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Landscape planning-addressed regional-scale mapping of geolithological units: an example from Southern Italy

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ABSTRACT

A 1:100,000-scale geolithological map has been prepared for the Basilicata region (Southern Italy) through an extensive review of official geological maps integrated by photogeological analyzes and field surveys. A double-key legend allows discriminating both lithological and technical properties of the rock bodies. This map together with the main relief-scale morpho-structural features, permitted us a subsequent recognition of the different landscape domains of the region, which have been summarized in a derived map. The two products represent an effective basis for landscape planning purposes and a key tool to highlight the spatial distribution of the 'geological landscape' in a sector characterized by a high degree of geodiversity.

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Geolithological mapping; landscape units; European Landscape Convention; geoheritage; geodiversity; Southern Apennines

1. Introduction

In the year 2000, the member states of the Council of Europe signed a Landscape Convention, with the aim of achieving a closer union among its members, to safeguard and promote the ideals and principles that are their common heritage (Déjeant-Pons, 2006). That purpose is normally pursued through the conclusion of agreements in economic and social fields. Good practices of landscape preservation and valorization include a detailed and comprehensive analysis of many different factors such as topography, lithology, hydrography and cultural/geological heritage. These thematic layers can be combined using different methods to obtain a synoptic classification of landscape (Simensen et al., 2018).

Yet, the Council also wanted to achieve sustainable development based on a balanced relationship between social needs, economic activity, and the environment. Since the landscape fulfills important functions of general interest, at a cultural, ecological, environmental, and social level and constitutes a resource favorable to economic activity, a document of intent was drawn up on this basis, the European Landscape Convention. In the last 20 years, different regions of European countries have started multidisciplinary activities related to the drafting of regional landscape plans (Civitarese Matteucci & Cartei, 2022). The Basilicata region in Southern Italy, as well, starting from the beginning of the millennium, issued the preparatory law for the drafting of the Plan, made mandatory in 2004. Only in recent years, however, have this region's research institutions started the drafting work of the Plan and related cartography.

Our research group was commissioned to draw up a geolithological map of Basilicata, as part of a wider study for the preparation of the guidelines for the landscape plan of the region. The geolithological map pertains to the editorial practices of the so-called 'derived cartography', i.e. based on the pre-existence of thematic documents. In the present case, the map derives directly from the revision of data from original field surveys, mostly represented by the official geological cartography of Italy at a 1:50,000 scale, edited in the last decade. Published cartography at the scale 1:10,000 and 1:25,000 (Civile et al., 2017; Giannandrea, 2009; Giannandrea & Schiattarella, 2019; Giannandrea et al., 2006, 2014; Gioia et al., 2020; 2024) and unpublished maps mainly surveyed by the authors of this paper during their 30-years research experiences, were also used. For the portions of the regional territory not covered by the aforementioned geological cartography, the 1:100,000 scale sheets of the Geological Map of Italy and to the 1:25,000 scale surveys that formed its basis (made available by the Geological Service of Italy – ISPRA) were used.

A geolithological map of Italy has also been recently published (Bucci et al., 2022). Although this work may

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represent a significant contribution to the general knowledge of the country and a starting point for such issues, its scale is not suitable for technical applications and maps that do not exceed the borders of individual Italian regions or districts are still needed. The geolithological map here attached represents an effective basis for identifying the Physical Landscape Units, as the subdivision adopted for that goal allows for determining homogeneous territorial units and the identification of the 'geological landscape'. Recent trends in landscape and geoheritage valorization emphasized the co-location of geosites and geomorphosites into their geological and geomorphological context (García-Quintana et al., 2004). Such a goal is frequently achieved by the construction of a Geological Landscape Map (Ferrando et al., 2023). It can therefore be considered a useful tool for emphasizing landscape diversity (Burnelli et al., 2023; Danese et al., 2021) by contrasting the tendency to homogenize the different concepts of landscape, but also a technical base-document for territorial planning. For this reason, the geolithological map is featured by a double legend to ensure the litho-technical correspondence of the single lithological units. Based on this document, a map of mountain-scale landforms was finally constructed as a synthesis of the regional landscape.

2. Regional setting

The South-Apennine chain is a NE-verging fold-and-thrust belt derived from the deformation of Mesozoic–Cenozoic circum-Tethyan domains, with associated Neogene–Pleistocene foredeep and satellite-basin deposits (Patacca & Scandone, 2007, and references therein). Restorations of the pre-orogenic (Triassic to Paleogene) south-Italian paleogeography showed that the African (i.e. Apulian) passive margin was characterized by alternating carbonate platforms and deep-sea basins. The simplest model suggests the presence of a unique Meso-Cenozoic pelagic basin, known as Lagonegro (or Lagonegrese–Molisano) basin, between two coeval carbonate platforms (Pescatore et al., 1999).

Starting from the Tortonian, the orogen underwent low-angle extension which led to the exhumation of its non-metamorphic 'core complex' (Schiattarella et al., 2003, 2006). Later on, the external tectonic units of the fold-and-thrust belt, mainly made of terrigenous formations, were thrust on the foreland-basin deposits of the Bradano foredeep.

During Late Pliocene and Quaternary times, the orogenic chain suffered severe stages of tectonic uplift associated with strike-slip and normal faulting (Cinque et al., 1993; Schiattarella et al., 2006), thus promoting the present-day structure of elongated fault-bounded ridges and tectonically controlled intermontane basins (Giano & Schiattarella, 2023; Giano et al., 2014; Gioia et al., 2023; Moro et al., 2007; Putignano & Schiattarella, 2008; Schiattarella et al., 2017; Zembo, 2010). High-relief fault slopes and mountain ridges are mainly carved in both Mesozoic shallow-water carbonate and deep-sea sedimentary rocks while tectonic depressions are occupied by thick successions of Pliocene–Pleistocene clastic deposits (Schiattarella et al., 2017). The main valleys of tectonic origin are transversally cut by braided-type rivers. Steep slopes, deep fluvial incision, V-shape valleys and large deep-seated complex landslides in clay-rich deposits are other typical features of the inner and axial zone of the region (south-western and southern sector of the map, see Bucci et al., 2021; Lazzari & Gioia, 2016; Lazzari et al., 2018).

The outer zone of the chain and foredeep areas are dominated by different geological and geomorphological features. This sector is carved in Cretaceous to Miocene pelagic deposits, Pliocene clastic deposits, and Quaternary foredeep silty clay, which formed low-relief thrust sheets, gently-dipping ridges and badland landscape (Schiattarella et al., 2017 and references therein). These landforms are transversally cut by the main rivers of the study area flowing eastward to the Metaponto coastal plain. The landscape of the outer belt exhibits a gentler topography than the axial zone and is dominated by widespread earth flows and shallow landslides. The main rivers have a parallel pattern on a regional scale and generally show low- and very low slope angle profiles in the middle and lower reaches.

The Ionian coastal belt (i.e. easternmost sectors of the study area) is featured by a hilly landscape, badland-type landscape and flat landforms. The latters correspond to several orders of marine and alluvial terraces of Middle Pleistocene to Holocene age (Cilumbriello et al., 2010; Corrado et al., 2017, 2022).

3. Methods

The geolithological map was carried out in a GIS environment using ArcGIS. As topographic bases, we used both a 5 m-resolution Digital Elevation Model (DEM) derived from LiDAR data available on the geoportal of the Basilicata Regional Authority (http://rsdi.regione.basilicata.it) and official topographic maps by the Italian 'Istituto Geografico Militare' (IGM) at 1:25,000 scale. Geological maps at 1:50,000 scale (sheet 506 Sant'Arcangelo, ISPRA, 2005; sheet 535 Trebisacce, ISPRA, 2009; sheet 451 Melfi, ISPRA, 2010a; sheet 504 Sala Consilina, ISPRA, 2010b; sheet 522 Senise, ISPRA, 2011; sheet 470 Potenza, ISPRA, 2012a; sheet 489 Marsico Nuovo, ISPRA, 2012b; sheet 523 Rotondella, ISPRA, 2012c; sheet 452 Rionero in Vulture, ISPRA, 2014a; sheet 490 Stigliano, ISPRA, 2014b; sheet 505 Moliterno, ISPRA, 2014c; sheet 507 Pisticci, ISPRA, 2014d; sheet 521 Lauria, ISPRA, 2014e; sheet 508 Policoro, ISPRA, 2016f; sheet 520 Sapri, ISPRA, 2016g; sheet 471 Irsina, ISPRA, 2017, from the new Carta Geologica d'Italia) and, where the 1:50,000-scale maps are not available yet, geological maps at 1:100,000 scale (sheet 188 Gravina di Puglia, ISPRA, 1966; sheet 201 Matera, ISPRA, 1969a; sheet 199 Potenza, ISPRA, 1969b; sheet 220 Verbicaro, ISPRA, 1970a; sheet 198 Eboli, ISPRA, 1970b; sheet 221 Castrovillari, ISPRA, 1971, from the Carta Geologica d'Italia) were used to draw the boundaries of the lithological units, together with edited (Giannandrea, 2009; Giannandrea & Schiattarella, 2019; Giannandrea et al., 2006, 2014; Gioia et al., 2020) or unpublished geological maps of the authors. Data were projected in the geodetic reference system of UTM 33N – ETRS1989. The map of the landscape units presented in this paper was edited in the same GIS environment and on the same topographic base, being derived from the geolithological map.

This map was drawn up through bibliographic–cartographic research and field checks integrated with photogeological analysis. For this reason, but also due to the specific criteria adopted for the legend, the document created is not simply a lithological map deriving from transformation by the unification of similar geological formations (as they are described in the legends of the consulted pre-existing maps), but it consists of a geolithological map, where the prefix *geo*-emphasizes a profound reworking of the data drawn from the pre-existing geothematic cartography and the connection of these data with characteristics able to influence the evolution of the physical landscape. Therefore, the cartographic work here produced contains all the information necessary to define the lithology, landscape characteristics, the general litho-technical characteristics, and the permeability of the outcropping formations. This possibility derives from the choice of a 'double' setting of the legend, made for lithological units ordered in a chronological sense (even if not in a strict manner as on a traditional geological map, due to the unification of lithological types belonging to different formations, therefore sometimes with different ages), from top to bottom, from the youngest rocks and/or incipient units to the oldest constituting the Mesozoic core of the chain or the crystalline-metamorphic units of 'internal' origin. These units were grouped into lithological complexes with similar characteristics from the genetic point of view, within which the lithological units are related to classes of lithotecnical features and/or to resistance to erosion.

After the classification phase, frequency distribution was carried out on the spatial distribution and areal extent of the different lithological units and complexes of litho-technical classes. A map of regional landscapes was produced using the lithological units defined in this work and the physiographic characteristics of the area studied as a reference. The landscape unit map was extracted starting from the geolithological map. The procedure was mainly based on the examination of the topographic, geomorphological and geological characteristics of the areas investigated, applying criteria derived from the synthetic observation of the main elements that make up the structure of the landscape at a regional scale.

4. Results

For the reasons above, the map includes two distinct lists: the first, with basic lithological descriptions and formational references, follows the geological division, while the second one obeys the logic of the division in complexes with similar litho-technical characteristics. The many different geological formations outcropping in the regional territory were grouped and/or subdivided on the basis of their fundamental lithological characteristics into 24 main geological units, which represent a limited number in relation to the great geological complexity of the region. The geolithological units thus identified are therefore grouped into the (A) sedimentary, (B) volcanic, and (C) crystalline-metamorphic complexes, which in turn are subdivided into classes of litho-technical characteristics.

In the main legend, the units are grouped according to the following scheme: (I) Surficial units; (II) Volcanic and epiclastic deposits of Monte Vulture and intermontane basins of Venosa and Atella; (III) Deposits of Bradano Foredeep and intrachain basins; (IV) Lithological complexes of the geological bedrock; and (V) Crystalline-metamorphic units.

The percentage distribution of each lithological class over the Basilicata territory is summarized in a bar chart (Figure 1). The surface of the study area is made up of 96.59% sedimentary rock, 0.64% crystalline-metamorphic rocks and 2.21% volcanic rocks (Figure 2). Relevant differences in the spatial distributions of lithologies exist. In the western and southern part of the study area, there is a predominant distribution of limestone and dolostone lithologies, the only exception being the Matera area near the eastern border of the region. The areal coverage of these lithological units slightly exceeds 5% (Figure 2). The central part of the region consists mainly of sandstones and marly clays (unit 16) and clays, marls and limestones (unit 17), with an arealcoverage of about 12% and 17%, respectively, whereas in the eastern one, there are mainly units 13 (Clays with sandstones and conglomerates) and 3 (Gravels and sands). Unit 1 (Present-day and recent loose and/or locally/weakly cemented cover deposits) is found in almost the whole region and has an aerial cover of about 14%.

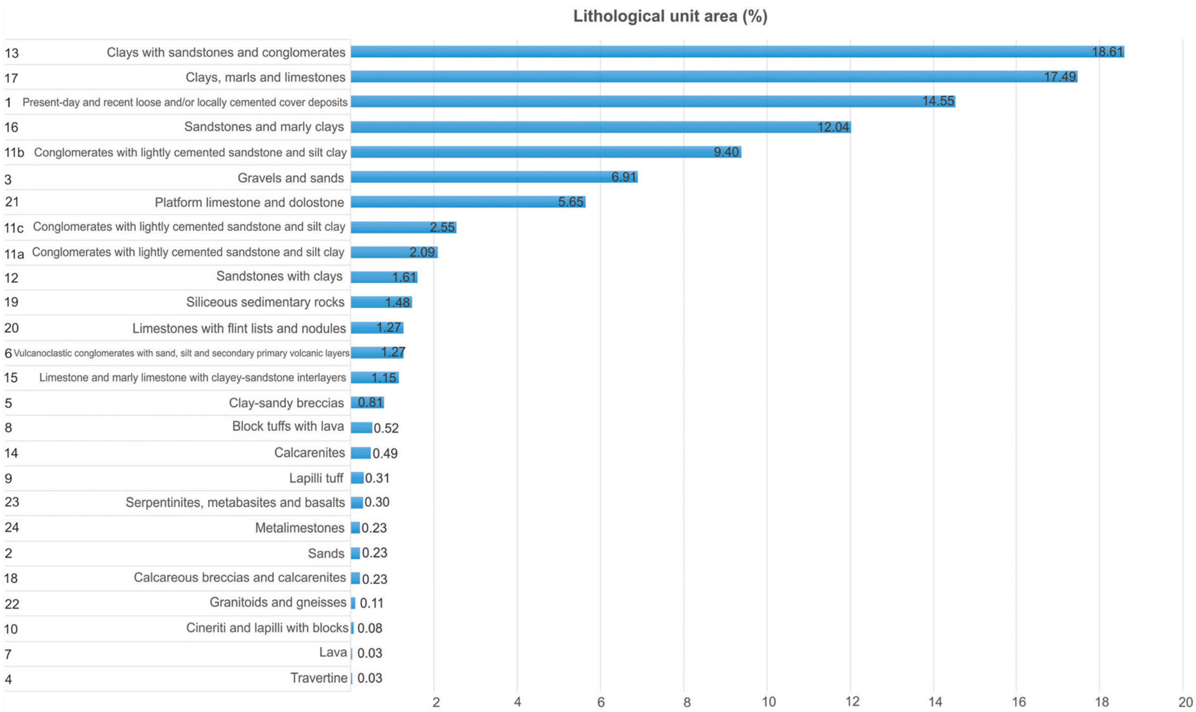

Figure 1. Graph of the percentage distribution of the lithological units of the geolithological map.

Data from the geolithological map and field observations about the main features of the physical landscape allowed us to produce a regional-scale morphological map. Such a map aims to describe the discrete sectors of the chain-foredeep system included in the regional borders and will be used in the Landscape Plan of the Basilicata region ('Piano Paesaggistico Regionale', PPR).

The map of the Physical Landscape Units of Basilicata (Figure 3), drawn up at a scale of 1:100,000, divides the regional territory into homogeneous areas from a physiographic point of view, identified by a characteristic geographical connotation ('Physiographic Landscape Units'). In Basilicata, eleven units have been identified and mapped. The procedure was mainly based on the examination of the topographic, geomorphological and geological characteristics of the areas investigated. Then, an expert-based criteria of homogenization and classification were applied in order to delineate the main landform units of the landscape at a regional scale. Visual inspection of the map highlights a high degree of landscape diversity of the Basilicata. In the westernmost sector, a clear delineation of the alternating occurrence of impressive mountain ridges (Figure 4(B)) and tectonic intermontane basins should be

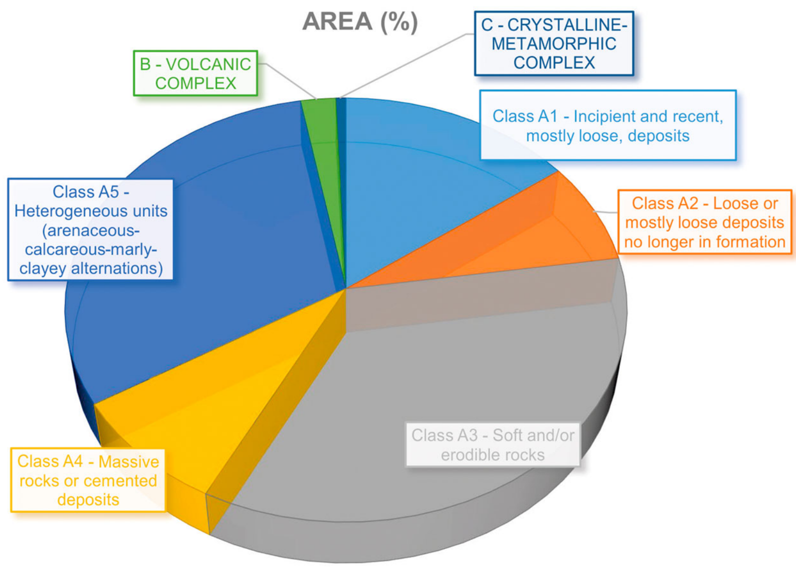

Figure 2. Graph of the percentage distribution of the complexes of litho-technical classes.

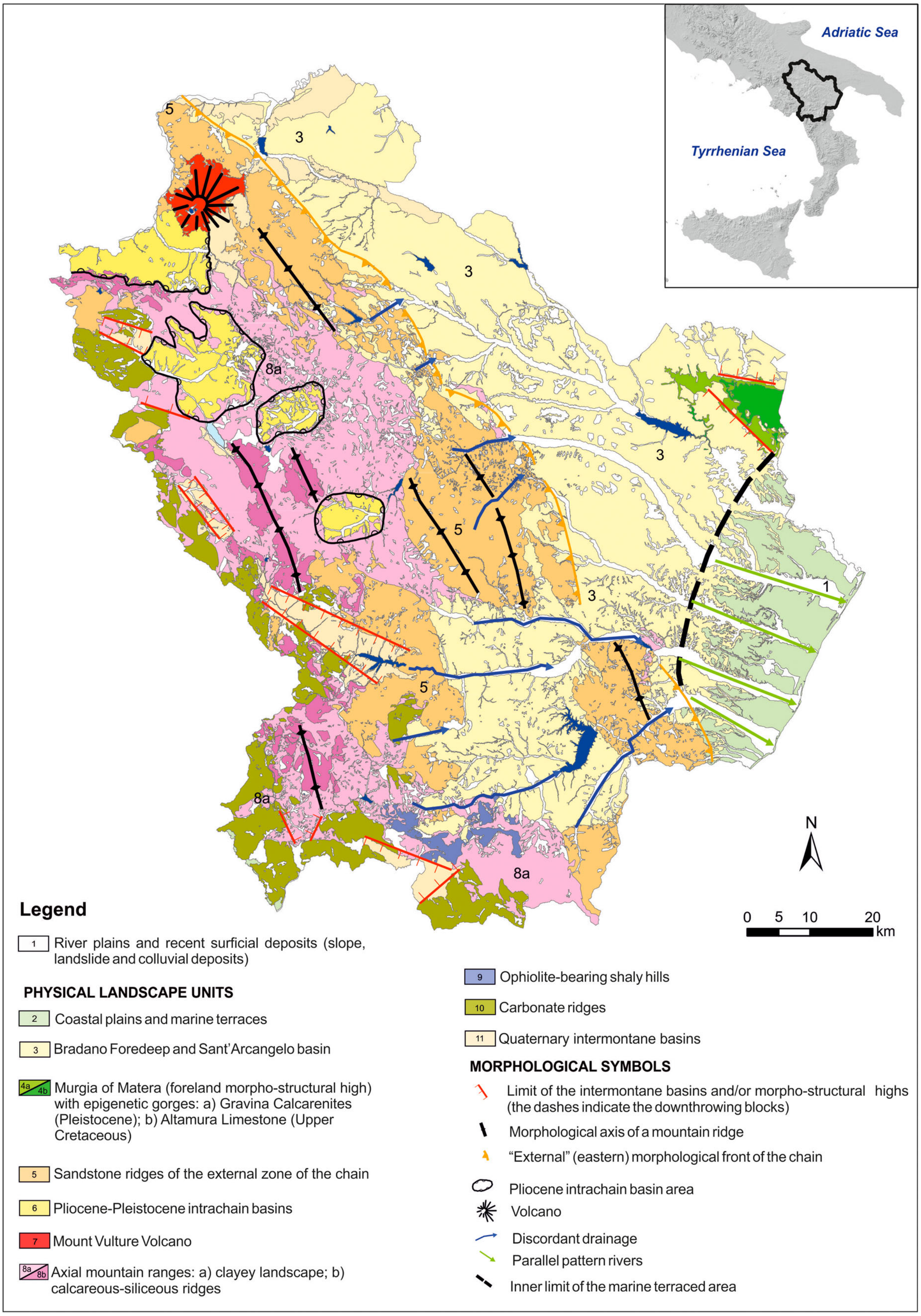

Figure 3. Map of the physical landscape units of Basilicata.

highlighted. The outer-eastern sectors of the chain are dominated by NNW-SSE thrust sheets, sandstone-bearing ridges and gently-dipping hillslope made by Miocene terrigenous units and Pliocene clastic deposits of thrust-top basins (Figure 4(A)). Landforms of the foredeep are sculptured mainly in Lower Pleistocene marine silty clay, which typically constitute a landscape with slopes largely affected by badlands and landslides (Figure 4(D)). Often the hills of this domain are flat-topped due to the presence of a

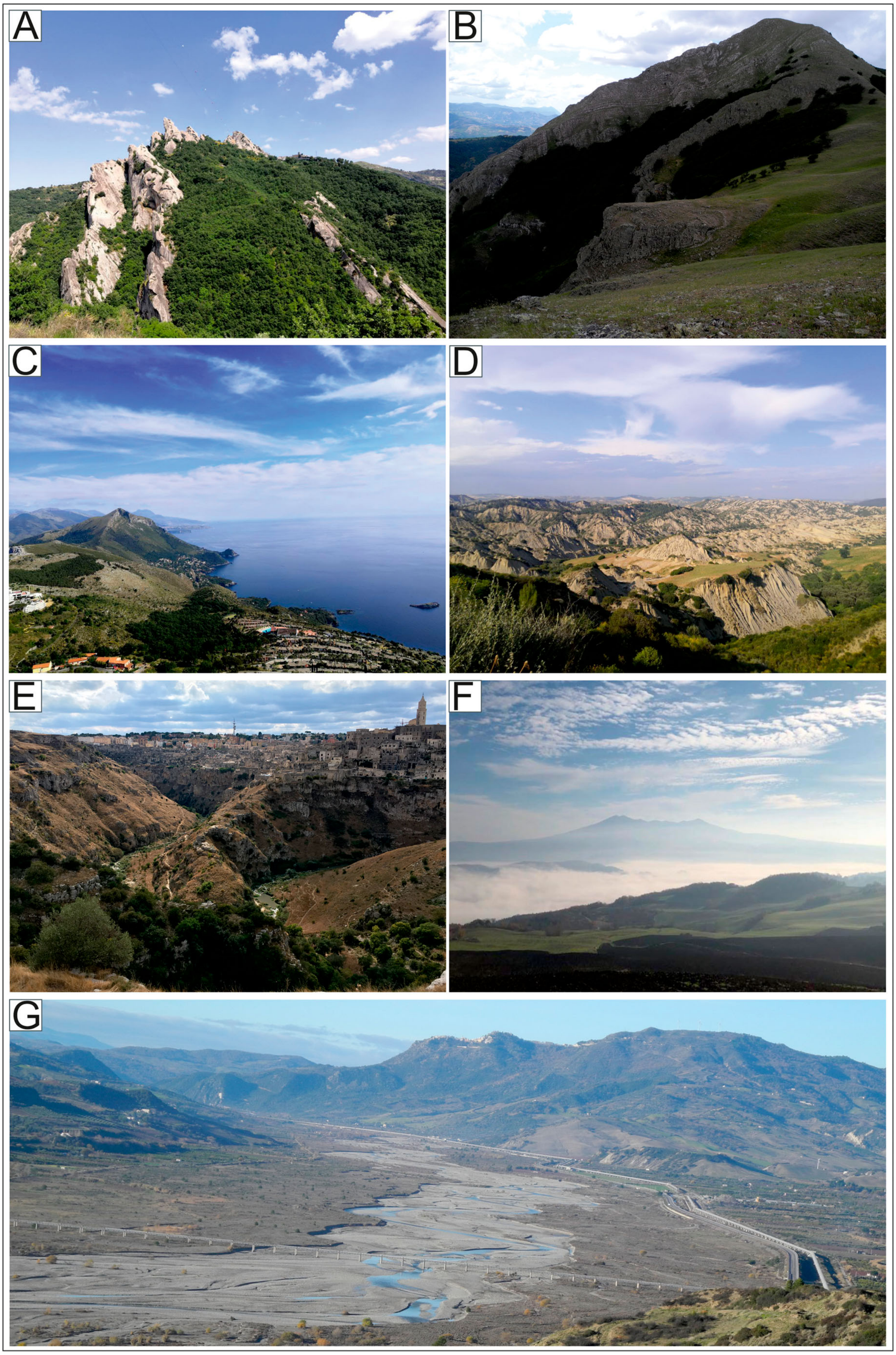

Figure 4. Some examples of landforms and lithology in the study area. (A) Sandstone of the Gorgoglione formation (unit 5 of the physiographic unit, unit 16 of the geological map); (B) folded limestone beds of the Calcari con Selce *Fm.* (unit 8b of the physiographic unit, unit 20 of the geological map); (C) platform limestone outcropping in the western coastal sector (unit 10 of the physiographic unit, unit 21 of the geological map); (D) badlands in the marine silty clays outcropping in the foredeep (unit 3 of the physiographic unit, unit 13 of the geological map); (E) gorges in foreland limestones near Matera (unit 4b of the physiographic unit, unit 21 of the geological map); (F) panoramic view of the Vulture volcano (unit 7 of the physiographic unit; units 7, 8 and 9 of the geological map); (G) the valley floor of the Sinni River, characterized by braided channels, a wide alluvial plain, and different orders of fluvial terraces. In the background, the mountain front of the Apennine chain (unit 1 of the physiographic unit; unit 1 of the geological map).

conglomerate caprock, forming mesas and plateaux. Terraced surfaces of marine and fluvial origin are also widespread (Figure 4(G)). Mount Vulture volcanic products and associated landforms features the northern sector of the region (Figures 3 and 4(F)). The landscape map highlights a strong control of the Pliocene-Pleistocene tectonic evolution of the Sothern Apennine chain, which mainly promoted the development of structural landforms at different scales (i.e. fault-related slopes, thrust sheet, flat-topped tectonic basin, consequent or parallel drainage).

5. Conclusions

Review of literature data, field surveys and a careful GIS-based homogenization of geological and stratigraphical data are summarized in a geolithological map of the Basilicata region. The map represents both an attempt to summarize the geological landscapes of a region with an extraordinary richness of geodiversity and geoheritage and a key product for landscape planning and the identification of areas a with high landscape value. As a matter of fact, our results can be useful to identify the geological landscape context of geosites or areas with a high cultural value. It also constitutes the basis for the correct identification of the main physiographic and landform-based domains of a large sector of the south-Apennine chain featured by a high degree of geological and geomorphological diversity.

Highlights

1. A geolithological and a physiographic landscape units maps have been prepared for the Basilicata region (Southern Italy)
2. The maps represent key products for landscape planning and the delineation of the main units of the Landscape Plan of the Basilicata region

Software

ESRI ArcGIS 10.3 and QGIS were used to digitize the data collected during field survey and aerial photo-interpretation and to perform statistical analysis. Topographic base and hillshade were derived from the CTR digital archive of the Basilicata region (https://rsdi.regione.basilicata.it). The final layout of the map was prepared in CORELDRAW X7. Vector files of the maps (SHP-format; coordinate system: ETRS-WGS 1989, zone 33N) are available on request.

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Disclosure statement

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

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References

Bucci, F., Santangelo, M., Fiorucci, F., Ardizzone, F., Giordan, D., Cignetti, M., Notti, D., Allasia, P., Godone, D., Lagomarsino, D., Pozzoli, A., Norelli, E., & Cardinali, M. (2021). Geomorphologic landslide inventory by air photo interpretation of the High Agri Valley (Southern Italy). *Journal of Maps*, *17*(2), 376–388. https://doi.org/10.1080/17445647.2021.1943552

Bucci, F., Santangelo, M., Fongo, L., Alvioli, M., Cardinali, M., Melelli, L., & Marchesini, I. (2022). A new digital lithological map of Italy at the 1:100 000 scale for geomechanical modelling. *Earth System Science Data*, *14*(9), 4129–4151. https://doi.org/10.5194/essd-14-4129-2022

Burnelli, M., Melelli, L., & Alvioli, M. (2023). Land surface diversity: A geomorphodiversity index of Italy. *Earth Surface Processes and Landforms*, *48*, 3025–3040. https://doi.org/10.1002/esp.5679

Cilumbriello, A., Sabato, L., Tropeano, M., Gallicchio, S., Grippa, A., Maiorano, P., Mateu-Vicens, G., Rossi, C. A., Spilotro, G., Calcagnile, L., & Quarta, G. (2010). Sedimentology, stratigraphic architecture and preliminary hydrostratigraphy of the Metaponto coastal-plain subsurface (Southern Italy). *Memorie Descrittive Carta Geologica d'Italia*, *90*, 67–84.

Cinque, A., Patacca, E., Scandone, P., & Tozzi, M. (1993). Quaternary kinematic evolution of the Southern Apennines. Relationships between surface geological features and deep lithospheric structures. *Annali di Geofisica*, *36*, 249–260.

Civile, D., Schiattarella, M., Martino, C., & Zecchin, M. (2017). Geology of the Pergola–Melandro basin area, Southern Apennines, Italy. *Journal of Maps*, *13*(2), 7–18. https://doi.org/10.1080/17445647.2016.1245633

Civitarese Matteucci, S., & Cartei, G. F. (2022). The impact of the European Landscape Convention on landscape planning in Spain, Italy and England. *Journal of Environmental Law*, *34*(2), 307–330. https://doi.org/10.1093/jel/eqac004

Corrado, G., Aiello, G., Barra, D., Di Leo, P., Gioia, D., Antonio, M. A., Parisi, R., & Schiattarella, M. (2022). Late Quaternary evolution of the Metaponto coastal plain, Southern Italy, inferred from geomorphological and borehole data. *Quaternary International*, *638–639*, 84–110. https://doi.org/10.1016/j.quaint.2022.01.008

Corrado, G., Leo, P. D., Giannandrea, P., & Schiattarella, P. G. M. (2017). Constraints on the dispersal of Mt. Vulture pyroclastic products: Implications to mid-Pleistocene climate conditions in the foredeep domain of Southern Italy. *Géomorphologie: Relief, Processus,*

Environnement, *23*(2), 171–182. https://doi.org/10.4000/geomorphologie.11731
Danese, M., Gioia, D., Amodio, A. M., Corrado, G., & Schiattarella, M. (2021). A spatial method for the geodiversity fragmentation assessment of Basilicata Region, Southern Italy. In *Lecture Notes in Computer Science (including subseries Lecture Notes in Artificial Intelligence and Lecture Notes in Bioinformatics), LNCS 12951* (pp. 620–631). https://doi.org/10.1007/978-3-030-86970-0_43
Déjeant-Pons, M. (2006). The European landscape convention. *Landscape Research*, *31*(4), 363–384. https://doi.org/10.1080/01426390601004343
Ferrando, A., Faccini, F., Paliaga, G., & Coratza, P. (2023). Geosites and geological landscapes of Liguria (Italy). *Journal of Maps*, *19*(1), 2145919. https://doi.org/10.1080/17445647.2022.2145919
García-Quintana, A., García-Hidalgo, J. F., Martin-Duque, J. F., Pedraza, J., & González-Martin, J. A. (2004). Geological factors of the Guadalajara landscapes (Central Spain) and their relevance to landscape studies. *Landscape and Urban Planning*, *69*(4), 417–435. https://doi.org/10.1016/j.landurbplan.2003.12.001
Giannandrea, P. (2009). Sedimentary evolution of the lacustrine and alluvial Quaternary succession of Venosa Basin (Southern Italy). *Alpine and Mediterranean Quaternary*, *22*(2), 269–290.
Giannandrea, P., La Volpe, L., Principe, C., & Schiattarella, M. (2006). Unconformity-bounded stratigraphic units and evolutionary history of the middle Pleistocene Monte Vulture volcano, Southern Apennines, Italy. *Bollettino della Società Geologica Italiana*, *125*(1), 67–92.
Giannandrea, P., Marino, M., Romeo, M., & Schiattarella, M. (2014). Pliocene to Quaternary evolution of the Ofanto Basin in Southern Italy: An approach based on the unconformity-bounded stratigraphic units. *Italian Journal of Geosciences*, *133*(1), 27–44. https://doi.org/10.3301/IJG.2013.11
Giannandrea, P., & Schiattarella, M. (2019). Geological map of the eastern sector of the Pliocene-Quaternary Ofanto Basin: An upgrade. *Geological Field Trips*, *11*(23), 1–15. https://doi.org/10.3301/GFT.2019.05
Giano, S. I., Gioia, D., & Schiattarella, M. (2014). Morphotectonic evolution of connected intermontane basins from the Southern Apennines, Italy: The legacy of the pre-existing structurally controlled landscape. *Rendiconti Lincei*, *25*(S2), 241–252. https://doi.org/10.1007/s12210-014-0325-x
Giano, S. I., & Schiattarella, M. (2023). Drainage integration of small endorheic basins at the Pleistocene-Holocene transition: An example from Southern Italy. *Geomorphology*, *427*, 108622. https://doi.org/10.1016/j.geomorph.2023.108622
Gioia, D., Bavusi, M., Di Leo, P., Giammatteo, T., & Schiattarella, M. (2020). Geoarchaeology and geomorphology of the Metaponto area, Ionian coastal belt, Italy. *Journal of Maps*, *16*(2), 117–125. https://doi.org/10.1080/17445647.2019.1701575
Gioia, D., Corrado, G., Danese, M., Minervino Amodio, A., & Schiattarella, M. (2023). Post-lacustrine evolution of a tectonically-controlled intermontane basin: Drainage network analysis of the Mercure basin, Southern Italy. *Frontiers in Earth Science*, *11*, 1–15. https://doi.org/10.3389/feart.2023.1112067
Gioia, D., Corrado, G., Minervino Amodio, A., & Schiattarella, M. (2024). Uplift rate calculation based on the comparison between marine terrace data and river profile analysis: A morphotectonic insight from the Ionian coastal belt of Basilicata, Italy. *Geomorphology*, *447*, 109030. https://doi.org/10.1016/j.geomorph.2023.109030
ISPRA. (1966). Carta Geologica d'Italia alla scala 1:100.000, Foglio 188 – Gravina di Puglia. Firenze.
ISPRA. (1969a). Carta Geologica d'Italia alla scala 1:100.000, Foglio 201 – Matera. Firenze.
ISPRA. (1969b). Carta Geologica d'Italia alla scala 1:100.000, Foglio 199 – Potenza. Roma.
ISPRA. (1970a). Carta Geologica d'Italia alla scala 1:100.000, Foglio 220 – Verbicaro. Ercolano (Napoli).
ISPRA. (1970b). Carta Geologica d'Italia alla scala 1:100 000, Foglio 198 – Eboli. Roma.
ISPRA. (1971). Carta Geologica d'Italia alla scala 1:100.000, Foglio 221 – Castrovillari. Roma.
ISPRA. (2005). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 506 Sant'Arcangelo. APAT, Firenze S.EL.CA.
ISPRA. (2009). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 535 Trebisacce. ISPRA, Roma, A.T.I. – SystemCart – L.A.C. – S.EL.C.A.
ISPRA. (2010a). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 451 Melfi. ISPRA, Roma, Litografia Artistica Cartografica.
ISPRA. (2010b). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 504 Sala Consilina. ISPRA, Roma, A.T.I. – SystemCart – L.A.C. – S.EL.C.A.
ISPRA. (2011). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 522 Senise. ISPRA, Roma, SystemCart.
ISPRA. (2012a). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 470 Potenza. ISPRA, Roma, SystemCart.
ISPRA. (2012b). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 489 Marsico Nuovo. ISPRA, ISPRA, Roma, SystemCart.
ISPRA. (2012c). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 523 Rotondella. ISPRA, Roma, SystemCart.
ISPRA. (2014a). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 452 Rionero in Vulture. ISPRA, Roma, SystemCart.
ISPRA. (2014b). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 490 Stigliano. ISPRA, Roma, SystemCart.
ISPRA. (2014c). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 505 Moliterno. ISPRA, Roma, SystemCart.
ISPRA. (2014d). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 507 Pisticci. ISPRA, Roma, SystemCart.
ISPRA. (2014e). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 521 Lauria. ISPRA, Roma, SystemCart.
ISPRA. (2016f). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 508 Policoro. ISPRA, Roma, SystemCart.
ISPRA. (2016g). Carta Geologica d'Italia alla scala 1:50.000, Foglio – 520 Sapri. ISPRA, Roma, SystemCart.
ISPRA. (2017). Carta Geologica d'Italia alla scala 1:50.000, Foglio 471 Irsina. ISPRA, Roma, SystemCart.
Lazzari, M., & Gioia, D. (2016). Regional-scale landslide inventory, central-western sector of the Basilicata region (Southern Apennines, Italy). *Journal of Maps*, *12*(5), 852–859. https://doi.org/10.1080/17445647.2015.1091749
Lazzari, M., Gioia, D., & Anzidei, B. (2018). Landslide inventory of the Basilicata region (Southern Italy). *Journal of Maps*, *14*(2), 348–356. https://doi.org/10.1080/17445647.2018.1475309
Moro, M., Amicucci, L., Cinti, F. R., Doumaz, F., Montone, P., Pierdominici, S., Saroli, M., Stramondo, S., & Di Fiore, B. (2007). Surface evidence of active tectonics along the Pergola-Melandro fault: A critical issue for the seismogenic potential of the Southern Apennines, Italy.

Journal of Geodynamics, *44*(1–2), 19–32. https://doi.org/10.1016/j.jog.2006.12.003

Patacca, E., & Scandone, P. (2007). Geology of the Southern Apennines. *Bollettino della Societa Geologica Italiana, Supplemento*, *7*, 75–119.

Pescatore, T., Renda, P., Schiattarella, M., & Tramutoli, M. (1999). Stratigraphic and structural relationships between Meso-Cenozoic Lagonegro basin and coeval carbonate platforms in Southern Apennines, Italy. *Tectonophysics*, *315*(1–4), 269–286. https://doi.org/10.1016/S0040-1951(99)00278-4

Putignano, M. L., & Schiattarella, M. (2008). Geology, geomorphology, and exhumation modalities of the Monte Motola structure, Cilento region, Southern Italy. *Bollettino della Società Geologica Italiana*, *127*(3), 477–493.

Schiattarella, M., Di Leo, P., Beneduce, P., & Giano, S. I. (2003). Quaternary uplift vs tectonic loading: A case study from the Lucanian Apennine, Southern Italy. *Quaternary International*, *101–102*(1), 239–251. https://doi.org/10.1016/S1040-6182(02)00126-X

Schiattarella, M., Giano, S. I., & Gioia, D. (2017). Long-term geomorphological evolution of the axial zone of the Campania-Lucania Apennine, Southern Italy: A review. *Geologica Carpathica*, *68*(1), 57–67. https://doi.org/10.1515/geoca-2017-0005

Schiattarella, M., Leo, P. D., Beneduce, P., Giano, S. I., & Martino, C. (2006). Tectonically driven exhumation of a young orogen: An example from the Southern Apennines, Italy. In S. D. Willett, N. Hovius, M. T. Brandon, & D. Fisher (Eds.), *Tectonics, climate, and landscape evolution: Special paper of the Geological Society of America* (Vol. 398, pp. 371–385). Geological Society of America.

Simensen, T., Halvorsen, R., & Erikstad, L. (2018). Methods for landscape characterisation and mapping: A systematic review. *Land Use Policy*, *75*, 557–569. https://doi.org/10.1016/j.landusepol.2018.04.022

Zembo, I. (2010). Stratigraphic architecture and quaternary evolution of the Val d'Agri intermontane basin (Southern Apennines, Italy). *Sedimentary Geology*, *223*(3–4), 206–234. https://doi.org/10.1016/j.sedgeo.2009.11.011