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Geohazard features of the western Sardinia

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ABSTRACT

The Maps of Geohazard features of the Western Sardinia produced by the Magic project (MArine Geohazard along Italian Coasts) were presented. The maps were created using morphobathymetric data obtained by surveying with a multi-beam echo sounder. The main potential geo-hazards on the western Sardinian margin are related with the presence of three pockmark fields which include hundreds of elements from few meters to several hundred meters in diameter. The pockmark fields are located ~25–35 km off the coastline and at more than 400 m depth.

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Magic project; geohazard; seafloor mapping

1. Introduction

The article illustrates the Maps of Geohazard features of the Western Sardinia produced by the Magic project (Marine Geohazard along Italian Coasts), a large, coordinated initiative that involved the whole marine geological research community in Italy in 2007–2013. The MaGIC Project was focused on the acquisition of morphobatimetric data in outer shelf and upper slope of the Italian continental margins, in order to depict and classify the geological hazard features. The features were derived from multibeam surveys and therefore mainly rely all morphological expression of seafloor and shallow sub-surface processes and events. Particular attention was paid to those features due to morpho-sedimentary dynamics that imply seafloor mobility and/or instability and therefore situations of potential hazard for seafloor infrastructures and the facing coastal areas.

Two levels of interpretation are presented: the map of the Physiographic Domain at scale 1:250.000 and the map of the Morphological Units and Morphobathymetric Elements (areas and vectors respectively) at 1:100.000 scale.

2. Study area: the western Sardinia margin

The western Sardinian margin is characterized by a wide continental shelf (~25 Km), developed for ~200 km along the western Sardinia coast.

The passive margin was structured between the Oligocene and the Lower Miocene, following the opening of the western Mediterranean Sea (Réhault et al., 1984; Thomas et al., 1988). During the Oligocene-Aquitanian, the Corso-Sardinian Block was part of the European Rift System, and the Sardinian Rift, which crosses the whole island between the Gulf of Asinara to the North and the Gulf of Cagliari to the South, is part of it (Cherchi & Montadert, 1982; Casula et al., 2001). Recently, other authors associated the Cenozoic tectonism of Sardinia to the collision between the European and Adrian plates, which, during the Oligocene-Aquitanian, generated mainly strike-slip faults NE-SW and E-W oriented (Carmignani et al., 2001, 2004; Oggiano et al., 2009).

The resulting tectonic features of the margin are NNE-SSW listric and NW-SE transfer faults which delineate horsts and half-grabens in the metamorphic basement, between the Nurra and the Sulcis scarps (Thomas et al., 1988; Fais et al., 1996; Casula et al., 2001).

During the last decades, the stratigraphic features of the margin were investigated through seismic surveys at different degrees of resolution, from the inner shelf to the lower slope (Lecca et al., 1983; Lecca et al., 1986; Lecca, 2000; Carboni et al., 1989; Casula et al., 2001; Sage et al., 2005; De Falco, Budillon, et al., 2015; De Falco, Antonioli, et al., 2015; Conforti et al., 2016; De Falco, Carannante, et al., 2022). In Figure 1, six profiles are reported (modified from Lecca, 2000), which allowed the identification of the following seismic-stratigraphic units: (1) The acoustic basement (Paleozoic-Lower Miocene); (2) The lower sedimentary sequence (Lower–Upper Miocene), including few stratigraphic discontinuities and bordered at the top by a regional erosional nonconformity (Mes); (3) The intermediate sedimentary sequence (Pliocene); (4) The upper sedimentary sequence (Pliocene-Quaternary) consisting of wedge-shaped prograding units (progressive units), separated by stratigraphic

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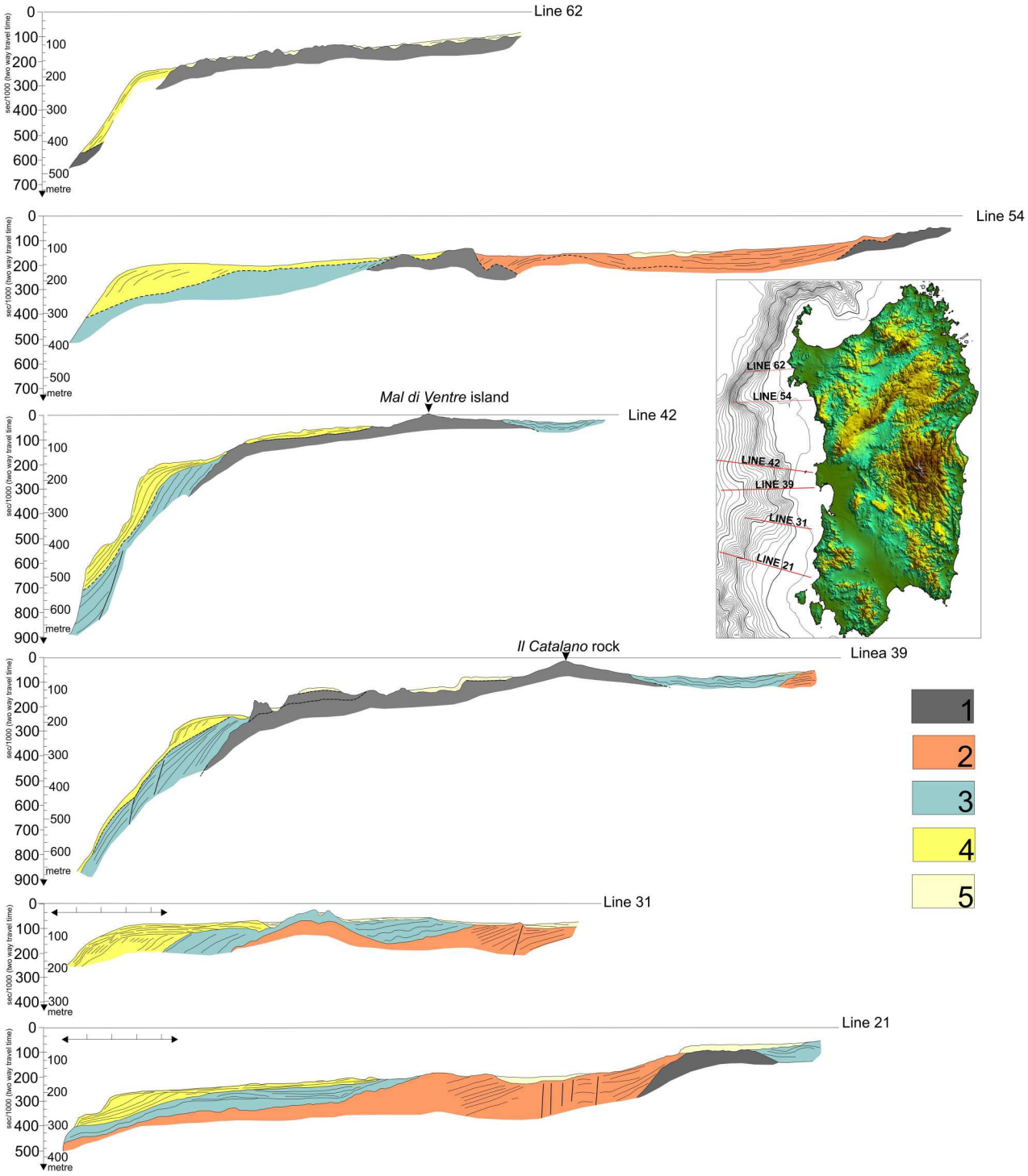

Figure 1. Line-drawing of selected high-resolution profiles (modified from Lecca, 2000), highlighting the main stratigraphic units along the western margin of Sardinia: (1) The acoustic basement (Paleozoic-Lower Miocene); (2) The lower sedimentary sequence (Lower-Upper Miocene); (3) The intermediate sedimentary sequence (Pliocene); (4) The upper sedimentary sequence (Pliocene-Quaternary); (5) The inner shelf units (Late Pleistocene-Olocene) (Lecca, 2000)

discontinuities; (5) The inner shelf units made by thin lenses of biogenic, organogenous and siliciclastic deposits (Quaternary) (Lecca, 2000).

Large sections of the inner mid-shelf, down to 130–140 m depth, were characterized by the presence of an irregular seabed surface which can be attributed to the (sub)outcropping bedrock, comparable to the acoustic basement described in previous studies (Lecca, 2000). The bedrock outcrop covers a total surface of 1651 km^2, mainly between 50 and 150 m depth, where it occupies almost half of the total surface surveyed. The bedrock outcrops are partially colonized by Coralligenous banks in the depth range 40–160 m (De Falco, Conforti, et al., 2022). The rocky outcrop encompasses small basins in the inner shelf, which are characterized by the presence of wide fields of

bedforms, including sorted bedforms (De Falco, Budillon, et al., 2015), dunes and comet marks, between 50 and 110 m depth.

The outer shelf is generally flat and the shelf break is about 200 m deep. Large canyon heads, which carve the shelf break, are located in the central sector of the Oristano amphitheater, whereas the canyon heads in the Nurra scarp are entirely located in the upper slope.

3. Methods and software

As the maps were produced using the same interpretative and cartographic standards, the procedure is described in detail in Ridente and Chiocci (this volume). The legend of the Physiographic Domain map is present on the map while the legend of the Morphological Units and Morpho-bathymetric Elements map is present as a separate table.

4. Maps of morphological units and morpho-bathymetric elements

4.1. Buggerru area (MaGIC sheet 64)

The Sheet 64 'Buggerru' includes the southern foothills of the Arburese Shelf and the southern portion of the Oristano Amphitheater. The southern sector includes the Iglesiente continental shelf and the upper slope of the Sulcis offshore.

The morphology of the area is characterized by a strong tectonic control: the shelf profile shows a coastal terrace located between 20 and 70 m depth, a low angle scarp from 70 to 120 m depth, a low angle outer shelf located below 120 m depth and a shelf break located at 200 m depth; the shelf is from about 20- to 33-km-wide.

In the inner shelf, down to 70 m depth, the rocky substrate extensively outcrops. Its composition can be related to the granites and granodiorites of the Hercynian cycle, which outcrop at Capo Pecora, and to the Cambric Ordovician sedimentary and metamorphic sequences. In the area in front of the Gulf of Gonnesa, the rocky substrate can be related to the calc-alkaline volcanic rocks, which extensively outcrop south of Porto Paglia. In the inner shelf, north and south of Nebida, the rocky outcrop is interrupted by small fluvial palaeo valleys and elliptic to subcircular depressions, hosting extensive bedform fields.

In the northern sector, the shelf edge is interrupted by the presence of two morphological highs, characterized by a highly irregular micro-topography, reaching 140 m depth. Here, the rocky substrate is characterized by steep cliffs, high up to 10 m, interpreted as erosion escarpments. In the northern sector of the continental slope, the heads of the tributary valleys of the Canyon of Oristano branch from 310 m depth, with a straight or slightly sinuous course and a N-S trend. Limited landslides were identified only in the case of the two westernmost heads, whose ribbon-trend seems to be conditioned by the presence of rocky outcrops.

Geohazard feature of Buggerru Area

In the northern sector and in the central sector of the continental slope, bathymetric data evidence the presence of a pockmark field (Figure 2). The smaller depressions are characterized by conical morphology and have a circular plane view crater shape. Diameters range between 300 and 20 m and they are located between 320 and 650 m depth. In some cases, pockmarks are aligned, forming depressions and channeled structures. In the western sector, these structures surround the heads of backward landslides, while in the northern sector they are upstream of the canyon heads. Larger structures are subcircular to elliptical depressions, with steep walls and a jagged morphology, and 'U'-shaped or truncated conical sections, sometimes up to 500-m-wide.

In both cases, the formation of such structures is generally attributed to paroxysmal phenomena of leakage of fluids, gas eruptions, escape of water or migration of hydrocarbons through not lithified sediments. Above 600 m depth, the northern sector and central-western slope are affected by landslides, characterized by amphitheaters mostly sub-circular or with a horseshoe shape.

4.2. Piscinas area (MaGIC sheet 65)

The sector of the western margin of Sardinia falling in the Sheet 65 'Piscinas' includes the south-central portion of the amphitheater of Oristano. The continental shelf is about 25-km-wide, excluding the wide inlet of the Gulf of Oristano. The inner shelf, between 50 and 60 m depth, is characterized by a gentle slope (about 0.2°), with a sedimentary coverage characterized by bedform fields which were classified as sorted bedforms (De Falco, Budillon, et al., 2015). In the inner shelf of the southern section of the sheet, comet marks NE-SW oriented, associated with the presence of blocks, were identified. The rocky substrate outcrops between 60 and 120/130 m depth; in particular, this occurs in the north-central portion of the sheet. The rocky substrate is tectonically lowered westward, and it is cut by channels with steep cliffs, up to 10-m-high, which can be attributed to the paleo-hydrography of the periods of low stand of the sea level. The rocky substrate supports the development of extended coralligenous assemblages.

In the outer shelf, flathead cones with circular shapes, interpreted as volcanic buildings, were detected. The top of the cones is covered by bioconstructions (De Falco, Conforti, et al., 2022). These volcanic edifices are aligned along directions which reflect the main tectonic features of the margin.

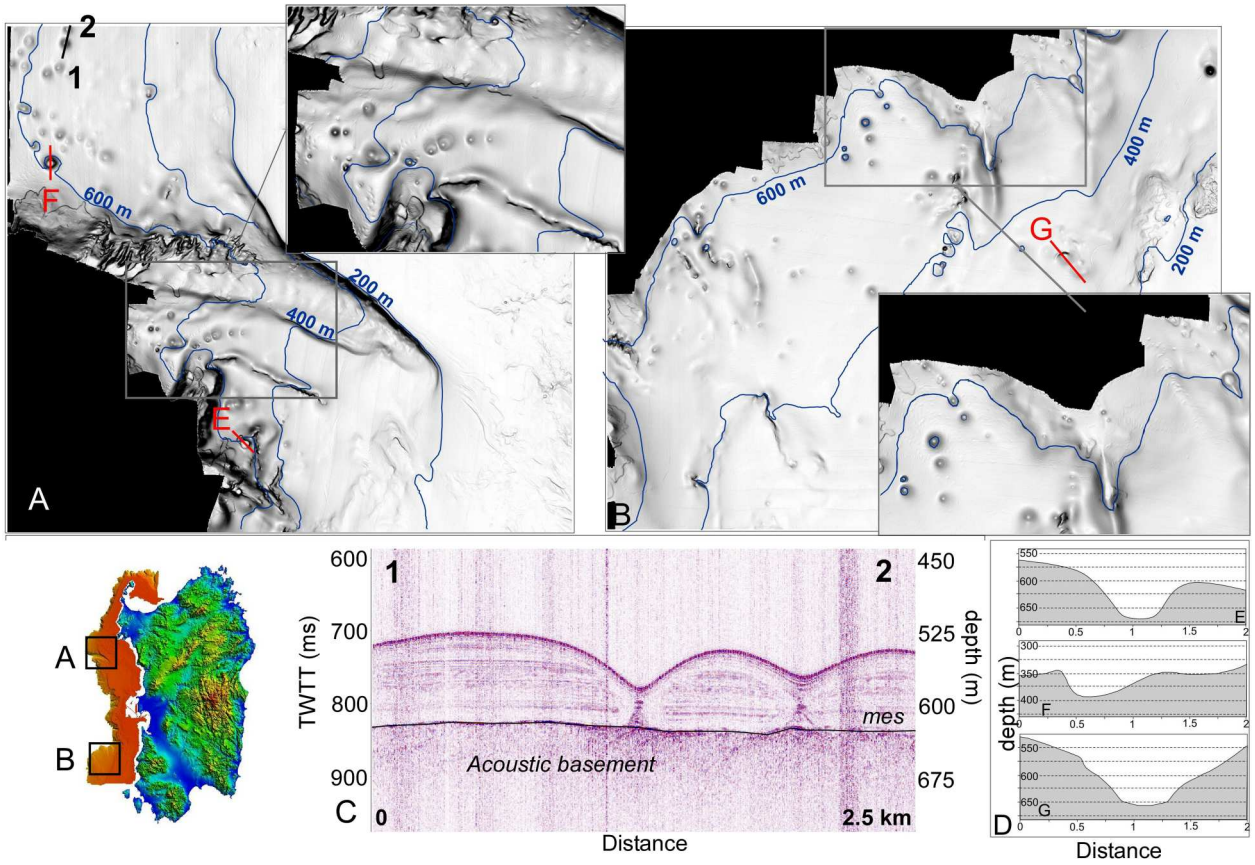

Figure 2. Digital Terrain Model of the sectors of the continental slope characterized by the presence of Pockmark fields, off Alghero (A) and Buggerru (B) coastal areas. C = High-resolution seismic section crossing two large pockmarks of the Alghero field: the pockmarks are rooted on the acoustic basement (mes = Messinian erosive surface). D = bathymetric profiles.

Volcanic edifices are also present in the upper slope, and sometimes affect the morphology of the shelf edge. Based on single-channel seismic surveys, the analysis of the stratigraphic relationship between these edifices and the sedimentary cover allowed us to attribute the volcanic structures to the Early Pliocene (Conforti et al., 2016). These buildings are therefore attributable to the volcanic anorogenic cycle of Sardinia. The outer shelf is characterized by the presence of a prograding sedimentary wedge. The shelf break is located at 220 m depth. In the northern sector, the edge of the shelf is deeply branched by the head of the Canyon of Oristano. Upward of the shelf edge, in correspondence of the head of the canyon, a series of sub-parallel escarpments, parallel to the canyon head, were detected. They were interpreted as due to erosion. The canyon has multiple heads with different channels that converge in the deepest area of the continental slope. The northernmost channel shows smoothed morphologies, probably because of the prevalence of the depositional processes and the subsequent burial. Those channels are deeply incised, with numerous niches of landslide present both along the channel bed and in the channel walls. The southern sector of the sheet is mostly covered with sediment. The margin of the shelf is not clearly defined by a break of slope on the sedimentary prism for the presence of the rocky substrate outcropping at 160/180 m depth.

Geohazard features of Piscinas area

In the southern sector, the continental slope is less steep and canyons do not erode the shelf edge. These canyons generally show smoothed morphologies. However, inside the canyons, landslide niches characterized by fresh morphology were detected. In two cases, the thalweg intercepts a series of circular depressions with diameters in the order of hundreds of meters, which sometimes engrave the bed of the channel. In the southern sector of the sheet, the continental slope is characterized by the presence of large circular depressions hundreds of meters large, and numerous small pockmarks mainly concentrated in two areas.

4.3. Oristano area (MaGIC sheet 66)

The sector of the Sheet 66 'Oristano' is characterized by a wide continental shelf (>25 km). A set of NE–SW oriented normal faults delineate a horst–graben structure on the shelf farther West in the Oristano Gulf. The granitic Palaeozoic basement in the footwall block crops out in the small Island of Maluentu, whereas the small Sinis Basin rests on the hanging block between the islands and the mainland (Thomas et al., 1988; Fais et al., 1996; Casula et al., 2001).

The inner shelf, located at 130/150 m depth, is mostly rocky. The nature of the rocky substrate can be assumed by analogy with the inland outcrops and on the basis of samples collected at sea. The substrate includes the sedimentary formations dated Miocene, Pliocene and Pleistocene of the Sinis area, the Paleozoic granites and metamorphic rocks respectively outcropping in the Island of Maluentu and sampled at sea, the basalts found in Capo San Marco, in the Sinis area, and in the Catalano Island. The rocky substrate was attributed to volcanic lithologies in the case of the volcanic edifices found in the southern sector. They are the products of the Plio-Quaternary volcanism, found offshore the Catalan basaltic rock. The rocky substrate is extensively colonized by bioconstructions. ROV surveys have shown the presence of coralligenous assemblages up to 145 m depth (De Falco, Conforti, et al., 2022; Piazzi et al., 2022).

The outer shelf is characterized by the presence of a sedimentary prograding wedge. The shelf break is at 200 m depth in the northern sector of the sheet, where the sedimentary cover has the greatest extension. In the south-central sector, the shelf break is deeper, around 220/230-m-deep. The shelf edge is deeply affected by several canyon heads with a fresh morphology, probably due to recent erosion.

The Mannu Canyon, in the northern area, is the most distant from the coast, about 20 km from the Island of Maluentu and 22 km from Cape Mannu. The head of the canyon branches the edge of the shelf for about 2.5 km. Inside the head, several channels have been mapped confluent in the main channel. The distance between the edges of the canyon walls is greater than 3 km.

The detection of inside terraces running parallel to the main axis suggests that the erosion of the canyon has been characterized by the occurrence of various successive phases. In the southern area, the continental slope is engraved by different channels. The Putzu Idu Canyon is the most developed, with the head that deeply affects the shelf and the presence of different ducts inside it.

Geohazard features of Oristano Area

A pockmark field has been identified along the continental slope. Thirthy circular depressions of varying depth and diameter are grouped over 500 m water depth. That may indicate the presence of gas leakage and/or fluids. The pockmarks are aligned in a north-east south-west direction according to the structural features of the margin.

4.4. Bosa area (MaGIC sheet 67)

The shelf sector included in the Sheet 67 'Bosa', is between 28- and 40-km-wide and is characterized by extensive outcrops of the rocky substrate. Along the outer shelf, on the northern edge of the sheet, the rocky substrate was uplifted in comparison with adjacent areas characterized by recent sedimentation.

The substrate shows the presence of steep escarpments. There are some nuclei of horizontally folds that suggest the presence of the Paleozoic basement extensively deformed. Tabular bodies prevail in the central sector, slightly relieved if compared with the surrounding areas, with extensive coverages of organogenic concretions and large erosive depressions partially filled by sediments. Near the coast, a morphologically more regular substrate is present at the seabed. This substrate has a slight elevation and could correspond to the volcano-sedimentary outcrops which extensively outcrop inland. In the inner shelf, limited areas with morphologies classifiable as sorted bedforms were detected. As highlighted by backscatter data, these areas are characterized by the alternation of coarse and fine sediments. A well-developed river bed paleo-hydrography was detected.

In some cases, the river bed can be connected to still active river mouths in emerging areas. The shelf is limited externally by a break of slope between 190 and 230 m depth. The break of slope marks the sedimentary flexure of the Pleistocene prograding wedge, which is juxtaposed to the Pliocene wedge.

The presence in outcrop or near the sea floor of the rocky substrate (Paleozoico-Miocene) reduced the space of accommodation for the sedimentary cover.

The sedimentary cover is more developed along the shelf edge, away from the coast; in the northern sector, it forms a wedge of limited extension, whereas, a more extended wedge is formed in the southern sector and in the inner basinal depressions.

Geohazard features of Bosa Area

The slope develops with mild gradient towards the North-West, interrupted by steeper slopes and straights that let assume a structural control. Fifty circular depressions of varying depth and diameter are grouped over 400 m water depth. That may indicate the presence of gas leakage and/or fluids. These are concentrated mainly in the areas of the continental slope which are structurally raised. The larger depressions show signs of 'cannibalization' due to the partial fill following the yielding of the side walls. At the outer limit of the sheet, several crowns of landslide were observed, together with the detachment of surface sediments (thickness ~15 m).

4.5. Alghero area (MaGIC sheet 68)

The continental margin in the Sheet 68 'Alghero' belongs to the tectonic block of the Nurra horst, limited westwards by a narrow set of sub-vertical faults which rapidly down-throws the basement to the bathyal plain (<2000m deep). The slope steep up to 20° did not hold the development of intra-slope basins (Lecca, 2000; Kenyon et al., 2002).

In the area, the Hercynian basement is overlaid with Mesozoic-Paleogene carbonatic covers and with Oligocene-Miocene calc-alkaline volcanics; marly, sandy and carbonatic deposits set up the Miocene sequence which in the northern border of the basin is almost underrepresented due to the Sardinia rift phase (Casula et al., 2001). The Messinian salinity crisis led to the prolonged exposure of wide sectors of the margin, enhancing the denudation of the clastic covers and the formation of incisions in the canyon heads, successively reactivated during the Quaternary 4th order low-stand phases. Thus, the Pliocene transgression, and successively the sea level excursions of the Pleistocene, governed the deposition of a sedimentary wedge on the outer shelf upper slope, formed by clinoform geometries and laterally-continuous and subparallel reflections relative to torbiditic deposition in the lower slope.

The inner and intermediate shelf, with low gradient, exposes the Herchynian basement, the Mesozoic covers, the Oligocene-Miocene volcanics and, locally, the arenaceous and biogenic lithified deposits of Quaternary age. Thus, the deposition of sediments in the inner shelf during the Pleistocene was limited to the narrow coastal sectors (Andreucci et al., 2009) or to the intra-basinal production of carbonatic sediments formed by different biogenic associations which often encrust the rocky outcrops (Carboni et al., 1989).

The morpho-structural and stratigraphical set up of the area defines a low geohazard degree from the submarine realm, mostly due to the general low gradient of the shelf, and the wide rocky outcrops combined with the low seismicity at the regional scale.

Geohazard features of Alghero Area

One of the most critical morphologies is represented by a large pockmark field, with hundreds of elements from few meters to several hundred meters in diameter, which is located ~25 km off the coastline and at more than 400 m depth (Figure 2). The field is surrounded seawards by a ring of landslide scarps, mainly translational, localized at 600 m depth on average, never exceeding 10 m of height. Finally, the upper slope is characterized by two large erosive embayments at the northern and southern margin of the map, which have undergone withdrawal processes on the long-term.

5. Conclusions

The western Sardinia margin exhibits the characteristics of a starved shelf with frequently outcropping bedrock.

- A new volcanic field has been identified in the central sector of the margin. These volcanic features can be attributed to the Pliocene-Pleistocene cycle.
- Sorted bedforms were found over sandy sedimentary wedges along the inner shelf, composed of siliciclastic gravelly sands and calcareous bioclastic medium fine sands.
- A complex drainage system characterizes the upper-shelf slope with numerous channels which carve the bedrock in the inner shelf and are connected with the canyon heads in the upper slope.
- Three wide pockmarks fields were also identified with potential geo-hazard relevance such as those related to land-slides and fluid seepages.

Software

Global Mapper© by Blue Marble Geographics and GeoSuite AllWorks© package by Geo Marine Solutions are used for bathymetric and seismic data visualization and interpretation.

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Disclosure statement

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

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Data availability statement

Bathymetric data and interpretation data (vector format) are available at the web site https://github.com/pcm-dpc/MaGIC/tree/master/MaGIC-1 Seismic data are available upon reasonable request by contacting the first authors at the mail address giovanni.defalco@cnr.it.

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References

Andreucci, S., Pascucci, V., Murray, A. S., & Clemmensen, L. B. (2009). Late Pleistocene coastal evolution of San Giovanni di Sinis, west Sardinia (Western Mediterranean). *Sedimentary Geology*, *216*(3–4), 104–116. https://doi.org/10.1016/j.sedgeo.2009.03.001

Carboni, S., Lecca, L., & Ferrara, C. (1989). La discordanza versiliana sulla piattaforma occidentale della Sardegna. *Bollettino Società Geologica Italiana*, *108*(3), 503–519.

Carmignani, L., Funedda, A., Oggiano, G., & Pasci, S. (2004). Tectonosedimentary evolution of southwest Sardinia in the Paleogene: Pyrenaic or Apenninic Dynamic? *Geodinamica Acta*, *17*(4), 275–287. https://doi.org/10.3166/ga.17.275-287

Carmignani, L., Oggiano, G., Barca, S., Conti, P., Funedda, A., Pasci, S., & Salvadori, I. (eds.) (2001). Geologia della

Sardegna (Note illustrative della Carta Geologica della Sardegna a scala 1:200.000). Istituto Poligrafico e Zecca dello Stato, pp. 284, https://doi.org/10.13140/RG.2.1.1530.6723

Casula, G., Cherchi, A., Montadert, L., Murru, M., & Sarria, E. (2001). The Cenozoic graben system of Sardinia (Italy): Geodynamic evolution from new seismic and field data. *Marine and Petroleum Geology*, *18*(7), 863–888. https://doi.org/10.1016/S0264-8172(01)00023-X

Cherchi, A., & Montadert, L. (1982). Oligo-Miocene rift of Sardinia and the early history of the Western Mediterranean Basin. *Nature*, *298*(5876), 736–739. https://doi.org/10.1038/298736a0

Conforti, A., Budillon, F., Tonielli, R., & De Falco, G. (2016). A newly discovered Pliocene volcanic field on the western Sardinia continental margin (western Mediterranean). *Geo-Marine Letters*, *36*(1), 1–14. https://doi.org/10.1007/s00367-015-0428-0

De Falco, G., Antonioli, F., Fontolan, G., Presti, V. L., Simeone, S., & Tonielli, R. (2015). Early cementation and accommodation space dictate the evolution of an overstepping barrier system during the Holocene. *Marine Geology*, *369*, 52–66. https://doi.org/10.1016/j.margeo.2015.08.002

De Falco, G., Budillon, F., Conforti, A., Di Bitetto, M., Di Martino, G., Innangi, S., & Tonielli, R. (2015). Sorted bedforms over transgressive deposits along the continental shelf of western Sardinia (Mediterranean Sea). *Marine Geology*, *359*, 75–88. https://doi.org/10.1016/j.margeo.2014.11.008

De Falco, G., Carannante, A., Del Vais, C., Gasperini, L., Pascucci, V., Sanna, I., Simeone, S., & Conforti, A. (2022). Evolution of a single incised valley related to inherited geology, sea level rise and climate changes during the Holocene (Tirso river). *Marine Geology*, *Volume 451*, 106885. https://doi.org/10.1016/j.margeo.2022.106885

De Falco, G., Conforti, A., Brambilla, W., Budillon, F., Ceccherelli, G., De Luca, M., Di Martino, G., Guala, I., Innangi, S., Pascucci, V., Piazzi, L., Pireddu, L., Santonastaso, A., Tonielli, R., & Simeone, S. (2022). Coralligenous banks along the western and northern continental shelf of Sardinia Island (Mediterranean Sea). *Journal of Maps*, *18*(2), 200–209. https://doi.org/10.1080/17445647.2021.2020179

Fais, S., Klingele, E. E., & Lecca, L. (1996). Oligo-Miocene half graben structure in Western Sardinian Shelf (western Mediterranean): Reflexion seismic and aeromagnetic data comparison. *Marine Geology*, *133*(3–4), 203–222. https://doi.org/10.1016/0025-3227(96)00030-8

Kenyon, N. H., Klaucke, I., Millington, J., & Ivanov, M. K. (2002). Sandy submarine canyon-mouth lobes on the western margin of Corsica and Sardinia, Mediterranean Sea. *Marine Geology*, *184*(1–2), 69–84. https://doi.org/10.1016/S0025-3227(01)00282-1

Lecca, L. (2000). La piattaforma continentale miocenico-quaternaria del margine occidentale sardo: blocco diagramma sezionato. *Rendiconti del Seminario della Facoltà di Scienze della Università di Cagliari*, *70*(1), 49–70.

Lecca, L., Carboni, S., Scarteddu, R., Sechi, F., Tilocca, G., & Pisano, S. (1986). Schema stratigrafico della piattaforma continentale occidentale e meridionale della Sardegna. *Memorie della Società geologica d'Italia*, *36*, 31–40.

Lecca, L., Scarteddu, R., & Sechi, F. (1983). La piattaforma continentale sarda da Capo Mannu a Capo Marrargiu. *Bollettino Società Geologica Italiana*, *102*, 57–86.

Oggiano, G., Funedda, A., Carmignani, L., & Pasci, S. (2009). The Sardinia-Corsica microplate and its role in the Northern Apennine Geodynamics: New insights from the Tertiary intraplate strike-slip tectonics of Sardinia. *Italian Journal of Geosciences*, *128*(2), 527–539.

Piazzi, L., De Falco, G., De Luca, M., Guala, I., Borras Palomar, A., Conforti, A., Pascucci, V., Simeone, S., & Ceccherelli, G. (2022). Coralligenous assemblages of continental shelf: Multiple spatial scale variability in the western Sardinia. *Continental Shelf Research*, *245*, 104790. https://doi.org/10.1016/j.csr.2022.104790

Réhault, J. P., Boillot, G., & Mauffret, A. (1984). The Western Mediterranean basin geological evolution. *Marine Geology*, *55*(3-4), 447–477. https://doi.org/10.1016/0025-3227(84)90081-1

Sage, F., Von Gronefeld, G., Déverchère, J., Gaullier, V., Maillard, A., & Gorini, C. (2005). Seismic evidence for Messinian detrital deposits at the western Sardinia margin, northwestern Mediterranean. *Marine and Petroleum Geology*, *22*(6-7), 757–773. https://doi.org/10.1016/j.marpetgeo.2005.03.007

Thomas, B., Lecca, L., & Gennesseaux, M. (1988). La Structure de la marge occidentale de la Sardaigne et la fragmentation de l'ile au Cénozoïque. *Marine Geology*, *83*(1–4), 31–41. doi:10.1016/0025-3227(88)90050-3