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REVIEW ARTICLE

A geotouristic proposal for Amendolara territory (northern ionic sector of Calabria, Italy)

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Abstract The Calabria Region is one of the most interesting areas in the world for the extraordinary variety of structural and geomorphologic configurations, an interest which reflects primarily the complex geological processes that characterise it. Moreover, in the Amendolara, geological resources represent both scientific and cultural values and together define the geodiversity significance of this territory. Such geological resources therefore represent an important part of the cultural component because they are connected to historical events. On-site and photo-aerial investigations were carried out in the Amendolara area, allowing us to develop a thematic map in which the "geomorphologic memory places" could be identified. These were divided into geosites (typically geological and geomorphological sites) and geoarchaeological sites (the "Hermit caves" specifically). All geosites were identified, mapped and described in conformance with the "Italian geosites inventory method". The adoption of a GIS software system allowed us to both obtain a geotourism map as a final output and integrate potential environmental factors as these represent a significant added value to social structures in the area. A conceptual geotourism route has been developed which will contribute to and provide a framework for the development of eco-sustainable tourism. This route commences with the oldest lithologies and geological features, and continues down slope towards coastal areas which are characterised by the earliest record of human interactions in the territory. This linear trail design is preferred to a loop trail as it provides better continuity between morpho-geological and historical features. The route is very simple for visitors as it follows the course of main roads and the beginning, the intermediate stops and the end all correspond to well-known places. This proposal offers a useful support to planning-management decision-making processes, as the destruction of "geomorphologic–geoarchaeologic monuments" would result in an enormous loss to future generations.

Keywords Geologic heritage · Cultural geomorphology · Cave · GIS

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Introduction

The paper contributes to the evolution of the "cultural geology" concept, a discipline which integrates geodiversity (Sharples 1993; Dixon 1996; Zwolinski 2004) and "geohistory" (Panizza and Piacente 2003). Indeed, to fully understand the evolution of a territory in all of its cultural diversity, it is necessary to evaluate the relationship between all historical and geomorphological components as part of an integrated process. Studies focussed upon enhancement of geological heritage first appear in the scientific literature of the UK and the USA (Fines 1968; Linton 1968; Leopold 1969).

Comparable efforts to protect geodiversity in Italy commenced in the 1960s (Nangeroni 1968), especially in the regions of Emilia Romagna, Liguria, Marche, Abruzzo, Lazio and Sardinia. In Calabria, however, a region which contains a considerable wealth of geological monuments, a lack of scientific interest in its geodiversity probably reflects both limited knowledge and awareness of these resources, as well as a lack of appropriate protection legislation. This study seeks to redress this knowledge deficit by identifying the extent of geodiversity resources, assessing their heritage and geotourism value and developing actions to heighten public awareness of the resources.

The study sought to identify all those places which conform to the definition of "cultural geological–geomorphological interest" places worthy of conservation (Wimbledon et al. 1996) and then seek to promote their protection for the benefit of future generations. A list of all potential sites was compiled, as was the identification of geoarchaeological sites which combine both natural and human historical features.

This process involved extensive bibliographic research, construction of a digital elevation model (DEM) from a 1:5,000 scale topographic map, and photo-interpretation and construction of a geomorphological map to provide a template for field research. Information about geological sites identified during this process was uploaded into a GIS database from which the geotourism map was produced. This approach is necessary in this area because the interesting geological characteristics provide an additional context to the record of different civilizations, from the Neolithic period through the "Metals", Classical, Roman, Byzantine and Mediaeval times, right up to the present day (Laviola 1971).

It is considered that this proposal will help to develop a wider knowledge of the geology and geodiversity of the area, particularly through the innovative inclusion of the human dimension, and overall contribute to sustainability, especially in the context of territorial planning, as declared in the "European Manifesto on Geological Heritage and Geodiversity" (Panizza and Piacente 2003).

Geology

The geology of northern Calabria is characterised mainly by granitic, metamorphic (low and high grade) and ophiolitic rocks that structurally overlie sedimentary terrains of the "Apennine Chain (Amodio Morelli et al. 1976). This area borders the Pollino Massif, formed of Meso-Cenozoic carbonate rocks, and it also contains Quaternary basins filled with both marine and continental sediments. At present, the region is subject to intense geodynamic activity as well as widespread landslides, high erosion rates and by earthquakes that have affected the region repeatedly in the past (Guerra and Moretti 1994). The northern sector of Calabria provides an excellent example of an area where it is possible to document the importance of normal faults propagated by large-scale gravitational processes developed by a regional tilt towards the Bradanic Trough (Bentivenga et al. 2004).

At macro- and meso-scale, the border of the Calabria and Lucania regions is affected by sub-vertical left-slip faults which strike WNW–ESE N (120–130°) and which were active up to the Middle Pleistocene (Sorriso Valvo and Tansi 1996). These tectonic structures upfaulted the Mesozoic carbonate sequences into Ligurian units. The composition of Quaternary deposits reflects the complex deformation history of the area (Iovine and Merenda 1996), in particular the reorganization of pre-existing tectonogenetic configurations by Plio-Quaternary brittle tectonics (Schiattarella 1998). Evidence for the Pleistocene uplift of the Ionian coast of Calabria is best reflected by the analysis of sequences of marine terraces and their relationship with glacioeustatic sea-level high stands to calculate uplift rates (Carobene 2003). In a southern sector of Amendolara, the uplift rates, calculated for each order of terrace, range between 0.5 and 1 mm/year. The terrace study demonstrates that regional, continuous uplift occurred in the study area during the late Quaternary, with a significant pulse of uplift in the western sector during the Late Pleistocene (Robustelli et al. 2008).

Various rock types, in particular marine and continental sedimentary lithotypes, are exposed in Amendolara, which is located in the north-east part of the Calabria region (Fig. 1a, b). The oldest rocks are of lower Miocene age: limestone–clayey complex and the turbidite (flysch) clayey–limestone complex (Fig. 2a). These are overlain by turbiditic (flysch) arenaceous marly rocks of lower-middle Miocene age (Fig. 2b), late Pliocene grey-blue silty clay with poorly cemented yellow sand above (Fig. 3a) and Pleistocene age polygenic conglomerates (Fig. 3b). Holocene deposits include river bed sediments; landslide debris; and alluvial fan, coast and dune deposits.

Methodology

All landscape forms were surveyed and mapped on a scale of 1:10,000 and all surveyed geomorphological features compared with interpretation of air-photo coverage provided by two aerial surveys: IGM 1955 (scale 1:33,000 and "Flight of Calabria", 2001 (mixed flight scale). This comparison has been particularly useful for assessing the activity of some forms in order to estimate, on a temporal range of 50 years, the evolutionary trends in different geomorphological sectors. These results were combined with bibliographical research, photo-interpretation and survey on site, to produce a geomorphological map. All data were managed through ArcGIS 9.2 that accommodated production of a DEM and a TIN (Triangular Irregular Network) derived from the 1:5,000 scale "Carta tecnica regionale". The field research identified the presence of particular landscape forms which, combined with bibliographic research, contributed to the development of a methodology most appropriate for this type of research. A

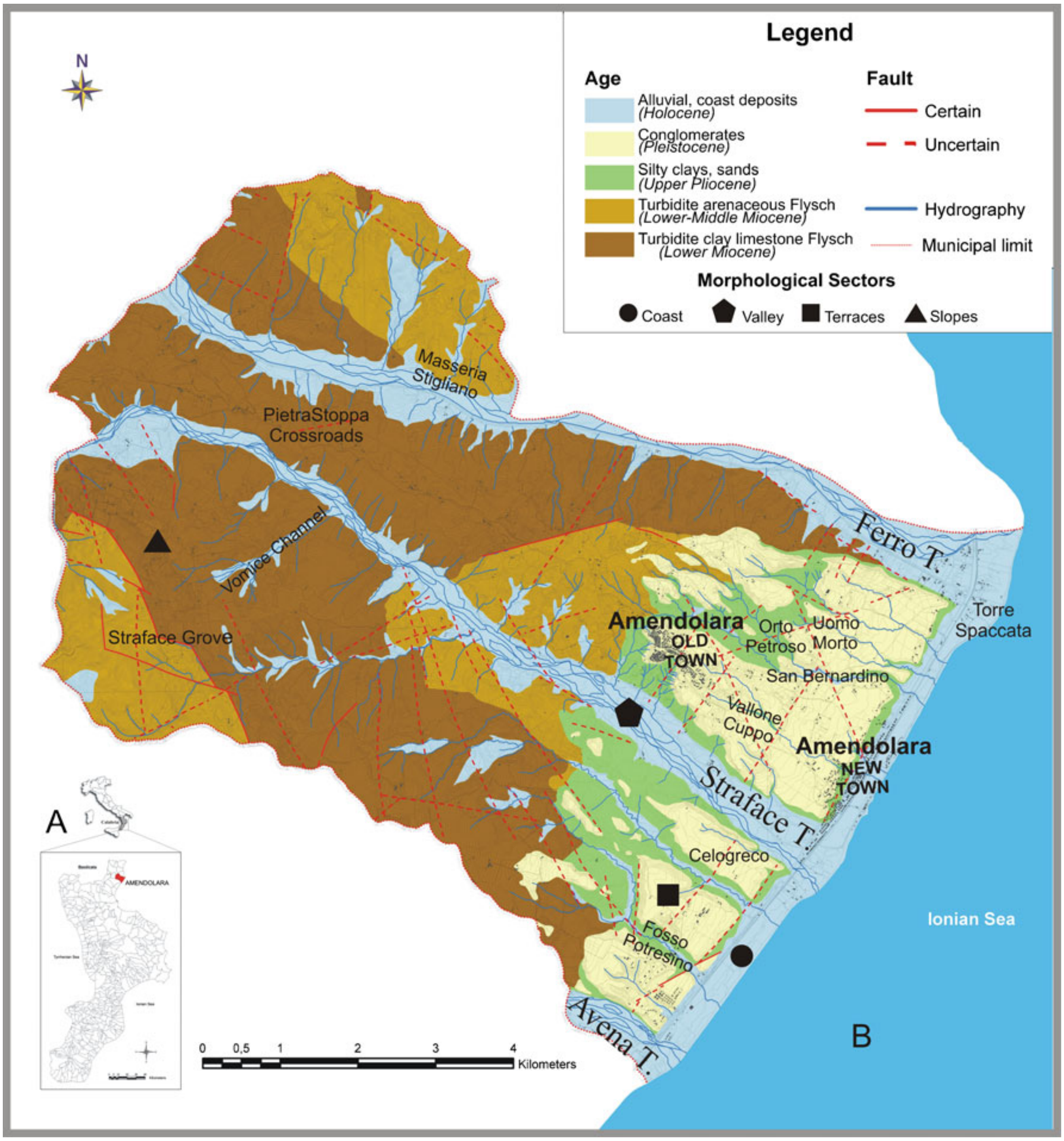

Fig. 1 *A* Geographical location, *B* geological map of Amendolara area. Three fault systems are recognised in the area. The first is represented by thrust faults which strike NW–SE, and the second set by WNW–ESE striking slip fault

further step involved the development of a slope gradient map for the entire municipality, in which six gradient classes are defined (0–10%, 10–20%, 20–35%, 35–50%, 50–80% and >80%).

An "Experimental card for the Italian geosite inventory" was completed for each site and, in each case, contained all the information necessary to define and make a qualitative assessment of the geological context of each object. The data recorded on each card also facilitated incorporation of geological site information into the national database, thereby making it more easily accessible and updatable (http://sgi2.isprambiente.it/geositi/).

The next stage was to create a conceptual geotourism route to reflect and represent the

- evolutionary history of the landscape and archaeological heritage;
- location of geological sites and geoarchaeosites.

We define "places of geology" as those objects which have geological characteristics of rarity and uniqueness. However, the geoarchaeological sites are particular forms of the landscape which contain additional evidence of human interaction with any given feature. Finally a geotourism map was designed to present an alternative type of route

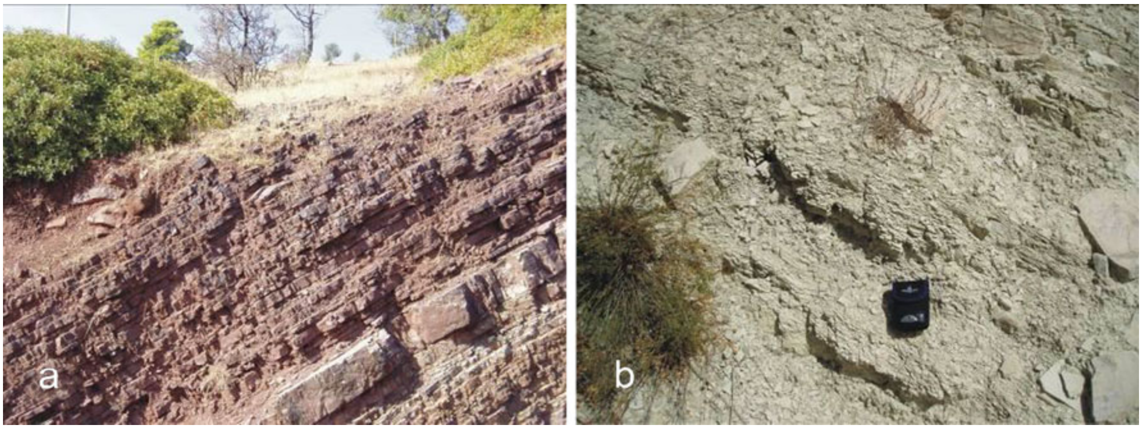

Fig. 2 **a** Limestone–clayey complex, and **b** arenaceous marly rocks (Crossroads Pietra Stoppa locality). The third group consists of NS to NNE–SSW to ENE–WSW striking faults which define an arcuate pattern that mimics the present day coastline (Bentivenga et al. 2004)

specifically to advance understanding of the geodiversity of this area. The overall objective of this work was clearly tied to two basic principles: (1) adoption of a multidisciplinary approach during the compilation and classification of sites, and (2) processing of different maps with ArcGIS 9.2 to map and query, in a dynamic way, all data including detailed information about characteristics, location and accessibility to places and features (faults, folds, geomorphology, natural cavities, significant panoramic points, paths, roads, slopes, etc.).

Geomorphological Setting

Calabria covers an area of 15,080 km^2, with a perimeter of 818 km characterised by a border 80 km in length with the Basilicata Region to the north, and a coastline 738 km in length. It is one of the most mountainous regions of Italy, with 42% of the territory occupied by mountains, 49% by hills and only 9% by plains. Amendolara is located in the north-east part of Calabria, on the border with Basilicata. This area extends from the Ionian Sea to the east, to the Serra del Prete-Monte Carnara to the west and the Pollino Massif to the south-west; and, to the south, the Plains of Sybaris, and the Policoro-Metaponto to the north.

The territory is subdivided into four main geomorphological sectors (Fig. 1), each reflecting different morphogenetic processes:

Coastal Sector The coastal sector of Amendolara extends from the mouth of the Avena Torrent to the Ferro Torrent (Fig. 1b). This typically low-lying zone of dunes has been

Fig. 3 **a** Silty clay, cemented sand, and **b** polygenic conglomerates (along terraced surfaces)

adversely affected for many years by erosion and anthropogenic factors, in common with other similar areas in Italy. Much of it has been either heavily urbanized or exploited for cultivation of forestry plantations. This growing economic importance, combined with the lack of proper management policy, has weighed heavily on urbanization of this environment (Simeoni et al. 1998). The zone is relatively flat, sloping gently towards the coastline and ranging in height between between 0.00 and 3.00 m above sea level (a.s.l.). The coastal zone sediments consist mainly of very heterogeneous rounded, primarily carbonate composition, gravel-sized clasts deposited in a series of channels and water courses. Grain size decreases from south to north.

Terraces Sector Raised marine deposits and emergent marine terraces are one of the most striking landscape features of a large portion of the Italian coast. Marine terraces along the Ionian coast of northern Calabria reflect interaction between interglacial sea levels, regional uplift and local fault-related elevation changes. Overall, seven orders of terraces are well preserved, with interior margin and exterior borders clearly distinguishable. The terraces may be correlated with oxygen isotope stages 1, 5a, 5c, 5e, 7, 9 and 15, which correspond to the 7, 81, 102, 124, 215, 330 and about 600 ka high stands of the palaeo sea-level curve (Bordoni and Valensise 1998). The elevation of the strandlines is related to the activity of tectonic structures as the result of combined coseismic deformation caused by the normal Castrovillari fault and probably by an hitherto unknown active fault responsible for the strong vertical displacements of the flight of terraces near the Avena Torrent (Cucci and Cinti 1998). On average, the highest elevation of terrace interior margins outcrop about 300 m a.s.l. (for example, near the historic centre of Amendolara), while the lowest border outcrops at less than 10 m a.s.l., near C. Sisco. Various archaeological sites occur on the terraced surfaces, including, for example, an indigenous village, and its cemetery, which has been correlated with the old city of “Lagaria”. That city, although developed principally between the seventh and sixth centuries BC, reflects a significant Greek influence (Laviola 1989).

Slopes Sector The steepest slopes occur near the historic centre of the region, while the gradual slopes predominate at higher altitude, in areas underlain primarily by deformed flysch deposits. The slopes are characterised by elongate ridges produced by a combination of tectonic and geomorphological processes, and some of these have been exploited for infrastructure development, for example, the provincial road n0. 266 which runs through the centre of Amendolara. Landslides and erosion are of critical importance in this part of the territory and reflect the presence of various slope instability features, such as weathering (Calcaterra and Parise 2005), which may be activated by a variety of factors, including intense and/or clustered rainstorms and anthropogenic activity. In addition, the relationship between normal faults and the development of the terraces can be recognised by geomorphological, sedimentological and stratigraphic analyses. These studies indicate that the terraces are underlain by five upper and lower beach-face and neritic clay facies associations, all of which may represent part of a single sedimentary body displaced by faults. The terrace deposits visible on slope cuts are related to a beach progradation event of Middle Pleistocene age, which has been documented in other areas of the Italian peninsula (Robustelli et al. 2008). These results outline an intimate relationship between the arcuate trend of the recognised fault set and the present coastline pattern (Bentivenga et al. 2004). Further, geomorphological analysis has shown the occurrence of prominent geomorphic lineaments, which appear to control the local drainage pattern. Some of these structures coincide with the normal faults that produce vertical offsets of the marine terrace surfaces. Many of the fault escarpments reduce their elevation and terminate laterally. In other cases, fault escarpments, which range between 2 and 10 m in height, are laterally continuous and can be traced for up to 3–4 km (Bentivenga et al. 2004).

Valley Sector The three main rivers are the Avena Torrent, Straface Torrent and Ferro Torrent (Fig. 1b). These all conform to a typical V-shaped thalweg profile, although of more irregular form in upstream sectors. Near the mouth, the thalweg is wide and more tabular, and is often dry with several abandoned bars. The hydrographic network is strongly controlled by tectonic patterns, and there are several examples where stream flow direction has been controlled by structural features. The short distance between the coast and the mountains has resulted in the development of fiumare—steep walled mountain torrents which transform downstream into highly braided, multi-channel streams (Fairbridge 1968). The alluvial fans are among the most important type of landform in all intramontane valleys in southern Italy (Maraga et al. 1988). In these sectors, very large alluvial fans are developed in the upper reaches of the thalwegs, many of which show signs of recent activity linked to processes further upslope. Many alluvial fans are built through episodic debris-flow events which mobilise substantial amounts of surficial material from upslope sources in the catchment basin (Parise and Calcaterra 2000).

Geotouristic Itinerary

The geosites may be classified into three principal categories, and from these, representative sites have been incorporated into the proposed geotourism route. The categories are as follows.

Folds of Pietra Stoppa. This is a complex structure consisting of alternating faulted folds with NW–SE orientated axes exposed at about150 m a.s.l (Fig. 7). The folds are developed in Miocene turbidites with a red clay-marly package outcropping locally. The present structures are due to the effects of two different Quaternary tectonic stages. The first, of lower Pleistocene age, is characterised by strike-slip tectonics represented by truncated ramp folds and, on the opposite sides of the carbonate ridge, new contractional and extensional features. The second stage, of mid-Pleistocene age, is a purely extensional regime with an Apenninic tensional axis, which reactivated the pre-existing structural pattern with different kinematics. However, both tectonic stages should be interpreted as a consequence of the continuous reorganization of the local stress fields as a result of a rotational field acting along the Pollino shear zone (Schiattarella 1998).

Alluvial Fans of Straface Torrent and Ferro Torrent. Various alluvial fans may be observed in the principal river valleys (Figs. 6, 7 and 8). The most representative are located near Masseria Stigliano (on Ferro Torrent valley) and at the base of the Vomice Channel (slope base facing NE on to the Straface Torrent valley; Fig. 1b). These alluvial fans were deposited by coalescent debris flows originating from Miocene flysch deposits at an elevation of 130–120 and 300–160 m a.s.l., respectively. The alluvial fans cover a surface area of 9,500 and 94,000 m^2 with an average slope gradient of about 6% and 11%, respectively. Debris-flow (or mud-flow) materials are the principal components of most of these alluvial fan successions, characterised by abundant and lithologically diverse gravel grade material proximal to source. According to Bull (1977), debris-flow propagation is prevalent on slopes which lack significant vegetation cover and which are subject to short periods of abundant water supply, and in which, source materials have a significant muddy matrix. These examples of alluvial fans are of considerable importance and tectonic significance as they reflect the sharp terrestrial relief produced by lithospheric uplift at continental margins or by faulting within continental plates.

Badlands of Avena Torrent, Old Town, Vaccaro. Prominent gullies, eroded into Pliocene silty-clay deposits, are the characteristic erosion form in the lower part of the Amendolara territory (Fig. 13a, b). Particularly noteworthy examples of this type of geosite occur at elevations between 105 and 25 ma.s.l., on slopes with an average gradient of more than 80%. These unstable landforms affect soil productivity, restrict land use and can threaten roads, fences and buildings, particularly near the historic centre of the region.

Active gully formation reflects erosion of soil by ephemeral, high velocity flows constrained into restricted flow paths. Soil eroded from this gullied area results in siltation of fencelines, waterways, road culverts, dams and reservoirs. Water quality may be adversely impacted by suspended sediments which may contain trace levels of fertiliser and pesticides. These fine colloidal clay particles remain in suspension and may clog groundwater aquifers, pollute water courses and affect aquatic life.

Geoarchaeosites

Prominent "Hermit caves" (Fig. 12) occur in the following locations: Fosso Potresino, Celogreco, Vallone Cuppo, San Bernardino, Orto Petroso and Uomo morto. These sites are concentrated within an altitude range between 75 and 100 m a.s.l., in an alignment parallel to the coastline and exposed to the south-west. It is possible that this particular location reflects exposure conditions favourable for habitation, although their origin remains uncertain. Initial occupation may have occurred during the Neolithic period, at a time when humans were in a period of transition between hunter-gatherer to agrarian-pastoral food gathering activities and, with that, a transition from a nomadic to a more settled lifestyle at least partly influenced by Middle Eastern culture (Favia 2006). They are located near archaeological areas where artefacts have been found which date from the Bronze Age (XI B.C.) to the VI BC. The "Hermit caves" later assumed an important role in Italian-Greek monasticism, most likely in the Middle Ages, through their re-occupation as places of hermitage. Sadly, many such sites have been subject to inappropriate use, such as animal shelters, in modern times due to a lack of appreciation of their cultural and archaeological value. The geotourism route (Fig. 4) is designed to present, illustrate and enhance the natural history of this territory from a geological–geomorphological perspective as well as demonstrate how humans have interacted with that environment in pre-historic times. Accordingly, the route was conceived to link areas containing the oldest rocks and structures with regions which contain younger rocks and evidence of human interaction with the geological features.

The proposed route commences at the Torre Spaccata locality (Fig. 5) and continues along provincial road no. 481 to "Oriolo". From there, the route follows the valley of the Ferro Torrent to stop 2, where the alluvial fan of Masseria Stigliano (Fig. 6) may be observed. Stop 3, where

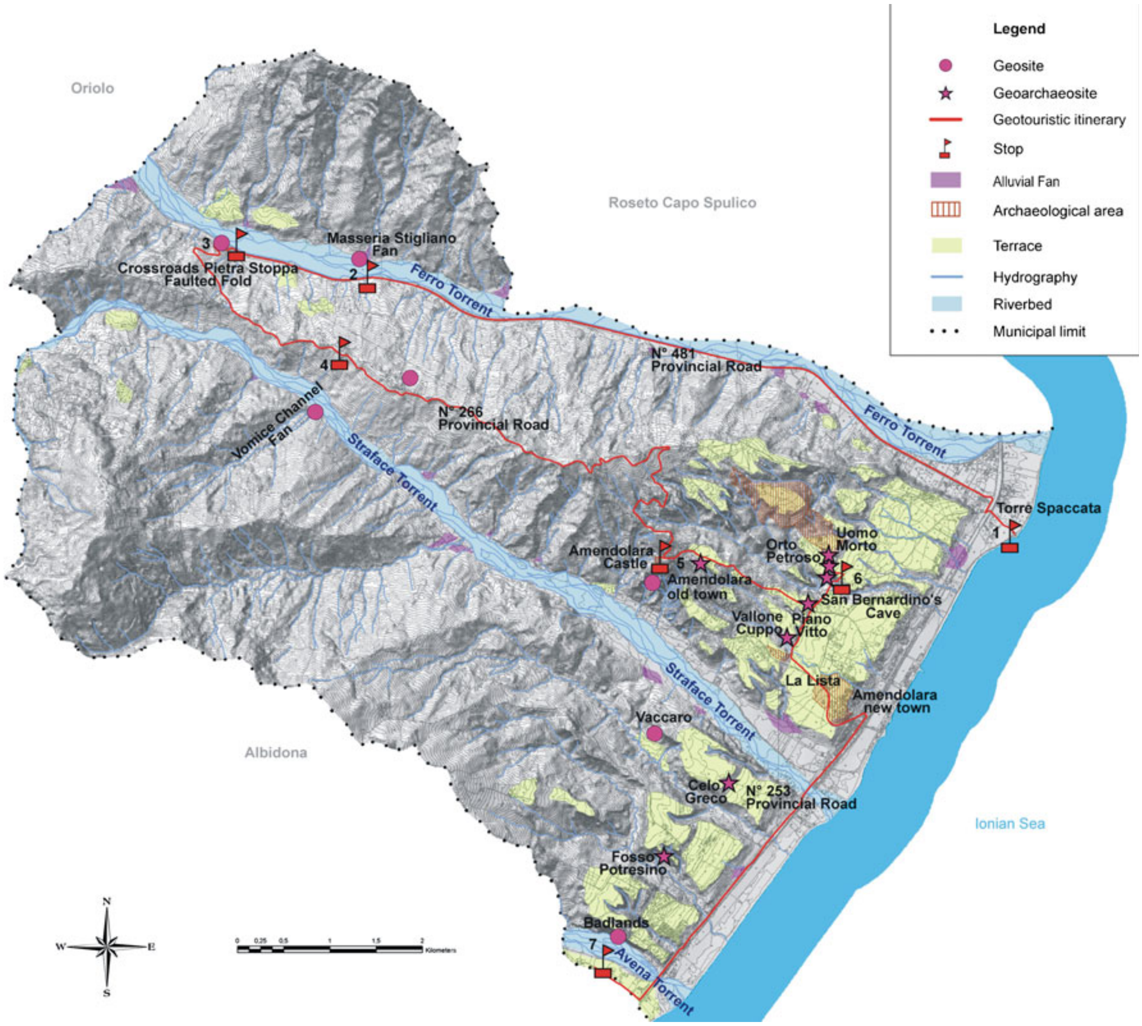

Fig. 4 The proposed Geotourism route

a fold in Miocene flysch may be observed, lies further along the way, in proximity to "Castroregio" (Fig. 7). Further up slope, the route ascends to Crossroads Pietra Stoppa locality and the 266 provincial road to Amendolara. The Vomice Channel alluvial fan is easily observed from this road (stop 4; Fig. 8).

Continuing onward, the route traverses up to the old town of Amendolara and the Giovanni XXIII Square (stop 5) from where it is possible to visit the "Castle of Amendolara" (Fig. 9), other historic buildings and the "Archaeological Museum". Here, the preserved traces of Neolithic civilization may be observed, as well as Roman urbanization that took place around a Statio ad Vicesimum. This development was served by a great aqueduct constructed along a consular road that links the Amendolara new town to Oriolo, through Amendolara old town. Remains of late Roman buildings, pottery, imperial coins and stretches of floor have been found close to the Statio of Masseria La lista locality. From Corso Umberto, the route turns left down towards and crosses the San Sebastiano locality to a zone of sub-horizontal terrace surfaces (Fig. 10) adjoining the Straface valley (Fig. 11). Many archaeological sites occur on these terrace surfaces.

From the San Bernardino locality (stop 6), it is possible to visit the "Hermit caves" (Fig. 12), present at Orto Petroso, Uomo Morto and Vallone Cuppo. From stop 6, the route continues towards the L'Annunziata locality before returning on the no. 266 provincial road towards the marine zone.

From here, the route follows the no. 253 provincial road to Trebisacce town south of Albidona town (Fig. 4). After the road bridge across the Avena Torrent, the route turns right to follow the public road for several hundred metres to a vantage point from which, at stop 7, a fine example of the badlands landscape (Fig. 13a) may be observed. Here, a very good example of terraced deposits displaced by normal faults is readily visible (Fig. 13b).

Fig. 5 Torre Spaccata, the first historical locality of the route (stop1, Fig. 4)

Discussion

This area may be divided, from a geomorphological and geological perspective, into two macro-areas representative of outcropping rocks, and the forms and processes involved in the evolution of the landscape. In the upslope sector, flysch and larger landslides outcrop around the old town of Amendolara, and while various observations arise from this study, such as a repetitiveness of slides to debris flows easily seen in road cuts and rocky cliffs, there is a need to undertake a more thorough inventory of the number and location of such events. Often, the nucleation points of landslides lie along or in close proximity to roads. This observation is undoubtedly important in terms of planning landslide prevention measures, as incised slopes are particularly susceptible to rapid debris flows. Furthermore, the tectonic structures influence mass movements through secondary deformation resulting in greater susceptibility to these instability phenomena (Tansi et al. 2000).

The combination of faulting, which also influences the drainage pattern, and uplift controls the elevation of terraced surfaces in the downslope sector. Here, areas of archaeological interest first appear and, in combination with younger rocks and processes, define and characterise human interaction with the geological environment. It is no accident that the earliest human imprint is first seen in the more geomorphologically stable areas, the terraced surfaces, a landform which probably influenced initial human settlement through its suitability for cultivation and sheep farming as well as providing good views over the coastline and caves suitable for occupation. However, in the

Fig. 6 Masseria Stigliano alluvial fan (stop 2, Fig. 4)

Fig. 7 Faulted fold of Crossroads Pietra Stoppa locality (stop 3, Fig. 4)

absence of documentary evidence on the exact origin of the "Hermit caves", it is only possible to interpret them through changes to the natural environment which serve to create a physical record that persists even through the imprint of subsequent civilizations. That record suggests that these geoarchaeosites may have their origin as a place of ancient human settlement in the period of transition between the Palaeolithic and the Neolithic.

Subsequent re-use occurred with the advent of Greek-Italian monasticism (ninth to tenth century) as attested by Byzantine chapels constructed after the fall of the Roman Empire. Evidence of this phase is provided also by a Statio ad Vicesimum consisting of a single large roman villa constructed on top of an urban centre which contains remains of a Roman bath complex (Arslan 1966). The subsequent arrival of Christianity in nearby Turio, as well as evidence of Christian martyrs who lived in the Sibaritide area, suggest that Calabrian Christianity originated in this general region, although evidence of early Christian presence in the Amendolara territory is only circumstantial. This is in distinct contrast to the strong physical evidence of Byzantine developments, attested by churches, chapels, hermitages, caves, wall paintings and various place names (Barrio 1979).

The caves may have been further modified during ancient transhumance migrations that took place many

Fig. 8 View of the Vomice Channel from the no. 266 provincial road (stop 4, Fig. 4)

Fig. 9 The Castle of Amendolara (stop 5, Fig. 4)

centuries later, during the late Mediaeval age (thirteenth to fifteenth century), and now recognised as part of a more general European phenomenon, called *villages désertés*. This term refers to transient depopulation during transhumance movements, a phenomenon which occurred widely throughout southern Italy and especially around the core region of Tavoliere (Apulia Region) (Favia 2006).

Some of these caves are located on the highest parts of the slopes which might reflect their occupation during periods of higher channel levels than that at present. The "Hermit caves" thus provide an example of how the evolution of a natural landscape feature reflects combined geological and archaeological imprints.

In other areas of Calabria (e.g. Belvedere Spinello, Caccuri, Cotronei, Casabona, Petilia Policastro), and elsewhere in other Mediterranean countries, there are numerous examples of rupestrine settlements all with a regular alignment comparable to that seen in Amendolara. This is an important local and regional cultural and natural heritage feature which needs to be recognised and accommodated within environmental planning processes. Indeed, the combination of geomorphological and archaeological features in Amendolara is not only of local importance but might also serve to provide a case study of such geological–human cultural landscapes more widely. Their conservation is neither at variance with ecosystem conservation nor the

Fig. 10 Sub-horizontal terrace surfaces

Fig. 11 The valleys of Straface and Avena Torrent

economy of the region. If carefully and thoroughly evaluated and promoted, such conservation can make a significant contribution to regional and environmental education (Poli 1999; Cresta 2000).

Conclusion

It is possible to identify in the Amendolara area several geosites of significant geological, geomorphological and historical value. They form part of the natural features of the landscape, and they represent a valuable scientific and educational resource in a land of great economic and tourism potential.

Accordingly, the present study sought to identify all those sites for which it is possible to define a "cultural geologic–geomorphologic interest" and to provide a basis to preserve and safeguard them for future generations. The geosites are categorised according to rock types, their age and geomorphological processes which they illustrate. Rather than assess and present such sites in isolation, they have, instead, been integrated within the context of the historical evolution of the area, for which this study has introduced the concept of "geoarchaeosites", of which

Fig. 12 Hermit caves at Uomo morto locality (stop 6, Fig. 4)

Fig. 13 **a** Typical badlands landscape of Amendolara (*arrow* indicates location of **b**). **b** A close-up view of faulted deposits: the *arrows* indicate the raised and lowered sides, the *red line* and *the dotted line* are the fault and the stratigraphic contact, respectively (stop 7, Fig. 4)

"Hermit caves" are the principal expression. The caves were probably excavated by humans during the transition from the Palaeolithic to the Neolithic periods, and much later, they assumed an important role during the Byzantine period.

It is however important that knowledge of the complex heritage should be made available very widely, especially to all in local and regional communities, rather than remaining within the preserve of scientists only. The geotourism route proposed here represents one stage in the process of developing wider awareness and knowledge. It has been deigned to demonstrate these anthropogenic features, and their cultural value, as an extension of the concept of geodiversity. The ethical value of safeguarding geological values has to be perceived not only as an environmental resource but as part of the global cultural heritage. It should be considered the memory and inheritance of this area. Furthermore, the importance of this proposed route seeks to demonstrate and exemplify the strong interaction between man and landscape and thereby present a new method to improve understanding of natural and human heritage as parts of a holistic system. It is essential that protection is provided through suitable legislation, yet to be provided, in order to provide a framework for better informed planning decisions in the future. The distinctive features of the sites, their extent and, for the future, their conservation, will facilitate an improved appreciation of geological landscapes as part of the community. To advance this objective within the Cosenza Province, of which Amendolara is a part, a project has been initiated recently in association with the Calabrian Cultural-Scientific Association (http://www.terra360.it/). This project will initiate identification, selection, cataloguing and evaluation of geosites at provincial level as a prelude to its extension on a regional scale.

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