European Union Soil Thematic Strategy

Geodiversity and Geoheritage as features of Soil Protection

Advice to the Working Groups *Towards a Thematic Strategy for Soil Protection*
(COM (2002) 179 C5-0328/2002 2002/2172(COS))
Committee on the Environment, Public Health and Consumer Policy

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1. Introduction

This report elaborates on articles 21 and 22 of the Resolution of the European Parliament on the
Commission communication 'Towards a Thematic Strategy for Soil Protection' (COM(2002) 179 - C5-0328/2002 - 2002/2172(COS)) of 19/11/2003. The European Parliament:

> *Article 21 highlights the need to integrate soil protection objectives in spatial planning strategies and to commit itself to the further development of the European Spatial Development Perspective; calls on the Commission, in the communication that it is due to submit in 2003 on 'Planning and Environment the territorial dimension', to study ways of preventing the soil sealing which occurs when new areas are assigned for urban development and infrastructure; calls for rules to be introduced bringing land use into line with soil characteristics, taking account of social values, and putting an end to the indiscriminate sealing of land;*
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> *Article 22 takes the view that the topography, structure and natural form of the land must be respected in housing development processes in the interests of sustainable development; considers it necessary, further, to restrict soil sealing and the distortion of natural rock and land formations, and considers it necessary to exercise greater control over the disappearance of soil and prevent the environmental and visual impact of large-scale excavations to extract aggregate.*

Also, the European Parliament urged the Commission to draw up by 2007, in cooperation with the Member States and the competent regional authorities, a scientific soil catalogue which should include the nature of the soil, its biography, health and vulnerability, degradation and erosion processes and contaminated areas, recognising the existence of

high-value soils (in terms of agriculture, geology, ecology, history or the countryside) and the need to draw up recommendations for their conservation and sustainable use;

2. Introducing the concepts geodiversity and geoheritage

The resolution 'Towards a Thematic Strategy for Soil Protection' is another milestone in the history of
Man's dealing with soil. The study of soils began with the rise of agricultural chemistry during the
nineteenth century, when it appeared that soils gave unforeseen reactions to the application of artificial fertilizers. Soil physics and soil chemistry are now among the best developed disciplines in agricultural and environmental research. These aspects of soil science are of great assistance in defining and alleviating the problems of soil contamination in its widest sense which was the concern of EU policy up to the present time. They are the base of the activities of the Working Group on Soil Contamination. Soil contamination still is one of the most important themes in the list of eight threats that will receive EU's special attention in the future.

The present Commission communication wishes to enlarge the scope of the EU's concern for soils by
recognizing that soil is not merely an independent mass of material at the Earth' surface, but a living part of the Earth with its own identity, laws and processes. This concept, developed in the nineteenth century in the Russian school of soil science, sees soils as natural bodies with a unique morphology and resulting from a unique combination of climate, living matter, parent rock materials, relief and time. In short, the soil was treated as a system of interdependent properties, part of a much larger system composed of the upper part of the lithosphere, the lower part of the atmosphere and a considerable part of the hydrosphere and the biosphere.

This revolutionary idea quickly spread across the world and lead to the establishment of soil surveys in almost all countries. Each soil survey organization developed its own classification system adapted to the specific combination of soil forming conditions prevailing in the country.

Soil forming factors

In 1941 Jenny summarized the systems approach to soils by systematically exploring the relationship of soil to five main soil-forming factors:

$ *Parent material*
The nature of the surface rocks and sediments has probably the most profound influence on soil properties. For
instance, coarse-grained rocks and sediments produce sandy soils whereas fine-grained rocks and sediments produce clayey soils. These textural differences control soil permeability and drainage, the need for fertilizer and manure, workability, type of crop, and ultimately sensitivity to erosion and desertification. Since there is a rich geodiversity of rocks and sediments, it should not be surprising that this factor alone creates an immense variety of soils.

$ *Climate*
This factor has a major influence on soils because it determines the nature and intensity of weathering processes. In turn this influences several soil characteristics and the rate of soil formation. According to the Commission communication, soils are extremely sensitive to the effects of climate change.

$ *Topography*

Relief, elevation, slope angle, aspect and landscape setting all play an important role in soil development, particularly through their impact on other variables: e.g. topography controls water infiltration, exposure to sun and wind, and the rate of erosion.

$ *Biota*
Plants and animals have a strong influence on several soil processes including accumulation of organic matter,
biochemical weathering, nutrient cycling, aggregate stability, infiltration capacity, soil mixing and rates of soil
erosion. In turn soils form the medium in which vegetation, both natural and cultivated, grows. Plants need sunlight and carbon dioxide from the atmosphere but they rely on soil for the nutrients , water and support that are essential to life. And without plants no animals could survive. Soil therefore forms the crucial link between the abiotic substrate below (the geosphere) and the living world above (the biosphere).

$ *Time*
Rock weathering and soil development take time, so that we would expect that rocks and sediments recently exposed e.g. those in dune areas, in front of retreating glaciers, to have thin profiles compared with those where deep weathering has been ongoing for millions of years. The Commission communication rightly states that 'soil
characteristics are the product of an age-old process, making it a non-renewable resource'.

Cross-border correlations
As each soil survey organization developed its own classification system adapted to the specific combination of soil forming conditions prevailing in the country, in the 1960s it became increasingly clear that cross-border correlations were needed. This led to a lively exchange of information. Even in the midst of the Cold War, soil scientists of the Soviet Union and other countries of Eastern Europe met with their colleagues of Europe and the United States in congresses and excursions to discuss their soils. Great efforts were made to come to internationally accepted principles of nomenclature and classification. The FAO played an important role in the publication of resulting international soil maps.

Towards sustainable use of the soil system = geodiversity and geoheritage
The Commission communication recognizes that soil is a key component of the earth's environment, and following the Russian pioneers of the nineteenth century, as the interface between the lithosphere or geosphere, hydrosphere, atmosphere and organisms inhabiting it. The concept of soil as a natural system is also central to the activities of the Working Group on Soil Erosion and the Working Group on Organic Matter. The concept of soil as a natural system is even more fundamental within the modern perspective of sustainable development, either from an ecological, economical or aesthetical point of view. The need to integrate these objectives in spatial planning strategies and in land use into line with soil characteristics asks for new terminology. In this communication when referring to the sustainable use of soil system in spatial planning the terms ***geodiversity*** and ***geoheritage*** are introduced.

Definitions
Geodiversity, geoheritage and geoconservation are defined as follows:
- *Geodiversity* refers to the topography, structure and natural form of the land: the natural range of soil, geomorphological and geological features. It includes their assemblages, relationships, properties, interpretations and systems (Gray, 2004).
- *Geoheritage* comprises concrete examples of geodiversity which may be specifically identified as having
  conservation significance.
- *Geoconservation* is the endeavour of trying to conserve geodiversity and geoheritage (Sharples, 2002).

3. Pressures, threats and consequences

There are a large number of threats on the integrity of soil, topography, structure and natural form of the land. The main threats are:

1. Ignorance
Some say that ignorance is the biggest threat of all to geodiversity. As the African conservationist Baba Dioum has said:
"We will only conserve what we love.
We will only love what we understand.
And we will only understand what we are taught."
An absence of understanding and information on the value of sites or lack of protective measures is an
important cause of degradation of soil sites and landscapes. Governments in Europe up to now have shown little concern for geodiversity education and geoheritage. Most planners and ecologists are not aware and thus do not aim at sustainable planning. It is also the ground for the low public awareness.

2. Development and urban expansion
Modern building works have large impacts on geodiversity by:
- removing surface soil and adding building sand thus damaging soil structure and soil biota;
- removing and re-profiling land surfaces leading to loss of landforms, loss of landscape pattern and landscape character;
- obscuring the underlying rocks, sediments, soils;
- loss of sub-surface sediments, rocks and fossils;
- increase of discharge and decrease of water quality.

Examples include: building blocks, cuttings, embankments, dams, reservoirs, golf courses, habitat creation schemes. A sustainable urban development should respect the natural land characteristics. In The Netherlands the borough of Gouda is famous. By building on the wrong soil more money is needed for street maintenance than the city can afford to spend.

3. Agriculture
Modern agricultural activities can lead to serious impacts. Land allocation projects and even regular
ploughing have levelled out many subtle landforms in sedimentary environments and thus caused erosion of geodiversity, erosion of soil, geomorphology, geology and its relationships with the landscape. Other impacts include the change in the natural soil forming processes through
application of fertilizers and pesticides, also causing soil pollution. Soil compaction from use of heavier farm machinery changes the infiltration capacity and the ecological potential of soil.

4. Coastal and river management
The construction of sea defences, such as sea walls, cliff stabilisation, dune stabilisation, rock armouring, or coastal slope regrading can adversely affect or destroy geodiversity since all are designed to prevent the natural evolution of coastal systems. Similarly, human impacts on rivers can be extensive both through direct engineering within the channel and floodplain e.g. canalisation, flood embankment, dams and indirect effects through land use change within the catchments which can transfer large amounts of soil and sediment to river channels.

5. Extraction of construction materials and other minerals
Although also clearly essential to modern society there is always loss of geodiversity in mineral extraction as landscape, topography and soils are disturbed and removed. This may not be significant where the resource being quarried is large, the landscape character is weak or degraded and the soils are common, but it will become more problematic where rare soils, important landforms, limited rock exposures or important fossil-bearing strata are removed during mineral extraction. In Great Britain there are many examples of eskers and other important glaciofluvial landscapes being quarried away to provide aggregate, and limestone pavements being lost to provide weathered stone for garden rockeries. Equally important may be the burial or pollution of soils, landforms or rocks by deposition of quarry spoil and mine tailings.

6. Afforestation and deforestation
Afforestation and vegetation growth can obscure the visibility and accessibility of landforms and rocks. Roots can damage sensitive geological formations, while conifer plantations can result in soil
acidification. In general trees play an important role in conserving the natural soil environment, preventing soil erosion by intercepting rainfall, encouraging infiltration and binding the soil. Deforestation may therefore result in increased soil erosion through loss of soil structure and hence infiltration capacity. Commercial felling often results in major disruption and compaction of soils and loss of topography and subtle landforms.

7. Recreation and tourism
Many recreational activities have impacts on geodiversity. Footpath erosion ultimately exposes the soil and may lead to erosion, gullying and slope instability. The use of mountain bikes, motorbikes and all-terrain vehicles is of increasing concern. In some environments visitors may want to take home souvenirs such as parts of stalactites or beach pebbles thus affecting geodiversity. The development of ski resorts often involves grading of slopes, removal of landforms and impacts on soils and sediments.

4. Impacts: why geodiversity and geoheritage are important

There is much more at stake than loss in soil productivity when the surface soil with its structure and biota is damaged or removed: a well-developed soil with its surface intact is an important part of our geodiversity and geoheritage. It should be respected for reasons of sustainable use, reserved for future generations to learn from and to enjoy; geodiversity and especially the organic matter/soil ecosystem control biodiversity; the countryside loses aesthetic value by visually degraded soils. Loss of geodiversity and geoheritage is important because the abiotic world is of value in various ways:

- *Intrinsic value* - free of human valuation;
- *Cultural values* - e.g. landforms and landscapes are associated with cultural history: patterns of enclosure, traditional land use, archaeology, traditional building materials, folklore, religion and a local sense of place;
- *Aesthetic value* - e.g. the visual appeal of landscapes, geotourism, the effect on health, recreational uses and the artistic inspiration;
- *Ecological value* - e.g. the abiotic world is the basis for the biodiversity;
- *Functional values* - e.g. the role of the soil and substrates in providing platforms, storage, burial sites, pollution control, nutrients and growing media, as well as geosystem and ecosystem functions;
- *Economic values* - e.g. the current or potential use of soils, rocks and sediments for agriculture, forestry, tourism and recreation, construction and other industrial materials, fossils;

$ *Scientific & educational values* - e.g. the use of the abiotic world to provide information about the history of the Earth, the evolution of life, landscape evolution and climate change, and to provide opportunities for field education and training.

5. Responses: what needs to be done

The subscribers of this report request the Working Groups Towards a Thematic Strategy for Soil Protection to include into their documents the approaches stated below.

As in all environmental management the following four broad approaches to geodiversity and geoheritage conservation need to be developed and promoted:

Advisory/educational approaches

$ this will include policy development and public involvement in pratical activities, education about values of soils as part of our geoheritage;
$ development and implementation of policies, strategies and charters, e.g. related to soil conservation, retention of topographic character, restoration of former topography, sustainable use of geo-resources;
$ preparation of books promoting the use of geodiversity and geoheritage in spatial planning;
$ provision of museum and visitor centre displays on soils;
$ preparation of books, leaflets, maps, field guides, videos, site interpretation boards;
$ television programmes on the geoheritage;
$ influencing political decision-makers at all levels.

Regulatory approaches

This involves, for example:

$ adopting conservation laws that include geodiversity and geoheritage;
$ introducing geoconservation and geoheritage into land-use planning regulations, Environmental Impact Assessment procedures, etc.;
$ identifying and designating protected geoheritage areas and sites;
$ enforcement and imposition of suitable penalties for non-compliance.

Fiscal approaches

These would include:

$ listing the important "green" taxes such as an Aggregates Tax on virgin sources to encourage recycling or "red for green" Tax;
$ grants and subsidies for the sustainable management of land.

Inventory and Monitoring

These should include:

$ describing the characteristic geodiversity and geoheritage values of the European regions important for spatial planning activities;
$ listing these variables and regions in the soil catalogue and in national and regional atlases and geographical information systems and databases;
$ selecting criteria for the designation of European Geoheritage Sites and Parks;
$ development of geodiversity and geoheritage review methods;
$ selecting criteria for monitoring geodiversity and geoheritage.

The FAO played an important role in the publication of the international soil maps. In line with the Commission communication's recommendation, the existing databases should be adapted to future needs. However, there has always been a tendency to map the soils with respect to their genetic processes. Some additional inventory is needed to improve the

description of the variables geodiversity and geoheritage. An global overview of the state of geodiversity and geoheritage in the different European countries is presented in Annex A. In line with the communication of the working group on Monitoring we suggest there is no need for an EU-wide unique solution, though it should be aimed at.

Annex A The state of Geodiversity and Geoheritage in the EU countries

The data presented here are summarized from the book *Geodiversity* by dr. Murray Gray published by Wiley in 2004. A more elaborated description of the state of geoheritage in Europe will be published this summer by ProGEO, the European association for the conservation of Geological Heritage. The first copy of this book will be presented during the ProGEO conference in Florence in August 2004.

The country systems

UK

The UK currently has *13 National Parks* or equivalent, 8 in England, 3 in Wales and 2 in Scotland. It is usually only coincidental if important soils, landforms and geology are included within these areas, though their scenic beauty and often ancient geology inevitably mean that landscape and geoscientific interests often coincide. Thus many of the British national parks, such as the Lake District, Snowdonia, Dartmoor and others, although designated for their landscape beauty, all contain important geological and/or geomorphological interests.

National Nature Reserves (NNRs) are areas preserved primarily to maintain and enhance their scientific status and research potential. Marine Nature Reserves (MNRs) are also designated. They are generally owned by the State and managed by one of the three national conservation agencies. A few of the NNRs and many of the MNRs contain important geological and geomorphological sites.

The main way in which geoheritage is conserved in the UK is through the designation of *Sites of Scientific Interest (SSSIs)*. Originally this status did not give a site direct protection, but rather it simply ensured that local authorities were notified of the sites and that a full consultation process took place if developments affecting SSSIs were proposed. Most SSSIs are on private land. The situation has been strengthened significantly in England and Wales by the Countryside and Rights of Way Act (2000) (usually known as the CROW Act). This puts the emphasis on positive site management and partnership between the conservation agencies and landowners and occupiers, rather than paying them not to carry out operations that could damage sites. However, if agreement cannot be reached the new Act allows it to be imposed, and this allows action to be taken to prevent site deterioration through neglect or deliberate damage. The Act also makes it an offence for anyone to knowingly or recklessly damage an SSSI. The Act also gives powers to introduce bylaws on SSSIs to further protect them from third party damage, and strengthens their right to enter private land to investigate offences and monitor the condition of SSSIs. The Act gives public right of access to several categories of open land and therefore is helpful in giving access to geoheritage features. A major review, the Geological Conservation Review (GCR), took place between 1977 and 1990 to establish a systematic list of important geological and geomorphological sites. The site series was intended to reflect "the range and diversity of Great Britain's Earth heritage" About 2300 SSSIs are currently being designated by the three UK nature conservation agencies as of value geodiversity and geoheritage. This represents over one third of the UK's 6,573 SSSIs as of April 2002, the remainder being biological. GCR-site descriptions are

being published in a set of 42 volumes, each made up of blocks covering a particular geological period, rock or landform type and/or part of the country. It has been referred to as the most comprehensive review undertaken by any country. In Northern Ireland the equivalent of the GCR, has identified about 300 sites, and these are being designated as Areas of Special cientific Interest (ASSIs).

The *RIGS (Regionally Important Geological/geomorphological Sites) scheme* was introduced in
the early 1990s to meet the need for more local involvement in earth science conservation in the same way that many local wildlife groups operate. The aim was to set up a country-wide network of sites,
established and managed locally by volunteer groups. Most English counties now have active groups
though the situation in Wales and Scotland is more patchy.

Limestone Pavement Orders (LPOs) are one of the few pieces of legislation to protect a specific landform type and make it a criminal offence to damage the landforms so designated. About 100 orders have been made, and all significant limestone pavements in England are now protected.

The Wildlife & Countryside Act (1981) provides a framework to regulate fossil collecting at designated SSSIs or NNRs, but there is still no law relating specifically to fossils.

Ireland
Ireland is an interesting example since, apart of the geological importance of its *six National Parks*,
including The Burren with its important karst geomorphology and limestone pavements, there has been no significant tradition of geological conservation (there) until relatively recently. As a \ consequence a major review has been undertaken and the *Irish Geological Heritage Programme (IGH)* instituted. The IGH Programme is run as a partnership between the Geological Survey of Ireland (GSI), which undertakes scientific site selection, and Dúchas, the Heritage Service of Ireland which carries out the statutory designation of Natural Heritage Areas (NHAs) under the Wildlife (Amendment) Act (2000) and their management. Sixteen themes have been identified, and or each one expert panels are established to select the sites. The system is intended to establish is a representative selection of Ireland's geodiversity, but unique, exceptional and internationally important sites are also included. In addition to the NHAs, a *County network of non-statutory sites* is being established (similar to RIGS in the UK) with some level of protection achieved through the Irish land-use planning system. Concern over damage to limestone pavements at The Burren has led to the introduction of the *Burren Code* which discourages visitors from removing limestone or building cairns and dolmens from shattered limestone or field wall stones.

Finland
Finland has *34 National Parks* some of which include important geological or geomorphological features. For example, Päijänne National Park includes some of Finland's best esker systems. In fact Finland has a *conservation programme for esker protection*, and also has *developed management guidelines applying to all its protected areas*. One of the the main principles is not to interfere with natural processes without good reasons related to nature conservation. Mining is prohibited within protected areas but traditional gold panning is permitted by license.

Sweden

Sweden's Nature Conservation Law has allowed the designation of *national parks, national reserves and natural monuments* incorporating landscape types, terrain forms and geology. Other legislation, policies and inventories aim to protect inland dunes, ravines, wetlands, lakes and rivers. Since 1999 the *Natural Resources Law* has allowed the selection and designation of national objects. The Nature Conservation Council and regional councils undertake this work with geoscientific input from the Swedish Geological Survey.

Denmark

In Denmark over *200 national areas of geological interest* have been identified since the 1980s and include landscapes, landforms, bedrock exposures and soils. Each of these areas/sites has a documentation including description, values, threats, references and administration. There is *regular site monitoring* and public interpretation of suitable sites. A survey of Denmark's coastline has been undertaken with the aim of identifying areas of geological, geomorphological or coastal dynamic interest. The Wilhjelm Committee was appointed in 2000 to prepare a report as a basis for a government action plan on biodiversity and nature conservation. This report was completed in 2001 but it contains few references to geodiversity and geoconservation though it does promote the operation of natural processes.

Germany

Germany identifies *geotopes* defined as "distinct parts of the geosphere of outstanding geological and geomorphological interest". An inventory of over *10,000 geotopes* has been compiled by Länder, but questions of use, management and accessibility have yet to be resolved and there is cross-Länder inconsistency. Germany also has a *Federal Monument Protection Law (1973)* though its implementation also varies widely across the country. Baden-Württemberg uses its Monument Protection Law in a similar way to the Danish Museum Act, i.e. to pay compensation to finders of fossils deemed to be of importance to the State. However, other Länder have no such Act.

France

France also has limited geoconservation programmes apart from the spectacular *Haute Provence Geopark* and about *12 geological nature reserves* designated on palaeontological, stratigraphic, mineralogical and stratotype grounds.

Netherlands

The Netherlands has about *120 areas considered to be of (inter)national importance*. The areas were designated through expert judgement, an initiative of the government in cooperation with the Platform for Earth Heritage and Geodiversity. The areas were selected mainly on geomorphological and landscape criteria. The areas have no legal protection although the idea of national government protection is introduced in the National Nature and Landscape Policy Scheme of 1985. The areas will be part of the Memorandum Landijs announced by the government for 2004. Eleven of the twelve provinces have designated *provincial areas of geodiversity and geoheritage value*. As in Germany the legal system and enforcement differ from province to province. The strongest legal protection is by designating *areas of geodiversity and geoheritage value to the zoning schemes of the local authorities*. An overview of areas with this local protection will be available from 2005 onwards. The areas considered of (inter)national importance and the geomorphology units scale 1:50.000 are part of Monitoring System Landscape, a database for monitoring landscape development under construction (www.meetnetlandschap.nl).

Although the first Earth Monument was assigned in 1926, further activities remained limited to a few gardens of erratics. From the mid 1990's the provinces of Utrecht (6, 6 in preparation), Zuid-Limburg (40 excavations), Overijssel (2) and Noord-Holland (2, 14 in preparation) started to appoint Earth Monuments. These are sites with scientific as well as touristic and recreational value. Only in the province of Noord-Holland these sites have an

additional legal protection through the Soil Law. The other provinces now start allocating Earth Monuments.

Belgium
no data available

Luxembourg
no data available

Austria
Austria has a series of geotopes but there is no nationally co-ordinated scheme. In 1928 Austria passed one of the first *laws dedicated especially to the protection of a geological feature caves*. Criteria for establishing protected caves include scientific value, for historical research, palaeontology, geological structures, sediments, etc. The law also made it possible to create buffer zones around cave entrances. Over *10,000 caves* are now documented and the protection system has been regionalised, though this has led to inconsistencies in enforcement.

Spain
Spain has *two national laws protecting Spain's geological heritage* passed during the 1980s. First, the
Law of Conservation of Natural Spaces and Wild Flora and Fauna (1989) established four categories of protected natural area defined as "areas or natural features composed of elements of known uniqueness, rarity or beauty which merit being the object of special protection". The four categories are: *National Parks, Natural Reserves, Natural Monuments, Protected Landscapes*.
National Parks are designated by the Spanish Parliament and managed by both the State Administration nd the Autonomous Communities in which they lie. Responsibility for designating and managing theother categories of sites lies locally. Natural monuments include geological or palaeontological sites designated for their special interest due to the unique importance of its scientific, cultural or scenic value. The *Law of Historical Heritage (1985)* gives protection to sites of cultural interest including geological and palaeontological sites related to the history of mankind, generally treating them as subordinate to archaeological sites. These are the responsibility of the *Autonomous Communities* and some of the latter have also developed their own heritage laws. For example, Catalonia, Galicia, Valencia and Madrid have introduced legislation to protect their fossil heritage. Responsibility for enforcing these laws lies with the 17 existing Autonomous Communities and enforcement is inconsistent. The emphasis on geoconservation in Spain has tended to centre on landscape criteria rather than geological science stratotypes, tectonic structures or depositional systems. The Geological Survey of Spain has developed a National Inventory of Points of Geological Interest (PIGs), though the sites identified have yet to be given legal protection.

Portugal
Portugal has *5 natural monuments* all based on palaeontology (dinosaur footprints), and *12 natural parks* many of which contain important geological features. Attempts are being made to promote these interests.

Greece
Greece has *10 national parks*, five of which have buffer zones and geological and geomorphological
interests are recognised in several of these parks. A number of the *53 protected monuments of nature* are specifically designated for their palaeontological or geomorphological interests.

Italy
There has been an upsurge of interest in geoconservation in Italy, partly through the passing of the *outline Law on Protected Areas (L.394/91)*. This includes in its provisions scope to protect geological and geomorphological features of national or international significance due to their natural, scientific,
aesthetic, cultural and recreational value. The categories of protected areas include *parks, reserves and natural monuments*. More recently, the Italian Geological Survey has been compiling an *Italian Geosites database.*

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