

GEOMORPHOLOGICAL MAP OF TREMITI ISLANDS (PUGLIA, SOUTHERN ADRIATIC SEA, ITALY)

Scale 1:15.000

INTRODUCTION

The Tremiti Islands lie in the central-southern Adriatic Sea, in northern Apulia, at about 20 km north from Gargano promontory coast. It includes San Domino, San Nicola, Capraia and Cretaccio islands, and La Vecchia rock; Pianosa island, also belonging to the archipelago, is 11 miles away from the main ones towards NE. Being located around the centre of the Adriatic basin, and facing the junction between central and southern Apennines, the islands lie in a complex geological area, crucial for the study of Quaternary Adriatic basin evolution, strongly driven by eustatic processes and tectonics along well known regional faults. The archipelago is the emerged part of one of the main structural highs within the Adriatic basin, well studied for erosional/depositional processes on the continental shelf due to Late Quaternary tectonics and eustatic sea-level changes.

A detailed integrative geomorphological analysis in the Tremiti Islands, on both the islands and the inner continental shelf around the islands, enabled the elaboration of a geomorphological map (1:15,000 scale) of above and below sea level areas.

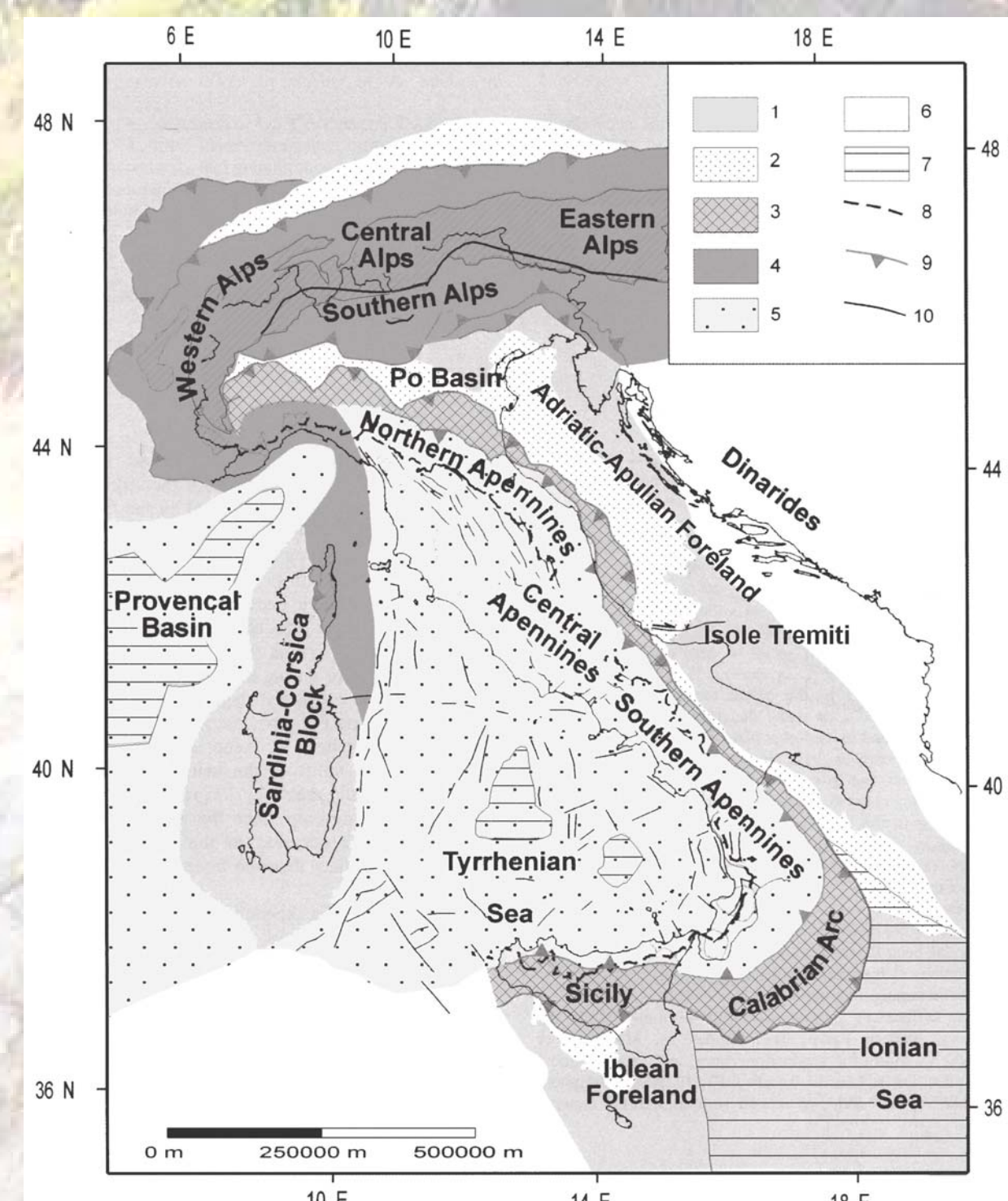
The Geomorphological map of the Tremiti Islands (Puglia, Southern Adriatic Sea, Italy), scale 1:15,000, incorporates three main sections:

- 1) main geomorphological map and legend (center and left on the Map);
- 2) geomorphological profiles and morphostratigraphic correlation of Quaternary continental deposits (lower part of the Map);
- 3) geomorphological block diagrams and figures (right on the Map);

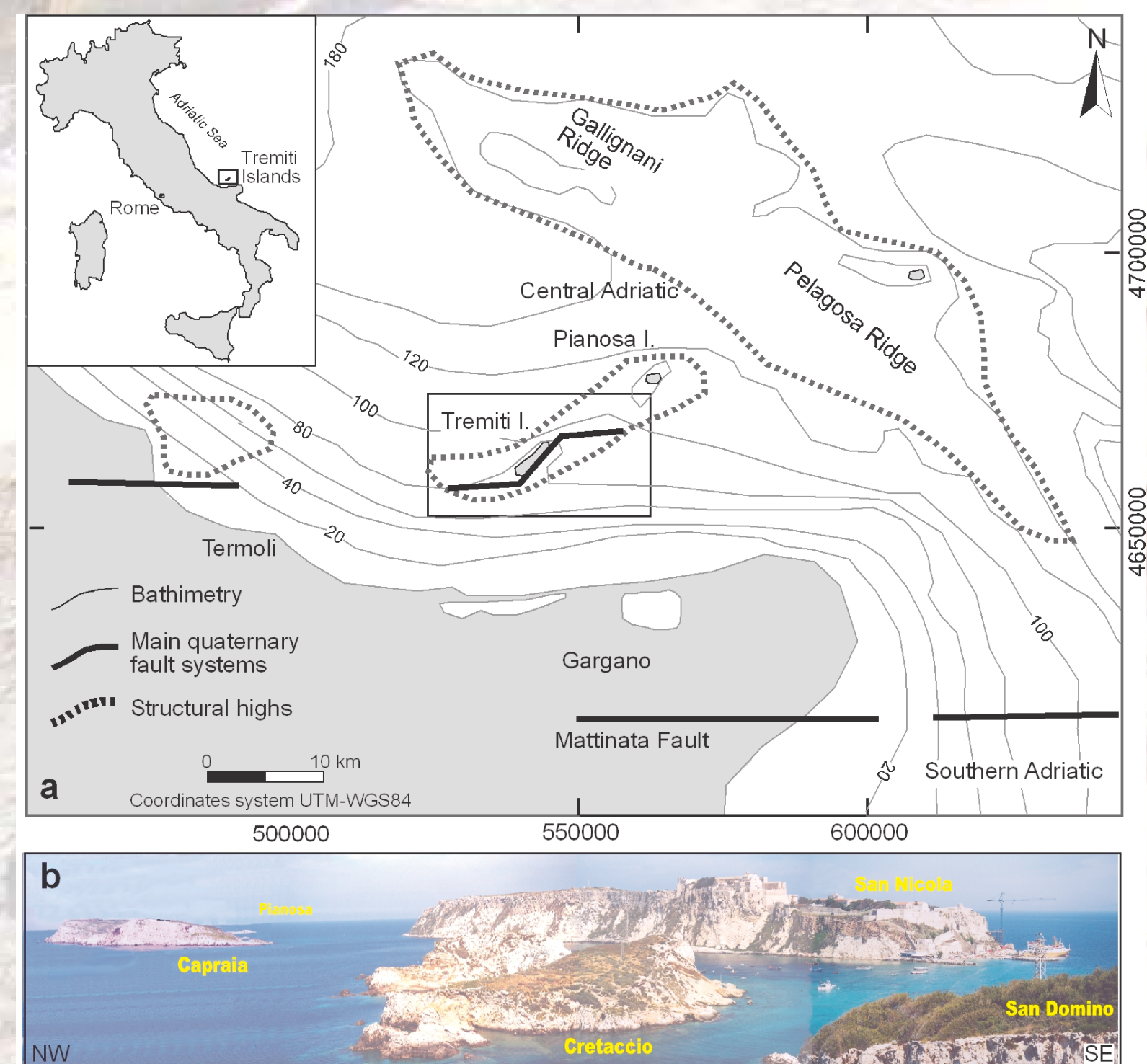
The study characterizes deposits and erosion surfaces of the Quaternary continental succession, outlining some new chronological constraints; main tectonic and geomorphological features, in surface and underwater area, are defined. The geomorphological and stratigraphical data analysis allowed the reconstruction of morphostratigraphic relationships between the islands; moreover, the correlation with tectonic features allowed the reconstruction of morphotectonic setting of the archipelago.

At local scale, this correlation has provided a contribution to the reconstruction of Late Quaternary landscape and geomorphological evolution, as the result of tectonics, sea-level fluctuations and marine, coastal, and continental geomorphological processes.

At a regional scale, this study provides new data useful for the reconstruction of foreland area Quaternary evolution, due to the relationships between tectonic and eustatic processes, as well as clues and contributions for the correlation to coastal and piedmont areas. Discussion and conclusion coming from this analysis has been presented in two specific research paper on international journals.



STUDY AREA



METHODS

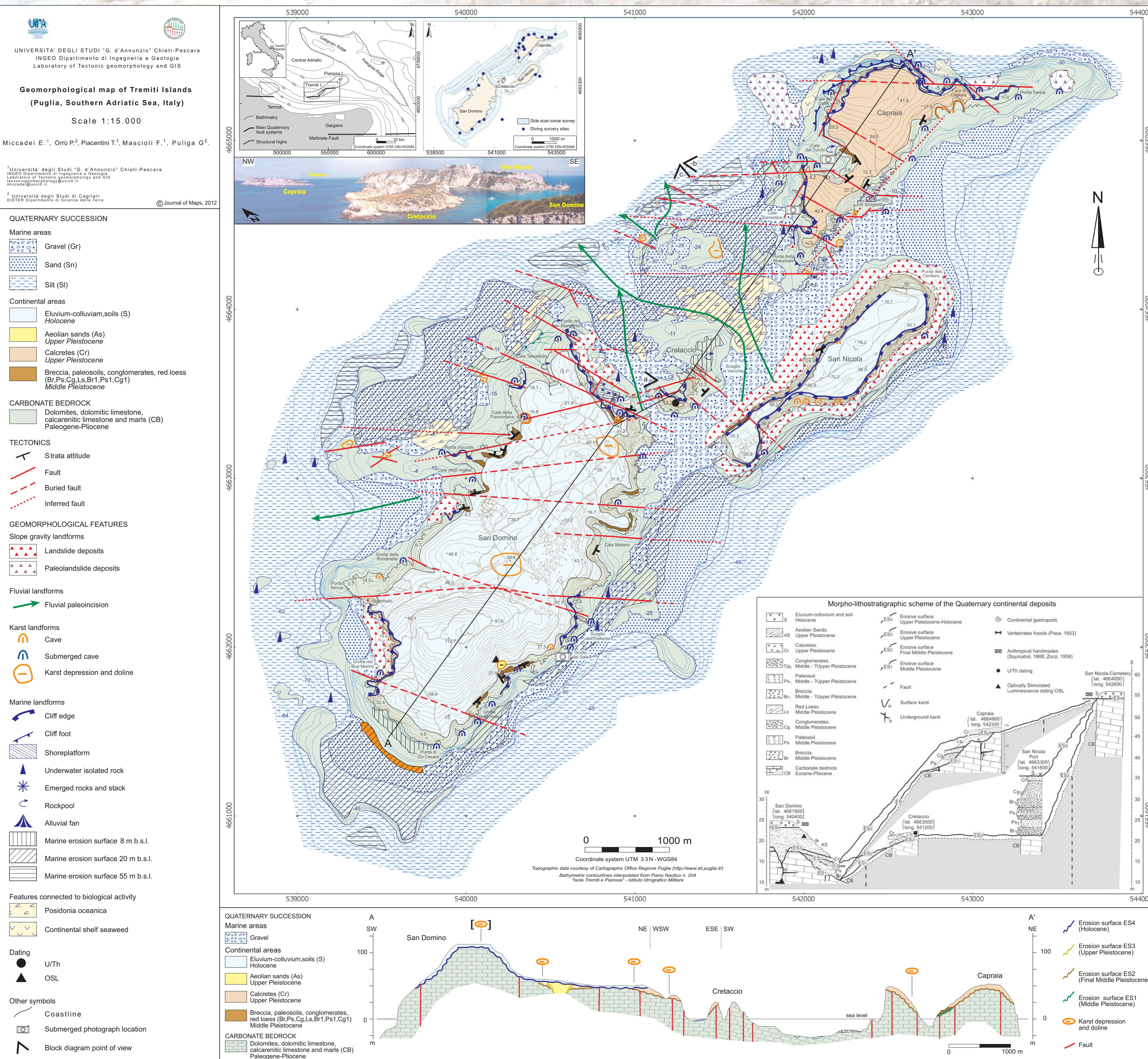
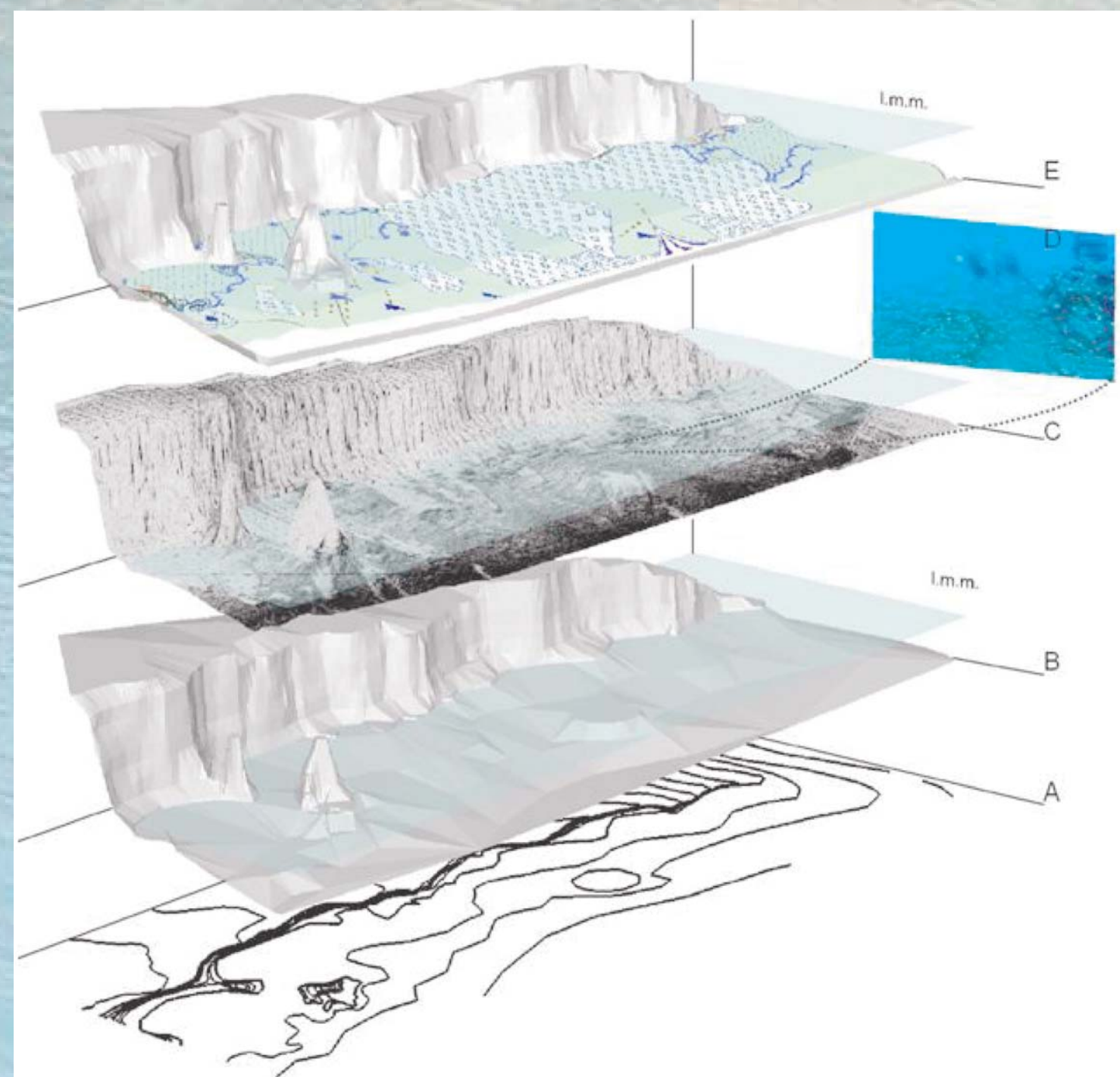
This work is based on a detailed geomorphological analysis of the Tremiti Islands and of the inner continental shelf sea bottom around them, from coastline to about 70 m b.s.l., incorporating: (1) field mapping of Quaternary continental deposits and landforms, supported by U/Th and OSL dating, (2) bathymetric analysis, (3) side scan sonar survey and (4) scuba-diver geomorphological mapping.

The field mapping study was carried out by means of a geological survey of Quaternary continental deposits (1:5,000 scale), allowing for the construction of detailed lithostratigraphic logs for each island, and geomorphological survey (1:5,000 scale, and 1:1,000 for the most significant areas). Dating of a calcareite and an aeolian deposit supported the morpholithostratigraphic correlation of the deposits among the different islands.

Bathymetric analysis has been performed processing and interpolating data from nautical cartography of Istituto Idrografico Militare, Piano Nautico n. 204 "Isola Tremiti e Pianosa" (1:15,000 scale). The resulting map has a detail that enables the analysis of the main morphological features and to discriminate flat areas and scarps.

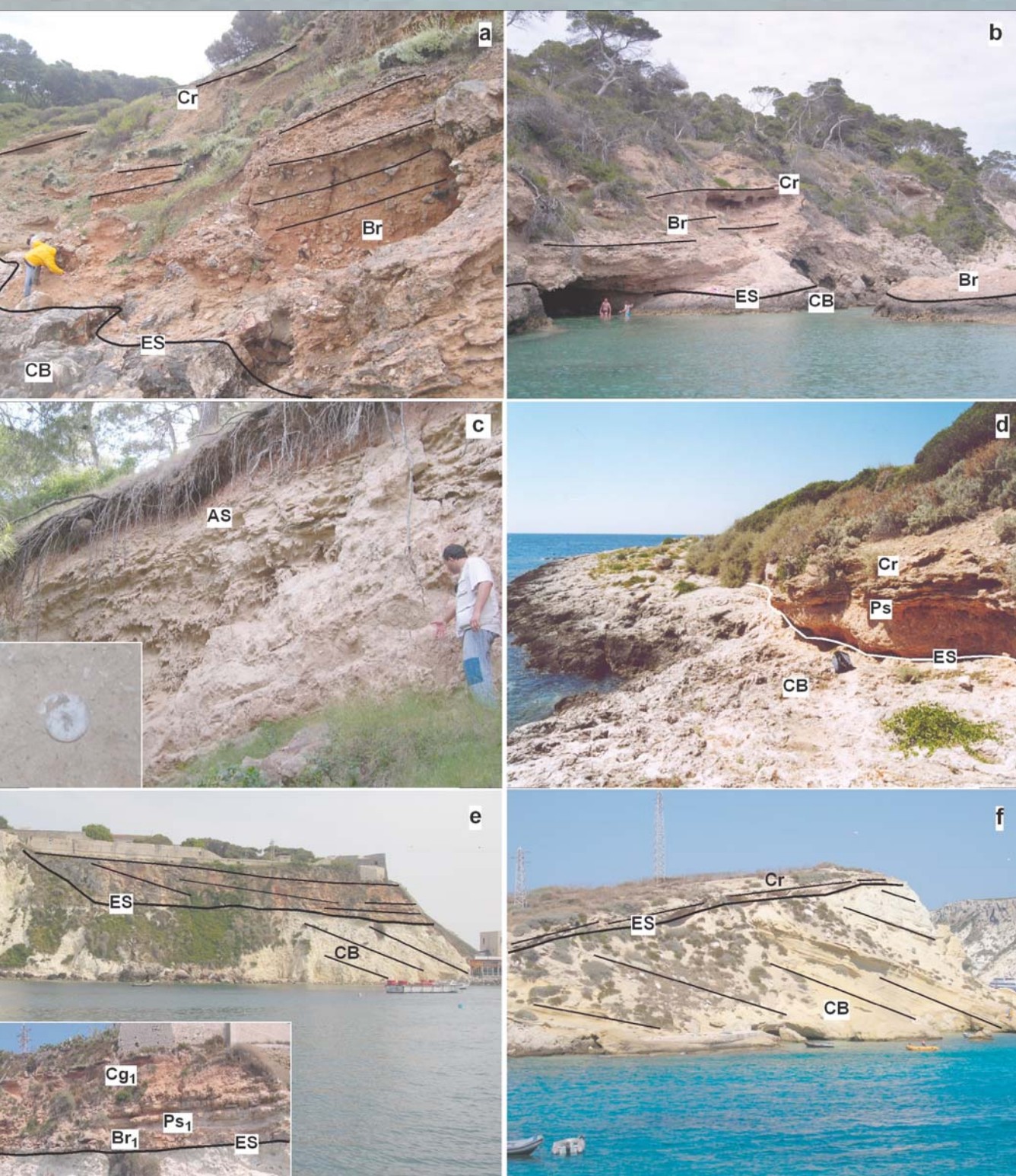
Bathymetric data allowed for plan geomorphological survey of an area of about 9 km², carried out by means of a side scan sonar records (1:5,000 scale), during the years of 2006 and 2007.

Scuba-diver geomorphological mapping, up to a depth of 50 m b.s.l., allowed for detailed direct observation of inner continental shelf landforms (1:1,000 scale) and the observation of the below sea-level cliff portion and caves, enabling side scan sonar record calibration and improvement.



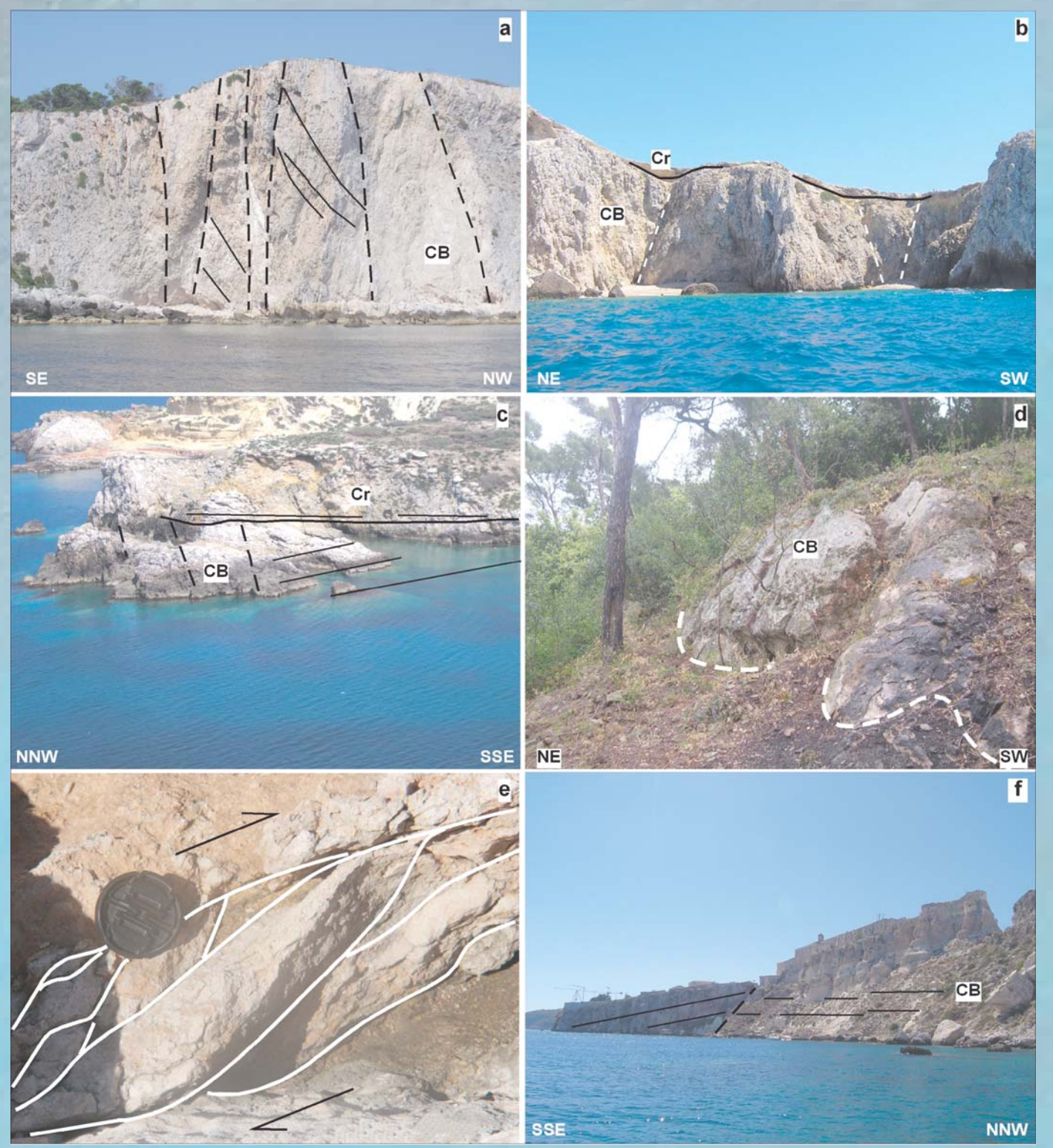
da: Miccadei E., Orrù P., Piacentini T., Mascioli F. & Puliga G. (2012) - "Geomorphological map of the Tremiti Islands (Puglia, Southern Adriatic Sea, Italy), scale 1:15,000". Journal of Maps, vol.8, pp.74-87, 2012. <http://www.tandfonline.com/doi/abs/10.1080/17445647.2012.668765>

QUATERNARY CONTINENTAL DEPOSITS



Quaternary continental deposits (the abbreviations refer to the Morpho-lithostratigraphic scheme included in the map). (a) San Domino, Cala degli Inglesi, stratified breccia, formed of decimetric and centimetric clasts, in tightly cemented red-brown sandy matrix, laying on an erosion surface, within pre-existent depressed morphologies, on Cenozoic carbonate bedrock. In the higher part calcareite outcrops are about 0.7-0.8 m thick; (b) San Domino, Cala delle Roselle, stratified breccia with sub-angular centimetric clasts, laying on carbonate bedrock; (c) San Domino, Cala delle Roselle, yellow aeolian sand within a karst depression, with a particular of the fossiliferous content formed of continental gastropods; (d) Capraia, Cala dei Turchi, paleosols and calcareites, in contact with carbonate bedrock; (e) San Nicola, breccia, paleosols and conglomerates, stratified in about 0.25 m thick layers; in the lower left a close up of the deposits is included; (f) Cretaccio, calcareite in angular discordance on carbonate bedrock, age is 121 ±21 kyr (U/Th dating).

MAIN TECTONIC ELEMENTS



Main tectonic elements (the abbreviations refer to the Morpho-lithostratigraphic scheme included in the map). (a) San Domino, I Pagliai, intensely tectonic area, characterized by NW-SE-oriented fault surfaces and cataclastic rocks; (b) Capraia, NW-SE-oriented faults; (c) Cretaccio, NE-SW-oriented faults, characterized by cataclastic rocks; (d) San Domino, Poggio Romito, visible E-W fault plain on carbonate bedrock; (e) San Domino, Cala Tramontana, sigmoid structure indicating right strike-slip kinematic (plan view); (f) San Nicola, tectonic contact between Miocene limestone and marl, in the southeast sector of San Nicola.

GEOMORPHOLOGICAL FEATURES



Geomorphological features on the islands (the abbreviations refer to the Morpho-lithostratigraphic scheme included in the map). (a) Capraia, partially submerged karst pothole, along the southern coast of the island; (b) San Domino, karst pothole in the north-east sector of the island, with calcareites on top; dashed line indicates a tectonic discontinuity, characterized by NW-SE fault planes and cataclastic rocks; (c) San Domino, pothole at Cala delle Roselle, partially filled by aeolian sands (AS); (d) San Domino, karst cave at sea-level.

Submerged landforms surveyed by scuba-diver observations on the inner continental shelf (numbers indicates depth): (a) Capraia island, incisions and erosional features, between sea-level and about 20 m b.s.l.; (b) San Domino island, detritic fan with centimetric and decimetric calcareous elements, sub-rounded, fossilized by algal fouling. Fan apex is located at about 8 m b.s.l.; (c) San Domino island, cave at sea-level extending down to 8 m b.s.l.; (d) San Domino island, submerged cave at 10 m b.s.l.; (e) Capraia island, flat surface developed between 20 and 25 m b.s.l.; (f) Capraia island, inner margin of flat marine erosion surface observed by bathymetric analysis, at about 20 m b.s.l.; (g) Capraia island, shore platform at 8 m b.s.l.; (h) Metric sub-rounded coastal rockpools, at 8 m b.s.l.

CONCLUSIONS

The Geomorphological map of the Tremiti Islands, scale 1:15,000, is the result of the integrative geomorphological analysis presented in this work, on both the islands and the inner continental shelf around them. This analysis has provided several elements for the comprehension of the Quaternary continental deposits and geomorphological features, and of the Pleistocene landscape evolution of the archipelago. Quaternary continental deposits and geomorphological features are summarized in the morpho-lithostratigraphic scheme, in the geomorphological profile and in the block diagrams included in the map (lower and lower-right section).

The interpretation of new stratigraphical, geomorphological, chronological data, compared with previous studies in the surrounding areas, indicates a correlation (from islands to inner continental shelf) of subaerial erosion surfaces (ES₁, ES₂, ES₃, ES₄) and paleo sea-levels with sea level change curve, allowing for an integration of the limited information existing in this area. The main subaerial erosion surfaces, following the oldest one on carbonate bedrock (ES₁), are ascribed to late Middle Pleistocene (ES₂), Upper Pleistocene (ES₃) and Upper Pleistocene-Holocene (ES₄). Subaerial erosional processes are evident also in the continental shelf areas, where erosion surfaces bound the transgressive/regressive depositional sequences of the Quaternary marine succession; these surfaces are strongly controlled by eustatic sea-level changes and are referable to subaerial exposure of platform during final Middle Pleistocene and Upper Pleistocene sea-level lowstands and Holocene rise.

Furthermore, the correlation between landform distribution, Quaternary deposits, tectonic features, and eustatic interpretation of morphogenetic processes, provides a new contribution concerning regional tectonics. The SE-NW paleodrainage networks developed during Late Middle Pleistocene (ES₂) and Late Upper Pleistocene (ES₄) lowstands were followed by tectonic activity during the Middle and Upper Pleistocene, along E-W and SW-NE regional discontinuities. These features have lowered the area between Tremiti and Gargano, beheading the SE-NW Middle Pleistocene fluvial drainage and inducing a strong evolution of the landscape.

REFERENCES

- Ferranti L., Antonelli F., Mauz B., Amorosi A., Dai Pra G., Mastroruzzi G., Monaco C., Orrù P., Pappalardo M., Radice U., Renda P., Romano P., Sansò P., Verrubbi V., (2006). Markers of the last interglacial sea-level high stand along the coast of Italy: Tectonic implications. Quaternary International 145:143-30-54.
- ISPRA Istituto Superiore per la Protezione e la Ricerca Ambientale, (2003b). Progetto CARG: linee guida per il rilevamento geologico, la cartografia e l'informaticizzazione dei dati delle aree marine - Scala 1:50.000. Quaderni Serie III del Servizio Geologico d'Italia 12 II, Roma.
- Miccadei E., Mascioli F., Piacentini T. (2011a). Quaternary geomorphological evolution of the Tremiti Islands (Puglia, Italy). Quaternary International 222, 3-15.
- Miccadei E., Mascioli F., Orrù P., Piacentini T., Puliga G., (2011b). Late Quaternary paleolandscapes of submerged inner continental shelf areas of Tremiti Islands archipelago (northern Puglia). Geografia Fisica Dinamica Quaternaria, 34 (2).
- Selli R., (1971). Isola Tremiti e Pianosa. In: Cremonini G., Elmi, R. (Ed.), Nota illustrativa della Carta Geologica d'Italia alla scala 1:100.000 Foglio 156 "Marco in Lami", 49-65. Servizio Geologico d'Italia, Roma.