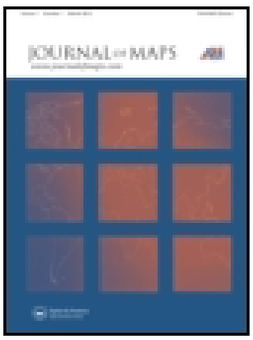

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Geosites and geological landscapes of Liguria (Italy)

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ABSTRACT

Liguria is a small region in Northwestern Italy which is characterized by significant and valuable geoheritage. The 1:250,000 map presented in this paper displays the 120 geosites of Liguria, officially approved by regional and national authorities, framed in the context of the geological landscapes of the region. The geological landscapes were obtained by categorizing and thematizing geological, lithological and geomorphological data in macro-units with similar characteristics. Protected areas (National parks, regional parks and natural reserves) and caves are also highlighted in the map. This work aims to give a better understanding of the Ligurian geoheritage, its relationship with the geological and geomorphological context, and the framework of protected areas. Thus, the present map can be a useful tool for developing effective geoheritage management and enhancement strategies.

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Geosites; geological landscapes; geoheritage mapping; Liguria; geodiversity

1. Introduction

Recent global trends have shown an increasing interest and appreciation of geoheritage both by the scientific community and by society in different contexts (e.g. geoconservation, geotourism, geoparks), as shown by the vast amount of scientific literature in topics related to geoheritage (e.g. Brocx & Semeniuk, 2007; Gray, 2013; Reynard & Brilha, 2018 and reference therein). Despite the static and museographic view through which geosites are often perceived by society, these geological resources are fragile and sensitive to human and natural disturbance (Brooks, 2013; Fuertes-Gutiérrez et al., 2016; García-Ortiz et al., 2014; Selmi et al., 2022) and therefore their conservation and management are challenging (Crofts et al., 2020; Németh et al., 2021; Prosser et al., 2006; Vereb et al., 2020; Wignall et al., 2018). In this perspective, the correct understanding of a territory and the mapping of its physical and geological characters and its geoheritage, will benefit from effective lasting-in-time territorial planning, management, geoconservation and enhancement strategies. In this perspective thematic maps are a strong scientific and dynamic source of information and can be considered as useful tools of both scientific and practical significance (Coratza et al., 2021 and reference therein). Despite the great abundance of thematic maps concerning geosites, especially in the geoheritage promotion, nevertheless, there are still few cartographic documents which combines geosites location and boundaries and their geological and geomorphological context.

Liguria is one of the smallest Italian regions, and it's characterized by a rich cultural and natural heritage, usually exploited as a resource for the growing development of mass tourism, mainly concentrated in the coastal belt (e.g. Callegari, 2003; Peira et al., 2021). Moreover, recent research has clearly demonstrated that Liguria is characterized by rich geodiversity (Ferrando et al., 2021a) and valuable geoheritage (Ferrando et al., 2021b), that together with the esthetic value of the geological landscape, may be considered a key resource for sustainable development of both inland and coastal areas. However, the region, due to its complex geological and physiographical settings and the intense urban sprawl, is also affected by a high geo-hydrological hazards (e.g. Paliaga et al., 2019; Raso et al., 2021), that can threaten both geoheritage elements and visitors or the community of the region.

Starting from these premises, the research introduces the Geosites and Geological Landscape map of the Liguria region. The map represents in a single cartographic document the 120 geosites inventoried and approved by the regional and national authority and the geological landscape units, characterized by the presence of specific lithological units and particular geomorphological features. This document aims to contribute to better framing geoheritage within its

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geological and geomorphological context at regional scale, providing a support for the effective development of both management and enhancement activities.

2. General setting

2.1. Geography

The Liguria region (Figure 1) is located in Northwestern Italy. On the south it faces the Ligurian Sea, part of the Mediterranean Sea; on the east, it is bordered by Tuscany, on the north by the Piedmont and Emilia-Romagna regions, while on the west it is bordered by France.

The Ligurian land is mainly mountainous, with an arch-shaped mountain chain constituted by the Ligurian Alps in the west and the Ligurian Apennines in the east. The highest peaks of the mountain chain are located in the western part of the region (Mt. Saccarello, 2201 m) and in the eastern part (Mt. Maggiorasca, 1804 m). In the central part of the region, the mountains are lower and are separated by very low cols (Cadibona Pass, Giovi Pass) between 400 and 500 m in elevation.

The Alpine-Apennine mountain chain is the watershed between the Ligurian Sea and the Po River basin. The watershed is very close to the Ligurian Sea, reaching a 5 km distance from the coastline. The maritime side of the mountain chain is thus very narrow, with short and steep valleys. The northern side of the mountains, facing the Po river basin, is very different, with longer valleys and gentler slopes.

The region is characterized by a Mediterranean climate. Because of the rugged morphology of Liguria, the climate has some notable variations at the regional scale. In the mountain areas the climate can be classified as cool-temperate, while the coastal zone is hot-temperate. The climate of the northern side of the Ligurian Alps and Apennines can be classified as subcontinental (Fratianni & Acquaotta, 2017).

2.2. Geology

Liguria is a geologically complex region, lying at the junction between the Alpine and the Apennine orogenic systems (Figure 2). The junction between the two systems occurs in a 100-km wide area in the central part of the region, sometimes called the 'Ligurian Knot' (Laubscher et al., 1992; Molli et al., 2010; Mosca et al., 2010).

The Ligurian Alps' main tectonic units (see Cortesogno & Vanossi, 1984) are:

Ligurian-Piedmont units: These units are composed of a Jurassic oceanic lithosphere (made of serpentinites, metagabbros and metabasalts) and a metasedimentary cover consisting mainly of calcschists. The metamorphic peak conditions are either in eclogite or in blueschists facies.

Prepiedmont units: They are composed of a continental crust basement, with gneiss and amphibolites, and a Jurassic-Cretaceous sedimentary cover ascribable to a sinking external continental margin, made of quartzites, dolomites, limestones and flyschs. Peak metamorphic conditions are in green-schist facies.

Briançonnais units: They are similar to the Prepiedmontese Units, but belong to a more internal part of the ancient continental margin.

Dauphinois-Provençal foreland: Part of the Provençal sedimentary sequence outcrops in the westernmost part of Liguria, with marls, limestones and sandstones.

Western Ligurian flysch units: These non-metamorphic units occupy the highest structural position in the Ligurian Alps' thrust belt. The sedimentary sequence is composed by Cretaceous pelite, sandstone and marly-limestone flysch.

In the Ligurian Apennines the main tectonic units are (see Elter & Marroni, 1991):

Ligurian units: They comprise an ophiolitic sequence overlain by deep-sea sediments (cherts, limestones and claystones) and flysch. In the Internal Ligurian Units, ophiolites form the basement of the sedimentary series. In the External Ligurian Units there is no basement, and ophiolites are found as olistholites in the sedimentary formations.

Subligurian units: These units are composed mainly of Palaeogene marly-limestone and sandstone flysch.

Tuscan units: The Tuscan sedimentary series spans from Triassic to Oligocene; the oldest rocks are dolomites and limestones, while the youngest are claystones and the 'Macigno' sandstones.

Post-orogenic sedimentary rocks are found in the central and western part of the region: (i) the Oligocene conglomerates, marls and sandstones form the Tertiary Piedmontese Basin, near the border with the Piedmont region; (ii) Miocene limestones outcrop in the Finale Ligure hinterland; (iii) Pliocene claystones and conglomerates are found in grabens near the Ligurian coast from the French border to Genoa.

2.3. Geomorphology

The region is characterized by a wide geomorphological variety related to its physiographical and geological complexity. Liguria is a very rugged, mountainous region (Figure 1). Slope gradient is generally medium-to-high; higher values are seen in the maritime side of the Alpine-Apennine mountain chain, while the northern side tends to be gentler. This determines

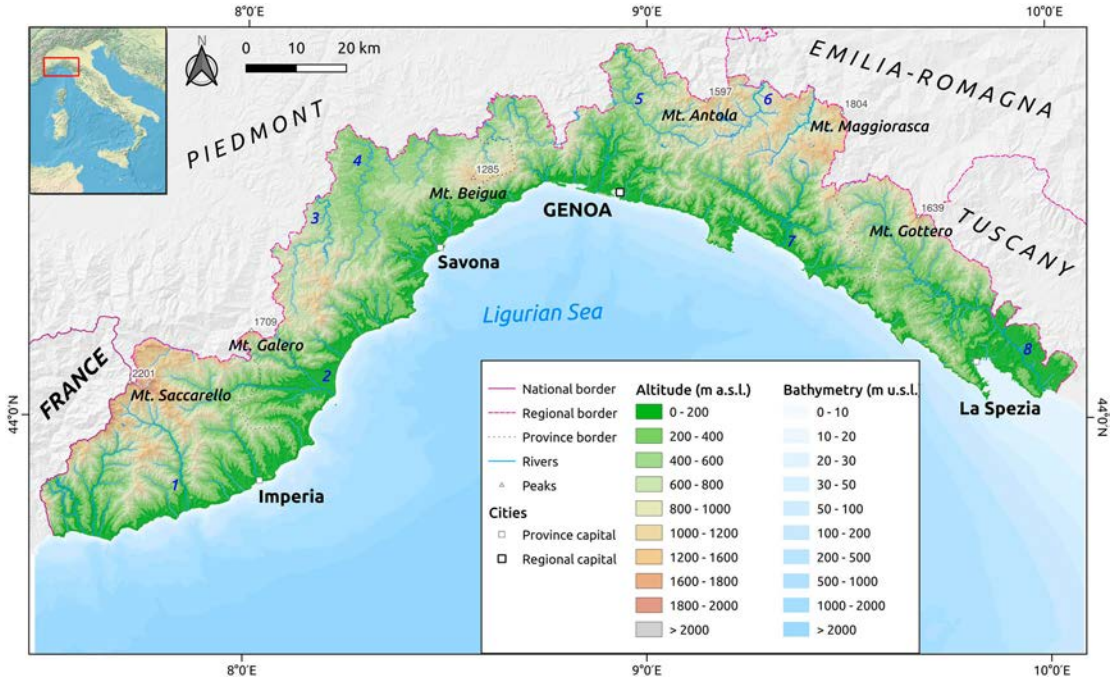

Figure 1. Physical geographic map of the Liguria region. Rivers: (1) Argentina; (2) Centa; (3) Bormida di Millesimo; (4) Bormida di Spigno; (5) Scrivia; (6) Trebbia; (7) Entella; (8) Magra.

the presence of many slope phenomena, landslides and DSGDs; as many as 13,500 landslides have been surveyed and cataloged (IFFI project; https://www.isprambiente.gov.it/it/progetti/cartella-progetti-in-corso/suolo-e-territorio-1/iffi-inventario-dei-fenomeni-franosi-in-italia), and related landforms are evident. Small floodplains are found in the coastal area, near the mouths of the main watercourses.

The main tectonic lineaments influence both the hydrographic network and the coastline. The river courses are mainly perpendicular or parallel to the main watershed, while the coastline is subparallel to the main watershed. The signs of recent tectonic activity are evident on the hydrographical network and on its related landforms, like entrenched meanders, fluvial captures, hanging valleys, relict terraces and surfaces (Fanucci & Nosengo, 1977).

The coast is mainly high and rocky, with cliffs that in some places are more than 300 m high. Rocky promontories are separated by small bays with gravelly pocket beaches. The coastal plains are characterized by sandy-gravelly beaches (Mastronuzzi et al., 2017).

Karst landforms are present at the main limestone and dolostone outcrops: the most important are in the Savona province, between Finale Ligure and Mt. Carmo, and in the vicinities of La Spezia. More than 2000 caves have been surveyed, but only 15 of them exceed 1 km in length (Gestionale Speleologico Ligure, https://www.catastogrotte.net/liguria/index.php).

Relict periglacial landforms (e.g. block fields, block streams, wetlands) are found in mountain areas like the Beigua massif and the Aveto valley; in some cases, the original periglacial landforms are then modified by gravitational slope processes (Faccini et al., 2012). On the highest ridges of the Ligurian Alps, relict glacial cirques can be seen, but they are rather small and poorly conserved.

The coastal strip is heavily urbanized, with effects on fluvial processes (the water courses being embanked or channelized) and coastal processes (affected by the presence of ports and other structures, and by artificial beach nourishment; Corradi et al., 1994). More ancient human landforms are stone wall terraces, built for agriculture, which are widespread in the hilly and low mountain areas of the region (Paliaga et al., 2020).

3. Materials and methods

The 1:250,000 Geosites and Geological landscape map of the Liguria Region was based on geological and geomorphological analysis and interpretation of the following data, acquired by available databases of regional and national relevance:

- DTM of the Liguria region, with 5 × 5 m cell size (https://geoportal.regione.liguria.it/). Out of the Ligurian borders, the shaded relief is provided by the Tinitaly DEM (Tarquini et al., 2007; link to the resource: http://tinitaly.pi.ingv.it/Download_Area2.html).
- Base features in vector format: administrative boundaries, infrastructures, hydrographic network, lakes, main peaks, cities and towns. For what concerns cities and towns, only those with more than 10,000 inhabitants are shown (https://geoportal.

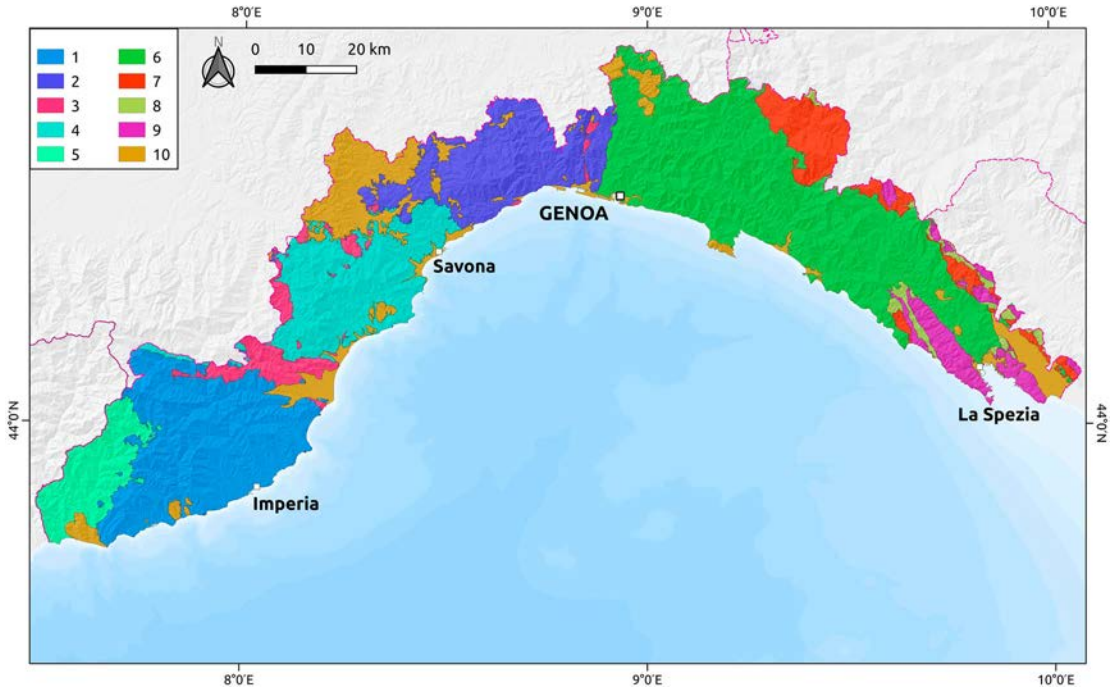

Figure 2. Geological sketch map of the Liguria region (after Giammarino et al., 2002). (1) Western Ligurian flysch units; (2) Ligurian-Piedmont units; (3) Prepiedmont units; (4) Briançonnais units; (5) Dauphinois-Provençal foreland; (6) Internal Ligurian units; (7) External Ligurian units; (8) Subligurian units; (9) Tuscan units; (10) Post-orogenic sediments.

regione.liguria.it/). The base features are derived from the topographic database of the 1:5000 Ligurian Regional Technical Map.

- Protected areas of the Liguria region in vector format, scale 1:10,000: national parks and reserves, regional natural parks and marine protected areas (https://geoportal.regione.liguria.it/).
- Lithological map of the Liguria Region in vector format (https://geoportal.regione.liguria.it/). It is derived from the 1:50,000 geological maps of Italy, made by the ISPRA (Superior Institute for Ambiental Protection and Research) as part of the CARG project.
- Inventory of Landslide Phenomena in Italy (IFFI project; https://www.isprambiente.gov.it/it/progetti/cartella-progetti-in-corso/suolo-e-territorio-1/iffi-inventario-dei-fenomeni-franosi-in-italia) in vector format, scale 1:10,000.
- Geosites in vector format, scale 1:10,000. Geosites were derived from the inventory made by Ferrando et al. 2021b, in course of approval by the Liguria Region.
- Cave entrances in vector format. These data were derived from the 'Gestionale Speleologico Ligure' (https://www.catastogrotte.net/liguria/index.php), which surveyed the regional caves at 1:10,000 scale.

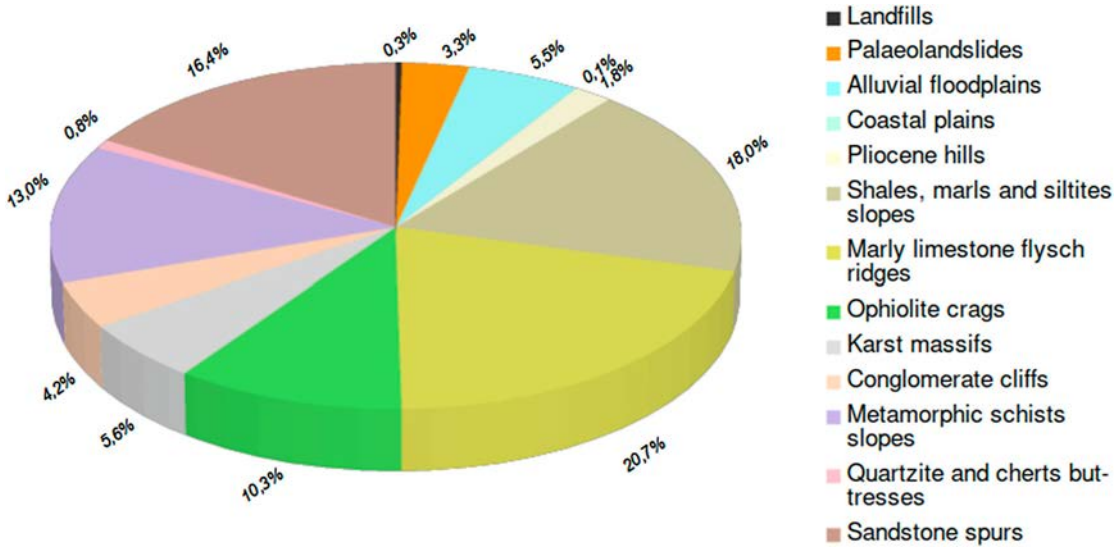

Figure 3. Flow chart of the methodological approach for the production of the Map.

The workflow in Figure 3 summarizes the different steps of the methodological process used for map design. The map was produced draping on a shaded relief base in a GIS environment (QGIS) the geological landscape, geosites and caves and protected areas of the Liguria region.

The geological landscape was derived, through simplification and integration, from the lithological map of the Liguria Region in vector format and from the Inventory of Landslide Phenomena in Italy for what concern the landslides. The IFFI vector map has a scale of 1:10,000, so not all landslides could be represented on the Main Map. Taking into account the scale of the Main Map, a filter has been applied to show only the landslides with area greater than 250,000 m^2. The lithologies were reclassified in macro-units, reflecting the different landscapes that can be observed on the regional territory. Lithological units were represented in solid colors, while landslides and landfills were represented with patterns.

Geosites have been divided in three vector layers, comprising areal, linear and point geosites. Point geosites are represented as small red circles, linear geosites are represented as red lines, and areal geosites are represented as polygons with red contours and transparent fill. On the Main Map, the ID number of each geosite is reported.

Concerning caves, since the regional inventory includes more than 2000 caves, the feature had to be filtered: it was decided to represent only the caves longer than 500 m. Caves were represented as small black crosses.

Protected areas have been categorized in national parks, regional parks, local protected areas and marine protected areas. The borders of national parks, regional parks and local protected areas are represented as dashed lines in different shades of green. The borders of marine protected areas are shown as light blue dashed lines.

On the bottom of the Main Map four thematic regional sketch maps are reported: (1) elevation map, obtained by simple thematization of the regional DTM; (2) aspect map, derived from the same DTM by means of the aspect QGIS algorithm; (3) slope gradient map, obtained from the DTM with the slope gradient QGIS algorithm; (4) geodiversity map, as computed by Ferrando et al. (2021a).

4. Results: geosites and geological landscape map

The Map reports all relevant geosites and the geological landscape units of the Liguria region, emphasizing the strict relationship between geology and landscape and showing how different rock masses produce several landforms of outstanding natural beauty in the Ligurian area.

4.1. Geological landscape units

By combining lithological and geomorphological data, 12 macro-units, aptly called 'geological landscape units' have been identified. Each unit is characterized by a specific lithology, or a group of lithologies, which give way to particular geomorphological features and landscapes. In Figure 4 the areal extension of these macro-units is shown.

Landfills: These are mainly the sea embankments that characterize the waterfront of Genoa, and to a lesser extent La Spezia, Sanremo, Imperia, Vado Ligure-Savona and Chiavari-Lavagna.

Palaeolandslides: The hilly-mountainous landscape of Liguria is marked by ancient and relict landslides, easily recognizable by the change in angle that characterizes the main body. Over the centuries, these landslides, often reactivated, have been chosen as sites for settlements because they are sub-planar areas with workable agricultural soil and water availability.

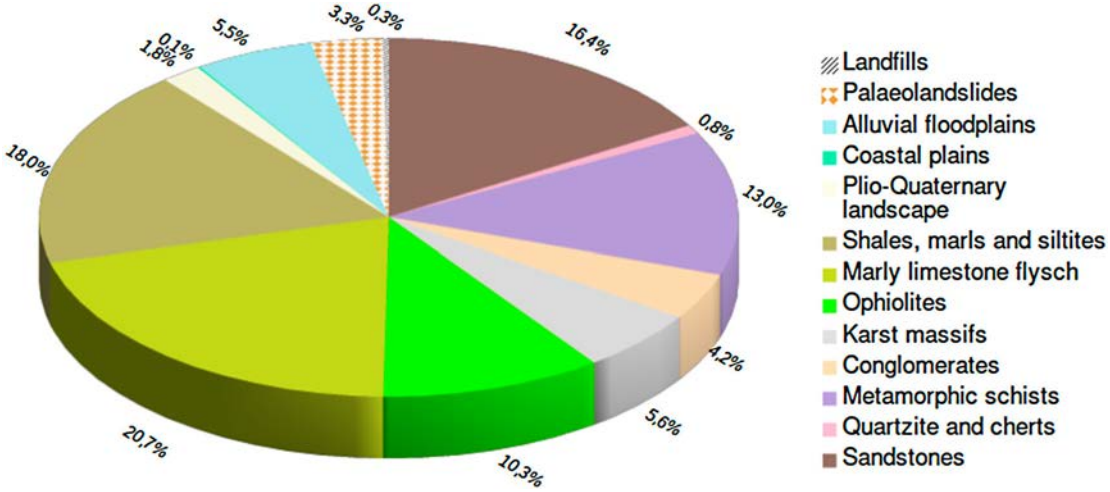

Figure 4. Areal extension of the geological landscapes units (% of the total Ligurian area).

Alluvial floodplains: The region features narrow floodplains, chosen since historical times as preferential areas for settlement (Luino et al., 2019): the main cities of Liguria are built on the coastal floodplains, nowadays urbanized and characterized by important anthropogenic transformations such as soil sealing, narrowing, culverting and deviation of riverbeds.

Coastal plains: The Ligurian coastal plains characterize the landscape on the sea front as they are intermeshed with high rocky cliffs. Many coastal plains have been transformed over time, especially since the second half of the nineteenth century, into embankments and port areas. Beaches of significant extension, although with evident anthropic transformations, can be observed at the mouths of major watercourses such as the Entella, Centa, Magra and Roja.

Pliocene hills: In the coastal area between Genoa and Ventimiglia and on the border with Tuscany, the Pliocene landscape can be appreciated. The Pliocene marls landscape is characterized by extremely gentle slopes. Significant outcrops of Pliocene marls can be found on the border with France and in the hinterland of the Albenga floodplain, where badlands morphologies can also be recognized. A particular case is represented by the historic center of Genoa, declared a UNESCO World Heritage Site in 2006: a horst-graben structure can be recognized, with Pliocene marls filling the lower parts (Faccini et al., 2021).

Shales, marls and siltites slopes: The landscape of shales and marls is easily readable from the gentle morphology of the slopes. Outcrops are limited as they are covered by debris of differing thickness and origin, often modeled by terraces with dry-stone walls. Significant examples of this landscape can be observed in the Entella river catchment and in western Liguria, where the slates have historically been subject of quarrying activity.

Marly limestone flysch ridges: Heterogeneous rock masses characterized by calcareous marls, marly limestones with shales and siltstones interlayers abundantly characterize the western and central Ligurian sector. The rock mass offers good resistance to erosion, resulting in moderately steep slopes that reach significant heights such as Monte Saccarello.

Ophiolite crags: The geological landscape of the ophiolites is one of the most exciting in Liguria as it shows denudated slopes and extensive outcrops of the bedrock. Beigua Geopark and Aveto regional park have their greatest interest in the presence of ophiolites. In the Ligurian-Emilian Apennines, especially in the domain of the External Ligurian Units, the ophiolites are detached from the original basement and stacked inside sedimentary flysch. This gives way to a highly characteristic landscape, where the rocky, steep and bare ophiolitic crags contrast with the gentler and rounded slopes formed by flysch.

Karst massifs: Liguria has significant karst massifs, spread throughout the region. The Finalese plateau, rich in epigean and hypogean karst landforms, is probably the most characteristic area. Another karst massif known at international level is the Mt. Carmo area, where the longest caves in Liguria are located, and the La Spezia area.

Conglomerate cliffs: The landscape of the Ligurian conglomerate is very peculiar as it shows rock towers and vertical cliffs. Extremely significant conglomerate outcrops characterize the Portofino Promontory (Faccini et al., 2018), the upper Scrivia Valley (Sacchini et al., 2016), the coastal strip between Albisola and Varazze, the upper Bormida Valley and the Gargassa Valley in the Beigua Global Geopark.

Metamorphic schists slopes: They represent the geological landscape of the central-eastern sector of the region and are characterized by calcschists, phyllites, porphyroids, gneiss and micaschists. These rock masses are of interest because they record numerous deformation phases and characterize areas of geological significance such as the Sestri-Voltaggio area, the Voltri tectono-metamorphic unit and the Paleozoic formations in the Savona area.

Quartzite and cherts buttresses: These rock masses, although limited to small hinterland areas, are interesting because they feature high resistance to erosion and therefore show buttresses that stand out in the hinterland valleys. Among the most significant examples are the cherts of the Ligurian Apennines, where several Manganese mining sites have been opened over time (Brandolini et al., 2007).

Sandstone spurs: The sandstone flysch landscape characterizes the Cinque Terre National Park, the coastal strip between Chiavari and Levanto, a large part of the Entella river catchment area and then the Aveto Park, as well as the extreme west of the region. A characteristic feature of the Ligurian sandstone landscape is the steep slopes that often show the tectonic and structural geology of the formation.

4.2. Geosites and protected areas

An extensive survey of the rich geological heritage of the Liguria region led to the identification of 120 geosites, classified in a scientific database (Ferrando et al., 2021b; Figure 5). Geosites were quantitatively assessed on the basis of criteria such as scientific value, additional esthetic, cultural and historical values and potential for use. This activity led to the inclusion of the Ligurian geosites in the National Inventory of Geosites coordinated by ISPRA, which is the official inventory of geosites in Italy. The geosites have been distinguished by interest, different geothematic categories, altitude, according to the proposal of enhancement.

Figure 5. Outstanding geosites in Liguria: (a) Piana Crixia 'stone mushroom;' (b) Edera Cave; (c) Cliffs of Portovenere; (d) Castello della Pietra; (e) Peridotite spheroids of Lago dei Gulli; (f) Arroscia waterfalls.

The majority of geosites are located in ophiolitic rock masses (24%) and karst massifs (22%). Other significant geological domains are on conglomerate and marly limestone flysch and on the landscape of ancient and relict landslides. The primary interest of half of the surveyed geosites (50.8%) is linked to geomorphology, to a lesser extent to geology, mineralogy and petrography, and applied geology. The Ligurian geosites are fairly well distributed in all the altitude ranges analyzed: although the relative majority of them lie between 0 and 300 m (39%), an appreciable number of geosites is found between 1000 and 1500 m a.s.l. (12%) and above 1500 m a.s.l. (5%). Geosites are well distributed between the four Ligurian provinces: the two largest provinces (Genoa metropolitan city and Savona province) have respectively 39% and 30% of the surveyed provinces, while the two littler provinces show littler percentages (18% and 13% for Imperia and La Spezia respectively). Among the more than 2000 caves surveyed by the Ligurian Speleological Delegation, seven are considered geosites for their striking geomorphological and hydrogeological features. The Toirano Caves and the Valdemino Cave can be visited in guided tours, and are among the most well-known touristic caves in Italy; as such, they are very significant for geotourism.

Liguria's biodiversity and geodiversity (Ferrando et al., 2021a, 2021b) are recognized in many areas established under the Natura 2000 Habitats Directive and in more than 20 protected areas, including national parks and minor reserves. The geological setting always represents a significant component of the protected areas: the geological and geomorphological landscape of the Cinque Terre and Portofino National Parks is internationally recognized. As already mentioned, the Aveto and Beigua regional parks are primarily concerned with the ophiolite bedrock, while the Portovenere, Alpi Liguri and Montemarcello Magra-Vara regional parks are characterized by limestone and dolomite massifs. The Piana Crixia Park protects the characteristic 'Stone Mushroom,' the Rio Torsero contains a wealth of fossils and Bric Tana and Bergeggi have karst environments. The Antola Park presents in the conglomeratic buttress of

the Castello della Pietra the synthesis of cultural and landscape value, as well as the Parco delle Mura (Genoa Walls Urban Park) in Genoa (Sacchini et al., 2018).

5. Conclusions

The Geosites and Geological landscape map of Liguria represents a first cartographic contribution at the regional level regarding the relationships between geology and landscapes. It's meant to be a friendly tool to highlight the richness and diversity of the geoheritage that characterize the region, providing an innovative and useful tool both for sustainable environmental management and for enhancement of geoheritage. In Liguria, the Regional Inventory of Geosites, established by the Ligurian regional law (L.R. 39/2009) has been used to help identify sites which deserve protection and enhancement. In this process of geoheritage management, framing geosites within the wider geological landscape context makes its management, conservation and enhancement much more likely and relevant to public policy and planning. In fact, understanding the different earth materials which form the landscape, and the processes responsible in shaping various landforms, their assemblage and evolution, and the relationship with geosites, it is crucial tool for enhancing public awareness on geological landscape, geoheritage and geotourism as well as a tool in future safe and lasting-in-time development planning of this territory.

Further research is required to investigate the relationship between geology and landscape. Detailed studies can be dedicated to protected areas: national and regional parks, natural reserves and special protection areas of the Natura 2000 network, which can give insights on links between geodiversity and biodiversity.

Software

All data processing and the designing of the map layout were carried out with the free and open-source software QGIS.

Disclosure statement

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

Data availability statement

The authors confirm that the data supporting the findings of this study are available within the article (Section 3: Materials and Methods).

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Geosites and geological landscape of Liguria (Italy)

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irpi Istituto di Ricerca per la Protezione Idrogeologica

UNIMORE Università degli Studi di Modena e Reggio Emilia

Peak
Mountain pass
Lake
Hydrographic network
Cave
Province
Photograph location

Cities
Region capital
Province capital
Towns
>10.000 inhabitants
5.000-10.000 inhabitants

Roads
Motorway
Primary Road
Railroads
Railroad
Railroad tunnel
Geosites
Areal geosite
Linear geosite

Point geosite
12 Geosite code
Protected areas
National Park
Regional Park
Local protected area
Marine protected area
12 Protected area code

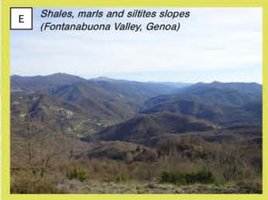
A *Palaeolandslides (Cento Croci Pass, Varese Ligure, La Spezia)*

B *Alluvial floodplains (Luni, la Spezia)*

C *Coastal plains (Borgio-Verezzi, Savona)*

D *Pliocene Hills (Terre Bianche Badlands, Camporosso, Imperia)*

E *Shales, marls and siltites slopes (Fontanabuona Valley, Genoa)*



Geological landscape units

- Landfills
- Palaeolandslides
- Alluvial floodplains
- Coastal plains
- Pliocene hills
- Shales, marls and siltites slopes
- Marly limestone flysch ridges
- Ophiolite crags
- Karst massifs
- Conglomerate cliffs
- Metamorphic schists slopes
- Quartzite and cherts buttresses
- Sandstone spurs

The colour of the frames of the pictures correspond to the colour of the depicted geological landscape unit.

F *Marly-limestone flysch ridges (Mt. Fasce, Genoa)*

G *Ophiolite crags (Mt. Argentea, Arenzano, Genoa)*

H *Karst massifs (Bric Pianarella, Finale Ligure, Savona)*

I *Conglomerate cliffs (Rocche del Reopasso, Crocefieschi, Genoa)*

J *Metamorphic schist slopes (Rocca dei Corvi, Vado Ligure, Savona)*

K *Quartzite and cherst buttresses (Molinello Mine, Ne, Genoa)*

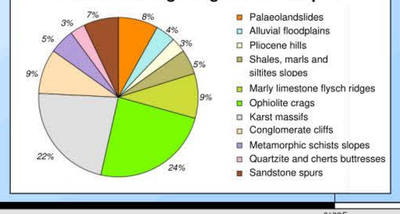
L *Sandstone spurs (Mt. Ramaceto, San Colombano Certenoli, Genoa)*

PROTECTED AREAS

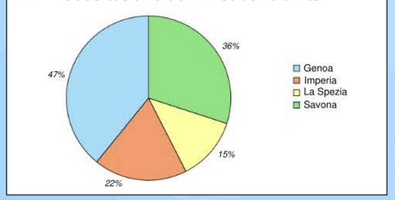
CODE	NAME
1	Isola Gallinara Natural Reserve
2	Rio Torsero Natural Reserve
3	Bergeggi Natural Reserve
4	Bric Tana Natural Regional Park
5	Piana Crixia Natural Regional Park
6	Beigua Natural Regional Park
7	Antola Natural Regional Park
8	Portofino National Park
9	Aveto Natural Regional Park
10	Porto Venere Natural Regional Park
11	Montemarcello-Magra-Vara Natural Regional Park
13	Giardini Botanici Hanbury Protected Area
14	Cinque Terre National Park
15	Alpi Liguri Natural Regional Park
16	Portofino Marine Protected Area
17	Cinque Terre Marine Protected Area
18	Isola di Bergeggi Marine Protected Area
19	Agoraie di Sopra-Moggetto Natural Reserve
20	Parco delle Mura Protected Area

	Geosites (%)
Natural Parks	33
Natura 2000 Areas	65

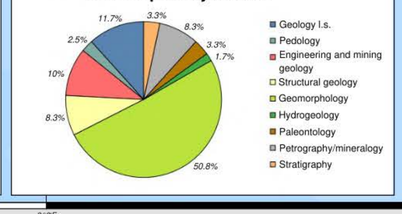
Geosites and geological landscapes



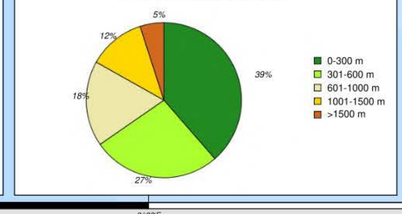
Geosites and administrative units



Geosite primary interest



Geosites and altitude



Coordinate system: EPSG 4326 - WGS84