



MAGIC Project collection – Marine Geohazards along the Italian Coasts

Fabiano Gamberi, Tommaso Piacentini, Enrico Miccadei, Giorgio Paglia, Francesca Budillon, Silvia Ceramicola, Francesco Giuseppe Falese, Paolo Emanuele Orrù & Francesco Latino Chiocci

To cite this article: Fabiano Gamberi, Tommaso Piacentini, Enrico Miccadei, Giorgio Paglia, Francesca Budillon, Silvia Ceramicola, Francesco Giuseppe Falese, Paolo Emanuele Orrù & Francesco Latino Chiocci (2025) MAGIC Project collection – Marine Geohazards along the Italian Coasts, Journal of Maps, 21:1, 2593962, DOI: [10.1080/17445647.2025.2593962](https://doi.org/10.1080/17445647.2025.2593962)

To link to this article: <https://doi.org/10.1080/17445647.2025.2593962>



© 2025 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group on behalf of Journal of Maps



View supplementary material [↗](#)



Published online: 17 Dec 2025.



Submit your article to this journal [↗](#)



Article views: 110



View related articles [↗](#)



View Crossmark data [↗](#)



MAGIC Project collection – Marine Geohazards along the Italian Coasts

Fabiano Gamberi ^a, Tommaso Piacentini ^{b,c}, Enrico Miccadei ^{b,c}, Giorgio Paglia ^b, Francesca Budillon ^d, Silvia Ceramicola ^e, Francesco Giuseppe Falese ^f, Paolo Emanuele Orrù ^g and Francesco Latino Chiocci ^h

^aConsiglio Nazionale delle Ricerche (ISMAR-CNR), Istituto di Scienze Marine, Bologna, Italy; ^bDipartimento di Scienze, Università 'G. d'Annunzio' Chieti-Pescara, Chieti, Italy; ^cIstituto Nazionale di Geofisica e Vulcanologia (INGV); ^dConsiglio Nazionale delle Ricerche (ISMAR-CNR), Istituto di Scienze Marine, Napoli, Italy; ^eIstituto Nazionale di Oceanografia e di Geofisica Sperimentale – OGS, Sgonico, Italy; ^fConsiglio Nazionale delle Ricerche (IGAG-CNR), Istituto di Geologia Ambientale e Geoingegneria, Rome, Italy; ^gDipartimento di Scienze Chimiche e Geologiche, Università degli Studi di Cagliari, Cagliari, Italy; ^hDipartimento di Scienze della Terra, Sapienza Università di Roma, Rome, Italy

ABSTRACT

The collection about the MAGIC Project (Marine Geohazards along the Italian Coasts) presents the result of a comprehensive cartographic and scientific overview of geohazard features across the Italian offshore regions. The Project mapped 15 geodynamically distinct regions through a standardized methodology and a unified legend. The outcomes highlight how the interplay of tectonic, volcanic, sedimentary, and oceanographic processes shape the seafloor and pose risks to coastal and offshore infrastructures. Key hazards include widespread landslides, fluid venting, volcanic seamounts, and active faulting. The maps also reveal the influence of structural lineaments, sediment transport, and erosional dynamics in shaping submarine landscapes. Each regional study contributes to a broader understanding of marine geohazards, offering essential data for future research and for guiding sustainable development and risk mitigation in Italy's coastal zones. The MAGIC Project thus serves as a foundational resource for marine geoscience and hazard assessment in tectonically active Mediterranean settings.

ARTICLE HISTORY

Received 29 October 2025
Accepted 1 November 2025

KEYWORDS

Italian seas; marine geology; tectonics-volcanoes; sedimentary processes; oceanographic processes

1. Introduction

The Italian Seas have been formed in the geological framework of the Alpine-Appennine collision zone and of the Tyrrhenian-Ionian subduction system. As a consequence, their evolution and on-going processes take place in different geodynamic settings: from fore-deep and foreland regions, to active orogenic belts and accretionary wedges, to rift and back-arc basins. Volcanic activity is widespread, forming islands and seamounts in volcanic arc and rift setting. Since most of the Italian seas are tectonically active, their complex geology produces different structural settings, degree of tectonic and volcanic activity, and oceanographic regimes. Thus, in the various Italian offshore sectors, the relative role of canyons, landslides, fluid venting, and faulting, in shaping the morphology of the seafloor varies greatly and induces various marine geohazards.



The present collection is a showcase of marine geohazard features of the Italian Seas, as interpreted within the framework of the MAGIC Project – Marine Geohazards along the Italian Coasts. The maps produced by the project are a remarkable scientific


collection of active seafloor features and a fundamental foundation of knowledge, to support the planning of infrastructure and economic activities in coastal regions and in the offshore.

2. The papers' collection

After an introductory paper (Chiocci, 2025, 2025), which provides an overview of the project, a contribution explains the cartographic methods and procedures, and the legend, of the maps (Chiocci & Ridente, 2025). Then, the morphologic elements and potential hazards of the Italian offshore regions, divided into 15 areas with homogenous geodynamic and physiographic settings, are presented in the following cartographic papers.

Morelli et al. (2024) describe the Ligurian Sea. The authors stress the distinct morphological character of the Alpine and the Apennine sectors of the Ligurian margin. The area is actively uplifting and presents a narrow continental shelf. The most important geohazards are due to retrogressive canyon heads and

CONTACT Tommaso Piacentini  tommaso.piacentini@unich.it  Dipartimento di Scienze, Università 'G. d'Annunzio' Chieti-Pescara, Via dei Vestini 31, 66100, Chieti (CH), Italy

 Supplemental map for this article can be accessed at <https://doi.org/10.1080/17445647.2025.2593962>.

© 2025 The Author(s). Published by Informa UK Limited, trading as Taylor & Francis Group on behalf of Journal of Maps. This is an Open Access article distributed under the terms of the Creative Commons Attribution-NonCommercial License (<http://creativecommons.org/licenses/by-nc/4.0/>), which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited. The terms on which this article has been published allow the posting of the Accepted Manuscript in a repository by the author(s) or with their consent.

instability in the slope. Active tectonics, demonstrated by high seismicity, can trigger slope instability. Interestingly, a large slide in the Portofino area is connected with erosional and depositional contour currents. The association between landslides and pockmarks is also shown in the maps.

Budillon et al. (2024) describe the Gulf of Naples and the Pontine Islands. In the continental shelf around the volcanic islands, Pliocene-Pleistocene volcanic units outcrop at the seafloor and are often covered by biogenic build-up and *Posidonia oceanica* meadows. The Gulf of Naples is largely carved by canyons. Steep and large escarpments, related to regional structural lineaments, often host widespread mass-wasting processes, which are also linked to volcanic processes. In particular, offshore Ischia, large-scale debris avalanches/debris flows originated from the subaerial and submarine flanks of the volcano may represent a geohazard. Seafloor fluid venting, shown by small to giant pockmarks (such as around Zannone island), is a further element of geohazard.

Casalbore et al. (2024) describe the Cilento and the Tyrrhenian margin of the Calabria Peninsula, in the forearc and back arc regions of the Tyrrhenian-Ionian subduction system. Here, the continental shelf is very narrow and punctuated by bioherms and rocky outcrops. The head of the Gioia Canyon, close to the coastline, represents a particular geohazard feature due to the presence of a large commercial harbour. In the Calabrian margin, landslides are a widespread geohazard, both on the coast and on the slope, where they may reach a density of 1 landslide/8km². Active fluid seepage produces specific and widespread morphologies. The area also hosts active faults offsetting the seafloor, responsible for high seismicity of the area and historical tsunamis, which is a further element for geohazard.

Gamberi et al., (2024a) describe the Aeolian Islands and the north-eastern Sicily continental margin. The area is complex, comprising the volcanoes of the Aeolian arc, and the Sicilian margin, formed through extensional tectonics at the rear of the Apennine-Maghrebian chain. Landslides are a geohazard on both the volcanic and continental slopes. In particular, at the Stromboli Island, large flank collapse and smaller scale, but more frequent, landslides have a high tsunamigenic potential. For the submarine arc volcanoes, hydrothermal activity has been described. In the Sicilian margin, landslides can attain very large dimension on the continental slope, while smaller-scale landslides affect the head of some of the canyons which are very close to the coast.

Marani et al. (2024) describe the central-southern Tyrrhenian Seamounts. The volcanic seamounts develop in the back-arc region of the Tyrrhenian-Ionian subduction system. The Marsili Seamount is active and, due to its widespread hydrothermal

alteration, it is hypothesized to be prone to possible slope collapses, as have occurred on the older (Pliocene) – but similar – Vavilov seamount. As the depth of the Marsili summit is less than 500 m, it may represent a source of geohazard, owing to possible explosive submarine eruptions. A similar geohazard also characterizes the Palinuro Seamount, whose summit is less than 100 m deep. The latter presents a very steep and wide slope facing the Marsili Basin, and therefore a large submarine landslide could be a further element of geohazard.

Sulli et al. (2024) describe the north-western Sicily continental margin and Pantelleria island. The continental margin of the Sicilian Island (the rear region of the Apennine-Maghrebian chain) is affected by extensional and strike-slip tectonics, due to the back-arc opening. Pockmarks, steep fault escarpments and canyon systems are the main elements of geohazards. The Egadi offshore is identified as a more stable and less active area in contrast to the offshore surrounding the volcanic islands of Pantelleria and Ustica. Here volcanism shaped the seafloor and appears to be controlled by tectonic activity. Large submarine volcanic fields are located in the offshore of Pantelleria. Some of them are recent and a vent is related to the last eruption that occurred in 1891. Shallow-water eruptions, if explosive, could represent a threat to navigation and offshore installations.

Chiocci et al. (2025) describe the eastern Sicily continental margin. In this area, the Malta escarpment, a large crustal tectonic structure inherited from Mesozoic times, dominates the area with a length of more than 200 km. It represents a sharp, more than 1000 m-high, drop from the shallow-water Sicily Channel to the deep-water Ionian abyssal plain. Therefore, it is affected by strong erosional processes and widespread landsliding, causing a large-scale and widespread submarine badland landscape. To the north, the shelf is particularly narrow and displays the offshore reach of the Etna volcano system. Features related to the deep-seated gliding of the continental margin causing the sliding of the eastern flank of the Etna volcano, are identified as the main geohazard feature. On the Calabrian side, the heads of canyons and gullies connect directly with the lowest subaerial reach of torrential streams called ‘fiumara’, causing hyperpycnal flows and mass wasting threatening the coastal area.

Ceramicola, Cova, et al. (2024a) describe the Ionian continental margin of Calabria. The areas are part of the Calabrian accretionary wedge above the Ionian subduction zone. It displays large gulfs and promontories. Offshore of the gulfs, large canyon systems are present with single or dendritic heads which sometimes are located very close to, or directly at, the coastline. Offshore of the promontories, multiple failures act at different scales, up to large-scale deep-

seated and gravity driven movements, such as the Croton Basin, linking the offshore to the onshore. Widespread fluid venting is evidenced by mud volcanoes and pockmarks both on the flanks of the canyons and in the basin.

Ceramicola, Senatore, et al. (2024b) describe the Gulf of Taranto, encompassing the accretionary wedge of the Calabrian arc to the west and the Apulian foreland to the east, divided by the long canyon system of the Taranto Valley. The Calabrian margin has a narrow continental shelf and a complex slope with multiple landslide scars, indicative of recurrent instability. Gullies and canyons incise the slope and the narrow shelf. The retrogressive trend allows most of them to reach the coastline, where infrastructure is subject to serious hazards. Seafloor instability is also prominent in the Apulian margin, where the shelf is wider but stacked landslide bodies affect the entire continental slope.

Campiani et al. (2025) describe the southern Apulia continental margin, encompassing the Apulian swell, an antiformal feature due to lithosphere buckling in the Apennine foreland. The shelf is relatively narrow and displays bedforms, which are possibly active. The slope is dissected by gullies and canyons. In the case of the Tricase Canyon, faults seem to promote seafloor instability of the canyon flanks. Relatively small mud volcanoes can also foster slope instability and show fluid escape and sediment remobilization.

Campiani et al. (2024) describe the central Apulia continental margin. The area is part of the Adriatic foreland of the Apennine Chain. Tectonics is active and cause a complex deformation belt in the continuation of the Mattinata strike-slip on-land fault. It results in a small escarpment that is locally offset from the seafloor. Slope instability is demonstrated by widespread mass-transport deposits, which show a multiphase evolution and retrogressive dynamics. Cascading currents of the North Adriatic Deep Water result in erosional and depositional features. Both the effects of seafloor instability and bottom currents can generate hazards to offshore infrastructure.

De Falco et al. (2024) describe the western Sardinia continental margin. The area has a relatively large, sediment starved, continental shelf, where bedrock outcrops are frequent. Seafloor outcrops in the shelf are also connected with an extensive volcanic field in the central sector of the margin. Bottom currents shape sedimentary bodies in the inner shelf. Slope-canyons sometimes connect with channels in the outer shelf. Pockmarks fields demonstrate the possibility of fluid venting on the seafloor. In addition, they are evidence of gas in the sediment that can ease seafloor instability.

Orrù et al. (2024) describe the southern Sardinia continental margin. The area is related to Tertiary rift basins, which show signs of various reactivations.

In the continental shelf, strong evidence of past volcanic activity and of depositional terraces is present. Tectonic structures control the Toro canyon, where landslides are possibly earthquake-induced. Megablocks slides, with a conspicuous run out, characterize the largest landslides. Seafloor instability is also linked to fluid venting, shown by extensive pockmark fields. Cyclic steps demonstrate that gravity flows are active within the canyons.

Gamberi et al., 2024b describe the eastern Sardinia continental margin, which represents the passive margin of the Tyrrhenian back-arc basin. The shelf is mostly very narrow. Only to the north, it reaches a width of ~20 km and is the site of outcrops where transgressive coastal deposits are preserved. Closely spaced canyons dissect the slope and evolve through retrogressive processes. In some cases, their heads are very close to the coastline and show signs of recent instability and landslides and are therefore elements of geohazards. The canyons connect downslope to leveed channels that originate from relatively large turbidite systems.

Conforti et al. (2024), describe the northern Sardinia continental margin, part of the Corsica-Sardinia basement block, extended by rift tectonics during the opening of the western Mediterranean Sea. Between the Sardinia and Corsica islands, the shelf is very wide and shallow. In the area of the Bonifacio Strait, strong bottom currents and other oceanographic processes form active bedforms. They could form a geohazard for future offshore infrastructure developments. The Castelsardo, the Caprera and the Lavezzi are large canyon systems, which indent the shelf edge. Geohazards can be due to the retrogressive processes in the head of the Castelsardo canyon located a few kilometers from the coastline.

3. Concluding remarks

The present collection is a showcase of marine geohazard features of the Italian Seas. The maps produced by the MAGIC Project are in the meantime an extensive scientific collection of active seafloor features and a foundation of knowledge that must be considered in the planning of infrastructure and economic activities in coastal regions and in the offshore. The map collection is specifically based on a standardized methodological approach and on a common legend with a three-level hierarchy.

Landslides are almost ubiquitous hazardous elements that can be a threat, especially when associated with canyon heads close to the coastline. Their retrogressive evolution may cause coastal landslides and their tsunamigenic potential is very high. Many areas with fluid venting have effects on the seafloor and can pose a direct hazard to offshore infrastructure. Faults offsetting the seafloor are described and

interpreted as a proof of active tectonics, responsible for the high seismicity of some of the offshore areas, and of their tsunamigenic potential. Bottom currents can erode the recent sediment and so alter the seafloor to such an extent as to impact on eventual offshore infrastructure developments. Sedimentary and tectonic structures capable of tsunami generation are also described.

This collection as a whole, and the various papers therein, highlight the large variability of geohazard features that in the majority of the areas, often combine, forming a complex cascade of processes. As such, they represent a baseline of knowledge for future studies of the Italian offshore and for the development of any activity involving the exploiting and conservation of the Italian offshore.

Map design

As all the maps of this Collection were produced using the same interpretative and cartographic standards, the procedure is described in detail in [Chiocci and Ridente \(2025, this volume\)](#). The legend of the Physiographic Domain map is present in each single paper of the collection (on the map), while the legend of the Morphological Units and Morpho-bathymetric Elements map is present in the papers (as a separate table). Global Mapper and Geo Suite were used for bathymetric and seismic data visualization and interpretation. The maps are realized after a discussion between guest editors along with the editorial board of *Journal of map*.

Acknowledgements

The Magic Project involved the whole community of Italian marine geologist and personnel of the National Civil Protection Department. As the outcome of the project is the result of a cumulative effort, we would like to thank all of them (as listed in the introductory paper, [Chiocci, 2025](#), in this volume). We would like to thank also the EIC of *Journal of Maps*, Mike Smith, for supporting the publication of this Collection which required a long lasting process, and the cartographic reviewers Giedrė Beconytė and Chris Orton and all the reviewers of the papers, for all the suggestions and comments that largely improved the quality of the papers and map of this Collection.

Disclosure statement

No potential conflict of interest was reported by the author(s).

Data availability statement

The Authors agree to make data and materials supporting the results and/or analyses presented in this paper available upon reasonable requests.

ORCID

Fabiano Gamberi  <http://orcid.org/0000-0001-7365-8573>
Tommaso Piacentini  <http://orcid.org/0000-0002-5007-7677>
Enrico Miccadei  <http://orcid.org/0000-0003-2114-2940>

References

- Budillon, F., Martorelli, E., Conforti, A., De Falco, G., Bosman, A., Di Martino, G., Firetto Carlino, M., Misuraca, M., Innangi, S., Pierdomenico, M., Sposato, A., Tonielli, R., Casalbore, D., Capperucci, R., Conte, A. M., Falese, F. G., Ingrassia, M., Marsella, E., Montanaro, C., ... Chiocci, F. L. (2024). Geohazard features of the Gulf of Naples and Pontine Islands (Eastern Tyrrhenian Sea). *Journal of Maps*, 20(1), Article 2378935. <https://doi.org/10.1080/17445647.2024.2378935>
- Campiani, E., Corselli, C., Savini, A., Fogliani, F., Dalla Valle, G., Gariboldi, K., Leidi, E., Marchese, F., Mercorella, A., & Trincardi, F. (2025). Geohazard features of the Southern Apulia. *Journal of Maps*, 21(1), Article 2451292. <https://doi.org/10.1080/17445647.2025.2451292>
- Campiani, E., Trincardi, F., Fogliani, F., Dalla Valle, G., Leidi, E., Mercorella, A., & Ridente, D. (2024). Geohazard features of the Central Apulia. *Journal of Maps*, 20(1), Article 2429707. <https://doi.org/10.1080/17445647.2024.2429707>
- Casalbore, D., Conforti, A., Budillon, F., Martorelli, E., Morelli, E., Pierdomenico, M., Bosman, A., De Falco, G., Di Martino, G., Falese, F. G., Innangi, S., Tonielli, R., Adami, C., Foderà, I., Lai, E., Lodi, M. D., Lo Presti, V., Marsella, E., Montanaro, C., ... Chiocci, F. L. (2024). Geohazard features of the Tyrrhenian Calabria. *Journal of Maps*, 20(1), Article 2347897. <https://doi.org/10.1080/17445647.2024.2347897>
- Ceramicola, S., Cova, A., Forlin, E., Markežic, N., Mangano, G., Civile, D., Zecchin, M., Fanucci, F., Colizza, E., Corselli, C., Morelli, D., Savini, A., Caburlo, A., Candoni, O., Coste, M., Cotterle, D., Critelli, S., Cuppari, A., Deponte, M., ... Tessarolo, C. (2024a). Geohazard features of the Ionian Calabrian margin. *Journal of Maps*, 20(1), Article 2349785. <https://doi.org/10.1080/17445647.2024.2349785>
- Ceramicola, S., Senatore, M. R., Cova, A., Meo, A., Forlin, E., Critelli, S., Markežic, N., Zecchin, M., Civile, D., Bosman, A., Candoni, O., Casalbore, D., Coste, M., Cotterle, D., Deponte, M., Dominici, R., Facchin, L., Gordini, E., Morelli, E., ... Chiocci, F. L. (2024b). Geohazard features of the Gulf of Taranto. *Journal of Maps*, 20(1), Article 2431073. <https://doi.org/10.1080/17445647.2024.2431073>
- Chiocci, F. L. (2025). The MAGIC project: Genesis, implementation, and results. *Journal of Maps*, 21. <https://doi.org/10.1080/17445647.2025>
- Chiocci, F. L., Argnani, A., Gasperini, L., Martorelli, E., Bosman, A., Ligi, M., Ridente, D., Marchetti, M., Adami, C., Calarco, M., Casalbore, D., Cavallaro, D., Coltelli, M., Del Bianco, F., Falese, F. G., Fascetti, A., Ferrante, V., Ingrassia, M., Lai, E., ... Sposato, A. (2025). Geohazard features of the Eastern Sicily. *Journal of Maps*, 21(1), Article 2451298. <https://doi.org/10.1080/17445647.2025.2451298>
- Chiocci, F. L., & Ridente, D. (2025). Cartographic criteria and map legend and layout of magic project. *Journal of Maps*, 21. <https://doi.org/10.1080/17445647.2025>
- Conforti, A., Budillon, F., De Falco, G., Deiana, G., Demurtas, V., Di Martino, G., Innangi, S., Meleddu, A.,

- Orrù, P. E., Paliaga, E., Simeone, S., & Tonielli, R. (2024). Geohazard features of the Northern Sardinia. *Journal of Maps*, 20(1), Article 2357356. <https://doi.org/10.1080/17445647.2024.2357356>
- De Falco, G., Conforti, A., Di Martino, G., Innangi, S., Simeone, S., Tonielli, R., & Budillon, F. (2024). Geohazard features of the Western Sardinia. *Journal of Maps*, 20(1), Article 2347890. <https://doi.org/10.1080/17445647.2024.2347890>
- Gamberi, F., Casalbore, D., Marani, M., Rovere, M., Bosman, A., Calarco, M., Dalla Valle, G., Leidi, E., Martorelli, E., Mercorella, A., Pierdomenico, M., Romagnoli, C., Adami, C., Falese, F. G., Fascetti, A., Ferrante, V., Ingrassia, M., Lai, E., Montanaro, C., ... Chiocci, F. L. (2024a). Geohazard features of the Aeolian Island slopes and the North-Eastern Sicily offshore. *Journal of Maps*, 20(1), Article 2343314. <https://doi.org/10.1080/17445647.2024.2343314>
- Gamberi, F., Marani, M., Dalla Valle, G., Rovere, M., Leidi, E., Mercorella, A., & Ferrante, V. (2024b). Geohazard features of the Eastern Sardinia. *Journal of Maps*, 20(1), Article 2343316. <https://doi.org/10.1080/17445647.2024.2343316>
- Marani, M., Gamberi, F., Leidi, E., Mercorella, A., Rovere, M., & Ferrante, V. (2024). Geohazard features of the Central-Southern Tyrrhenian seamounts. *Journal of Maps*, 20(1), Article 2359973. <https://doi.org/10.1080/17445647.2024.2359973>
- Morelli, D., Migeon, S., Locatelli, M., Cianfarra, P., Crispini, L., Corradi, N., Savini, A., Balduzzi, I., Coste, M., Cuppari, A., Olivari, E., & Falese, F. G. (2024). Geohazard features of the Ligurian Sea. *Journal of Maps*, 20(1), Article 2342920. <https://doi.org/10.1080/17445647.2024.2342920>
- Orrù, P. E., Demurtas, V., Meleddu, A., Paliaga, E., Todde, S., & Deiana, G. (2024). Geohazard features of the Southern Sardinia. *Journal of Maps*, 20(1), Article 2375093. <https://doi.org/10.1080/17445647.2024.2375093>
- Sulli, A., Calarco, M., Agate, M., Albano, L., Bosman, A., Di Grigoli, G., Gargano, F., Lo Presti, V., Martorelli, E., Pennino, V., Sposato, A., Zizzo, E., Anzelmo, G., Bonfardeci, A., Casalbore, D., Ciaccio, G., Conte, A. M., Ingrassia, M., Innangi, S., ... Chiocci, F. L. (2024). Geohazard features of the North-Western Sicily and Pantelleria. *Journal of Maps*, 20(1), Article 2342931. <https://doi.org/10.1080/17445647.2024.2342931>