keywords:* Diatom, Foraminifera, Arctic, paleoclimate, last 10 ka.

Diatoms are one of the major phytoplankton groups blooming in cold and nutrient-rich regions. They are sensitive to minute changes in environmental parameters (e.g. temperature, salinity etc.) therefore are widely used to study Quaternary oceanographic and climatic evolution (Leventer et al., 2010; Crosta, 2011). In the Arctic area diatoms tend to be less silicified and, therefore, more easily dissolved in the sediments (Leventer et al., 2010; Crosta, 2011).

In this work, we present the results of the combined study of diatom and foraminifera assemblages together with sedimentological characteristics of the long Calypso core GS191-01PC collected on the Bellsund Drift (South-western margin of Spitzbergen) during the expedition of the RV G.O.Sars (5-15 June 2014), in the framework of the Project Eurofleets-2 PREPARED. The study focuses on the last 10 ka with the final aim to understand the variations of the sea surface temperature a. The preliminary results of the micropaleontological and sedimentological analyses allow to recognize three different units that correspond to three different climatic periods: the Cold event 8.2, the Holocene Climate Optimun (6-4 ka) and Neoglacial period (4-2 ka).

Chemical-geochemical (organic and total carbon, major and trace elements) analyses and radiocarbon data support the results based on microfossils assemblages and sedimentological data.

*References:*

Crosta X. (2011) - Marine diatoms in polar and sub-polar environments and their application to Late Pleistocene paleoclimate reconstruction. IOP Conf. Series: Earth and Environmental Science 14.

Leventer A., Crosta X. & Pike J. (2010) - Holocene marine diatom records of environmental change, In Smol J. P., Stoermer E. F. (eds) The Diatoms: Applications for the Environmental and Earth Sciences, 2nd Edition, Cambridge University Press, UK, 401-423.

# Evidence of a wide and active NW-trending fault system in the Apulia foreland (N-Ionian Sea)

Volpi V.[1], Civile D.[1], Maesano F.E.[2], Conti A.[3], Tiberti M.M.[2], Conte R.[1], Zgur F.[1], Basili R.[2], Rossi G.[1] & Accettella D.[1]

[1] Istituto Nazionale di Oceanografia e di Geofisica Sperimentale (OGS), Trieste, Italy.
[2] Istituto Nazionale di Geofisica e Vulcanologia (INGV), Roma, Italy.
[3] Dipartimento di Scienze della Terra, Sapienza Università di Roma, Italy.

*Corresponding author email:* vvolpi@inogs.it

*Keywords:* Northern Ionian, Apulian foreland, tectonic deformation.

In the northern Ionian Sea, the Apulian block, at the southern end of the Adria microplate, constitutes the foreland of the two opposite-verging chains, the Apennines to the west and the Albanides-Hellenides to the east. It represents an interesting and rare case where collision and subduction have interacted with the foreland block, resulting in a lithospheric-scale deformation and isostatic rebound in response to the loading of the opposite-verging chains.

The internal deformation of the Apulian Foreland, which consists of a thick Mesozoic carbonate platform/basin (South Apulia Basin) successions covered by Miocene-Pleistocene siliciclastic and evaporites deposits, was investigated integrating a dense network of multichannel seismic profiles (part of which are provided in the collaborative framework between Spectrum Geo and INGV), multibeam high-resolution bathymetry, and CHIRP profiles recently acquired by R/V OGS Explora.

The interpretation of this extensive dataset allowed us to investigate a major NW-trending fault system, named South Apulia Fault System (SAFS), developed for at least 50 kilometers. The fault system consists of several km-scale faults characterized by normal offset up to several hundreds of meters. Various authors (Argnani et al., 2001; Butler 2008; Milia et al., 2017) have already reported the presence of these normal faults but the accurate age, lateral continuity, and their role was not well constrained due mainly to the lack of available information.

The SAFS consists of fault segments arranged in a left-stepping en-echelon pattern; the analysis of the associated syn-tectonic basins suggest a Plio-Pleistocene deformation still on-going based on the features observed at the seafloor.

Although the geodynamic role of this structure in the complex puzzle of the north Ionian Sea remains to be defined, the SAFS could have played a role in the 1743 Southern Apulia Mw 6.8 earthquake which widely damaged the Salento (S-Italy) and Ionian Islands (Greece) regions and whose source is still a matter of debate.

*References:*

Argnani A., Frugoni F., Cosi, R., Ligi M., Favali, P. (2001) - Tectonics and seismicity of the Apulian Ridge south of Salento peninsula (southern Italy). Ann. Geofis. 44, 527-540.

Butler R.W.H., (2009). Relationship between the Apennine thrust belt, foredeep and foreland revealed by marine seismic data, offshore Calabria. Boll. Soc. Geol. It128 (2), 262-278. http://dx.doi.org/10.3301/IJG. 2009.128.2.269.

Milia A., Iannace, P. & Torrente M.M. (2017) - Active tectonic structures and submarine landslides offshore southern Apulia (Italy): a new scenario for the 1743 earthquake and subsequent tsunami. Geo-Marine Letters, 37(3), 229-239.

# Palaeotopography of the North Sicily continental margin (central Mediterranean) during the Messinian Salinity Crisis and Zanclean flooding

Zizzo E.[1], Sulli A.[1], Micallef A.[2] & Spatola D.[2]

[1] Dipartimento di Scienze della Terra e del Mare, Università di Palermo, Italy.
[2] Marine Geology and Seafloor Surveying, Department of Geosciences, University of Malta.

*Corresponding author email:* elisabetta.zizzo@unipa.it

*Keywords:* Messinian paleo-topography, Zanclean flood, Mass Transport Deposits.

During the Messinian salinity crisis (MSC), the Mediterranean Sea became disconnected from the world's oceans and a fast and continuous evaporation resulted in its partial desiccation. One of the theories for the end of the MSC postulates that a large volume of Atlantic waters entered the Mediterranean Sea through the Gibraltar Strait and rapidly refilled the Mediterranean basin in an event well-documented known as the Zanclean Flood (~5.33 Mya). The pathway of the Zanclean flood during its passage from the western to the eastern Mediterranean Sea is unclear. The aim of this study is to understand the effects of the Messinian palaeotopography of the southern Tyrrhenian Sea on the dynamics of the Zanclean flood. We analysed a large number of multichannel seismic reflection profiles acquired in the Northern Sicily Continental Margin, calibrated with stratigraphic log from the hydrocarbon exploration wells, and very high resolution multibeam data showing the present-day morphology. A detailed seismostratigraphic and structural analysis of these data allowed us to identify two different types of chaotic bodies in the Plio-Pleistocene sedimentary succession. The first type consists of a very thick deposit characterised by chaotic to transparent seismic facies, deposited non-conformingly above an older substrate with a very high-amplitude reflector along its top. This older substrate correlates to the MES horizon (Lofi et al., 2011). The second type consists of thinner bodies having smaller volumes and chaotic seismic facies interbedded with the well-stratified Pleistocene-Holocene deposits. We interpret the Pleistocene-Holocene chaotic bodies as small-scale mass transport deposits (MTDs) that are mainly located at the foot of steep escarpments and partly triggered by the compressional, extensional, and strike-slip Plio-Pleistocene tectonics. We hypothesise that the larger chaotic body is a flood deposit, possibly emplaced by a branch that separated from the main flow transferring water and sediment through the Sicily Channel (Micallef,et al., 2018). Based on the reconstructed Messinian palaeotopography of the southern Tyrrhenian Sea, the Zanclean flood flowed from west to east across an elongated depression that is now bordered by the "Elimi Chain" to the north and the Sicilian coastline to the south. The material transferred was finally deposited at the toe of Scuso bank and Solunto high.

*References:*

Lofi J., DéverchèreJ., Gaullier V., Gillet H., Gorini C., Guennoc P., Loncke L., Maillard A., Sage F. & Thinon I. (2011) - Seismic atlas of the Messinian Salinity crisis markers in the Mediterranean and Black Sea. Société Géologie de France & CCGM, pp. 72.

Micallef A., Camerlenghi A., Garcia-Castellanos D., Cunarro Otero D., Gutscher M., Barreca G., Spatola D., Facchin L., Geletti G., Krastel S., Gross F. & Urlaub M. (2018) - Evidence of the Zanclean megaflood in the eastern Mediterranean Basin. Scientific Reports 8, doi:10.1038/s41598-018-19446-3.

## Authors' Index

Authors are listed alphabetically: For each contribution, the page number and the session are given.

## SUPPORTED BY

CODEVINTEC
Tecnologie per le Scienze della Terra e del Mare

FUGRO

GBT
offshore

IDROSFERA
SERVIZI IDROGRAFICI

9 788894 269673