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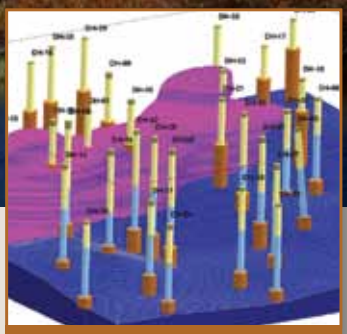

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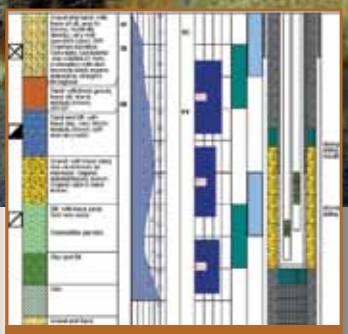

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Cover photo:
San Juan de Gaztelugatxe is a tiny island in the Biscay Gulf of the Iberian Peninsula connected to the continent through a bridge over the sea. The access way to the bridge and the bridge itself are being endangered by many geologic risks associated to the water sheds dynamics and the sea dynamics. This area is exclusively dedicated to tourism and its infrastructure elements need to be constantly maintained due to the landslides provoked by the erosion of the cliff bottom by action of the tides. The rock is the Black Flysch of the Basque-Cantabrian basin, aged lower Cretaceous, 90 million of years.
© Roberto Pinedo 2011. Winner of the category "Natural Hazards" of the EFG/EGS photo competition "Geology in the 21st century".

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Foreword

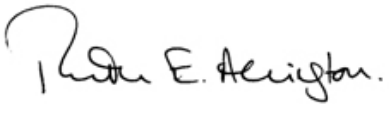
EurGeol. Ruth Allington, President

It is a pleasure to introduce this 34th European Geologist magazine with its diverse selection of papers under the theme of "Geoheritage". The celebration and preservation of geoheritage as a resource is an essential element of support to geological and scientific education at all levels. It also provides our community with opportunities to create and disseminate accessible and useful information on geoscientific issues and the way they relate to protection of the public, sustainable use of natural resources and environmental protection. These are issues that are central to EFG's mission and strategic aims.

At its Tenerife meeting in May, the Council made further progress on strategic planning for the Federation. A revised statement of the 'Objects' of the EFG at Article 2 of the statutes, re-worded to add clarity and focus, without detracting from their meaning, was approved, and a list of strategic aims, drawn from the Objects in the statutes, was developed to underpin the strategic plan for the period 2012-2017.

At its meeting in Brussels in November, the Board will be seeking approval for the strategic aims, following the current period of consultation. Since the summer meeting, the Board has used the substantially agreed draft strategic aims to draw up, and rank, priority actions for the plan period – this document is now with the Council for consultation. At the Council meeting in November, a major item of business will be work on agreeing a finalized list (and ranking) of priority actions for the plan period so that the Board can work on detailed action plans and budgets that can be presented for approval at the June 2013 summer Council meeting in Stockholm.

It has taken us some time to reach this stage with our strategic planning and the 'end of the beginning' is now in sight, when we will have in place a hierarchy of documentation representing a robust and well-articulated strategic plan to guide and underpin our activities. The work done by Council members and the Board and Officials in getting to this stage has been valuable in itself – it is helping us to be an even more 'connected' organization with more of a sense of common purpose, and this can only continue as we implement the strategic plans we have worked so hard to produce. I call this the 'end of the beginning' because it is intended that the 2013-2017 strategic plan will be a rolling plan, updated annually so as always to have a five year time horizon for the EFG's activities.



Introduction by the EFG Panel of Experts on Geological Heritage

Geodiversity and Geoheritage, modern perspectives for Earth Scientists and for Europe

Hanneke van den Ancker[*]

In the introduction to this EFG Special I would like to highlight some of the major achievements in geodiversity and geoheritage over the last decade. Then, I ask you to consider that the majority of these initiatives were started off by a small number of dedicated professionals supported by enthusiastic local officials. Thus, I hope this issue will inspire you to start new initiatives.

The birth of the European Geoparks Network (EGN) certainly was one of the main successes of this decade. Looking back, it is hard to believe that it only started off in 2000 with four European Geoparks. Twelve years later, it is an active network of 50 accredited European Geoparks, that are regularly evaluated, and the network is still growing. In 2004, it gave rise to a Global Geopark Network (GGN) and got the support of UNESCO. Thanks to the efforts of the Chinese, the GGN in 2012 embraces 85 geoparks, including most EGN parks.

European and Global Geoparks are important in raising the awareness of local officials and the wider public for regional identity, the geological history of the area and how cultural history and nature respond to it. The economic development of local geosites in sustainable tourism is another important geopark issue, for example in walks, cycle tours, wine and local cuisine. Old quarries are thus given a second life. The European and Global Geoparks are in close cooperation; exchanging best practices and experience in raising environmental education, green geotourism, regional product innovation and quality management.

The EU regional funds were an important tool that made the European Geopark development possible.

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Furthermore, the EGN triggered the start of national quality geoparks networks. China, Germany and Japan are front runners in this respect. In less than five years, China produced a network of over 150 national geoparks.

ProGEO, the European organization for the conservation of the geological heritage is the European seed organization and was founded in 1986. It is very involved in the more academic aspects, such as the criteria for the selection of sites for national and international geoconservation, mapping, GIS-techniques and databases, rules for monitoring and the development of legislation.

ProGEO is also a large network with national representatives in all European countries. Each year it organizes a meeting, regional or European, in which members present their studies, projects or ideas. They later can be published in the ProGEO journal Geological Heritage and quarterly ProGEO Newsletter. In October 2012, ProGEO has published an overview of Geoconservation in Europe, see page 60 of this issue. The Belgian and Italian contributions to this EFG issue are examples of such overviews (page 8 and 23).

For the geomorphological aspects of our landscapes the IAG working group on Geomorphosites is a sister organisation of the ProGEO network. It has produced several reports and publications and also has yearly meetings. Prof. Dr. Emmanuel Reynard of the University of Lausanne, Switzerland, its present chairman, is very active in developing interesting geo-based walks and tourism and supporting national and European geopark initiatives. He was also a member of the team of the Swiss Academy of Sciences that published a report and proposed a structure to support these initiatives. See page 44 for his contribution to this issue.

Links to the websites of the organizations can be found in the article about our Green Week contribution by Patricia Cortes, page 56, that highlights the combined action of six European organizations to make EU officials more aware about the role of geodiversity and geoheritage for sustainable water management and in EU water policy, issues that are still being developed.

Before getting to the role of the EFG-PE Geological Heritage and Soil Protection, I would like to mention the role of the UK and two universities. The UK already in the 1940s started a well-documented network of Sites of Special Scientific Interest (SSSIs), including geosites. These sites are protected by legislation and regularly monitored. The database can be consulted through the website of Natural England (formerly English Nature). More recent UK products are the Geodiversity Action Plans; even London has such a plan. Dr. John Gordon, who this year joined the EFG-PE Geological Heritage, was the driving force within Scottish Natural Heritage behind several publications on a more sustainable management of rivers, estuaries, hills and mountains. In this issue, page 48, he writes about the Scottish Geodiversity Charter and what it tries to achieve. Prof. Dr. Murray Gray of the Queen Mary University, London began lecturing in geodiversity more than a decade ago. In 2004, he assembled his lectures into a first book on geodiversity, entitled GEODIVERSITY. As a consequence, he was invited to speak all over the world. In the interview on page 60 he gives a preview of the new edition of GEODIVERSITY and his opinion about issues that need development. The summer schools, PhDs and Postdocs of the University of Minho, Braga, Portugal are another important achievement.

Finding solutions for society goes through a cycle of raising awareness, formulating policies, developing tools and evaluating products. The PE on Geologi-

cal Heritage of the European Federation of Geologists is active in these fields. We have responded to EU documents and legislation. With the support of the EGN we produced a *Manifesto on Geodiversity and Earth Heritage*, that was signed by 11 organizations, and led to geodiversity and geological and soil heritage becoming part of the EU Soil legislation, 2006, which is still under discussion. We participated in and organized several Taiex workshops, for example in the Baltic countries and on sustainable coastal management. We promote geodiversity in academic teaching, and have co-organized a session in the yearly EGU Vienna conference 2012. One of the issues we are now working on is to improve the geodiversity and geoheritage aspects in the Quality Coast label of the EUCC, the Coastal Union. First discussions are taking place to extend this label to non-coastal communities (see page 53).

My own country, the Netherlands, is a good example of how policies can change from one moment to the next. Although proactive in developing soil and environmental legislation in the 1980s and 1990s, the present government has a tendency to think clean food and drinking water and prevention of disasters are sidelines, and the Ministry of Environment has thus become subordinate to and part of the Ministry of Infrastructure. Innovation in small-scale landscape fitted solutions, culture, cultural heritage, nature conservation, development of geotourism, even officially, are called 'left wing hobbies', and are managed at community level and by the private sector. Government funding for these issues has been cut by 40 – 60%.

In recent years I have often had to be at the hospital, because of relatives getting older. There I noticed how the existence of patient societies helps to improve the treatment. Better information through brochures, individual experiences with treatments and even medical development itself, thus is stimulated. It is my belief that our geological societies have a similar role to play, e.g. with respect to geodiversity and geoheritage.

A last example, Geopark Mecklenburgische Eiszeitlandschaft (Ice Age landscape) is a project of the local geological society.

Challenges to geoheritage conservation and sustainable development in Belgium

Michiel Dusar[*] and Roland Dreesen

Geoheritage - in brief, the legacy of the geological past, in rocks, soils and landforms - is not so much an issue of peculiar interest for countries endowed with mineral wealth or wild landscapes. On the contrary it is an essential though not so frequently recognized component of the history of land use and the quest for natural resources. In countries like Belgium, with continuous occupation, exploitation and modelling of the landscape for at least two millennia, the environment in which we live seems utterly cultural and devoid of natural interest, except for all the other living creatures which share our environment or struggle to survive within their own tiny part of a common habitat.

The Great Acceleration witnessed during the last one and a half centuries has allowed current generations to dominate their environment to the point where they resist any natural event disturbing their lifestyles and consider humanity as the driving force for evolution. The Knowledge Economy seems to be detached from the geological substrate, which was so evident in the Industrial Revolution, the source of social evil and environmental degradation. However, the critical minerals issue and legitimate fears of dependency on countries monopolizing exploitation of geological resources - or more correctly, practising long-term geological exploration - have awakened at the European level sobering thoughts that we need the blessings of the Earth just as we need to know how to deal with its misfortunes.

Geo-information is regaining importance, but how to make it visible and meaningful to the public or to decision makers? Geoheritage conservation and management has to play a vital role, especially in countries where daily life is no longer connected to the resources on which our well-being is based.

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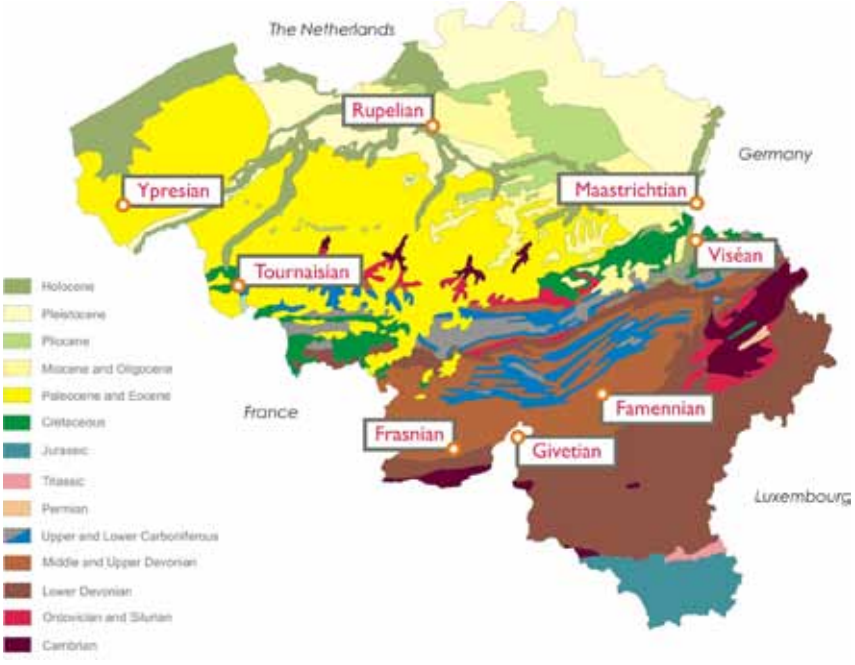

Figure 1: Geological map highlighting the chronostratigraphic stage names derived from locations with stratotypes (partially) in Belgium (from Dejonghe, 2006).

Public acceptance of geodiversity

Protection of nature and maintenance of biodiversity is the driving force behind the creation of nature reserves or nature parks, widely supported by the public as essential for the well-being of the Planet Earth and the sustainable development of humanity. However, with reference to the biome concept, ecosystem diversification would be very limited in Belgium, resulting in rich but uniform ecosystems, without the intervention of geodiversity. Geoheritage, i.e. geodiversity and human exploitation of this geodiversity, have resulted in a great variety of additional apparent or half-natural landscapes. In flat-lying areas like Flanders it is often the past extraction of mineral resources (peat, clay, sand) which has created the most valuable wetland nature reserves. At a higher scale World Nature Heritage sites derive their nomination from outstanding geological and physiographic features, i.e. the underlying geodiversity, but their management is also mainly restricted to protecting the living nature. This biased approach leads to problems: ignoring the geological substrate and dynamic processes involving interaction between geo-hydro-biosphere means that the rare and endangered species for which the nature reserves are created in the first place may be highly vulnerable and as a result biodiversity gradually loses its most unique representatives. This problematic situation - the fact that protecting the living nature is insufficient in sustaining what is rare and exceptional - is observed worldwide and it is now realized that it may be - in a significant way - due to a conceptual flaw, the separation of geo- and biodiversity. Remedial action now appears top down. IUCN adopted at its World Conservation Congress, held in Barcelona, 5-14 October 2008, a motion emphasizing the link between geoheritage and biodiversity and the need to conserve both forms of heritage.

Figure 2: Rocher de Freyr – protected rock outcrop (Dinantian limestones).

Figure 3: Underground quarry (building stone = Maastricht limestone) : site protected for cultural reasons (Caestert quarry, Kanne): medieval graffiti on the wall (photograph: Bert Beckers).

Geoheritage potential in Belgium

The geology of Belgium forms the stage where a large part of Earth's history has been elucidated: indeed, geologists make worldwide use of chronostratigraphic stage names coined in Belgium (Rupelian, Ypresian, Visean, Tournaisian, Famennian, Frasnian) or derived from border towns where part of the type section is located in Belgium (Maastrichtian, Givetian) (***Fig.1***). As the legacy of pioneering 19th century geologists such as André Dumont and Jules Gosselet, these stage names belong as much to the global cultural heritage as they refer to the local rock outcrops and quarry sites in the historical name-giving areas. If Belgian geologists had been more attentive, this list could have been longer and include, e.g. Landenian or Couvinian (Dejonghe, 2006). It is primarily the responsibility of present and future generations of academic geoscientists to preserve the value of these names and of regional geoscientists to maintain the link between the historical type areas and the preserved geoheritage. The classical Meuse profile between Namur and Givet, displaying different facies for the Palaeozoic international stage names, is hailed as one of world's finest showcases of a geological succession in an orogenic belt (***Fig. 2***).

Besides the sites and sections linked to the chronostratigraphic stages, Belgium possesses emblematic natural heritage sites with a long history of human curiosity about their geological character. These sites where underground expeditions took place, before geology as a science or the stratigraphical time scale were established, were the precursors to geotourism. Examples are; the natural caves of Han-sur-Lesse, a model for a meander cut by an underground river, or the underground labyrinth of Montagne St Pierre created by room and pillar mining of the Maastricht stone, where the Mosasaurus hoffmanni was discovered in 1770 and subsequently deposited in the Muséum in Paris as a war trophy. Han-sur-Lesse is a popular showcave but has retained its importance for geological research. The underground quarries of Montagne St Pierre have been destroyed by open cast quarrying but efforts are being made to protect the remaining underground quarries (***Fig. 3***).

The recent morphological evolution - epeirogenic uplift with river incision - has exposed many more rock outcrops or allowed their exploitation, showing more than 500 million years of geological history in a restricted territory (Dejonghe & Jumeau, 2007). This has resulted in a legacy of rock sections, type sections and quarry sites of high regional stratigraphical and educational value (***Fig. 4***), many if not most of which are threatened by oblivion and only occasionally the subject of conservation. Fossil and mineral occurrences sometimes produce new minerals (e.g. minerals first described from Belgium, Hatert *et al.*, 2002; Van Der Meersche *et al.*, 2010) or exceptional fossil finds unmatched elsewhere in the world (e.g. the Neogene whales of Antwerp, or the Cran aux Iguanodons in Bernissart, now the showcase of the Natural History Museum in Brussels). The industrial basin along the Meuse - Sambre - Haine rivers was the start of the industrial revolution on the European mainland, fuelled by coal but with a rich and diversified tradition of mineral extraction and manufacturing (Goemaere *et al.*, 2010). Nowadays, its geoheritage is concealed whereas the industrial heritage is acquiring UNESCO World Heritage status (n° 1344).

Despite greening of the landscape, back filling and the obligation to flatten slopes of closed extraction sites, a number of geosites still exist in some regions, while in other regions former outcrops need to be exhumed to display any contact with the geological substrate. An inventory and classification of these geosites including their values and threats needs to be updated.

With respect to the industrial and mining heritage, many initiatives for conservation and development are already operational (cf Dejonghe *et al.*, 2009). Also, nature reserves, natural parks and regional landscapes often possess sites of geoscientific interest. The insight that their preservation contributes to ecosystem diversification is gaining ground (***Fig. 5***). Indeed, new threats arise from the vigorous restoration of more natural ecosystems. Vulnerable landforms, resulting from past and abandoned forms of land use may be sacrificed, e.g. the blow-outs uniquely preserved in the Bocholt plain (NE Limburg) have been levelled to create new nature areas.

A special category of urban geology, historic monuments, whose raw material source may have been lost in time, forms

Figure 4: The Beauchateau quarry: type section for Upper Frasnian red mud mounds with a high educational value. Site also cherished for outdoor activities and rock climbing (photograph: Pierres et Marbres de Wallonie).

an attractive type of 'displaced' geoheritage, allowing the study of facies development and weathering phenomena in conjunction with physical characteristics of the building materials.

Geoconservation as part of the geo-bio-cultural heritage management chain

Barriers to conservation of geosites / preservation of geodiversity

Experience from many countries shows that geologists as a stand-alone group are unable or even unwilling to protect geodiversity or to convey the message of its urgency. Geomorphologists (physical geographers in the Belgian context) share the same values. With their backgrounds in the educational system or land use agencies they are more efficient in dealing with the public. Moreover, sharing knowledge among geologists, geomorphologists, soil scientists and hydrologists will bring a more holistic approach, which is necessary to convince society as a whole of the importance of geodiversity.

Filling the gap left by the inadequate treatment of System Earth in the educational system, resulting directly in lack of visibility, indirectly in insufficient numbers of professionals and funding of geoconservation programmes, can be achieved by involving volunteers. Because of their different background and interest they allow overlap with conservation of biodiversity and cultural heritage issues. A problematic issue is the rapid deterioration or abandonment of many geosites located in quarries, once quarrying operations are terminated. Without local volunteers, remedial action may come too late or become more expensive.

Nature conservation groups are well established in our society and manage those areas where conservation is most urgently needed. Cooperation would create a win-win situation because these groups can provide the supporting framework for effective geosite protection while they can use geoscientific input for sustainable management of ecosystems. This requires mutual understanding: biologists should realize that nature is dynamic and that working geological processes contribute to ecosystem resilience, while geologists should intuitively accept that living nature has a higher value from an ethical perspective.

There are so many urgent needs for conservation of the geological heritage and so few government or industry-supported programmes that this issue cannot be left only to professionals. Geoscientists wherever they are working, or retired, should continue to instruct if not assist local conservationists or more actively participate in - and why not initiate - local conservation projects. This could mean that presentation of geoheritage values does not meet academic standards. However, geological information provided to the public by guides and volunteers will rarely represent state-of-the-art scientific knowledge. It need not be academic but instead address the feeling of the public. The public must feel satisfied with the acquired information, proud of the work of past generations and attached to the works of nature. Popularization is not necessarily a downgraded form of science communication but can play a vital role in public involvement in conservation issues (***Fig. 6***). Not many geoscientists are trained as science communicators but they should realise the value of non-scientific communicators.

Figure 5: Combining natural environment and geoheritage values in the former glass sand pit of Opgrimbie: great outcrop exposing evidences for climate change (from Miocene lignites to Pleistocene polygonal soils) (photograph: Regionaal Landschap Kempen en Maasland).

Actions for the advancement of geoheritage conservation and management

Act locally. Help conservationists to discover the geodiversity values which are often present in what they cherish. Past geological processes or human use of natural resources are responsible for current biodiversity; active geological processes are often vital for maintaining the health of an ecosystem; windows on geological features increase the ecosystem variability. Similarly, industrial and mining heritage are linked to the natural environment in which the industry was operating, and depend on the natural inorganic ingredients of the products manufactured. This seems obvious for coal mines, brick yards, lime kilns, but is equally the case for breweries, water mills, metallurgy. Geoscientific input is essential in explaining the geographical origin of many industrial activities while its impact remains secondary to building and manufacturing processes in the public outreach.

On a policy level, a common practice for all countries is raising awareness of geodi-

Figure 6: Example of popularisation: geological bicycle route in the province of Limburg (Eastern Belgium): explaining the landscape and linking substrate with nature (flora and fauna) and culture (natural building stones).

versity and the importance of geoconservation by systematically putting it on the agenda of decision makers or their advisory committees dealing with the organization of the territory, mitigation of natural hazards, heritage conservation (Natura2000, Commissions of Monuments and Sites, land use management plans).

Think globally. Heritage conservation – of whatever type – meets a solid community support, as testified by popular events such as open monument days. A plethora of heritage organizations are active on the heritage scene thanks to subsidies. There is a large volunteer population maintaining many local initiatives, also related to geological resources such as mining museums. Our many governments spend considerable budgets on acquisition and maintenance of monuments, nature reserves or heritage sites. Why then does geoheritage remain in the background and why are so few geoscientists involved? This may be, firstly, because geoheritage has been orphaned at the institutional level. The responsibility for geoheritage has been split between nature reserves and mining heritage. Moreover, these institutions lack the structural support for assessment of geoconservation issues by a stable and influential educational/environmental/geoscientific organization. Decisions for protection are made ad-hoc but there is no ranking of sites, no thematic approach or possibility for addressing hiatuses in the geoconservation initiatives. Secondly, geoheritage initiatives are developed in near-isolation. There is no representation of Belgium or its subdivisions on the European / international scene regarding the promotion of geoheritage conservation and sustainable development, e.g. the European Association for the Conservation of the Geological Heritage, Pro-GEO, or European Geopark Network, EGN.

Protecting geosites is the first step in the more holistic geopark approach, enhancing the sense of place and enlarging the leisure industry. Geoparks are a hot issue: the geopark concept was initiated in 1991 with the Digne Declaration, made official in 2000 with the European Geopark Network and has conquered the world in less than a decade. The Global Geopark Network is likely to become a UNESCO Programme to which our governments will have to pay equal attention as to World Heritage and Man and Biosphere programmes. Belgium has the potential to develop geoparks, both in the north and the south as well as cross-boundary. The geoscientific community can make itself the messenger of new ideas concerning conservation and must be prepared to introduce the geopark concept right now.

In the absence of a clear framework of geoheritage concepts in Belgium, creative use is being made of terms, such as geopark or its translations, without reference to the internationally accepted standard definition. However, the visitor management and stakeholder cooperation of the National Park Hoge Kempen is reminiscent of the European Network of Geoparks. Upgrading this and other 'park' areas, e.g. the Vallée du Viroin to EGN status requires making some administrative adaptations but resistance appears to be more of a psychological nature, because of fears of having to give in on biodiversity protection, or more generally because the operating mode of the network of geoparks is still unknown.

Conclusions

Due to its complex geological makeup and intensive use of mineral resources, Belgium has a rich geological heritage, of worldwide importance, as shown by the great concentration of chronostratigraphic stage names from such a tiny area.

The knowledge society, however, is no longer connected to the geological substrate, which is intricately linked with the history of the country. The concept of heritage is a cultural construction, a value attributed to natural sites or areas and/or to their historical use. Similarly to biodiversity and cultural heritage, geoheritage must be recognizable and interesting for scientific, educational, esthetic and/or recreational purposes. No identification and assessment of the value of geoheritage is possible without geoscientists.

As a second step, no protection and conservation of geoheritage is possible without public consent and support by the authorities in charge. Not unexpectedly, geoscientists are convinced that geology is interesting, but to the general public the same geology may be inaccessible and boring. Therefore it is necessary to 'humanize' geology to make it understandable for ordinary people not accustomed to the geological scale of time and dimension. Besides geoscientists, who are aware of the importance of geoheritage, and science communicators who are able to take this message to the public, geosites need 'community champions', proud of their geoheritage, and who can promote the assets of their locality or region. Sustainable conservation of geoheritage can only succeed when this cooperation is functional and the barriers between the different forms of heritage are overcome.

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Plitvice Lakes National Park (Central Croatia) - More than 50 years of continuous monitoring of natural and human influence

Jasenka Sremac, Srećko Božičević and Izidora Marković*

Plitvice Lakes National Park is one of the most beautiful and oldest protected areas in south-east Europe and the largest national park in Croatia. The principal natural phenomenon is a dynamic system of lakes separated by tufa barriers and waterfalls. Tufa barriers were deposited during the warm episodes of the Quaternary period and are still growing. The area has recently been endangered by global climate trends, watercourse regulations, forestry and agricultural activities, leaking wastewater systems, war operations and tourist pressure. Eutrophication of lakes is additionally caused by natural input of humus from the surrounding area.

Le Parc National des Lacs de Plitvice est l`une des plus belles et des plus anciennes zones protégées du Sud - Est de l` Europe ainsi que le plus grand parc national de Croatie. Le phénomène qui détermine le parc est le système dynamique des lacs séparés par des barrières de tuf et des cascades. Les barrières de tuf proviennent des sédiments qui se sont formées au cours des épisodes chauds du quaternaire et qui sont toujours en croissance. De nos jours la région est menacée par les changements climatiques, la régulation des cours d`eau, les activités forestières et agricoles, les systèmes de canalisation perméables, les opérations de guerre et la pression touristique. L`eutrophisation des lacs est accélérée par l`introduction naturelle de l`humus des environs.

Plitvice Lakes National Park es una de las áreas protegidas más bellas y antiguas de Europa Sudoriental y el parque nacional más grande de Croacia. El principal fenómeno naturale es un sistema dinámico de lagos separados por barreras de toba y cascadas. Barreras de toba se depositaron durante los episodios cálidos del período Cuaternario y siguen creciendo. El área fue recientemente puesta en peligro por las tendencias del clima global, los reglamentos del curso de agua, los bosques y las actividades agrícolas, derrame de aguas residuales, operaciones de guerra y la presión turística. La eutrofización de los lagos es, además, causada por el ingreso natural de humus de los alrededores.

Plitvice Lakes National Park is one of the oldest protected areas in Croatia. The name Plitvice, probably originating from the Croatian word *plitko* (= *shallow*), was first published in a document by the priest of Otočac, Dominik Vukasović (1777). The first efforts to protect Plitvice go far back to 1914, when the Croatian Parliament received the petition. The area was proclaimed a National Park for the budget year 1928/1929, but the National Park was not fully established till 1949, and was inscribed on the UNESCO World Heritage list in 1979 (Stilinović, Božićević, 1998 and references therein).

The park is managed by a Public institution whose activities are regulated by the Croatian Constitution and the Nature Protection Law and monitored by the Council of Management. The establishment of such an institution opened the possibility of continuous monitoring of natural and anthropogenic processes in the area. National and international institutions additionally support the sustainable development of the area through legislation and through various projects (e.g. ANTHOPOL.PROT – FP5, SOWAUEMED project etc.) (Obelić *et al.*, 2006; Obelić, 2011)

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Main features of the park

Plitvice Lakes National Park covers an area of 19,200 ha (296.85 km^2). It is situated on a plateau 650-700 m high, between the mountains Lička Plješevica (1,640 m) and Mala Kapela (1,280 m), in the karst region of the Croatian Dinarides. Sixteen lakes cover ca. 10 % of the park, but they are considered the most beautiful and interesting part of the territory (***Figs 1, 3***). The rest is covered mostly with beech or beech-fir mixed forests (***Fig. 2***) with high plant biodiversity and is inhabited by a rich and diverse fauna (http://www.np-plitvicka-jezera.hr). Lakes originate at the confluence of Crna and Bijela Rijeka rivers, and are additionally fed by streams, temporary creeks and rainfall (***Figs 1, 3***).

Due to the differing rock base, two different lake systems can be clearly differentiated. The Upper lakes are large and are situated on impermeable Triassic dolomites, whilst the Lower lakes occupy a narrow limestone canyon and outflow into the Korana River (***Figs 3, 4***) (Polšak, 1974).

Tufa barriers grow by incrustation on mosses, algae and aquatic bacteria, with an estimated rate of 1-3 cm per year. This process is very sensitive to environmental stress and is often associated with warmer climate periods. The attempts to protect this phenomenon can be traced in published literature since the beginning of the 20th century (Pevalek, 1935; Stilinović, Božićević, 1998 and references therein). Pevalek was particularly important in establishing the National Park, and its research centre is named after him. According to the latest radiometric dating, older inactive barriers were precipitated between 250,000 and 300,000 years ago (Mindel-Riss) and also 90,000 - 130,000 (Riss-Würm) years ago. Active barriers have been produced within the last 7,000 years (Obelić, 2011).

Besides their geomorphological and geological value, Plitvice lakes are famous for their exceptional flora and fauna, including several endemic species and healthy populations of endangered taxa. Therefore they are continuously monitored by a variety of natural scientists – biologists,

geologists, geographers, chemists, physicists and others.

The Croatian Geological Institute, with collaborators, was responsible for the geological mapping and the Faculty of Science, University of Zagreb is continuously present with various teams studying geological and ecological factors.

The Veterinary Faculty, the Faculty of Forestry and the Faculty of Agronomy in Zagreb are also involved. Research teams from the Croatian Academy of Science are monitoring the biota. Scientists from the Institute Ruđer Bošković introduced radiometric and isotope analyses, and this team is permanently studying and publishing on the area (e.g. Horvatinčić *et al.*, 2006; Obelić *et al.*, 2006; Obelić 2011). The Plitvice Lakes have several times been the subject of dissertations (e.g. Barešić, 2009), and the research process is ongoing.

Evidence of natural and anthropogenic processes

Natural processes

Lakes in general are very sensitive environments, due to their close interactions with surrounding areas. Complex processes of sedimentation and dissolution of limestone require specific climatic preconditions. Weather and temperature factors are of great importance, as well as the water quality and other natural factors. For precipitation of calcium carbonate the water saturation level needs to be higher than 3, and the pH value of water must be above 8.0. In modern times the deposition rates (average 13 mm per year) have exceeded the dissolution rates (0.001-4 mm per year), enabling the accretion of tufa barriers and the formation of new lakes, but at the same time resulting in lake-level rise in the Upper lakes and fall in the Lower lakes (***Figs 3, 5, 6***). Plants indirectly contribute to tufa formation. Mosses, algae and cyanobacteria

Figure 2: Forests cover 75 % of the Park. Čorkova uvala with Čorkovo vrilo spring is a locality with protected virgin forest, July, 2012.

Figure 1: Position and topographic map of the Plitvice National Park (Basic topographic map of Croatia, sheet Bihać 420-1).

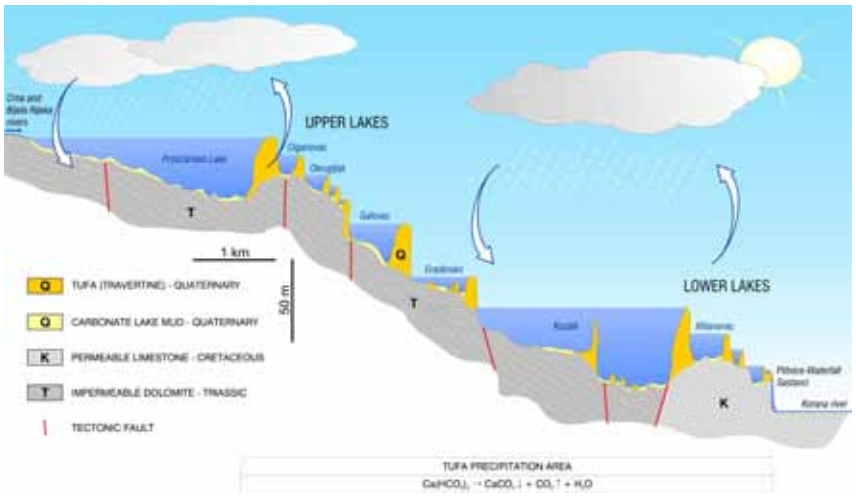

Figure 3: Cross section of the Plitvice Lake System with simplified water cycle (based upon: Petrik, 1958; Polšak et al., 1976; Božićević, 1994).

are responsible for different biological types of travertine (Barešić, 2009 and references therein).

Global warming, and water-level fall have been monitored in recent decades, showing a more pronounced influence on smaller lakes (***Fig. 7 a, b***) (Barešić, 2009). Fragments of ice cover can cause damage to tufa barriers in early spring.

Anthropogenic processes

Global influence

Radioactive explosions during the 1960s can be traced by contamination in lake sediments (***Fig. 8***) (Barešić, 2009). This indicates that global processes can indeed affect the geological heritage, no matter how isolated and protected it is. Another process that may affect the state of Plitvice Lakes National Park is global warming, which accelerates natural processes and affects the precipitation in the lakes.

Local influence

Human influence has affected Plitvice Lakes for many years. The area has been inhabited since Illyrian times and was later incorporated into the Roman Empire. The area shared the destiny of the whole of Croatia, with many battles and different conquerors. A military Frontier was established in this area in 1538, during the Ottoman Empire, and a lot of autochthonous people from this area migrated to the west. Due to some horrific battles the area acquired the name, Devil's garden. After the defeat of the Ottoman army, the Habsburg monarchy restored civil reign in 1788. Another conqueror, Napoleon, held the province from 1805-1814.

Roads, war camps, fortresses and other structures (e.g. water-mills) were constructed during that period. The forest was intensively exploited. Logs were transported downstream, often causing damage to tufa barriers.

The first accommodation for tourists was built in 1861, and the first hotel was built in 1890. Since that time several measures have been taken in order to protect the lakes. In the early 1980s, the regional road from Zagreb to the coast, originally built along the lakes, was replaced by modern roads and highways away from the park and heavy truck traffic was diverted to Ličko Petrovo Selo and Prijeboj. The swimming pool at Lake Kozjak was closed in 2006 in order to diminish the organic pollution, but the principal problem of leaking drainage is still unsolved.

The lakes were placed on a Danger List by UNESCO from 1992-1997, during, and shortly after the occupation by the paramilitary Serbian army. From 1991-1995 the Park was abandoned by staff, the forest was severely damaged, hunting of bears and fish by dynamite was common, and the area of the Čorkova Uvala forest was mined.

Although the Park is no longer considered as an endangered area, the large numbers of tourists visiting Plitvice during the whole year also represents a serious threat for this fragile pearl (Pevalek, 1935; Božičević 1991; Stilinović, Božićević, 1998; Horvatinčić *et al.*, 2006; Barešić, 2009). In 2011, the number of tourists exceeded one million. Previous management of the park did not recognize the threat in these trends, but considered such large numbers of visitors as a great success. Currently, Plitvice does not have an adequate set of indicators that could be measured and monitored with the aim of decreasing the tourist impact, as there are no daily limits for entrance of tourists. This leads to further degradation

Figure 4: View towards the lower lakes and Korana River carved in limestone canyon, July, 2012.

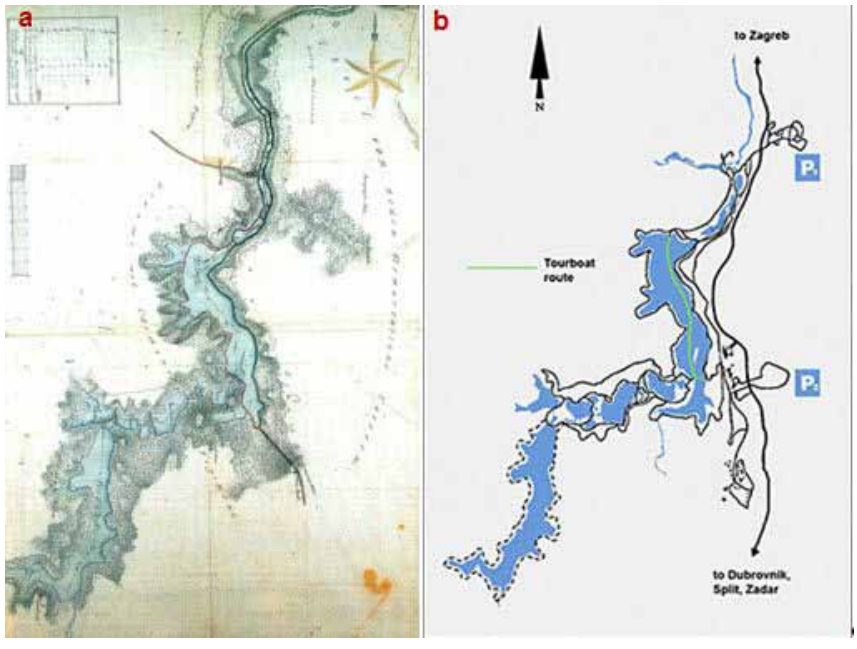

Figure 5: a) Ancient (Wagner, 1770) and b) modern sketch of lakes (www.worldwater.com). Full line: Common tourist paths with combination of walking, electric boat and electric train tours. Dashed line: Walking route.

of this area of international value. At the end of 2011 another threat appeared at the lakes. Despite the organized control in the Park, barriers at the Lower lakes were mechanically damaged, and several small young lakes were destroyed (***Fig. 9***). This devastation caused the additional fall of water levels in the Lower lakes (***Fig. 9***).

Conclusions

The Plitvice Lakes National Park in Central Croatia is a dynamic hydrological complex extremely sensitive to natural and anthropogenic processes. The equilibrium of physical, chemical and biological features in the lakes can be easily undermined by global warming, decrease of precipitation and input of organic matter.

Natural processes are hard to control, but human influence should be carefully maintained by the Park Public institution.

Figure 6: Sunken remains of tufa barrier in the lake Kozjak (Božićević, 1995).

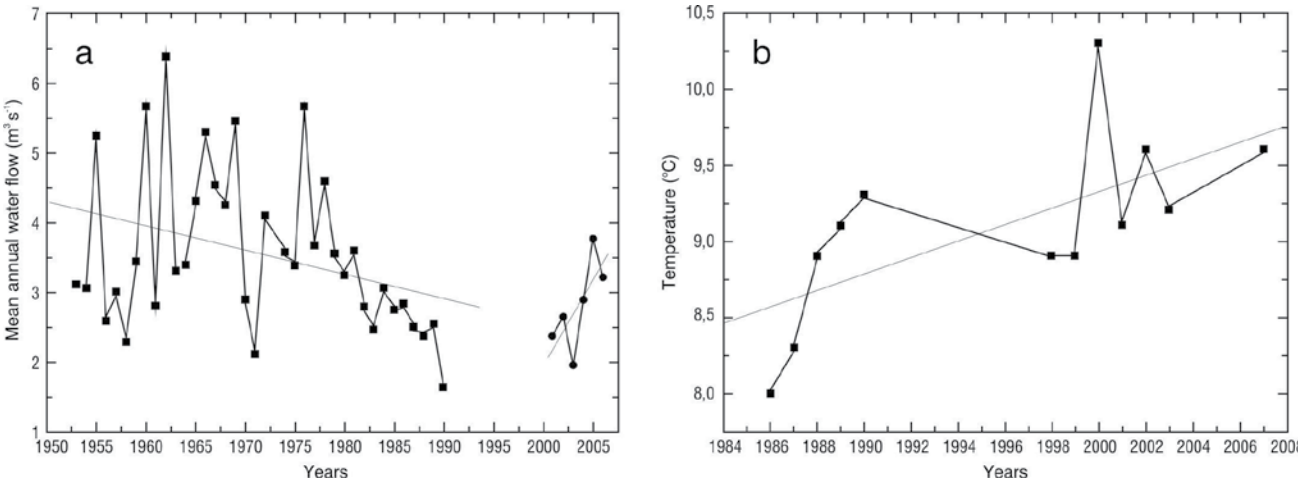

Figure 7: Mean annual temperatures (a) and mean annual water flow (b) for Plitvice lakes (Barešić, 2009).

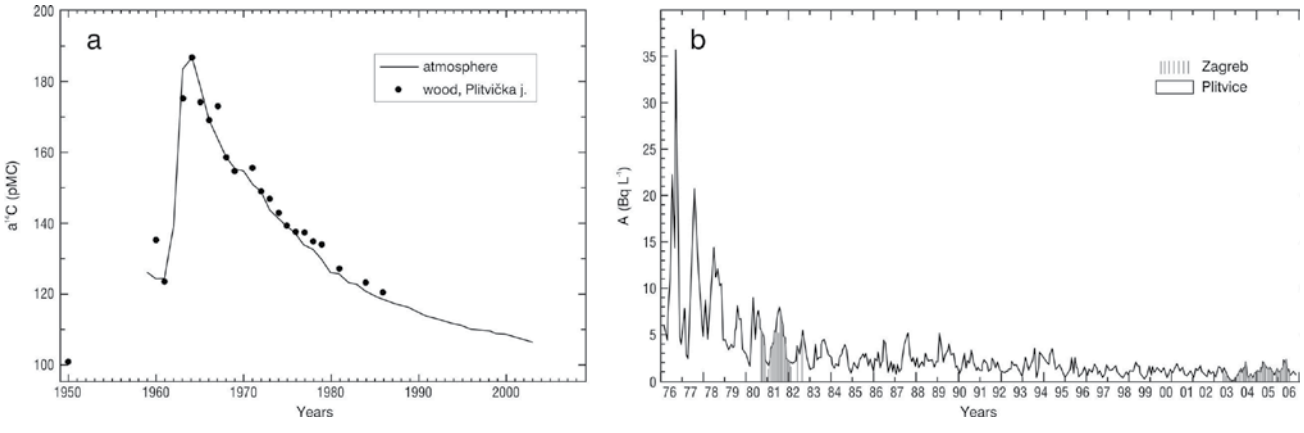

Figure 8: Distribution of 14C in atmosphere and wood at Plitvice (a) and tritium in precipitation in Zagreb and Plitvice area with pronounced peaks due to the nuclear weapon tests particulary in the period 1952-1963 (Barešić, 2009).

The most important threat is the inadequate water drainage system, which requires complete rearrangement.

The number of tourists should be kept under control by daily and/or monthly limits and by redistribution of groups away from the lakes to other interesting areas in the park that could also be interpreted as natural or ethnological heritage.

Acknowledgements

The authors are grateful to the Croatian Geological Society for the data on devastation at Plitvice Lakes in November 2011, and to the Croatian Ministry of Science, Technology and Sports (Project 119-1951293-1162) and the Institute for Tourism for overall support during field research.

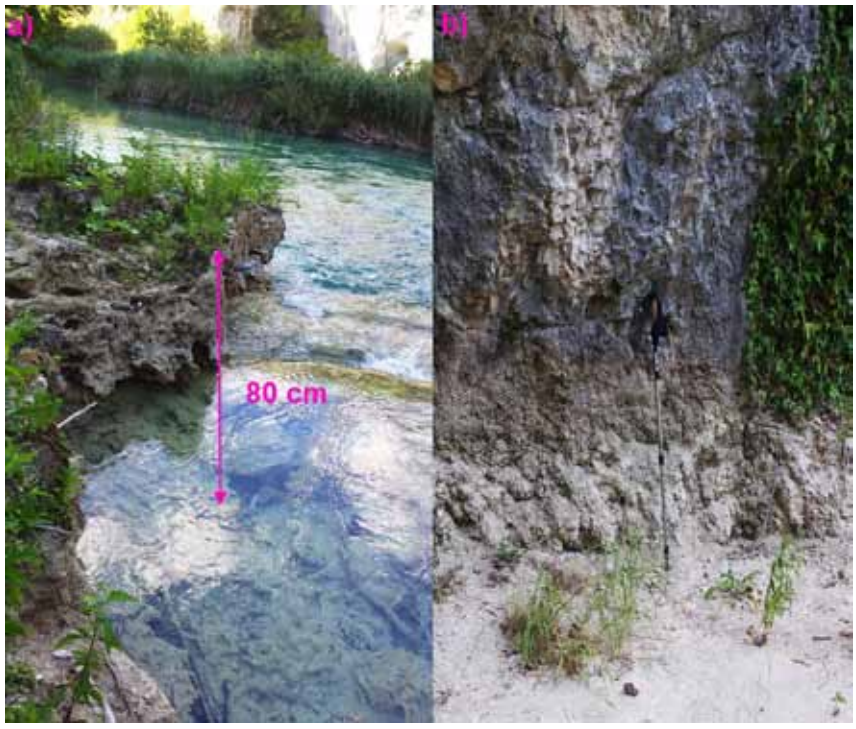

Figure 9: a) Damage at the barrier caused by anthropogenic impact in November 2011, b) Desiccation caused by damaging the tufa barriers, July 2012.

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Vulcania, a unique enlightening Earth Science site

François-Dominique de Larouzière and Antoine Bouvier*

Figure 1: Vulcania site.

The scientific exploration park, VULCANIA, which belongs to the Auvergne regional Council, is located about 15 kilometres to the west of the city of Clermont-Ferrand at an altitude of 1,000 metres. The 57 hectare site is nestled in a beautiful natural landscape within the young volcanoes (6,000 years old) of the Chaîne des Puys volcanic area.

Created in 2002 and open each year from March to November, the Park is not only dedicated to volcanism but to the Earth Sciences as a whole. It also deals with environmental themes and Natural Sciences (i.e. Botany, Physics, Astronomy).

To attract a large public and introduce them to the fascinating world of volcanoes, a moving scenography harmonizes the necessary scientific detail from the data display equipment and the efficient and modern communication system.
The themes and information are controlled by an international scientific Council made up of 15 members, all experts in their fields.

* Director of Science Vulcania.

The permanent scientific team of Vulcania, including five geologists, is reinforced during the summer by some 20 students (Masters level) specializing in geology, geography, geophysics, biology and environment.

Sensitization and communication missions outside the Park resulted in 66 weekly newspaper pages (1.2 million readers each week), but also interviews and articles for different media, radio programmes, newspapers, as well as commenting on topical geo-news items...

Thus Vulcania is neither a museum nor an attraction park and has been designed as a scientific exploration site where the need for amusement and pedagogy are closely associated to meet the wishes of a large public.

In August 2012, the Park welcomed its four millionth visitor. The impact of the park, with its task force of over 50 full-time employees, on tourism and the economy of this mountainous area, is also greatly appreciated by the regional authorities.

Vulcania is unique because it is the only centre of scientific discovery located in a rural area, although the city of Clermont-Ferrand is only 15 kilometres away. The site provides many facilities attractive to tourists: documentation service, a library offering 5,000 books, various audiovisual resources (picture bank, videos, CD ROM, DVD), restaurants and cafeteria, shopping facilities offering products linked to the natural sciences, pedagogy, reception rooms for groups and centres dedicated to conferences and colloquia.

The visitor is not left alone and can be accompanied during his discovery circuit by a geologist focusing on oral communication and spread of scientific themes, thereby contributing to the excellence of the visitor experience. All the information provided on the site is available in six languages: French, English, Spanish, Dutch, German and Italian, while a synchronized audio-guidance system allows the non-French-speaking visitors to benefit from the visit.

This cultural site, built mainly underground into recent lava (30,000 years old),

Figure 2: Ash clouds.

Figure 3: The unveiled planet.

consisting of scoria, lapilli and basalt, includes permanent exhibition rooms located mainly between 13 m and 20 m below the surface. They are connected locally to the surface through a luminous well, a glass oculus or semi-buried greenhouse. The Cone and the restaurant are the only buildings visible in the natural landscape.

A sensational gallery dug through the trachy-andesitic lava flow evokes a travel to the Earth's centre discovering legends and myths concerning the relationships between man and volcanoes; the visitor thus arrives in a volcanic garden bathed in sunlight, protected by a glass casing and can walk among exotic plants, six metre high tree-ferns, and other species growing on extrusive rocks.

Different areas are devoted to the Solar system and to the particular volcanoes discovered by space probes, from Martian structures to the powerful eruptions affecting Jupiter's Galilean moon, Io, and the craters of Venus.

On the ground, a luminous cross-section of the globe, nine metres in diameter, reveals the Earth's structure, with its plate movements, and shows the continuous slow convective stirring affecting the Earth's mantle. This interactive floor houses "pop-ups", short movies explaining the main phenomena of the mantle and the deep regions of our planet.

The tourist in a hurry can simply refer to a display synthesizing the site's contents and requiring only a few minutes attention, but the mean visit duration is actually six and a half hours.

Figure 3: Sight by night.

Figure 4: Volcanic garden.

The history of the Earth, from its birth 4.6 billion years ago to the present Global Change events, with its magnetic field, plate tectonics, earthquakes and volcanoes, are clearly explained and illustrated.

Among the key elements of interest available to the visitor are:

- the Cone, 28 m high, located in front of the Puy de Dôme, the main volcanic dome of the Chaîne des Puys, and covered with volcanic rocks;
- the Crater that is reached via a spiral ramp, 38 m deep dug through lava. Impressive special effects include muffled roaring, spouting fumaroles and reddish glares at the crater bottom;
- pedagogic spaces for pupils and students allowing geological debates about topics fitted to teacher and pupil needs.

Beyond the volcanoes, a panel showing the phenomena linked to their decline and inactivity is displayed. Geysers, solfatara, thermal or thermo-mineral springs and geothermal energy, mofettes, slow concentration of ores or slow crystallization of gems in the heart of ancient volcanoes or lodes, use of volcanic materials for the construction are also explained.

Today the public is eager to get information about the main challenges linked to natural risks, natural resources scarcity and environmental or climatic hazards. Since explanations provided by the media are often variably succinct or abstruse, the Vulcania scientific team is involved in discussing recent dramatic events: the volcanic eruption in Iceland (Eyjafjallajökull, 2010) or Indonesia (Merapi, 2011); the earthquakes in Banda Aceh (Sumatra, 2004), in Haïti, (2010) or in Japan (Sendaï, 2011) with the associated devastating tsunamis. Understanding the origin of tornadoes and droughts are also themes which interest tourists who appreciate the presence of passionate scientists able to answer their questions in easily understood language. Conference sessions enlivened by well-known scientists reinforce this communication mission.

Every year, Vulcania opens new and spectacular attractions: in 2010, *Machine Earth* and *Unveiled Planet*, explored the raised relief earth allowing the visitor to select his own Earth's segment. In 2011, *Mission TOBA* enabled the visitor to fly above a super volcano in Indonesia (2,800 cubic km of tephra erupted 74,000 years ago), and to visit the *Tunnel of the incandescent ash-clouds*, and a new temporary exhibition room: the *Volcano Devils*, commemorating the 20th anniversary of the death of the Krafft volcanologists. The Krafft family have indeed donated to Vulcania the core of their collections built during their scientific volcanic explorations all over the world. This year (2012), there were entertaining attractions for children, the result of a partnership with Universcience (Paris): the *Children's City*.

Each exhibition or leisure area is equipped with up-to-date technologies: raised relief holograms, rotating seats, earthquake simulators, tactile tablets, rotating platforms, special effects, etc. The various presentation units are independent and self expressive. An emphasis is put on the immediate visualization of the important messages portrayed. Each thematic unit is shown with variable objectives encouraging participation by the explorer, who is not only a spectator but a dynamic actor in this discovery.

Vulcania also plays a role as an interface relaying laboratory research to the public through several partnerships such as the laboratory "Magma and volcanoes" (CLERVOLC) from the Blaise Pascal University in Clermont-Ferrand.

Vulcania is an active mover in the cultural development of the Auvergne region, successfully harmonizing culture, various partnerships, territorial environmental protection and tourism.

For the students temporarily attached to the Park, their training is seen as a first step in developing competences, particularly in terms of oral communication and mediation of scientific themes.

Vulcania, without any equivalent in Europe, is dedicated to the knowledge of our planet. Promoting Earth Sciences, this site will continue its mission as a scientific culture centre, opened to all the visitors to this attractive area in central France.

Photos from Jerôme Chabanne,
www.vulcania.com

Geoheritage in Hungary - present and future

Géza Chikán, Ildikó Szentpétery, Szabolcs Nagy, Barbara Kerék, Ildikó Selmeczi and Gábor Csillag*

The protection of the geological heritage has a long history in Hungary. Formerly, geological objects of value were placed in museums, because this provided adequate protection for them. Since the 1970s the importance of in situ *conservation has come to the front. At present the ministry of the environment provides the legal protection. However, it has neither financial nor human resources to carry out a professional review. Therefore, it has been suggested that control should be restored to the Geological and Geophysical Institute of Hungary (formerly, and in the text, Geological Institute). In this regard, some promising cooperation is taking place with the responsible colleagues in the ministry. A review of the key sections records has started and an experimental Internet access to the elements of the database - on a geological map compiled by the Institute - has been provided.*

La protection de l'héritage géologique en Hongrie a une longue histoire. Précédemment, les objets géologiques de valeur étaient placés dans les musées car cela constituait pour eux une protection convenable. Depuis les années 1970, l'importance d'une conservation in situ *est apparue comme essentielle. Aujourd'hui, le ministère de l'environnement a rendu légal cette protection. Cependant, il n'a ni les ressources financières ni le personnel nécessaire pour effectuer une évaluation professionnelle des sites. C'est pourquoi on a pensé à confier à nouveau ce contrôle à L'Institut Géologique et Géophysique de Hongrie (anciennement, et dans le texte, L'Institut Géologique). A cet égard, une coopération prometteuse est mise en œuvre avec les responsables des Géosciences au Ministère. La revue des éléments clefs enregistrés a commencé et un accès expérimental par Internet aux éléments de la base de données est disponible – sur carte géologique compilée par l'Institut.*

En Hungría la protección del patrimonio geológico tiene una larga historia. Antiguamente los objetos geológicos de más valor se llevaban a los museos, porque de este modo quedaban perfectamente protegidos. Desde los años 70 ha empezado a tener relevancia la importancia de su conservación in-situ. *Actualmente el Ministerio de Medio Ambiente les proporciona protección legal. Sin embargo no dispone ni de recursos humanos ni económicos para llevar a cabo su estudio de un modo profesional. Por ello se ha sugerido que se debería devolver la competencia al Servicio Geológico y Geofísico de Hungría (previamente y en el texto está citado como Instituto Geológico). A este respecto se está produciendo una cooperación muy prometedora con los colegas responsables del Ministerio. Se ha empezado una revisión de los principales cortes geológicos y se ha elaborado una página web experimental para el acceso a las bases de datos sobre un mapa compilado por el Instituto.*

Since the emergence of human society, people have constantly struggled to co-exist with their natural surroundings, whilst having a sense of affinity for nature's beauty. Today, we have various approaches to dealing with nature, from constant redevelopment and improvement of infrastructure, which barely takes the environment into consideration, to a situation where any change, even a new pylon, is considered damaging.

Possibilities for the conservation of geological heritage

The removal of certain geological 'treasures' from the landscape may be necessary to protect them from damaging environmental factors or from human impact. It is also true that geology may be sidelined in connection with environmental protection and considered merely as a framework for the protection of the fauna and flora.

While objects such as fossils and minerals can be safely protected only in museums, the in situ conservation of the geological landscape is also desirable. An example of this is the "footprint sandstone" from Ipolytarnóc, pieces of which were removed for conservation in the Museum of the Hungarian Royal Geological Institute in 1902 and displayed in 1927 (***Fig. 1***).

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The National Geological Key Section Programme in Hungary

A significant initiative was taken in the 1970s in Hungary when efforts were made toward geological protection. The National Key Section Programme began in the Geo-

Figure 1: The "footprint sandstone" (Lower Miocene) from Ipolytarnóc in the corridor of the Geological and Geophysical Institute of Hungary.

logical Institute; one of the main aims was to excavate and protect geological sites *in situ*. In the frame of this project the scientific investigation of the most significant exposures of Hungarian stratigraphy took place throughout the country. Besides the geological description of stratigraphic units, mineralogical–petrographical analyses have been carried out from the rocks that make up the units. Brochures summarizing the results of these analyses and containing photos, geological profiles and maps were published by the Geological Institute. Simultaneously, the exposures have been kept in good condition, and efforts were made to protect them from the destructive effects of vegetation and humans. Documentation of 166 exposures was made in three languages (Hungarian, English and Russian) and was published up to 1990 (***Fig. 2***).

This project has also been influenced by the significant social changes that occurred in the early 90s. On the one hand, geological research spending significantly decreased; on the other hand the official (legal) protection of key sections was placed under the competence of the ministry of the environment. Simultaneously, the staff of the Geological Institute was reduced to less than one third; therefore records have been transferred from the Institute to the Hungarian Commission on Stratigraphy. Besides some concrete positive results this caused a number of disadvantages. The positive features include the fact that the establishment of legal protection can be more easily carried out by the ministry within its own competence. However, it was unfortunate that the Geological Institute was left out of the process, thus, the enlargement of the key section network and further detailed studies have become practically impossible. Departments in the ministry dealing with environmental protection did not consider the maintenance of this process or the enlargement of the project as their brief. Moreover, the Hungarian Commission on Stratigraphy received only occasional and variable amounts of funding.

Figure 2: The "National Geological Key Section Programme" book cover and the first page of an exposure's documentation.

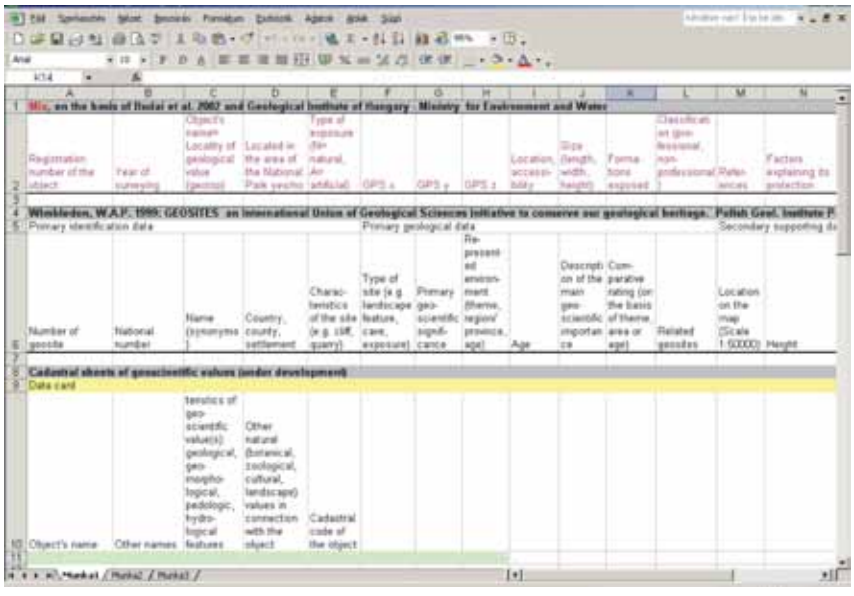

Figure 3: The table header — including different sources — created for the computer processing of geological items.

A new programme for managing geological heritage

In 2010 a new project was started in the Geological Institute with the aim of taking back responsibility for registration and professional supervision of our geological heritage. One of the subject's tasks was the definition of geological heritage; in our opinion, apart from natural exposures and collectible items, this includes drilling cores, which are worthy of conservation. Moreover, not only the spectacular aspects of geological heritage, which can be exhibited or are tourist attractions, should be taken into consideration, but those, which are important professionally. The programme also includes the compilation of references and a bibliography. The topic's ultimate goal was to provide the most complete approach, i.e. to create a processing system, which is valid for the large exposures (quarries/mines) and the smaller ones (road cuts) and may satisfy the requirements of both the profession and the general public.

In order to create a database for the numerous sites and objects, which are worthy of protection, we started to arrange data in a table (***Fig. 3***). For the design of the table international literature (Wimbledon, W.A.P., 1999), cadastral sheets (available from the ministry) and the above-mentioned register of the Hungarian Commission on Stratigraphy, concerning the key-sections of the country, were taken into account. The goal of compiling the table was to ensure a complexity which a) is suitable for registering each geological item, b) helps to separate the contents of

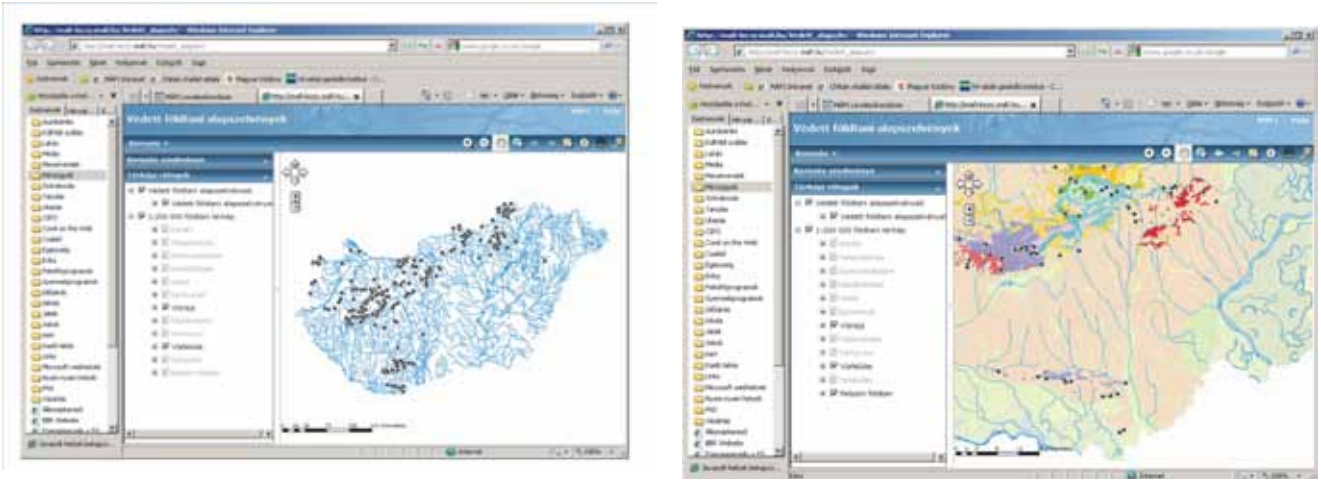

Figure 4-6: Currently available internet version of the cartographic display of geological key sections.

interest to the general public from those for professionals, c) makes the production, presentation and publishing of a map database possible and d) can be continuously updated. The table header and therefore its content are still under development. This table contains the data of more than 400 geological key sections registered by the Hungarian Commission on Stratigraphy, and with the help of this table we have also started to develop the map database.

In order to develop the map database, the best geological background must have been chosen. For this purpose the Geological Map of Hungary on a scale of 1: 200 000 (Gyalog and Budai, 2007) was the most suitable.

All key sections included in the table are plotted as points on a layer, which is added to the map that is available on the Internet (Chikán *et al.*, 2010). Clicking on a point on the map shows the code (number), the names, coordinates (in EOV - Unified National Projection - system) and character (quarry, road cut, etc.) of the key section and the stratigraphic position of the exposed formation (***Figs 4-6***) will appear. Link to *http://loczy.mfgi.hu/fdt_alapszelvenyek* and the map can be reached on the Internet.

Besides the improvement and completion of this database, it is intended to publish it as a Web 2.0 initiative and make the results available on the Internet; our colleagues in the Geological Institute have already made successful attempts to do this (Albert *et al.*, 2012). An important issue for the further development of these topics is that the ministry for the environment should hand over professional supervision of geological heritage to the specialized institute of the country, and the legal and financial basis for their maintenance, not only their protection, should be granted. In order to facilitate this, we would like to create a system of criteria, which will provide a higher level of protection. Modification of the geological institutional system will also exert an important influence on the management of geological heritage.

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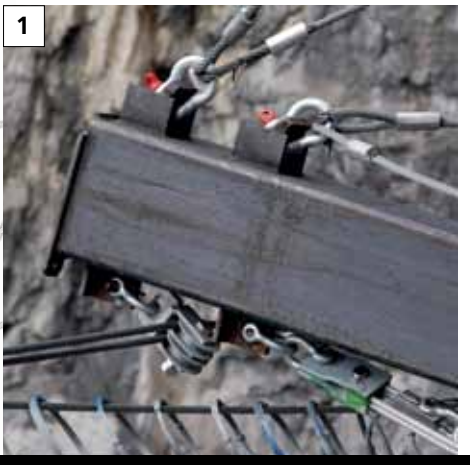
1. Support and transmission ropes are running virtually friction-free on running wheels
2. 20 metric tons impact into the barrier
3. Impact with 8,000 kJ successfully stopped



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Geoheritage: Nature and culture in a landscape approach

Francesca Romana Lugeri, Piero Farabollini, Gian Vito Graziano and Vittorio Amadio*

New environmental problems require new models for territorial study and innovative management strategies. The aim of enhancing local resources can be achieved only by directing development policies towards a path of integration between landscape protection, and socio-economic and cultural requirements. These functions can only be based on knowledge, enabled by new themes, such as wine production, and disseminated through new media, such as sports or film. Landscape is the key to the reading and cartography is the tool. With modern geographic information systems, each mapping process is associated with a database that indicates the value of each graphic element.

Des nouvelles problématiques environnementales demandent l'élaboration de nouveaux modèles pour l'étude du territoire et des stratégies de gestion innovatrices. Le but de valoriser les ressources du territoire peut être atteint uniquement en orientant les politiques de développement vers une voie d'intégration entre les exigences écologiques et de protection du paysage et les nécessites socio-économiques et culturelles. Ces fonctions ne peuvent être basées que sur la connaissance, activé par de nouveaux thèmes, tels que la production de vin, et diffusées à travers les nouveaux médias, comme le sport ou la représentation filmique. Le paysage est la clé de la lecture; la cartographie, et les systèmes d'information géographique, sont l'outil.

Nuevos problemas ambientales requerirá el desarrollo de nuevos modelos para el estudio del territorio y de estrategias innovadoras de gestión. El objetivo de aprovechar los recursos locales sólo se puede lograr mediante la dirección de las políticas de desarrollo hacia un camino de integración entre los requisitos ambientales y las necesidades de protección del paisaje y socio-económicos y culturales. Estas funciones sólo se puede basar en el conocimiento, habilitado por los nuevos temas, tales como la producción de vino, y difundida a través de nuevos medios de comunicación, como los deportes o la representación fílmica. El paisaje es la clave de lectura, los modernos sistemas de información geográfica, es la herramienta.

Landscapes, geosciences and heritage

Territorial and environmental problems, ever more delicate and dramatic in Italy, require the constant presence of the geologist in all social, cultural, economic and territorial contexts. A first step in this new direction is to pay closer attention to environmental geology and, at the same time, to create new, far-reaching kinds of communication. The Italian National Council of Geologists and the Regional Professional Orders are organizations concerned in this project and, today more than ever, an efficient and timely participation in geo-environmental protection as well as in the field of scientific communication is urgent. One of the most important goals is the popularization of Earth Sciences and the International Year of Planet Earth has, within a project that has highlighted scientific heritage helped to make Earth Sciences more accessible to the public. Landscape plays a key role in the knowledge processes: it is the result of the endogenous and exogenous activities that mould Earth's surface and, at the same time, can be considered the result of the interaction of many natural and cultural components; it could become a "medium" to communicate the Earth Sciences to the whole of society.

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The first step is knowledge and awareness: the geomorphological sciences are a powerful tool in order to reach and share a "sense of natural identity". The consciousness of being part of an ecosystem, is achieved through the knowledge and the experience of the environment.

Landscape is everywhere, but needs to be understood and recognized as a heritage; at the same time it needs to be protected, in order to become a resource: the quality of landscape impinges on individual and social well-being; moreover, as finally ratified in the European Landscape Convention (2000), "Landscape is everywhere and is an essential element of quality of life and cooperates in the development of local cultures". The key role of the landscape is in its perceptive and symbolic power: it is what mankind interacts with, from the first contact with the environment, source of resources, risk, emotions.

The following are different ways of reading, studying and researching the landscape, starting from new methodological approaches and going through different interpretative paths and a new concept, allowing an holistic interpretation of the landscape where Earth Sciences, as well as playing a role of primary importance, also act as a "catalyst", capable of stirring emotions that otherwise could not be interpreted and appreciated.

Landscape approach and GIS

Shape is synthesis: following an Aristotelian approach in studying nature, it is almost natural to read land features as the expression of the endogenous and exogenous processes that mould Earth surfaces.

The goals of the landscape approach in the field of geo-environment assessment and geosciences popularization are basically the following:

- to provide principles, theoretical reference criteria and methodologies for the study of landscape
- to enable environmental diagnosis and assessments, also through indices and specific quantitative models
- to provide synthetic models to predict the evolution of the landscape
- to influence the choice of territorial conservation and management

Figure 1: Geological Map GIS (ISPRA- Geological Survey of Italy).

Figure 2: "Carta della Natura" GIS.

- to allow controls on the planned changes.

Each individual landscape, studied at different scales, shows distinctive elements: structural, which depends on physical form and specific spatial organization; functional, which depends on relationships created between biotic and abiotic elements, and dynamic, which depends on the successive evolution of the structure.

By integrating different information sources, it is possible to analyze the landscape, referring to the geomorphological settings, and, consequently, to recognize and identify those landscapes that are special and significant enough to be worthy of protection as geoheritage.

Cartography, particularly digital cartography and GIS, are high-potential instruments to represent the significant link between nature and culture: maps are the most complete tools that allow a thorough understanding and a clear image of the studied areas. Thematic maps provide us with the identification and visualization of the natural environment and constitute a necessary basis for the evaluation of its state; at the same time they represent a powerful "medium" for the use of the public.

Geographical Information Systems (GIS) are able to hold a wide range of information on the physical, biotic and anthropic environmental components, and allow evaluation of their interrelations, especially in order to locate natural resources and areas to be submitted for protection. Moreover, GIS are flexible, multi-scale, dynamic, updatable tools; different scales of analysis allow us to consider the object of study from different points of view.

One of the most important cartographic projects in Italy is the CARG (Geological CARtography) project, coordinated by the Department for Soil Defense - Geological Survey of Italy - ISPRA. It involves over 60 entities, including Local Bodies, CNR-National Council of Research, University Departments and Institutes, as well as the Regions and Autonomous Provinces. CARG produces 652 geological and geothematic sheets on a scale of 1:50,000 covering the entire national area. The Project provides the cognitive tools – geological data – required for proper territorial planning and management and, in particular, for the prevention, reduction and mitigation of hydro-geological risk ***(Fig. 1)***.

Another ISPRA project is the Carta della Natura (law 394/91) that aims to assess the state of the environment in the whole of Italy ***(Fig. 2)***.

Each individual landscape, studied at different scales, shows distinctive elements; at a small scale (e.g. 1:250.000) physiography is the feature that best approximates the results of landscape classification using an holistic approach.

The considered parameters are mainly related to morphology and to geology and landcover: Elevation and energy of relief (A); Drainage pattern (B); Lithology (C); Land use (D); Landscape physiographic Units (E); Integrating these components and the gathered data, it is possible to identify and describe the so-called Landscape Physiographic Units ***(Fig.3)***.

Overlaying the thematic maps, such as the Geological and the Physiographical ones, and integrating the gathered data, we can identify areas of both natural and cultural importance fairly well.

This is particularly true of Italy, where the peculiarities of the landscape may add a

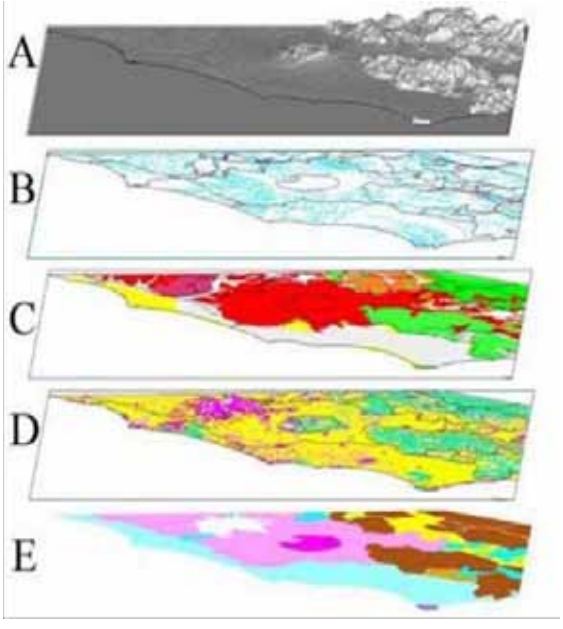

Figure 3: Landscape parameters and physiographic components A- Elevation - Energy of relief; B- Drainage pattern; C- lithology; D- Land use; E- landscape physiographic Units.

further interpretation of the cultural diversity that has been transmitted over the millennia, until you get a result unique in the world and particularly emphasized in painting and literature. Environmental analysis carried out using the paradigm of landscape ecology essentially consists of four methodological approaches: numerical "sensu strictu", spatial, multi-scalar and modelling. Much of the information required to undertake environmental assessment and planning has a spatial component, therefore the best way to acquire and implement this information is through GIS and Remote Sensing.

Remote Sensing methods, particularly, supervised by field controls, play a primary role in these kinds of multi-scale landscape studies. By integrating information about the geomorphology and the land use of a region, it is possible to analyze the link between landscape shapes and the socio-economical development of an area.

Geosciences popularization

The study of the landscape is a complex process: integrating all the components of the studied system: its geomorphology, its landscape ecology and its cultural aspects must represent a new way to reach a complete comprehension of the landscape through a holistic approach that considers and integrates all the components of the studied system.

In recent years, a new theoretical approach to Earth Sciences integrates nature and culture, offering new powerful tools for educational programmes and a new dialogue between researchers and territorial managers. It is essential to try a new kind of popularization of scientific heritage, in order to involve the whole society in a common action towards a sustainable territorial management. The link between Earth, landscape and wine, for example, is a link between nature and culture.

A path through landscapes is a path through the Earth Sciences. A possible new approach is proposed here, trying to integrate the complex aspects of the landscapes and the historical development of some areas of special interest, in order to involve the public, using special media: nature, culture, sports will be useful tools for the modern geologist.

Figure 4: Sicily Landscape Physiographic Unit Map, scale 1:250.000.

Figure 5: Siracusa "Ear of Dionysius" Cave.

The characterization of natural and cultural heritage in film

A well-known Italian TV serial, "Il Commissario Montalbano" ("Inspector Montalbano"); has been adapted from the novels of the Sicilian writer Andrea Camilleri, known to millions of readers and fans. One of the characters, Cesare Bocci, is a geologist with an important role in the fiction: this combination gave us the idea of using film to popularize our natural and cultural heritage. The stories are set in Sicily, in such World Heritage Sites as Noto Valley, Ragusa Ibla, Modica, Scicli, Agrigento, Siracusa and the Aeolian Islands.

The landscapes and the archaeological sites in the film are spectacular and very significant components of the Italian natural and cultural heritage. The landscape, in particular, as a component of the movie location, offers new communication codes to spread scientific knowledge. In many episodes of the series, the geological arrangement of the landscape is an important component in the dramatization. The natural scenography lends a special significance: the local population, as well as tourists recognize the area and can better appreciate its value. Communicating natural and cultural heritage through film and fiction could represent a new way to involve the public in appreciating the landscape and to promote eco-tourism and sustainable development in Italy ***(Fig. 4-7)***.

Figure 6: Landscape of Erice – Sicilia region.

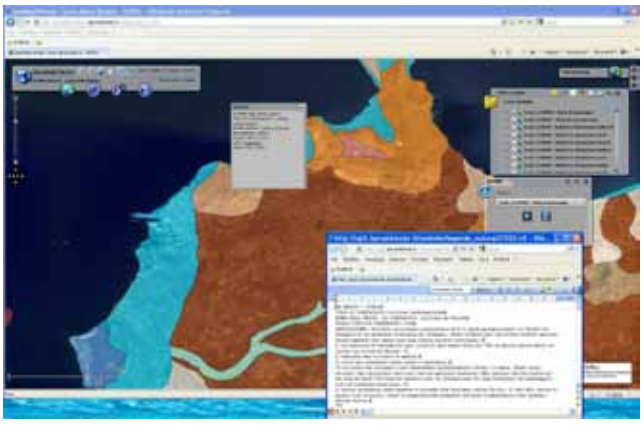

Figure 7: A sample of the GIS – Landscape physiographic Units of Erice -sc 1: 250.000.

Figure 8: Stelvio Landscape, a famous mountain stage of the "Giro d'Italia" (ph. Luca Paro).

Figure 9: Stelvio Geological Map 1:100.000 (ISPRA Geological Survey of Italy).

Geo-environmental heritage and sport

Cycling, popular sport par excellence represents a spatial-temporal relationship between individuals, communities and society. The Giro d'Italia is the most popular race in our country and is a medium of great communicative and multifunctional potential. The proposal is to show the general public (and the athletes) the geomorphological components of each stage of the race by describing the geology, nature and environmental characteristics of the areas ***(Fig. 8-9)***.

The competitive characteristics of the stages, as the racing climbs and descends, are related to the geology ***(Fig.10)***. GIS elaborations and images can help in showing the geo-environmental settings of the stages, making it easier for the public to recognize the landscape ***(Fig. 11)***.

Wine landscapes and geoheritage

Wine and wine production are very important in many cultures, and play an important role in local as well as in global economic development.

In Italian culture, vine cultivation is a common kind of land use; wine production represents an activity full of significance. In Italy, the geology and geomorphology strongly influence land use. Vineyards are linked to the ground more than other kinds of cultivation, for many scientific, social and cultural reasons, as shown by history, religion and myths. The strong link between landscape, terroir and geomorphology can be seen, for example, in the terrace vineyards at high altitude, on almost vertical slopes and these can be considered as a precious kind of geoheritage. These areas need special management, in order to safeguard both natural and cultural aspects and to apply well-balanced programmes for local development, that promote wine production and its special link with the landscape.

The relations between the components of the landscape and the environment itself are very close, like the relationships between cause and effect of natural phenomena and the biotic component, and are mutually reciprocal. The concept of "environmental diversity" can be understood as the integration of geodiversity and biodiversity: its components can be divided into hierarchical levels of organization; its conservation must therefore take into account the integrated studies on living organisms, habitats and ecosystems, and geological heritage.

A very useful tool for territorial planning and management are maps and GIS: by integrating many different strands of information we can analyze the link between vineyard cultivation and landscape, referring to the geomorphological setting ***(Fig. 12)***.

Starting from the link between vineyard cultivation and landscape, at different scales of analysis, it is possible to analyze the evolution of vine cultivation and wine production, in order to try,for example, the replanting of old vines in protected areas, as an experiment to integrate cultivation and culture.

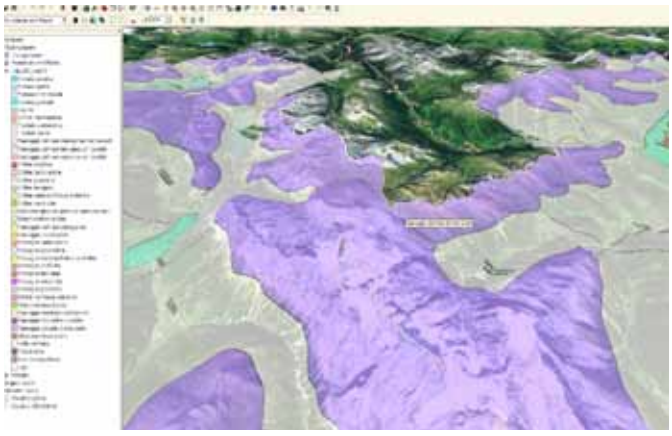

Figure 10: Stelvio - Landscape Unit Map (ISPRA "Carta della Natura" 1:250.000).

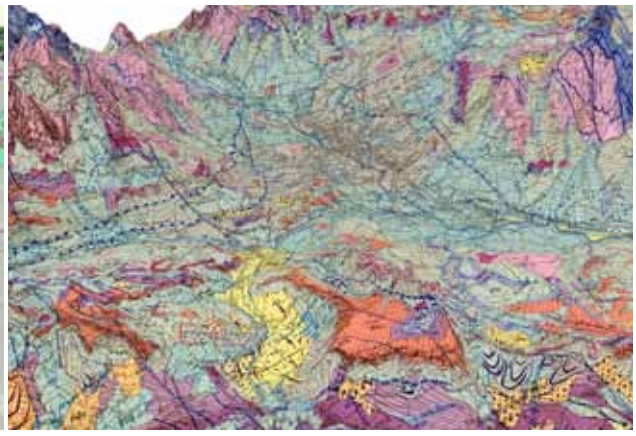

Figure 11: Geological 3D Map of the Dolomiti, near Cortina, UNESCO WHS, stage in the Giro d'Italia 2012.

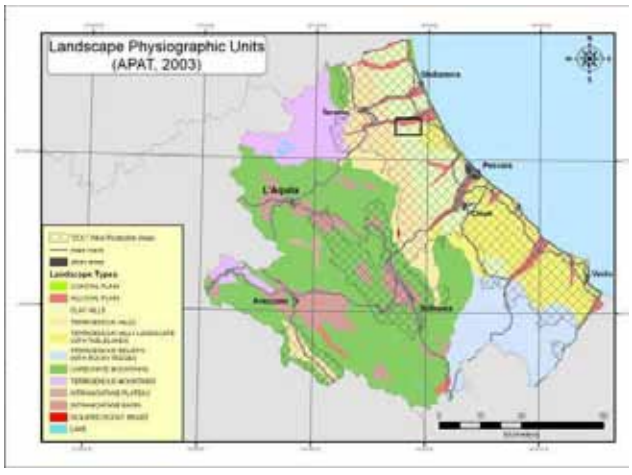

Figure 12: Landscape Physiographic Unit Map - scale 1:250.000 Abruzzo region.

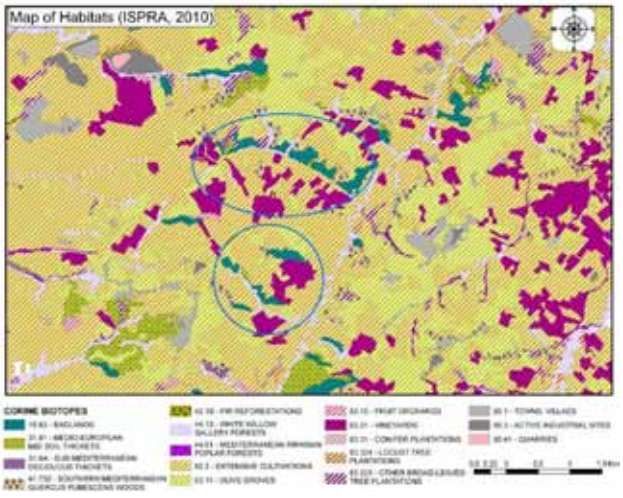

Figure 13: Map of habitat and land use, scale 1: 50.000.

The multi-scaled approach gives an added value in terms of tools, to the study of landscape. For example, the 1:250.000 scale map gives a general view of the landscape, in order to recognize, classify and map geomorphologically homogeneous areas.

The scale 1: 50.000 highlights soil use, in particular the distribution of wine cultivation in the area ***(Fig. 13)***.

At the same scale, thanks to the thematic maps produced by the CARG project it is also possible to gather geological and geomorphological data. Indeed, even if the biotic component plays a key role in the functional ecosystem dynamics, geology, being a part of all natural systems, plays a primary role in the study of landforms, climate, and biodiversity. In parallel, new attention is paid, in the study of nature and territory, to agricultural arrangement, cultural settlement and, more generally, to land use, recognized as a very important factor in an integrated approach to territorial analysis, that integrate both the natural and cultural aspects of a landscape ***(Fig. 14)***.

In many cases, spectacular land forms become a potential tourist resource. This situation is not easy to manage and needs scientific/geomorphological monitoring, new outlooks in agricultural practice, and social consensus, based on shared knowledge and on a common model of identification in the local landscape.

Conclusions

The Italian landscape, spectacular and varied, is made up of a dynamic set of geomorphosites. An important extra value, referring to the social aspects of geoheritage, is represented by local institutions which study and protect the territory, programmes for territorial monitoring, and promoting local action to restore, protect and exploit, in a sustainable way, the areas of interest. At the same time, special attention should be devoted to social involvement: communication, dissemination and education.

A proper technical and cultural approach to the question of managing and protecting the environment requires a multiscale and multidisciplinary approach, aiming at a balance between use of and respect for the land, in order to have development that is sustainable for both the natural and social ecosystems. Future planning should make use of interpretative landscape analyses using various tools.

The aim to protect places of significant geological interest derives from the need to guarantee a conscious and enjoyable use of landscape in all its forms for future generations. The relevant Italian law, the "Framework Law on Protected Areas" (394/1991), has among its aims the protection and management of certain areas and geological and palaeontological conservation, places of scenic and panoramic interest, natural processes, and hydraulic and hydrogeological equilibrium. New environmental problems need new solutions and new creative strategies in cooperation with citizens and policy

Figure 14: Risk/Resource in Abruzzo region (Photo: Mauro Cantoro).

makers. This goal can be reached only if it becomes a common aim, moving the development policies towards a real integration of ecological and socio-economical requirements.

The socio-economical scenario of an area is strictly linked to the geological one: even at different scales, the endogenous and exogenous processes, and the rocks, as elements of the landscape, condition the evolution of environment and form the basis of the spatial-temporal development of a region. Analyzing the landscape, in fact, it is possible to characterize the areas of special geological, environmental and cultural value, which in some cases can be considered geosites.

The aim of protecting places of significant geological interest derives from the need to guarantee a conscious and enjoyable use of landscape in all its forms for future generations: the development of an area follows the same path as eco-tourism. The suggested popularization of the natural and cultural heritage using new communication methods (through e.g., film, cycling, wine) could help new strategies for a balanced and sustainable management of the land.

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Geoconservation in Serbia – State of play and future perspectives

*Aleksandra Maran**

Geoconservation in Serbia dates back to the beginning of the 20th century. During the early decades, intensive geological activity took place and many scientifically important geological sites, outcrops and sections were discovered and explained. Before 1995, 78 geosites were protected, based on individual proposals. In 1995, Serbia became a member of the ProGEO and established the National Council for Geoheritage Conservation. The systematic inventory of geological sites began in 1996, and since then an additional 552 sites have been designated for conservation.

La conservation de l'héritage géologique de la Serbie remonte au début du 20ème siècle. Pendant les premières décades, on a assisté à une intense activité géologique et un grand nombre de sites géologiques majeurs, affleurements et coupesgéologiques ont ainsi été découverts et documentés. Avant 1995, 78 sites géologiques étaient protégés, sur la base de propositions individuelles. En 1995, la Serbie est devenue un membre de ProGEO et a fondé le Conseil National pour la Conservation de l'Héritage Géologique. L'inventaire systématique des sites géologiques a commencé en 1996 et, depuis cette date, 552 sites additionnels ont été sélectionnés pour faire l'objet d'une conservation.

La conservación del patrimonio geológico en Serbia comienza a principios del siglo XX. Durante las primeras décadas se llevó a cabo una intensa actividad de investigación geológica y se descubrieron y explicaron multitud de lugares de interés geológico, afloramientos y cortes geológicos. Hasta 1995 se protegieron 78 lugares de interés geológico en base a propuestas individuales. En ese mismo año, Serbia se convirtió en miembro de ProGEO y estableció el Consejo Nacional para la Conservación del Patrimonio Geológico. El inventario sistemático de lugares de interés geológico empezó en 1996, y desde entonces se han seleccionado para su conservación otros 522 lugares.

Geodiversity, geoheritage and geoconservation have been recognized worldwide as new challenges in geological research in the last two decades. The term geodiversity explains the nature of the entire abiotic world we are seeking to protect. Geodiversity encompasses the natural range of geological, geomorphological and soil features, assemblages, systems and processes (Australian Natural Heritage Charter, 2002). Geoheritage is an important part of geodiversity, dealing with the conservation of rocks, landforms and soils that are significant to humans (Dixon, 1996 in Gray, 2004). Geoconservation involves a set of actions focused on conserving and enhancing geological and geomorphological features, processes, sites and specimens for their intrinsic, ecological and heritage-related values (Sharples, 2002).

History of geoconservation in Serbia

The territory of Serbia is abundant in geological phenomena. It is one of just a very few countries where the two Alpine geotectonic units meet: the Carpathian-Balkan mountain arch is in the east whereas the Dinaric mountain system extends along the western part of Serbia.

The first data on the geology of Serbia were provided by foreign scientists, mostly geologists and geographers who travelled across the country during the 19th century. The beginning of the 20th century was the golden age for natural science research and geology and that period was marked by the geological surveys of the two great Serbian scientists, J. Pančić and J. Žujović and their successors, J. Cvijić, S. Urošević, S. Radovanović, P. Pavlović and V. Petković. The idea for conservation of geological sites in Serbia was born at the same time the first systematic geological investigations were undertaken. The initiative by P. Pavlović in 1924 to protect the Zlot caves in eastern Serbia (***Fig. 1***) was the first official proposal for conservation of a particular natural monument (Maran, 1998).

Figure 1: Zlot Gorge in eastern Serbia, first natural area proposed for protection in 1924 (photo: A. Maran).

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Figure 2: Geotectonic units of Serbia - 1: Carpathian-Balkanides, 2: Serbian-Macedonian Massif, 3: Vardar Zone, 4: Inner Dinarides, 5: Pannonian Basin (Maran 2012).

Figure 3: Map of protected natural monuments related to geoheritage (after the Institute for Nature Conservation of Serbia, modified by Maran 2012).

Prior to 1948 and the foundation of the Institute for Nature Conservation of Serbia, the conservation of nature was exclusively under the direction of the Natural History Museum in Belgrade (Maran, 2008). Since that time, management of nature protection and responsibility for its implementation has been divided between the Institute for Nature Conservation (*in situ* protection) and the Natural History Museum (*ex situ* protection). Experts from both institutions work on the advancement, protection and promotion of our natural environment, including geoheritage as one of their divisions. Today, about 10% of natural areas in Serbia are under statutory protection. They primarily refer to biodiversity: protected areas include 5 national parks, 20 natural parks, 120 nature reserves, 470 natural monuments as well as six Ramsar sites and one biosphere reserve. Each protected area has its own category acknowledged by related legislation.

Legislation and responsibilities

The first nature conservation act was declared in 1945 (Kujunžić-Popović, 1965). Geological, palaeontological, mineralogical-petrological sites and objects were mentioned for the first time within the Law on Protection of Cultural Monuments and Natural Rarities (81/1946). More detailed laws concerning nature conservation and management of natural resources, which also regulated the field of geological heritage, were promulgated between 1961 and 1995: the Act on Nature Protection (1961), the Law on Environment Protection (66/1991, 83/1992, 53/1993, 67/1993, 48/1994, 53/1995), and the Law on Cultural Properties (71/1994).

In Serbia, the terms "geodiversity" and "geoheritage" were recognized for the first time within the newly imposed laws on environmental (135/2004) and nature protection (36/2009, 88/2010). Although their dominant parts mostly concern biodiversity-related issues, they also bring some improvements in the field of geoconservation. For instance, the Law on Environmental Protection identifies geodiversity as a variety of geological sites and objects, including various rock formations, structures, landforms and processes as well as rock, mineral and fossil specimens that make a special contribution to the understanding of geology and the geological history of the Earth. Geoheritage is regarded as that part of geodiversity, which refers, among others, to structural and tectonic features, sedimentological and palaeontological sites, hydrogeological and speleological features, active and abandoned quarries formed by natural processes.

The governmental body responsible for nature conservation is the Serbian Ministry of Natural Resources, Mining and Spatial Planning. The Serbian Environmental Protection Agency (SEPA) serves as an advisory and executive agency under this Ministry. The Institute for Nature Conservation of Serbia is responsible for long-term strategic as well as commissioned applied research that facilitates the decision-support systems and implementation of international conventions in the field of nature protection. The Serbian Geological Institute is a government organization responsible for geological research and mapping. The Natural History Museum is a governmental institution that administers the field of

movable natural legacy, including important geological collections.

Geoheritage register

Five major geostructural units are distinguished in Serbia (***Fig. 2***). The Carpathian-Balkanides of eastern Serbia represent the northern Alpine branch formed under highly varied geological conditions. The Serbian-Macedonian Massif is the crystalline core area between the Carpathian-Balkanides and the Dinarides. The Vardar Zone, a remnant of the ancient Vardar Ocean, is located among the Serbian-Macedonian Massif, Dinarides and Pannonian Basin, respectively. The Dinarides is a part of the Alpine orogenic system, formed by closure of the ancient Tethyan oceanic realm. The Pannonian Basin represents a back arc extensional basin, situated in the north of country. Due to the complex geological evolution and history of the territory of Serbia, many geologists are involved in systematic and detailed surveys and research (Petković, 1935; Andjelković & Nikolić, 1980; Grubić 1980; Dimitrijević, 1995; Ćirić, 1996).

Serbia is a good example of a country rich in geological diversity and with a long geological tradition but still with an inadequate geodiversity conservation status in terms of regulation and practice. Prior to 1995, only 78 geological sites were protected (***Fig. 3***). Of that number, 14 localities were named as particular natural monuments and their protection was managed inside protected areas (e.g. national parks, natural parks or nature reserves). The other 64 sites were assigned as single monuments or landscapes with special attributes, including geological (12), geomorphological (14), hydrological and hydrogeological (12), and speleological sites (26).

In 1995, Serbia joined the ProGEO at its first regional meeting "Conservation of the geological heritage in SE Europe" organized in Bulgaria.

A milestone in the history of geological heritage in Serbia was the First Conference of Geoheritage of Serbia held in Novi Sad in 1995, where the Serbian National Council for Geoheritage Conservation was founded.

In 1996, the Council initiated the project "Inventory of the geoheritage sites of Serbia", which aimed to collect proposals for geosites that mark important events in the geological history of Serbian territory. This project was voluntary-based and many eminent geoscientists actively participated in its implementation.

Category	***No. of sites***	***Subcategories***	***No. of sites***
Geological and stratigraphic heritage sites	*130*	*Paleozoic*	*22*
		Triassic	*4*
		Jurassic	*18*
		Cretaceous	*39*
		Neogene	*47*
Petrological heritage sites	*53*	*Sedimentary rocks*	*13*
		Magmatic and metamorphic rocks	*40*
Structural heritage sites	*5*		
Geophysical heritage sites	*8*		
Hydrogeological heritage sites	*19*		
Pedological geoheritage sites	*4*		
Archeological heritage sites	*14*		
Geomorphological sites	*192*	*Karstic*	*56*
		Fluvial	*48*
		Erosional	*11*
		Aeolian	*9*
		Paleovolcanic	*11*
		Glacial	*21*
		Periglacial	*6*
		Peat moor	*30*
Speleological heritage sites	*80*	*Caves*	*56*
		Holes	*10*
		Sinkholes	*14*
Neotectonic landforms	*34*	*Epeirogeny forms*	*15*
		Faults	*19*
Sites with specific climatic features	*13*	*Air temperatures*	*7*
		Precipitation	*4*
		Atmospheric pressure	*1*
		Wind	*1*

Table 1: Inventory of the geological heritage sites of Serbia (from Archives of the Serbian National Council for Geoheritage Conservation, compiled by A. Maran).

The work on the inventory was undertaken between 1996 and 2003 and in 2004 a preliminary list was created. It includes 552 geosites proposed for conservation (***Table 1***). The sites are classified into eleven categories according to criteria of the ProGEO Framework List of geoheritage (Mijović, 2005). The geoheritage register of Serbia was published in 2005 within a special journal dedicated to the Second Conference of Geoheritage of Serbia, held in Belgrade in 2004.

In Serbia, as well as in some other southeastern European countries, a comprehensive National geoconservation strategy has still not been established despite many warnings from specialists. Prior to a definition of the strategy, however, substantial research needs to be done in selecting preliminary important geodiversity sites, valu-

ing geodiversity, assessing potential threats, and identifying general actions to control significant geoheritage features.

Categorization of geological heritage of Serbia

The study of geodiversity and geoheritage involves different scientific methods and procedures: 1) identification of geosites and evaluation of their importance in terms of science, education, economy and culture, 2) recognition of the threats to geosites and establishment of a geoconservation strategy to prevent and reduce these risks, 3) evaluation of the geosite potential for education and tourism to benefit nature conservation and the local inhabitants. Establishing the procedures for assessing geodiversity and geoheritage depends on evaluating criteria to identify those geological features that have nature conservation values (Maran, 2008).

The geoheritage of Serbia is recognized within two major categories - the immovable (*in situ*) and the movable (*ex situ*). Immovable geoheritage refers to geosites that display various phenomena exposed "on spot": rock and mineral types, fossils, stratigraphical contacts, structural and tectonic features, relict and active landscapes and processes, hydrogeological features, weathered rocks and soils and building stones (***Fig. 4***).

Four relevant principles, such as representativeness, uniqueness, complexity and vulnerability are used to evaluate the significance of Serbian geosites in terms of scientific, educational, economic, cultural and tourism aspects. Following these criteria, three categories of non-movable geoheritage of Serbia are proposed (Maran, 2010; 2012-unpublished PhD thesis): a) Internationally Important Geosites (IIG), b) Nationally Important Geosites (NIG) and c) Regionally and/or Locally Important Geosites (RLIG). Different conservation methods, including physical control, supervision, legislation, licensing, and site-explanation are proposed to protect valuable geoheritage features in Serbia.

Figure 4: Upper Cretaceous sandstones of Grlo Gorge, Stara Planina Mt., eastern Serbia, (photo: Z. Stevanović).

Moveable geological objects include rock, mineral and ore samples as well as fossil specimens that are housed in museums and in private collections (Maran, 2010). The principles for assessment of geological material are based on the attributes of a particular geo-object, including how unique and representative it is at global, national and regional levels, how instructive it is in terms of the evolution of inanimate and animate nature, its natural process and form, and how important it is for the development of geology and natural sciences in Serbia. In order to synchronize classifications, three categories of geological collections, equivalent to geosites, are proposed (Maran, 2010; 2012-unpublished PhD thesis): a) Internationally Important Collection (IIC), b) Nationally Important Collection (NIC) and c) Regionally/Locally Important Collection (RLIC). Conservation of geological collections includes various research methods and provision of optimal storage space to ensure their accessibility and long-term security.

Current problems of geoconservation in Serbia

The existing situation concerning the protection of geosites in Serbia can be summarized as follow:

- Numerous nationally important geological sites are recognized but not protected by any specific regulation and their protection zones are not delineated (e.g. geosites in the Djerdap Gorge, Stara Planina Mt., Belgrade area).
- There are few areas in Serbia that have updated inventories of geological resources including precise information on their location, state of preservation, value and vulnerability thus hindering appropriate conservation as well as management of geosites (e.g. Fruška Gora Mt., Mokra Gora area).
- Not all geosites of potential importance located within declared protected natural areas are well studied and scientifically assessed on a comparative basis. Their vulnerability to damage is not known, thus they are not properly protected and their potential is not properly utilized.
- There is a lack of common understanding among the different specialists involved in nature protection (e.g. biologists, ecologists, geologists or geographers). They have to develop joint, coherent measures and actions, in order to facilitate the efficiency of geoconservation and, in general, of nature conservancy.

Moreover, there are concerns regarding the status of the movable geoheritage of Serbia. The national cultural laws (71/1994, 72/2009) declare minerals and fossils as subjects of protection but do not specify the difference from the archeological or even historical legacy (Maran, 2012-unpublished PhD thesis). Moreover, the movable geoheritage is also regulated by three separate laws (Laws on Cultural Properties and on Culture, 71/1994, and 72/2009; Law 135/2004 on Environmental Protection and Laws 36/2009, 88/2010 on Nature Protection) and its conservation is administered by two different bodies, the Ministry of Culture and Media and the Ministry of Natural Resources, Mining and Spatial Planning. This complex system leads to many mistakes and is the main reason why the status and treatment of the movable geoheritage is less adequate than other national cultural properties (e.g. archeological heritage).

Perspectives

Geoeducation plays an important role in promoting geoheritage values in order to gain support for the implementation of geoconservation objectives and to ensure effective practical management of geoheritage. In the last decade several geoconservation-related projects have been undertaken, aiming at identifying areas of geological interest and informing the public of their existence. Some of these projects are: "Geoheritage of the National Park Fruška Gora" (2007-2009), "Geoheritage of the Nature Park Šargan-Mokra Gora" (2008-2010), "Geological sites and natural phenomena as an integral part of the geodiversity of the Belgrade city area" (2009-2010) and "Geoheritage and geodiversity of northwestern Serbia: Geological history of the Krupanj-

Figure 5: Geotourist map of Boljevac area with georoute „In limestone world" (Maran 2012).

Figure 6: On-site presentation at Kotroman section, Mokra Gora area, western Serbia (photo: D. Milovanović).

Valjevo region" (2008-2011). Based on these projects, some valuable publications have been issued in recent years, such as popular books, brochures, geoheritage and geotourist maps that contain relevant information on the geology and geodiversity of studied areas.

Serbia has a great educative potential for outdoor activities, including guided georoutes, thematic trails and on-site presentations, intended for the general public, students and children to promote the geodiversity values of Serbia as well as to increase geo-environmental knowledge and the public interest in exploring the natural surroundings. At the moment, one of the most promising activities is the establishment of georoutes. There are several proposals to organize geotours across Serbia that relate to areas with great geotourism potential (Maran, 2012-unpublished PhD thesis), such as those in its eastern (Djerdap Gorge and Boljevac area, ***Fig. 5***), western (NP Tara, NP Mokra Gora (***Fig. 6***) and Krupanj-Valjevo regions) and northern parts (Fruška Gora and Vršac Hills). Incorporation of the georoutes into local and regional tourist attractions could motivate other geologists, naturalists and stakeholders to be involved in and encourage new ideas and inventiveness.

Among the activities planned to raise awareness for geoheritage and geoconservation are: training courses for staff working in national parks, popular lectures for local and regional authorities and creation of geological displays for locals and the wider public.

Concluding remarks

The profile of geoconservation in Serbia has grown considerably since 2004 after completion of the preliminary list of geoheritage sites. The work is undertaken thanks largely to Serbian geoscientists, who made an effort to put internationally agreed objectives into practice, and also due to their active participation in the inclusion of international standards into the national regulation.

There are several further steps proposed to intensify work on the geoheritage of Serbia:

- prepare a national geoconservation strategy;
- standardize the criteria for geosite inventory and classification;
- continue the inventory of geoheritage;
- increase public awareness of the importance of geoheritage;
- ensure the support of planners, developers and strategic stakeholders for geoconservation;
- upgrade the existing legislation by establishing new directives on geoheritage protection;
- allocate the funds and provide the support for scientific geoheritage projects;
- strengthen the cooperation among relevant geological national and international institutions;
- enhance capacity-building in geoconservation, including new geological specialists - "geoconservationalists";
- develop a scientific and environmental base to evaluate the potential of Fruška Gora and Mokra Gora to become geoparks.

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Information system on important geosites in the Slovak Republic

Pavel Liščák and Alexander Nagy*

Between 2008 and2011, within the project on an Information system of important geosites in Slovakia, a database of 479 geosites was compiled. Each record of the database contains a detailed geological description of the site, the degree of and the reason for its protection, the map location and the geological map at a scale of 1:50,000, graphic documentation in the form of photographs, drawings and contemporary postcards and references. The popular texts are provided both in Slovakian and English. Most of the geosites are not protected by law, but from a scientific and academic point of view they are extremely valuable geological entities, which should be maintained for future generations as geological heritage.

Dans la période 2008 à 2011, pour le Projet de création d'un système d'Information relatif aux sites géologiques majeurs de Slovaquie, une base de données intéressant 479 sites géologiques a été compilée. Chaque enregistrement de la base de données comporte une description géologique détaillée du site concerné, son niveau de protection ainsi que les raisons de cette protection, sa position géographique, son contexte géologique à l'échelle du 1/50.000, une documentation graphique sous forme de photographies, dessins, images contemporaines et références. Les textes de vulgarisation sont écrits, à la fois, en langue slovaque et anglaise. La majorité des sites ne bénéficient d'aucune protection légale mais, d'un point de vue scientifique et académique, ils représentent des entités géologiques de valeur exceptionnelle qui devraient être sauvegardées pour les générations futures en tant qu'héritage géologique.

Entre los años 2008 y 2011 y dentro del proyecto sobre un sistema de información de los lugares de interés geológico más relevantes de Eslovaquia se compiló una basa de datos de 479 lugares. Cada ficha de la base de datos contiene una detallada descripción geológica del sitio y las razones por su protección, el mapa de situación de la zona a escala 1:50 000, documentación gráfica en forma de fotografías, dibujos, portales actuales y referencias. Los textos divulgativos están en eslovaco e inglés. La mayoría de los lugares de interés geológico no tienen protección legal, pero desde un punto de vista científico y académico son entidades geológicas de un elevado valor que se deberían conservar para las generaciones futuras como patrimonio geológico.

Geological Setting of Slovakia (in brief)

The Western Carpathians are a mountain range with a very complicated structural-tectonic and geomorphological evolution (genesis), and are part of the Alp-Carpathian-Himalayan mountain system. In this mountain range, the rocks-cover an immense geological timespan from more than 600 million years ago to recently-formed deposits (river deposits, weathering scree, various debris, loams, etc.).

The Western Carpathians overcame several orogenic events during the repeated collisions of continents in the Palaeozoic, Mesozoic and Tertiary eras. The Western Carpathians have gained their current position within the space between the edge of the European Platform and the northern part of the African Continent since the youngest Tertiary (approx. 15 million years ago).

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Along the northern edge of the arc of the Western Carpathians collisions of the upper crust blocks took place, accompanied by folding. At the same time in the south, in their rear, the crust was stretching and thinning out, giving rise to extensive marine pools (basins). The northern protrusions of the Pannonian Basin, with its centre in Hungary - (Vienna, Danubian, East- and South-Slovakian basins) encroach on Slovakian territory. These orogenic movements split the mountains ranges (Malé Karpaty, Tribeč, Považský Inovec, the Strážovské vrchy, Žiar, Vysoké and Nízke Tatry, Branisko, Zemplínske vrchy) into isolated islands (horsts); their margins are currently submerging below the Tertiary sediments. During this time, extensive volcanic activity created the Štiavnické and Kremnické vrchy Mts., Pohronský Inovec, Vtáčnik, Javorie, Poľana and Kováčovské vrchy (Burda) Hills (Central Slovakian neovolcanites). In eastern Slovakia the chain consists of the former active volcanoes of the Slánske vrchy and Vihorlat Mts.

The geological map, regardless of the scale, indicates the age of the rocks using colour, with the oldest rocks usually darkest and the younger rocks in brighter shades.

The geological structure of Slovakia consists of the Outer and Inner Carpathians separated by the Klippen Belt. The oldest rocks are metamorphic. Originally, they had been several kilometres thick sediments, deposited at the bottom of the primeval ocean, mainly in the older Palaeozoic and maybe even earlier (roughly 600-400 million years ago). In the wake of the primeval Carpathians, these sediments submerged to the depths of the Earth's crust; in the zone of increased pressure and temperature they were metamorphosed into schists. At the same time some of these rocks in the areas with the highest temperature melted, creating a magma, which after cooling and solidification created a colourful mosaic of varieties of granite (granitoid). In the subsequent movements of the crust these rocks were uplifted and denuded by deep weathering/erosion processes. Now, they form the central (core) parts of the Malé Karpaty, Považský Inovec, Tribeč, Strážovské vrchy, Vysoké and Nízke Tatry, Malá and Veľká Fatra, Žiar and Branisko Mts. and are called

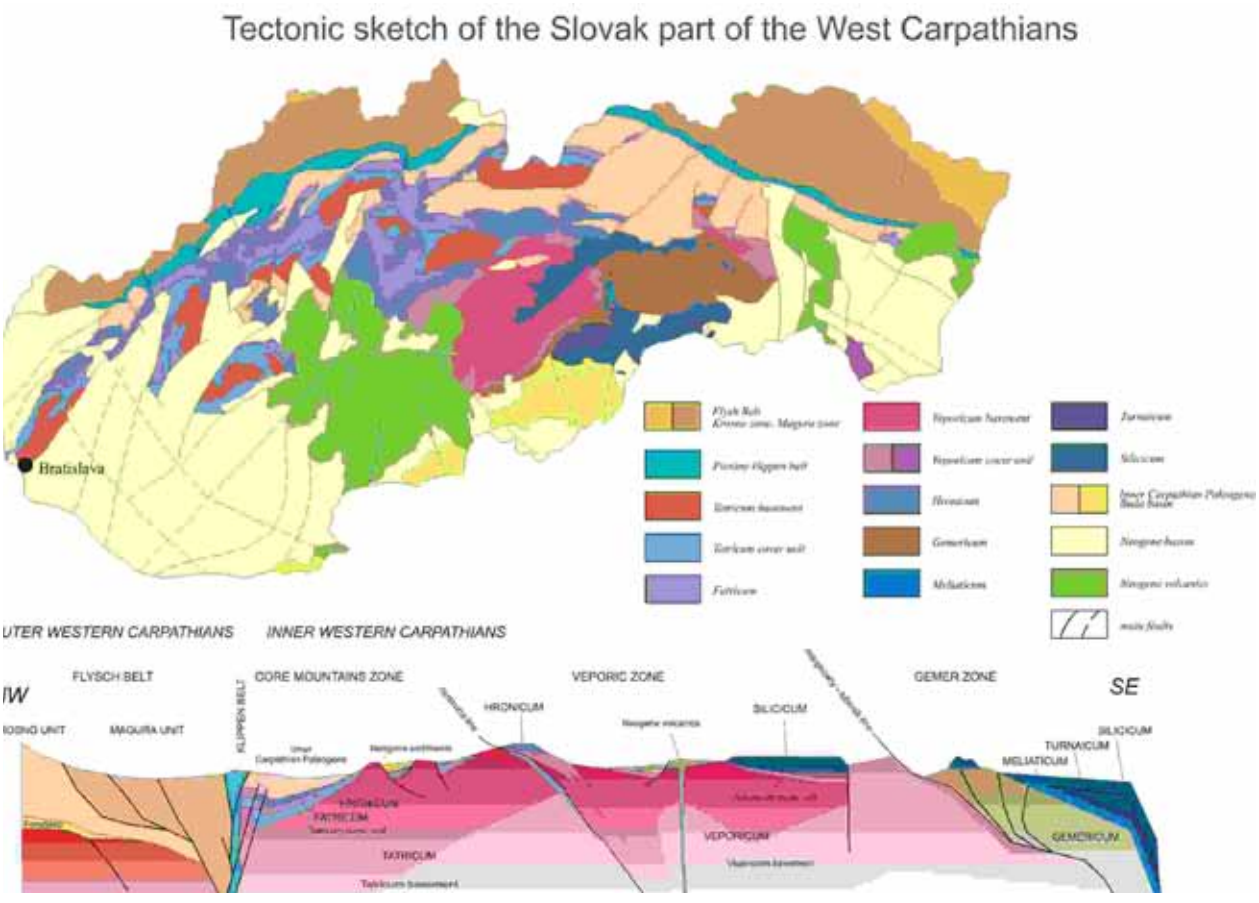

Figure 1: Tectonic scheme of the Slovak part of the Western Carpathians (Hók in Matejovič et al., 2001).

Core Mountains. The magmatic rocks were formed during the whole period of the Palaeozoic, but mainly in the Younger Palaeozoic (350-300 million years ago).

Then this primeval mountain range was peneplained and submerged in the ocean. Limestone (carbonate) Mesozoic rocks were the dominant deposits. These rocks were later folded due to pressure from the African Plate upon the European Platform and the secondary Carpathian Mountains evolved. After uplift and sinking of the crustal blocks in the Tertiary era (Palaeogene) these rocks were, along with the older ones, uncovered. After their partial subsidence and partial peneplanation, sand, gravel and clay sediments were deposited upon them in the Younger Tertiary (Neogene)

Figure 2: Realgar (Photo M. Števko).

seas, and freshwater lakes. The Neogene sediments have been preserved in depressions (lowlands and inter-mountainous basins). The movements of blocks along the faults were accompanied by intense volcanic activity, the maximum of which covered a period of approximately 10-13 million years. Some volcanoes became extinct only one million years ago, whilst the youngest (Putikov vŕšok) became extinct approximately 120,000 years ago.

At the beginning of the Quaternary era (approx. 2.5 million years ago), a variable thick sheet of terrestrial rocks of different types were deposited on the above rocks. They are formed of weathering scree, in particular upon granitoid and carbonate rocks of the Slovak Core Mountains. Their flanks are covered by colluvial deposits. The south-western part of Slovakia is typically eolian Quaternary loess, loess loams and sands. Along the streams, alluvial sediments – sands and gravels – were deposited in the form of fluvial plains, alluvial cones and river terraces. In the Vysoké and Nízke Tatry, Veľká and Malá Fatra Mts., glacial sediments evolved during periods of glaciation. In several areas of Slovakia travertines have been formed along the faults ***(Fig. 1)***.

Project solution

The variegated geology of Slovakia offers numerous potential geosites which will be part of the natural heritage of Slovakia. Some of the geosites are already protected under Law 543/2002 Coll. of 25 June 2002 on the Protection of Nature and Landscape as National Natural Monuments, Natural Monuments, Nature Reserves and National Nature Reserves; some of these have been declared World Cultural and Natural Heritage sites.

There are already three geoparks in Slovakia (*http://geopark.sk/geoparky-sr*); one of them, Novohrad-Nográd Geopark, is one of the first cross-border (Slovakia/Hungary) geoparks in the world. Yet, most of the stratigraphic and palaeontological sites are not protected by law. Moreover, Slovak elementary and high schools do not teach geology. The downward trend in the level of geological knowledge of the Slovak population is reflected in a low perception of the environmental links in the landscape between rocks, water, soil, atmosphere, and biota. Therefore it was thought necessary to create a geosite database which would; identify the geological characteristics of

Figure 3: National Nature Landmark Sivá brada, recent travertine formation (Photo J. Madarás).

the country, recognize the present physical status of them, assess their scientific-educational value and make recommendations for geosite protection.

From 2008 to2011, the State Geological Institute of Dionýz Štúr in Bratislava (SGIDS) completed a geological project, ***Database of important geological sites of the Slovak Republic***. The aim was to create an open file of the sites of geological heritage.

By the end of November, 2011 the database contained 479 sites, which have been divided into 11 categories according to their thematic scope. The database provided the groundwork for a compilation of the Map of important geological sites which has been published on the SGIDS website *http://www.geology.sk/images/aktuality/vgl/VGL_map_eng.jpg*. In order to attract a wider professional and amateur public we published information on the project objectives in Enviromagazín 5, Edition 2008/13 (Liščák, 2008) and we created a presentation poster for the project; this poster we installed in the Slovak National Museum, in the framework of the exhibition "International Year of Planet Earth".

At the beginning of the project, a team of 11 ***main authors*** (editors) tackled various special topics of the geological sites. It was the task of the editors to propose a basic set of sites of the geological heritage of the Slovak Republic, on the basis of their own expertise as well as the relevant literature, in particular the Geological guides and Explanations to geological maps at the scale 1:50 000, and also on the basis of consultations with the wider community. The groundwork also produced publications devoted to these issues, mainly under the umbrella of PROGEO (Wimbledon et al., 1998), or others (Jeleň S. & Galvánek J., 2009, Liščák *et al.*, 2002). The criteria used for selection of the geosites were as follows:

- representativeness and rarity
- degree of site protection
- visibility
- accessibility of the site.

The following team of specialists from relevant geological organizations took part in the project:

- **67** Sites of Paleozoic Metamorphites (***Prof. RNDr. Anna Vozárová, DrSc****, co-author Ing. Zoltán Németh, PhD*)
- **17** Sites of Magmatites and Tectonics (***RNDr. Ján Madarás, PhD****)
- **73** Mesozoic Sites (Doc. RNDr. Roman Aubrecht, PhD**)
- **18** Palaeogene Sites (***RNDr. Alexander Nagy, CSc****, co-author Ing. Martin Kováčik*)
- **17** Neogene Sites (***RNDr. Alexander Nagy, CSc****, co-authors RNDr. Ivan Baráth, CSc*, RNDr. Adriena Zlinská, PhD*)
- **90** Sites of Neogene Volcanites (R***NDr. Jaroslav Lexa, CSc****, co-authors RNDr. Vlastimil Konečný, CSc*, RNDr. Ladislav Šimon, PhD*);
- **38** Sites of Quaternary Sediments (RNDr. Martina Moravcová (Ábelová), PhD*, in 2010 she was substituted by ***Mgr. Martin Vlačiky****);
- **27** Sites of Historical Mining (***RNDr. Daniel Ozdín, PhD****);
- **61** Mineralogical Sites (***RNDr. Daniel Ozdín, PhD****);
- **39** Hydrogeological Sites (RNDr. Juraj Michalko, PhD*);
- **32** Geomorphological Sites (***RNDr. Pavel Liščák, CSc****)[1].

We have received several suggestions from professionals and the general public; on the basis of these initiatives, we have added extra geosites into the database.

The database groundwork was built up from geological guides through Slovakia, issued on the occasion of KBGA and IGC events, as well as important monographs (e.g. Mišík, 1976). Furthermore, the selection of sites was based on the authors' expertise as well as relevant literature. The broad professional and amateur geological community contributed significantly to the creation of the databases.

During the project, geological sites of a regional-geological, historical mining, mineralogical, geomorphological and hydrogeological nature were identified, all with prime scientific (educational) and aesthetical value and with the potential to become integral parts of the Slovak, even the European, geological heritage.

1 Note:
* SGIDS, State Geological Institute of Dionýz Štúr
** PriF UK, Faculty of Natural Sciences, Comenius University, Bratislava
*** GÚ SAV Geological Institute of the Slovak Academy of Sciences

Figure 4a: View of andesite cliffs of lava flow with columnar jointing, peak Štangarígeľ, Štiavnica Stratovolcano (Photo J. Lexa).

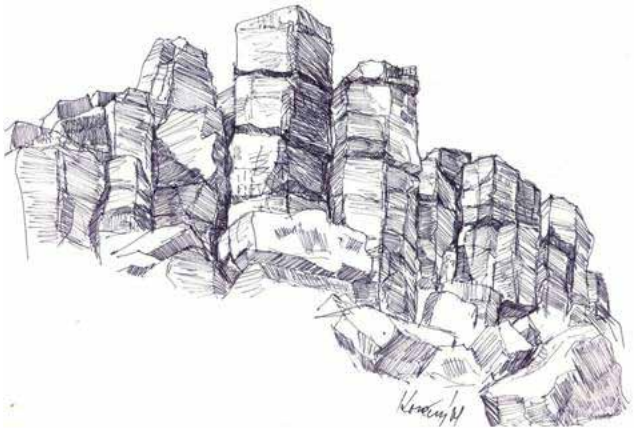

Figure 4b: Drawing of andesite cliffs of lava flow with columnar jointing, peak Štangarígeľ, Štiavnica Stratovolcano (Author V. Konečný).

Each site is documented in the inventory sheet, which was subsequently included in the MS Access database. Along with the field reconnaissance the passports to each site were being filled-in, both in written form (Microsoft Word) and finally also in the form of an electronic database (Microsoft Access). The passport was created on the basis of the model form of the geological passport drawn up for the needs of SGIDS electronic documentation diary in Microsoft Access.

Figure 5: Ratnovce, mammoth tusk (Photo M. Vlačiky).

High-quality photo documentation of the vast majority of sites along with geological sketches and pen drawings by the Slovak volcanologist Vlastimil Konečný (***Fig. 4b***) and the attached English summaries of each site, and illustration explanations were added to the database. Finally, the geosites were categorized according to their scientific significance and some have been proposed for further legislative protection. All-in-all, 39 sites of minor importance, 118 moderate, 193 major and 129 extraordinary have been identified. Of these, 77 have been proposed for processing for enrolment in the List of Protected Geosites or Protected Landmarks. In the scope of the project Geological Information System (GeoIS) the database has been published on the SGIDS website: *http://mserver.geology.sk:8085/g_vgl/* in order to disseminate the results among the public. The database is open for further input and for modern presentation of the geological heritage of the Slovak Republic.

Conclusions

The database of important geological sites provides a review of the geological heritage of the Slovak Republic. Generations of geologists since the times of the Austrian-Hungarian Empire have preserved highly scientific knowledge on the geological phenomena of Slovakia. The fact that in the processing and collecting of this information renowned specialists from the top geological institutes have taken part is a guarantee of the well-balanced and justified selection of the sites of the national geological heritage of Slovakia. The database of significant geological sites is not concluded, but, on the contrary, will be constantly updated to provide up-to-date information to the general public, in particular in the spheres of education, nature protection and geotourism.

Figure 6: Demänová Caves, Cave of Liberty, Ružovica (Pink) Hall (Photo P. Staník).

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Geological Heritage in the Idrija Region (Slovenia)

*Mojca Gorjup Kavčič**

Idrija, a town in western Slovenia, is world famous for its mercury ore deposit and 500-year-old mining tradition. The uniqueness of Idrija's mercury heritage has also been recognized by UNESCO, which inscribed it in the World Heritage List this year. Besides the mercury ore deposit, the whole region boasts a rich natural heritage, especially geological heritage, with many areas of outstanding value, the most important being the exposed stratigraphic cross-sections, karst and hydrological phenomena, and morphological features. In line with the Municipality's strategy of commitment to sustainable rural development, the Idrija Geopark was established. Already operational, the geopark will in future be responsible for the preservation, interpretation, education and development of geotourism in the Municipality of Idrija.

Ville de l'ouest de la Slovénie, Idrija est mondialement connue pour sa mine de mercure et 500 ans de tradition minière. L'unicité de sa mine de mercure est également reconnue par L'UNESCO qui l'inscrivit cette année sur la Liste du patrimoine mondial. Outre les gisements de mercure, la région a aussi un riche patrimoine naturel, notamment le patrimoine géologique avec ses nombreux sites grandioses, dont les coupes stratigraphiques exposées, les phénomènes karstiques et hydrologiques, et les particularités morphologiques. Fondé dans l'esprit de la stratégie de la Commune d'Idrija en matière de développement rural durable, Geopark Idrija est déjà opérationnel et voué à la future préservation, interprétation, éducation et développement du géotourisme de la Commune d'Idrija.

Idrija, situada en el oeste de Eslovenia, es conocida por su mina de mercurio y sus 500 años de historia minera. En reconocimiento del valor de este patrimonio minero Idrija ha sido incluida por la UNESCO en la Lista de Patrimonio Mundial. Además de la mina, esta región posee un rico legado natural, en especial su patrimonio geológico con muchos valores naturales, como ser los cortes estratigráficos, los fenómenos cársticos e hidrológicos y características morfológicas especiales. De acuerdo con la estrategia del Ayuntamiento de Idrija, comprometido al desarrollo sostenible de las zonas rurales aledañas, ha sido fundado el Geoparque Idrija que ya está en funcionamiento y que en el futuro velará por la conservación, la interpretación, la educación y el desarrollo del geoturismo en la región.

From the Mercury Mine to the present

The history of Idrija has been inseparably linked to the Idrija Mercury Mine since 1490, when mercury was first discovered by a tubemaker. After this discovery, the mine developed underground together with the town above it, reaching the peak of mercury excavation and extraction at the beginning of the 20th century. After a decision was made to shut down the mine, industry in this region underwent complete restructuring and the town of Idrija became a development centre for electric processing and high-technology industry.

Despite the strong industry present in the region, attention has always been devoted, in the past and today, to the environment and nature, as well as educating the population on their preservation. Although in the past natural science remained in the shadow of intensive industrial development of the town and region, the mine simultaneously attracted to Idrija, as early as in the 18th century, several scientists

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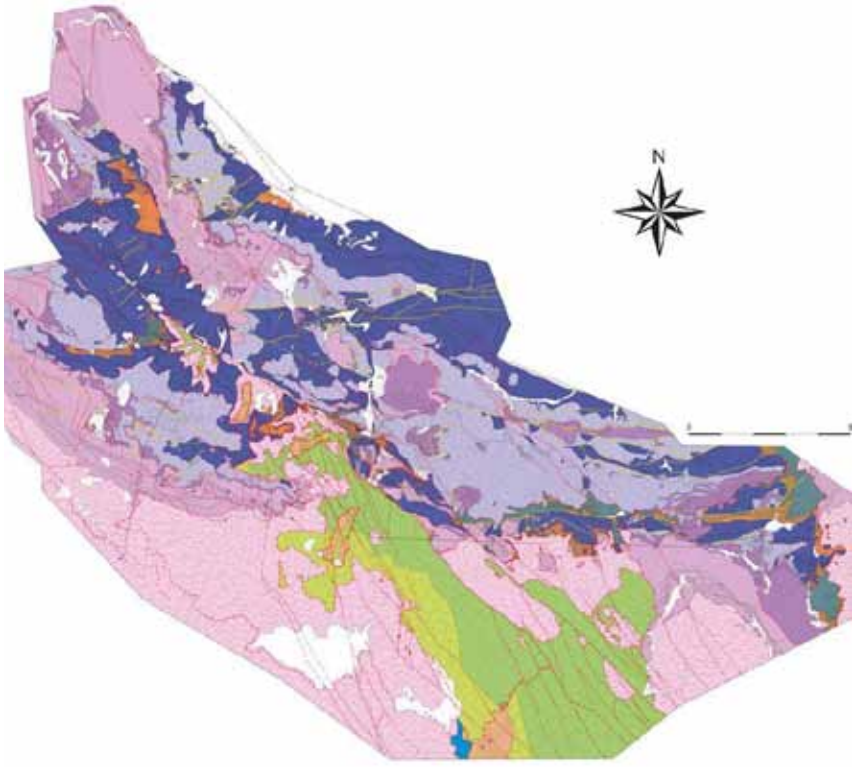

Figure 1: Geological map of the Idrija Region (Čar, 2010, published by Geološki zavod Slovenije).

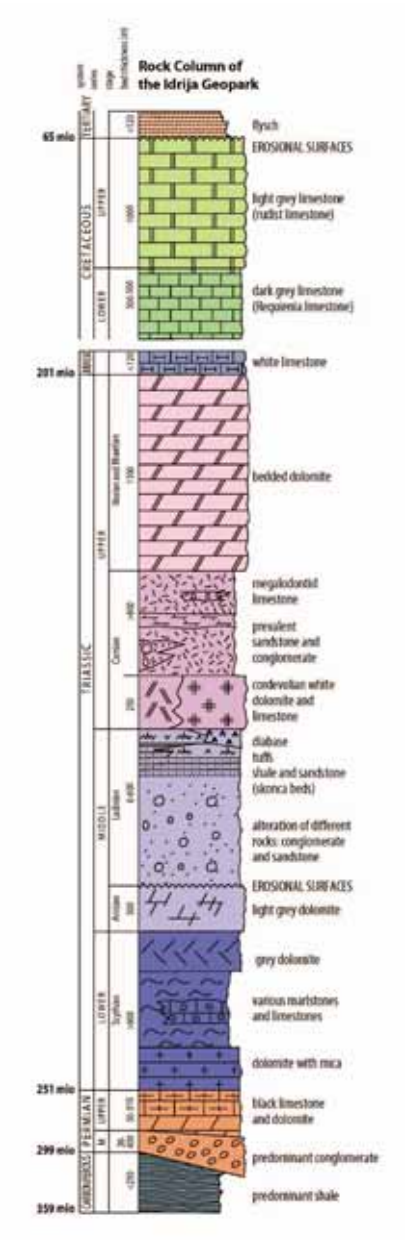

Figure 2: Stratigraphic column of the Geopark Idrija (Čar, 2010).

who, alongside their regular work in the mine, investigated and laid the foundations of natural science in Slovenia in this period (Joannes Antonius Scopoli, Henrik Freyer, Baltasar Hacquet, Franc Hladnik, and others).

However, great changes have been occurring in this area in recent years, as increasingly more attention is being devoted to the conservation and presentation of heritage in line with world trends in the areas of tourism, conservation, sustainable development, etc. In 2006 the Municipality of Idrija initiated a procedure for the inscription of its technical mining heritage on UNESCO'S List of World Heritage. This year, its nomination entitled, *The Mercury Heritage, Almadén and Idrija*, was confirmed at the Committee's session in Saint Petersburg. The second important initiative for the entire Municipality of Idrija was the establishment of the Geopark Idrija, which will be responsible for the conservation, presentation and sustainable development of the entire territory in line with the guidelines of the European Geopark Network. Special attention is put into development of geoutourism, as a form of niche tourism or special interest tourism is an actively growing tourism market, and geotourism destinations have been known to attract copious numbers of tourists and promise great potential for many regions. The Idrija Geopark is currently in the process of admission into the European and Global Geoparks Network.

Geoheritage in the Idrija Region

The Idrija hills (western Slovenia) have a complicated geological composition (***Figs 1, 2***). Due to intense and polyphase tertiary tectonic activity, the majority of contacts between the sequences of different Carboniferous to Eocene rock strata are tectonic. The oldest rocks are more than 300 million year-old dark-grey shales and sandstones of the Carboniferous period followed by middle Permian quartz sandstones. These deposits are overlain by various rocks of Permian to Early Triassic age that belonged to the shallow-water sedimentary environment called the Slovenian Carbonate Platform. They include Permian dolomites and fossil-rich limestones, Lower Triassic dolomites, marlstones and various limestones and massive and thick-bedded Anisian dolomite and conglomerate. This relatively quiet period of sedimentation was followed by a highly dramatic period in the geological history of the Idrija region, linked to the disintegration of the Slovenian Carbonate Platform. At the beginning of the Upper Anisian, during Idrija's rifting phase the area was dissected by normal faults forming horst-and-graben structures mainly directed in an E-W direction. The area at that time belonged to a new palaeogeographic unit called the Dinaric Carbonate Platform. This platform was not uniform but composed of different tectonic trenches (aulacogens). In one of these tectonic trenches, i.e. ore deposit trench, the famous Idrija mercury ore deposit was formed during this period. Along the strong normal faults with a vertical displacement component of 600 to 900 m, individual blocks were raised, while others were lowered. Some 750 m of strata were eroded from the raised blocks (Čar, 1990). The Anisian, Early Triassic, Permian and partly also Carboniferous rocks were removed. So in some tectonic blocks Ladinian rocks directly overlie Carboniferous clastites. In the final phase of development of the Idrija Middle Triassic trench, the entire region was covered with marshland in which Upper Ladinian rocks rich in organic materials, locally known as the "Skonca beds", began to form. Hydrothermal solutions rich in mercury began to flow through the deep faults. On their way towards the surface, they impregnated all the older layers, from Carboniferous to older Ladinian rocks. This resulted in the formation of diverse, even very rich epigenetic cinnabar ores. Some of the rich

Figure 3: Syngenetic sedimentary cinnabar ore.

Figure 4: Drops of native mercury in Carboniferous shales.

cinnabar solutions and cinnabar gels discharged directly into the marshland, forming exceptionally rich (up to 78% Hg), unusual syngenetic sedimentary cinnabar ores (***Fig. 3***). Due to the small inflow of sulphur, part of the Hg remained in its elemental form, creating ore-bearing deposits with native Hg primarily in the Carboniferous shales (impregnated with native mercury droplets, see ***Figure 4***), Skonca beds (Mlakar, 1969; Mlakar and Drovenik, 1971; Čar, 2010), and partly also in some other rocks. The final period of Ladinian tectonic events was accompanied by extensive volcanic activity with outpourings of diabase and keratophyre.

At the end of the Ladinian, tectonic activity ended. The following Carnian deposits are thus composed of different quartz conglomerates and sandstones, and shallow-water limestones and white dolomite. In the Norian and Rhaetian stages, fenestral and oncolitic dolomites, known as the "Hauptdolomite", frequently appear, with rare limestone intercalations. In the Jurassic, the shallow-water sedimentation continued with mainly oolitic limestones and dolomites. These rocks crop out only in the Trnovski Gozd area located south of the Idrija region. The Jurassic rocks were followed by more or less stratified organic shallow-water Lower and Upper Cretaceous limestones.

The shallow-water carbonate sedimentation was interrupted in the Upper Cretacious by extensive and complex tectonic events that led to the disintegration of the Dinaric Carbonate Platform and the onset of the sedimentation of flysch. An erosional unconformity is present between the Upper Cretaceous limestones and Paleocene-Eocene flysch, which concluded the sedimentation process in the Idrija region (Čar, 2010).

The area later experienced intensive Tertiary thrusting and Neogene strike-slip tectonic activity. According to existing data (Placer, 1999; Čar, 2010), folding and thrusting occurred in the territory of Idrija in the Late Eocene, and continued into the Early and Middle Oligocene. At first a large recumbent fold was formed which, under ongoing compression, was internally thrusted. Thrusting was directed towards the south-west, forming a thrust structure typical of western Slovenia. The lowermost structural unit, representing the basement of the Idrija region is the Hrušica nappe, which is overthrusted by the Koševnik, Čekovnik and Kanomlja thrust slices. The uppermost structural unit of the area is represented by the Trnovo nappe (Placer, 1973, 1999). This complex folding and extensive thrusting completely obliterated the primary spatial relations of different strata and created several interesting tectonic phenomena: various tectonic windows and tectonic half-windows, as well as tectonic klippes and half-klippes.

Figure 5: The levelling of the Zadlog was formed along the nappe plane between the 'Hauptdolomite' of the Čekovnik thrust slice in the basement and the Norian-Rhaetian dolomite of the Trnovo nappe. The Idrijca and Belca River valleys are in the background.

The Neogene to recent geological structure of Idrija's terrain was formed by numerous strong normal and then by dextral strike-slip faults which cut and displaced older thrust units (Mlakar, 1969; Čar, 2010). Of the numerous faults, let us mention only the two largest ones, the Idrija and Zala faults.

Geomorphology

The main characteristic of the Idrija region is a well-defined NW-SE trending straight and narrow morphological depression that actually represents the wide fault zone of the Idrija fault, which divides the Idrija hills into two morphologically highly diversified geotectonic blocks. Another characteristic is the valley of the Idrijca River and its unusual course, which is primarily due to the baserock lithology. However, the river in some parts also follows distinct tectonic lines. The variegated world of the Upper Idrijca River and the Belca stream represents a special geomorphological unit. The south-eastern part of the Idrija (***Fig. 5***) hills comprises a vast, karstified plateau.

The Karst

The richly developed and often somewhat specific karst phenomena in the Idrija region are a reflection of the complex rock composition, as well as tectonic and morphological stratification, of this highly variegated region. Broadly, the karst may be divided into the high karst and the solitary karst, which includes the other "non-karst" territory of the region (Čar, 2010).

Typical of the high karst are deeply karstified carbonate rocks, particularly limestones, with all the characteristics of classical karst. On the surface, numerous sinkholes can be found in various geological structures (Čar, 2010), whereas the underground karst is characterized by deep shafts, occasional subhorizontal short caves, as well as short sinking streams and swallow holes ('covered karst') along the thrust edges. All the remaining areas where high karst has not developed are formally classified as the "non-karst" world, but certain individual or group karst phenomena found here are classified as solitary karst. This type of karst is usually developed in limestones and dolomites of varying age found in the middle of impermeable rocks (shales, calcareous sandstones, etc.).

Most valuable geosites in the Idrija Geopark

The Idrija ore deposit is important and famous because of the complex Middle Triassic tectonic activity that led to its forma-

tion, the exceptional diversity of its rocks, remarkably rich and unusual sedimentary ores, geochemistry and mineralogical composition, as well as its complicated transformation into its present state. In the mine, 158 ore bodies were found, of which 141 were mineralized with cinnabar –14 of mainly syngenetic mineralization and 127 mainly or only of epigenetic origin. Native mercury is predominant in the remaining 17 ore bodies. Producing 13% of the world's mercury, the Idrija Mine was, in terms of the quantity extracted, the second largest mercury mine in the world (the first being Almadén in Spain).

Figure 6: Between the Carboniferous and the Ladinian rocks some 750 m of Permian, Scythian and Anisian age rocks are missing. This is due to the erosion that occurred in the Upper Anisian, when the rocks that had formed over approximately 60 million years were removed.

Anthony's Main Road is the oldest preserved part of the shafts of the Idrija Mine. After the shutdown, the mine remained open as a tourist attraction. In a specially protected section, native mercury drops are visible, which is exceptionally rare worldwide. Other exceptional phenomena are the Middle Triassic erosional unconformity (***Fig. 6***), visible at several locations and the Carboniferous and Ladinian pyroclastic rocks mineralized with native mercury, bedded ore in tuffites, and coral ore (brachiopod *Discina*), whose fossil shells and cores were replaced by cinnabar.

The Idrija fault (***Fig. 7***) is one of the most important tectonic elements in Slovenia, and one of the strongest in the Southern Alps. The fault begins in Carnia, cuts across the Resia Valley in Italy, crosses the entire territory of Slovenia, and ends in the Velebit mountain range in Croatia. It extends across Slovenia over a distance of more than 120 km, striking NW-SE in a so-called Dinaric direction.

Wild Lake (***Fig. 8***) is a complex geological, geomorphological and hydrological phenomenon. Its geological structure, the extensity of submerged pit shafts, and the morphological shape of the cauldron-like lake are exceptional. During high waters it spews out as many as several tens of cubic metres of water per second, creating a mighty, and at the same time the shortest, Slovenian river before flowing into the Idrijca River. Wild lake is also an area where numerous plant and animal species thrive. Some of these are endemic, e.g. the Carniolan Primrose (*Primula carniolica*) and the Human Fish (*Proteus anguinus*).

The Habe Shaft is situated on a karstified plateau, which belongs to the High Karst unit, to the south of Idrija. The entrance to the shaft opens into deeply karstified Upper Cretaceous Rudist limestones of the Koševnik thrust slice, in the direct vicinity of the thrust contact with Norian-Rhaetian bedded dolomite of the Čekovnik thrust slice (Mlakar, 1969; Placer, 1981). Recent colour-tracing indisputably proved a connection between the underground waters from the plateau at Wild Lake with the nearby springs at Podreteja, the location of a water reservoir for the town of Idrija. During an exploration conducted in 1997, speleologists determined the height difference between the highest and the lowest known points in the abyss to be 400 m (Vrhovec, 1997).

Figure 7: Several locations offer a view of the valley that was formed along the Idrija fault, with the displacement of the north-eastern block in a length of approximately 2500 m in a SE direction (Mlakar, 1969; Placer, 1981, 1982).

Figure 8: During low waters and drought, Wild Lake appears as a romantic miniature lake squeezed below a mighty limestone wall.

Geosites in the Zgornja Idrijca Landscape Park

The Zgornja Idrijca Landscape Park extends over an area of 44.74 km^2 in the upper reaches of the Zgornja (Upper) Idrijca River and the Belca stream. Almost the entire area of the park is forested, which in the past provided an important raw material and source of energy for the mine's operation. Exposed in many parts of the park are amazing rock sections, and the area also abounds in hydrological sites. Particularly interesting is the broader area of ***Kramaršca***, where, over a length of approximately 150 m, three well-known Idrija ravines terminate in the Idrijca River. Less than 100 m higher, the strong torrent of ***Bedrova ravine*** discharges into the Idrijca River, famed for its remarkable, perfect section of Carnian strata. A further 50 m higher, the ***Črni Potok ravine***, with the famous ***Suha Idrijca gorge*** in its lower part, comes to an end in the Idrijca River valley. Still higher, the Idrijca River is squeezed into the barely accessible ***gorge at Kramaršca***. This is an approximately 200 m long section of the Idrijca River with three waterfalls of heights ranging from 10 to 15 m and four large pools. The gorge is cut into Cordevolan (Middle Triassic, Lower Carnian) dolomite crossed by numer-

ous N-S striking fault zones. The intake of the gorge is filled with huge boulders of the ***Bašte rockfall***. A dark green magmatic rock called almond-shaped diabase (***Fig. 9***) can be found in Kramaršca. The landscape park also has significant sites of fossils named after Idrija. Megalodontide shells of the species *Triadomegalodon idrianus* (Vegh-Neubrandt) can be found in the so-called megalodontide limestone horizon of Tuvalian (Upper Triassic, Upper Carnian) age.

Acknowledgements

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Figure 9: Almond-shaped geodes were formed in a diabase after the rapid cooling of lava flowing into the shallow sea in the Ladinian. White calcite crystals then filled the geodes. This almond-shaped diabase represents the western-most occurrence of magmatic rocks in Slovenia.

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Geoheritage protection and promotion in Switzerland

*Emmanuel Reynard**

Switzerland has a long history of geoheritage protection but it is only during the last two decades that a growing attention has been given to geoheritage protection and promotion. This paper presents the legal framework for geoheritage protection in Switzerland, and the present situation concerning geosite protection and geoparks. Even if improvements have been made recently, geoscientists have failed at their attempts to carry out a national inventory of geosites that has legal value. As a result, the development of geoparks in Switzerland is relatively slow in comparison with other European countries.

La Suisse a une longue histoire dans la protection du patrimoine géologique, mais ce n'est qu'au cours des deux dernières décennies qu'un nouvel intérêt pour la protection des géopatrimoines et leur valorisation s'est développée. Cet article présente le cadre légal de la protection du patrimoine géologique, ainsi que la situation actuelle concernant la protection des géosites et la création de géoparcs en Suisse. Même si des améliorations ont eu lieu récemment, les géologues n'ont pas réussi à réaliser un inventaire de géosites ayant une valeur légale et le développement des géoparcs peut être qualifié de relativement lent en comparaison européenne.

Suiza tiene una larga tradición en la protección del patrimonio geológico, pero no ha sido sino en las últimas dos décadas que el interés por la protección y promoción del patrimonio geológico ha crecido. Este artículo presenta el marco legal de la protección del patrimonio geológico en Suiza, y la situación actual en relación con la protección de lugares de interés geológico y los geoparques. A pesar de que recientemente se han logrado grandes avances, los geólogos no han conseguido realizar un inventario nacional de lugares de interés geológico que tenga soporte legal. Como consecuencia de lo cual el desarrollo de los geoparques en Suiza es relativamente lento con respecto a otros países europeos.

Switzerland has a long history of geoheritage protection: the first example is an erratic boulder (*Pierre-à-Bot, Neuchâtel*) that was placed under protection in 1838 on the demand of Louis Agassiz. Erratic blocks can therefore be considered as the first natural objects to be protected at a national level (Vischer, 1946; Reynard, 2004). Nevertheless, in the 20th century, the protection of geoheritage slowly became secondary as a part of nature conservation. It is only during the last two decades that a new interest in geoheritage protection and promotion has developed, first among geologists, and more generally in society, as it is the case in other European countries (Reynard *et al.*, 2011). In this paper, the situation concerning geosite protection and geoparks in Switzerland is presented.

Legal framework

At the Federal level, geoconservation is mainly regulated by two pieces of legislation: the Federal Nature Protection Act, adopted in 1966, and the Federal Town and Country Planning Act, adopted in 1979. The main objectives of the former are the protection of landscapes, natural monuments and biotopes. The latter focuses on land-use planning based on land-use zones, such as building, agricultural or protected areas. Protection zones can be defined at various scales for rivers, lakes, moors, biotopes, natural and cultural monuments, and landscapes. Once nature conservation zones are approved, the decision is generally binding on authorities and landowners.

The Nature Protection Act is implemented at two main administrative levels. Nature protection is the responsibility of the Cantons[1]. The Swiss Confederation can commission inventories of objects of national significance. Accordingly, inventories of historical buildings, upland biotopes and landscapes, alluvial zones, dry lands, as well as historical roads have been carried out. An inventory of geosites does not exist at the moment – and is not planned – within the framework of the Nature Protection Act. The existing Inventory of Swiss geosites (SCNAT, 1999), currently under revision, undertaken by a group of experts from the Swiss Academy of Sciences (SCNAT), must be considered as an informal catalogue of sites, worthy of interest, but with no legal status.

Geoparks are territories with well-defined limits that comprise a rich and diversified geological and geomorphologic heritage and that should serve to foster sustainable development (Zouros, 2004). As a result of this double purpose – geoheritage and sustainable development – geoparks development in Switzerland depends on both Nature Protection and Land Planning Acts. In 2006, the Nature Protection Act was modified, allowing the creation of three types of natural parks under financial support from the Swiss Confederation: National Parks (NP), Regional Natural Parks (RNP), and Periurban Natural Parks (PNP). Each category has specific features and is composed of zones with different protection status. The central zones of NP and PNP, as well as the natural elements of RNP, contain natural objects, which may be geological or geomorphological. As a result, Switzerland now has a network of 18 recognized natural parks (*www.swiss-parks.ch*).

Geoconservation

Because nature conservation is the responsibility of the Cantons, the current state of geoheritage protection can vary substantially from one canton to another (***Fig.***

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1 Switzerland is subdivided in several independent political units (Cantons) to whom a certain degree of freedom is left to apply federal laws. Each Canton is further subdivided into smaller entities (Communes or Municipalities) that can have more or less sovereignty in land and resource management.

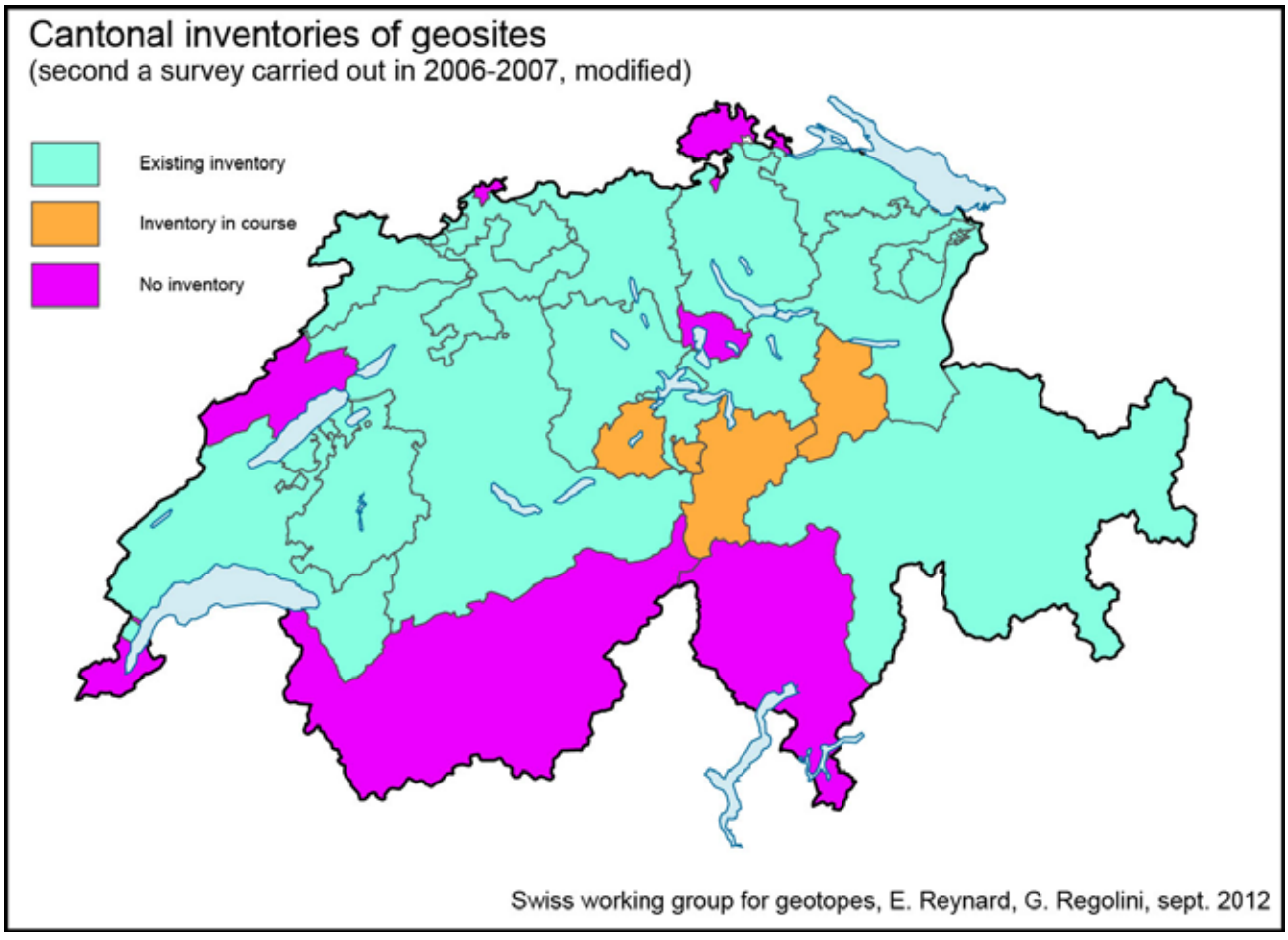

Figure 1: Geosite inventories in the Cantons, Switzerland.

1). Some cantons have inventoried their geosites since the 1990s, whereas other cantons, especially in the French and Italian speaking part of the country, have no inventory at all.

In order to disseminate knowledge of Swiss geoheritage and to encourage the Swiss Confederation and the cantons to protect this heritage accordingly, SCNAT created a working group on Geotopes back in 1993. Based on a survey of the activities and visions of the Cantons relating to geoheritage, the working group was able to publish in 1995 a report on Geosites in Switzerland (Strasser *et al.*, 1995). At the same time, the compilation of a list of geosites of national importance was undertaken. That work was not a real inventory, based on a common methodology, but much more a list of proposals made by experts coming from various parts of the country, various fields (palaeontology, mineralogy, geomorphology, etc.), and various institutions (cantonal administrations, natural history museums, universities, etc.). More than 800 proposals were received and after evaluation by the members of the working group, a list of 401 geosites was adopted (SCNAT, 1999).

This list suffered several problems. It was primarily an indicative list of objects thought to have high geoscientific value, but with no legal influence upon responsible (notably political) authorities. Thus, in 2000, a working group composed of scientists and federal offices studied the opportunity of carrying out an official inventory based on the Nature Protection Act. Nevertheless, because of financial restrictions and absence of real motivation in political circles, such an inventory was never carried out. Another problem of the 1999 geosites list was its heterogeneity both in terms of content (regional discrepancy, differences between the various fields of Earth Sciences) and of form (some proposals were very well documented, whereas others were limited to the name of the site without any detail about perimeter and description). Moreover, there was no information in digital form.

As a result a revision of the inventory was carried out in 2006 by a group of scientists of various disciplines under financial support of the SCNAT and the Federal Office for the Environment (FOEN). The revision was both of formal and digital type. A relational database was created and hosted on the SCNAT server. It allowed project contributors to introduce information into the system by filling in a form from their office. In parallel, all the geographical information – especially the perimeters – was managed within a Geographical Information System (GIS) in order to simplify use by the public administration. At the end of the project, the list was published on the Geological data viewer (*www.geologieviewer.ch*) of the Federal Office of Topography (Swisstopo). A book, containing the list of Swiss geosites and a selection of the most emblematic sites, described in more detail, will finally be published in 2013.

In terms of content, the revision of the inventory needed much homogenization work. A lot of data was added mainly because most of the geosites were poorly detailed in the 1999 inventory. Several sites were merged, other were abandoned because their national relevance was ques-

tionable. Moreover, a large survey was carried out to add new sites, especially for regions as well as fields of Earth Sciences that were missing in the 1999 inventory. Also, some sites, which were not known in the 1990s, could be added. A good example is the Courtedoux site where numerous dinosaur tracks were discovered in 2000 during construction of the A16 highway and that has gained international recognition today. The *Glarner Hauptüberschiebung / Sardona Tektonic Arena*, in the Cantons of Glarus, St. Gallen and Graubünden, is another good example. As a matter of fact, though the Glarus overthrust had already been recognized since the mid-19th century as one of the prominent examples of alpine tectonic history, it was curiously not proposed in the 1999 inventory. In the meantime, the site was inscribed as a World Heritage Site by UNESCO in 2008 and was added to the Swiss inventory of geosites.

A first list of 248 geosites was published in 2008, while the final list (322 sites) was published in 2012. This inventory stimulated an interesting debate around the generic name that should be given to it. According to FOEN, the terms "inventory" and "national importance" as used in 1999 (SCNAT) – should be avoided today because such references could create confusion with the official inventories carried out based on the Nature Protection Act. Finally, it was decided to give it the name "Inventory of Swiss Geosites".

The next step will be to distribute the inventory to Swiss cantonal administrations – in order to include its results in their land-planning strategies – as well as to the park managers.

Geoparks

Two geoparks were opened quite early in Switzerland: the *Geopark Sardona* in 1999, and the *Parco delle Gole della Breggia*, in 2001. Neither is a European Geopark.

The *Parco delle Gole della Breggia*, managed by a foundation, was established in a valley escarpment revealing a stratigraphic cross section that documents more than 80 million years of Earth history (Jurassic-Present). Due to its very small size (less than 1 km^2), it does not reach the international standards required for European geoparks[2]. The *Geopark Sardona*, that covers an area of about 1300 km^2 in eastern Switzerland, was created in 1999 by local geologists – with the name *GeoPark Sarganserland-Walensee-Glarnerland* –, with a focus on structural geology (Imper, 2003) and financed by regional development funds (Regio Plus programme) between 1999 and 2004. Today it is managed by an association of stakeholders and municipalities. The Geopark led to candidature for the World Heritage List (2008), although there is some ambiguity between the two entities (the Geopark and World Heritage Site) because they do not have exactly the same perimeter. Moreover, the motivation to apply to the European Geoparks Network (an objective during the initial phase) strongly decreased after the region became a World Heritage site.

After these two experiences several projects arose in various parts of the country (***Fig. 2***). According to the Federal tradition of Switzerland, each project was conducted by geologists active in their region and each one had different goals. The Geoparks Engadin and Val de Bagnes in the Swiss Alps were conceived to improve tourism during the summer season. Today, the project in Engadin has been abandoned. The Swiss Jura Geopark aimed at promoting the palaeontological findings along the A16 highway. The project was managed by the Canton of Jura with another promotional approach that resulted in abandoning the project of a Geopark. The Hohgant Geopark was a

2 According to the European Geoparks Network, a geopark should have a sufficient size to generate economic incomes and work places.

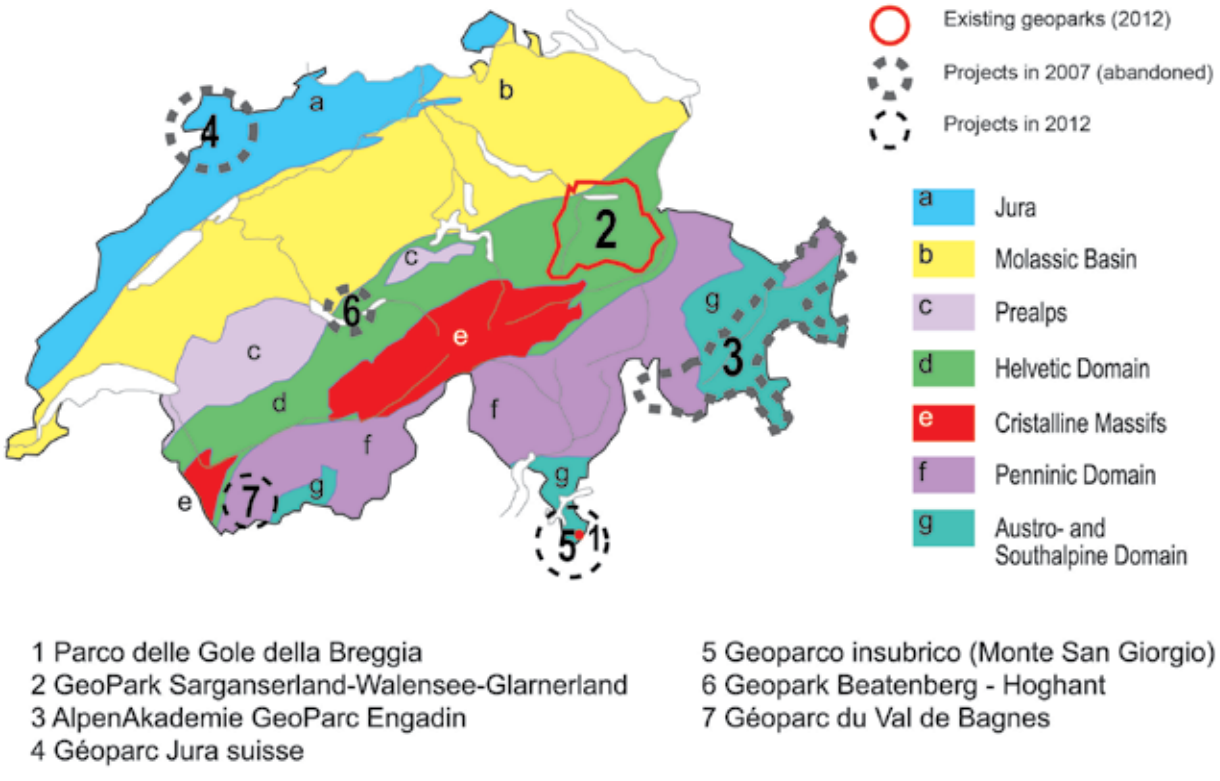

Figure 2: Geoparks in Switzerland.

project carried out in parallel to a candidature as a NRP according to revision of the Nature Protection Act. Three Communes refused the project for a NRP in 2011, and both projects (NRP and Geopark) were, therefore, abandoned. The last project is a transboundary one, between Italy and Switzerland (Insubrian Geopark). If accepted, it should include the Golle della Breggia Geopark. Another international geopark could have been created: in 2012, the Chablais Geopark (France) was accepted as a European Geopark. At the initial stage of the project, it was planned to develop a geopark covering both the French and the Swiss parts of the Chablais, but the Swiss municipalities did not agree to carry out the preliminary studies.

Due to the various projects that emerged in 2004, the Working group on Geotopes decided to develop guidelines for accompanying local projects and establishing a process of certification of Swiss Geoparks. A strategic report was published in 2007 (Reynard *et al.*, 2007) leading to the organization of a specific workshop in 2008. In 2009, SCNAT, FOEN and the Swiss Commission for UNESCO agreed on an application procedure for admitting Swiss Geoparks to the European and UNESCO Geoparks Network. No international candidate has been proposed yet.

Summary

Due to the presence of numerous erratic boulders, geoheritage conservation was initiated early in Switzerland, in the early decades of the 19th century, but it is only during the last two decades that scientists have re-discovered the heritage value of geology and have started carrying out inventories of geosites and development of geoparks. The activities were coordinated by SCNAT, which created in 1993 a specific working group dealing with these issues. The working group is still active and has played an important role in the promotion of knowledge on geoheritage, both at a political and public level. Some Cantons have also been quite active in protecting and promoting their geoheritage, especially in Eastern Switzerland.

In spite of improvements during the last two decades, disappointments still have to be faced. At the national level, geoscientists have failed in their attempts to compile an inventory with a legal value according to the Nature Protection Act. The inventory published in 1999 and lately revised (2006-2012) is only a proposed list of sites of interest proposed by the scientific community. This situation does not simplify the management and protection of particularly sensitive sites.

The development of Geoparks in Switzerland has been affected by the revision of the Nature Protection Act in 2006. As a matter of fact, most of the regions with a potential for geoparks preferred developing projects for Natural Parks due to the available opportunity for financial support. Nevertheless, a survey carried out on 19 projects for Natural Parks in 2009 shown that most of the park developers have a very poor knowledge of Geoheritage in their parks (Fontana and Reynard, 2011). All these reasons now lead the Working group on Geotopes to develop more active research and activities in Natural Parks.

Acknowledgements

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New directions in geoconservation: Scotland's Geodiversity Charter

John E. Gordon Hugh F. Barron and Angus D. Miller*

Scotland's geodiversity is world-famous as the foundation of a remarkably varied landscape, and the source of inspiration for many advances in our understanding of how the Earth works. This geodiversity also underpins most ecosystems and delivers essential benefits and services for society through its influence on landscape, habitats and species, economic activities, historical and cultural heritage, education, and people's health and well-being. Understanding geodiversity is vital to inform climate change adaptation and sustainable management of natural resources, including minerals, the land, river catchments and the coast. With an emphasis on these wider benefits to society, Scotland's Geodiversity Charter has been developed to promote and deliver a strategic approach to the conservation of geodiversity. As part of an ecosystem-based approach, and through the engagement of all relevant stakeholders, it represents an important step towards better integration of geodiversity and geoheritage conservation across a range of key policy areas. This article outlines the background to the Charter and its key aims and objectives as a model for a collaborative approach involving government, local authorities, public bodies, voluntary organizations, academics, teachers, commercial businesses, land owners and individuals in promoting and maintaining geodiversity.

La diversité géologique en Ecosse, reconnue mondialement, est basée sur une variété de paysages remarquables, source d'inspiration à la base des nombreux progrès acquis dans notre compréhension des phénomènes terrestres. Cette diversité représente aussi un soutien pour la plupart des écosystèmes, un bénéfice essentiel et une aide envers la société par son influence sur le paysage, l'habitat et les espèces, les activités économiques, l'héritage historique et culturel, l'éducation, la santé et le bien-être de la population. La compréhension de la diversité géologique est vitale pour faire face au changement climatique et gérer durablement les ressources naturelles, incluant les gisements miniers, les régions, les bassins et le domaine côtier En mettant l'accent sur ses avantages importants du point de vue social, la Charte écossaise de la Diversité Géologique a été développée pour fournir une approche stratégique vers la conservation de cette diversité et en faire la promotion. En tant qu'élément d'une approche de type écosystème, et avec l'engagement pertinent de tous les dépositaires d'enjeux, cela représente un pas important vers une meilleure intégration de la conservation de la diversité et de l'héritage géologiques à travers l'éventail de secteurs politiques clés. Cet article souligne les fondements de la Charte, ses buts et objectifs prioritaires en tant que modèle pour une approche synergique impliquant le gouvernement, les autorités locales, les organisations publiques et bénévoles, les enseignants, le milieu des affaires, les propriétaires et les particuliers, unis dans la promotion et la pérennité de la diversité géologique.

La geodiversidad de Escocia es famosa en el mundo entero como soporte de un paisaje extraordinariamente variado y fuente de inspiración de muchos avances en nuestra comprensión de cómo funciona la Tierra. Dicha geodiversidad es también el soporte de muchos ecosistemas y proporciona beneficios esenciales a la sociedad por su influencia en los paisajes, hábitats y especies, actividades económicas, patrimonio histórico y cultural, educación y la salud y el bienestar de la población. Entender la geodiversidad es vital para valorar la adaptación al cambio climático y la gestión sostenible de los recursos naturales, incluidos los minerales, el territorio, los ríos y la costa. Poniendo énfasis en tales beneficios para la sociedad, se ha desarrollado el Estatuto Escocés de la Geodiversidad, para promocionar y generar un enfoque estratégico de la conservación de la geodiversidad. Como parte de un enfoque basado en los ecosistemas, y por medio de la implicación de todas las partes interesadas, representa un paso importante hacia una mejor integración de la geodiversidad y el patrimonio geológico en una amplia serie de políticas. Este artículo repasa los antecedentes del Estatuto y sus principales objetivos como modelo de un enfoque colaborativo implicando al gobierno, las autoridades locales, los organismos públicos, las organizaciones de voluntarios, la universidad, los profesores, los empresarios, los propietarios y los individuos, en la promoción y mantenimiento de la geodiversidad.

Geoconservation has a strong focus on the assessment and management of protected sites for geological and geomorphological features. This is reflected in many national programmes across Europe to establish site inventories, including the benchmark Geological Conservation Review in Great Britain (Ellis, 2011), and initiatives such as ProGEO's GEOSITES project and the evaluation and promotion of geomorphosites by the International Association of Geomorphologists (Reynard *et al.*, 2009). Such activities have delivered benefits for geoheritage, tourism, education, public awareness and geoscience research. As recognized in the *European Manifesto on Earth Heritage and Geodiversity* (2004), there has also been growing appreciation in the last decade of the wider role and relevance of geodiversity in relation to landscape, biodiversity, economic development, climate change adaptation, sustainable management of the natural environment, historical and cultural heritage, and people's health and well-being (Johansson, 2000; Gordon & Leys, 2001; Gray, 2004; Stace & Larwood, 2006; Gordon & Barron, 2011).

At an international policy level, the importance of the conservation of geodiversity and its wider values has been

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highlighted by the Committee of Ministers of the Council of Europe (2004). They recommended that the "geological heritage constitutes a natural heritage of scientific, cultural, aesthetic, landscape, economic and intrinsic values, which needs to be preserved and handed down to future generations" and that geological and geomorphological features are essential characteristics of landscapes that should be considered when implementing the European Landscape Convention. IUCN, too, has recognized the wider role and relevance of geodiversity - "the conservation and management of geological heritage need to be integrated by governments into their national goals and programmes" (IUCN, 2008). Similarly, UNESCO has promoted the cultural and economic importance of geodiversity through the Global Geoparks network (McKeever *et al.*, 2010). However, in many relevant policy areas, including climate change, water, economic development and marine conservation, geodiversity has not been integrated either at European or national levels.

An ecosystem approach, as set out in the Convention on Biodiversity (1992) and the Millennium Ecosystem Assessment (2005), is now a key policy driver for nature conservation globally and is a central pillar of the EU Biodiversity Strategy (2011). Although often undervalued or overlooked, geodiversity contributes to critical ecosystem services (Gray, 2011; Gordon & Barron, 2011; Gray *et al.*, in press). Consequently, there is now advocacy for a more holistic approach that recognizes the wider benefits of geodiversity to society and integrates geodiversity more closely in environmental policy and practice (Prosser *et al.*, 2011; Henriques *et al.*, 2011; Gordon *et al.*, 2012; Gray *et al.*, in press). This should lead to better recognition that geodiversity is of significant value to society and relevant to society's needs. In turn, this should help to strengthen geoconservation and the role of geodiversity as the essential foundation of most ecosystems and the services they provide. Such an approach underpins the development of Scotland's Geodiversity Charter.

Scotland's Geodiversity Charter: recognizing the wider importance and value of geodiversity

The rationale behind Scotland's Geodiversity Charter (***Fig. 1***) was to demonstrate and build on the wider values of geodiversity and to advocate a more strategic and integrated focus to the conservation

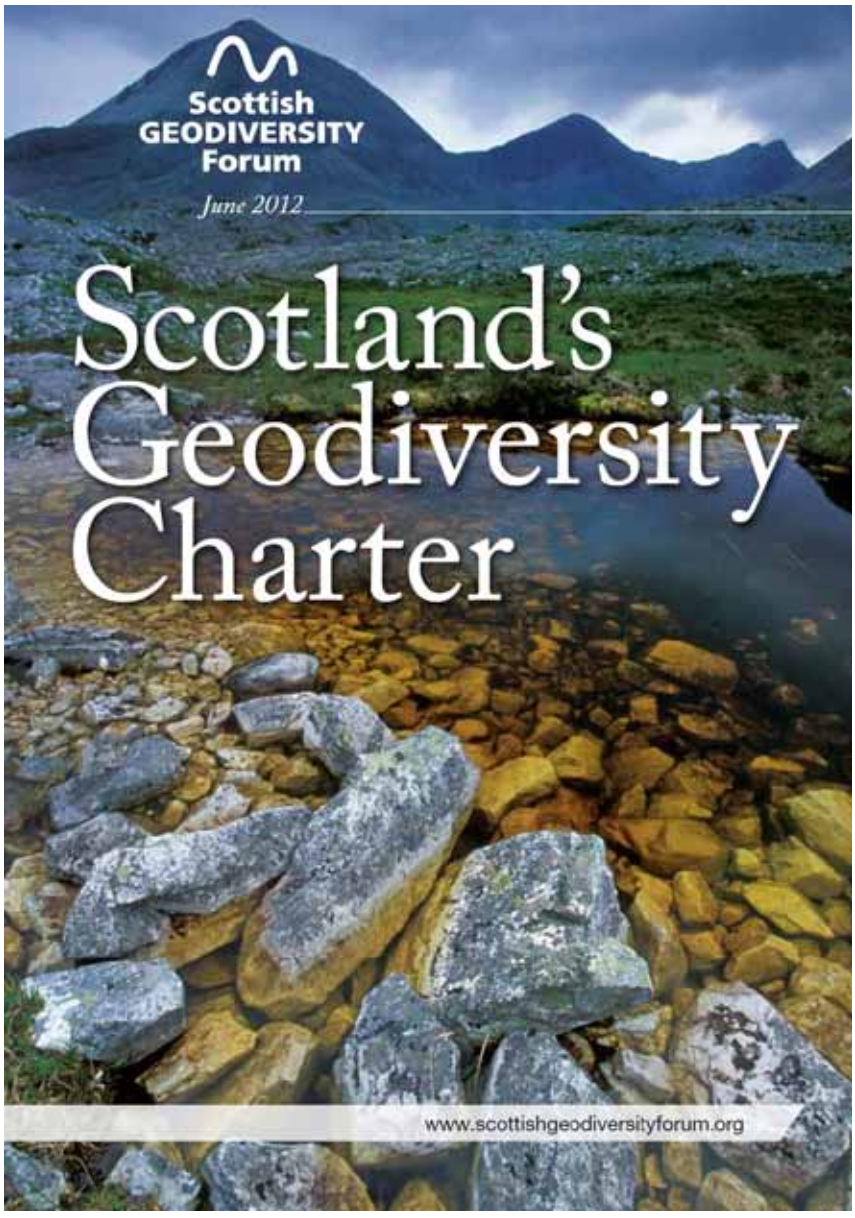

Figure 1: Scotland's Geodiversity Charter (http://scottishgeodiversityforum.org/charter).

of biodiversity, geodiversity and landscape within the framework of an ecosystem approach and underpinned by sound Earth system science. Working in collaboration, Scottish Natural Heritage (SNH) and the British Geological Survey (BGS) prepared an evidence base to support such an approach (Gordon & Barron, 2011). Their report demonstrated that geodiversity delivers or underpins many different types of ecosystem service and provides a wide range of benefits for society and the environment (***Table 1***). It concluded that a strategic framework would highlight the wider role and benefits of geodiversity and associated geoconservation activities and facilitate their better integration into the existing policy framework. It would also help to identify priorities for geoconservation activities and provide a foundation for actions by different stakeholders and sectors.

Geodiversity interacts with biodiversity through our ecosystems and also links landscapes, people and their cultures. In some cases the benefits from geodiversity are direct (e.g. enhancing the aesthetic quality of the landscape), whereas in others they are achieved through the influence that geological, hydrogeological, geomorphological or pedological factors and processes have on both landforms and the biodiversity they support. Not only is the conservation management of the non-living parts of the natural world crucial for sustaining living

Benefits arising from geodiversity and geoconservation	Links to EU policies
The knowledge to help society adapt to climate change and sea-level rise and to mitigate natural hazards through better understanding of natural processes and regional differences	*Supporting the Floods Directive, the EU Climate Change Policy – Adapting to Climate Change*
The physical basis for our varied landscapes (both rural and urban) and the foundation for terrestrial and marine habitats, wildlife and use of land and water	*Supporting the EU Habitats Directive, the EU Water Framework and Groundwater Directives, the EU Biodiversity Strategy, the European Landscape Convention, the Marine Strategy Framework Directive, the Integrated Maritime Policy and Recommendation on Integrated Coastal Zone Management*
The resources for many aspects of economic development, including minerals, tourism-based activities (e.g. Geoparks), soils, and renewable energy	*Supporting EU Economic policy, the Sustainable Development Strategy and Sustainable Tourism Policy*
A powerful influence on our cultural heritage as a source of inspiration for art, sculpture, music, poetry and literature, and on the character of our built environment through the use of different building stones	*Supporting EU cultural and education policies*
The resources for education and research (Earth system science) that support cross-curricular activities, provide opportunities for employment and enhance our knowledge of how the Earth works	*Supporting EU science, education and economic policies*
The resources for a variety of recreation and outdoor activities, with consequent benefits for people's health and well-being	*Supporting the EU Health Strategy and Health Programme*

Table 1: Benefits from geodiversity and geoconservation and links to EU policies.

species and habitats (e.g. Anderson & Ferree, 2010), but geodiversity also has a fundamental bearing on people's health and well-being. The basis of the Charter, therefore, is that geodiversity has an essential part to play in dealing with the challenges that society faces today, such as climate change adaptation, loss of biodiversity, sea-level rise, sustainable economic development and improving people's quality of life. These are cross-cutting issues of current concern to decision makers in government. By aligning with the Scottish Government's Strategic Objectives on the economy, quality of life, education, the environment and health, the Charter can help to add value to important economic, social and environmental outcomes (Gordon & Barron, 2012).

The voluntary geoconservation sector, through the Scottish Geodiversity Forum, has taken a lead in developing the Scottish Geodiversity Charter, facilitated by key organizations including SNH, BGS and the Scottish Government. The Forum (*www.scottishgeodiversityforum.org*), established in 2011, promotes Scotland's geodiversity and seeks to widen the profile of geodiversity and influence national and local policies in education, community involvement and health, the development of tourism and the wider economy. Its members include local geoconservation groups, Geoparks, the industry, education and academic sectors, related governmental and non-governmental organizations and interested individuals.

The Charter was launched in June 2012 by Stewart Stevenson MSP, Minister for Environment and Climate Change. It sets out a vision that Scotland's geodiversity is recognized as an integral and vital part of our environment, economy, heritage and future sustainable development, to be safeguarded and managed appropriately for this and future generations. The signatories commit to maintain and enhance geodiversity, recognizing its contribution to:

- natural heritage, valued landscapes and sea-bed features;
- habitats and species, and the many essential benefits it provides for society;
- adaptation to changes in climate and sea level through sustainable management of land and water at a landscape/ecosystem scale based on the principle of 'working with natural processes';
- sustainable economic development;
- historical and cultural development, intellectual growth and creative expression;
- public health, quality of life and national well-being and helping people to re-connect with the natural environment.

The Charter encourages determined and collective action from all sectors – public bodies, commercial businesses, land owners and managers, academics, teachers, voluntary organizations and individuals – to fulfil the vision and so ensure that geodiversity is adequately considered and conserved, and continues to provide essential benefits for Scotland. To achieve the vision, future action should address four main areas of activity:

1. raising awareness of the importance of geodiversity and its wider links with landscape, culture and sense of place, and encouraging a sense of pride through education (at all levels including schools, universities and life-long learning), promotion, outreach and public interpretation;
2. integration of geodiversity in relevant policies to ensure sustainable management of the natural heritage, land and water at a landscape/ecosystem scale for the wider benefit of Scotland's people, environment and economy;
3. conservation and enhancement of our geoheritage and its special character: within existing designated sites

and areas, by further designation of nationally and locally important sites, and in the wider rural, urban and marine environments;

4. research to improve our understanding of the role of geodiversity in providing benefits to ecosystems and people, and to address key knowledge gaps such as the functional links between geodiversity and biodiversity in terrestrial, freshwater and marine environments.

For example, local authorities, public agencies and government departments should undertake to ensure that due consideration, management, enhancement and promotion of geodiversity and national and local geosites are an integral part of decision making. The types of action they can take include:

- Acknowledging the value and importance of geodiversity in policy and guidance documents at national and local levels, including: national planning policy and Local Plans; policies and guidance for biodiversity, nature conservation, climate change, tourism, landscape, greenspace, land and water management, the historic environment and marine conservation, as well as seeking advice from appropriate expert bodies and agencies in decision making where appropriate;
- Promoting Scotland's geodiversity as a tourism asset that adds value to visitor experience and enjoyment;
- Forming partnerships with local geoconservation groups to audit geodiversity sites and develop geodiversity action plans, and involving local communities in collating information about sites of interest (e.g. former quarries, building stones);
- Encouraging developers to allow access to temporary exposures to record and sample, and to contribute borehole data to BGS.

Appropriate case studies illustrate the types of action that can be taken. For example, East Dunbartonshire Council, one of the signatories, completed a geodiversity audit in 2010, jointly funded by the Council and SNH, and carried out by BGS. In this local authority area in the west of Scotland, 36 sites were identified for their geological/scientific merit, education value, community site value, cultural heritage, economic importance, access and fragility, and 34 were recommended as Local Geodiversity Sites. As well as having geoheritage importance, the sites have numerous links to landscape character, historical structures, ecology and the economic and cultural history of the area. Such systematic inventory and evaluation provides a foundation for developing a Local Geodiversity Action Plan and better integration of geoheritage in local planning policies.

As of August 2012, the Charter had 31 signatories, including public bodies, NGOs, industry and landowner representative groups, geoconservation groups and Geoparks; further signatories are expected. The next step now underway is to monitor progress towards delivering the aims of the Charter, to encourage further sign-up and to develop and promote more examples of best practice. In terms of outcomes at a UK level, the Charter also aligns with, and supports, the UK Geodiversity Action Plan (UKGAP) (*www.ukgap.org.uk*) and will contribute to its delivery.

Opportunities at a European level

The type of approach underlying the Charter may have wider relevance since conservation of geodiversity and geoheritage can play a vital part in a more sustainable Europe in line with a range of EU policies (***Table 1***). For example, this was demonstrated at a stand organized by the EFG Panel of Experts on Soil Protection and Geological Heritage, together with five other European Earth Sciences and related organizations, at the Exhibition, 'Every Drop Counts', held as part of the European Commission's Green Week in Brussels, 22-25 May 2012 (*www.eurogeologists.eu*). The key message presented was that the role of geodiversity in the EU water policy framework should be enhanced. Care for Europe's geodiversity and geoheritage is crucial in relation to the globally increasing demand for clean drinking water, management of water-related hazards such as flooding and coastal erosion, climate change adaptation, development of renewable energy (hydro power) and opportunities for water-based recreation and outdoor activities with their benefits for tourism and people's health and well-being. Better integration of geodiversity and geoconservation in existing water policies, measures and decision frameworks would help Europe to find more sustainable solutions that in the long term would be less costly as well as providing positive economic benefits. At the same time, it would help to protect Europe's geoheritage and safeguard the quality of the living environment of European citizens, while mitigating risks such flooding, biodiversity loss and soil loss.

Conclusion

Integration of geodiversity in wider environmental policy and decision frameworks is now essential not only to protect our geoheritage, but also to ensure more holistic conservation management of biodiversity, geodiversity and landscape through an ecosystem approach, to inform climate change adaptations, and to contribute to resolving broader environmental, economic and social issues. Scotland's Geodiversity Charter represents an important step in this direction. It instigates a process through which key stakeholders will work together to achieve greater awareness of geodiversity and the realization of its benefits through the sustainable management of land and water, consistent with the economic, social, cultural and environmental needs of Scotland. By moving in this direction, the Charter aims to demonstrate that geodiversity matters and that geoscience knowledge and geoconservation can deliver positive benefits for people and the environment at national and local scales. In doing so, it should help to place geoconservation and geoheritage on a more strategic footing. This is part of a broader European challenge to raise awareness of the value and benefits of geodiversity at a policy level and to position geodiversity at the foundation of an ecosystem approach.

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How to implement Geoheritage and Geodiversity in the QualityCoast Label and COASTLEARN?

*Hanneke van den Ancker and Albert Salman**

The QualityCoast Label and Flag

With the QualityCoast Award programme, EUCC aims to establish a worldwide network of coastal areas that encourage sustainable development, conservation of nature and biodiversity, care for cultural heritage and identity, and social responsibility, whilst maintaining high standards in tourism.

The idea followed the Blue Flag programme, with 3489 beaches and marinas worldwide participating, (see *www.blueflag.org*). The public responds very well to the Blue Flag label because it indicates a good quality of water, a clean and well-managed beach and marina and proper safety regulations. As a result, local communities are eager to have a blue flag flying for their beaches and marinas.

For visitors, a holiday is more than a beach, and local authorities and the EUCC started to expand the scope from a single beach to a whole tourism destination. Since 2007, more than 140 tourist destinations in 23 countries have received a QualityCoast Award, including coastal towns, resorts, regional parks and islands. To acquire a QualityCoast flag, a destination has to pay attention to sustainable policies and management of nature and biodiversity, education and tourism facilities, the environmental quality (including Blue Flag requirements), keeping the identity of the region: the culture and historical values of villages, towns and landscapes, and respecting human rights.

A local authority or a national or regional park can submit an application for a QC Award by completing a form. Every year, December is the deadline for submitting applications. Filling out the questionnaire takes a community approximately two weeks. Costs for participating depend on the size of the area and the number of inhabitants. Some financial support for the QC programme is received from the EU. The application is screened by a team of experts and the response of the public visiting the area is incorporated into the judgement. The final evaluation is done by a Jury, paying attention to the regional, national and international standards in sustainability and the score is computed by adding several sectorial scores. A QualityCoast policy Award is valid for a two-year period.

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EUCC

The Coastal & Marine Union (EUCC) is the largest network of coastal practitioners and experts in Europe, an association with member organizations in 40 countries, 14 National Branches, and offices in five countries. Its main objectives are promoting sustainable coastal development, and maintaining healthy seas and attractive coasts for both people and nature. EUCC advocates best practice by developing coastal and marine policies, mobilizing experts and stakeholders, providing advice and information, and implementing demonstration projects.

Figure 1: QualityCoast flag in Noordwijk, The Netherlands.

Gold, Silver and Bronze Awards

For more details about the QualityCoast criteria and indicators, see the EUCC website and brochures: *http://www.qualitycoast.info/local-authorities/QCAward2013_Application_Manual.pdf*

Depending on the score and Jury evaluation, a gold, silver or bronze award and flag are presented to applicants for the quality of their sustainability policy. This is a higher award level than the BasicQ Award and Flag that a community receives when the actual situation ('status') meets the basic criteria for sustainable coastal management.

Top 100, Top 10

Each year a Top 100 ranking list of sustainable coastal destinations is published, and a Top 10 list of coastal regions that best satisfy the sustainable policy criteria.

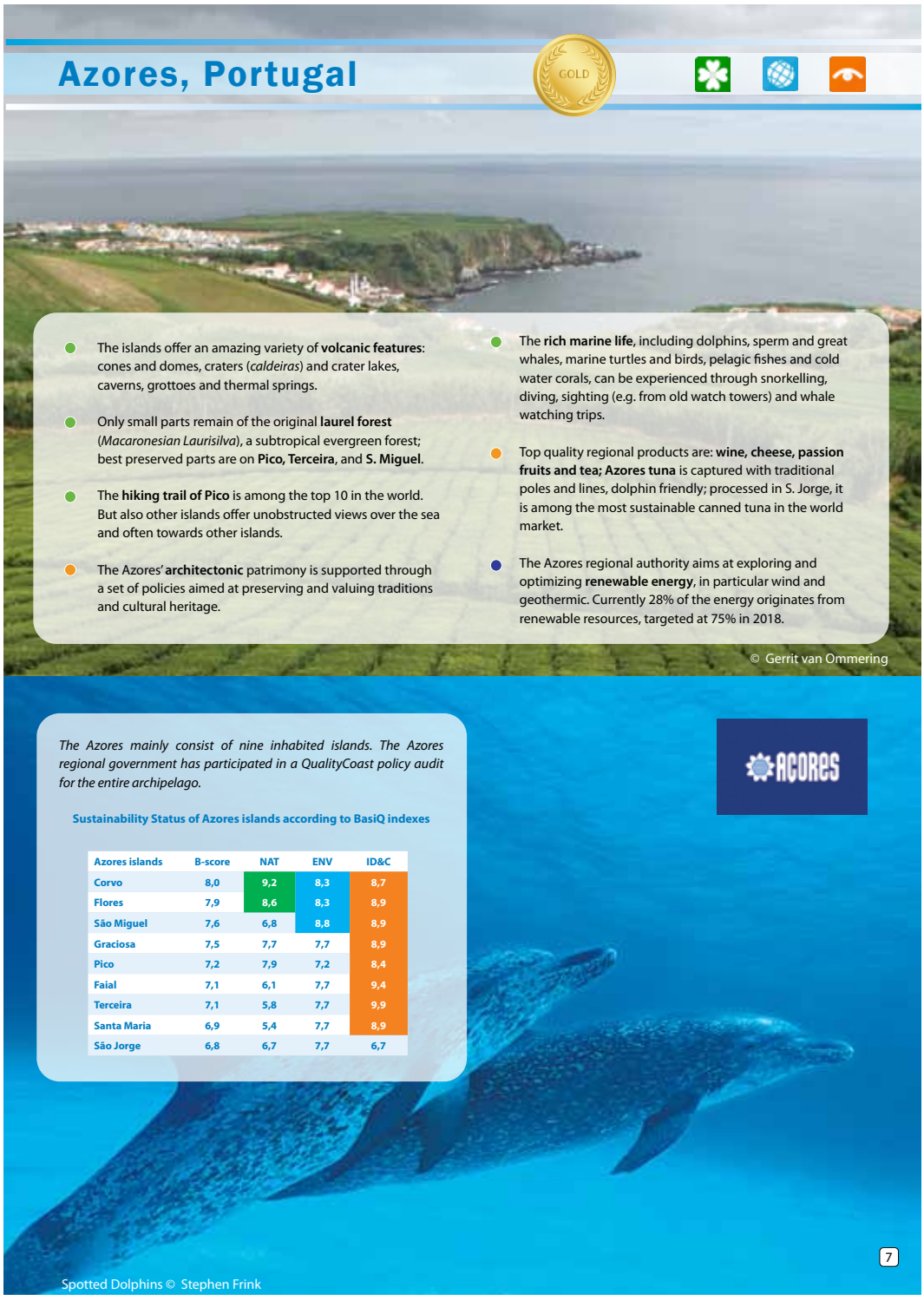

Figure 2: Page from the brochure re the Azoren and extra table of scores of the separate islands.

The Top 10 of coastal regions are highlighted in a special brochure that is freely distributed, and available on www.qualitycoast.info. This year, 2012, the Azores ended first in the Top 10 of coastal regions. All its nine islands were screened.

Ambassadors, travel organizations (TUI, booking.com), tourism fairs

To promote the QualityCoast policy programme and label EUCC has a network of ambassadors, television personalities and politicians that endorse the concept. QualityCoast destinations are promoted in several travel brochures of the TUI travel organization. Several tour operators have supported the QC label since 2010 and in 2012, for the first time, QualityCoast destinations were promoted at tourism fairs, including those of Essen and Utrecht and the special Tourism Fair of Berlin, ITB, (see photograph).

EUCC cooperates with the business sector, a number of individual hotels and tourist businesses, including Booking.com, the internet hotel booking system (Try booking your hotel next time via EUCC's homepage, *www.eucc.net*).

Call for experts to evaluate local policies regarding (coastal) geoheritage and geodiversity

To evaluate the geoheritage and geodiversity policy of areas that have applied for a QualityCoast Award, and will apply in the near future for a QualityTourism Award, a network of Earth Scientists is required. For this purpose, we would like to cooperate with organizations specialized in this and to set up a special database of geo-experts per country.

The fee for a complete evaluation will depend on the size of the area, but is about 200 – 400 Euro per evaluation. This only makes an evaluation possible, if you already know the region. If you are interested in participating, please submit a short CV, 1-2 A4 pages, highlighting your coastal and evaluation expertise and the regions that you are willing to evaluate.

You can submit your application through *info.efg@eurogeologists.eu* under the heading: *QC-expert*.

Figure 3: EUCC director Albert Salman at the Tourism Fair in Berlin.

Extending the QC policy label to inland destinations and cooperation with other organizations

By adopting the global destination criteria of the Global Sustainable Tourism Council (GSTC), QualityCoast is now open for destinations from all over the world. Under the umbrella of the ECNC Group, the Expertise Centre for Biodiversity and Sustainable Development (*www.ecncgroup.eu*), a broader programme is being developed, a QualityTourism Award and label, that can be acquired by all destinations, coastal and non-coastal. Furthermore, discussions with other organizations such as Blue Flag, EFG, EGN and GGN are taking place on how to improve cooperation.

Geoheritage and geodiversity in the QualityCoast / QualityTourism label

In 2012, with support of the EFG board, PE Geological Heritage established a small working group of six persons that checked the questionnaire of the QualityCoast label for improvement re geoheritage and geodiversity policies. It proposed a number of suggestions to the QualityCoast team on how to improve the questionnaire for geodiversity and geoheritage purposes. Minor adaptations only were needed in the nature, cultural heritage and tourism sections. New applications will be screened for geoheritage and geodiversity, around January 2013. For the screening we will need an extra group of experts in coastal geoheritage and geodiversity, from those regions and countries that did submit a QualityCoast application, and that will submit a QualityTourism application in the near future. EFG's Board and PE team on Geological Heritage have decided to support its development.

Call for case-studies and modules on geoheritage and geodiversity for EUCC's databases on coastal education (COASTLEARN) and best practices

Apart from the QC label, the EUCC network developed a database with projects, best practices, see *www.coastalguide.org* and educational programmes, see *www.coastlearn.org*. The overview of educational programmes and assignments of COASTLEARN especially attracts many visitors, with over 60,000 unique visitors in 2011.

Within the EFG - PE Geological Heritage, we have been regularly discussing the need for databases that promote best practices in geoheritage and geodiversity. Natural England, for example, developed such a database for quarrying. To give impetus to the idea, gain experience and have a bigger public looking at our materials, we think it is sensible to start a cooperation with EUCC and try to apply for best practices projects in coastal management with respect to geodiversity and geoheritage. The format will follow the EUCC format. An alternative or additional database is the OURCOAST database that was prepared by Arcadis and EUCC, under contract for the European Commission, see *http://ec.europa.eu/ourcoast*. If you are interested, submit a short description of a best practice example(s) – 1 A4 page maximum (see websites for proper formats) - through *info.efg@eurogeologists.eu* under the heading: *Coastal Best Practice project* or *COASTLEARN*.

Further reading

http://www.eucc.net
http://www.qualitycoast.info

EFG Stand at the European Commission's Green Week 2012 "Every drop counts"

Patricia Cortés, Hanneke van den Ancker and John Gordon*

Water shapes our landscapes and their geology, geomorphology, soils and biodiversity. The role of geodiversity in the EU water policy framework should be enhanced. Better integration of geodiversity and geoconservation in existing water policies, measures and decision frameworks will help Europe to find more sustainable solutions that in the long term will be less costly. At the same time, it will help to protect Europe's geoheritage and safeguard the quality of the living environment of European citizens, while mitigating risks such flooding, biodiversity loss and soil loss. The European Federation of Geologists participated in the European Commission's Green Week, 22-25 May, 2012, with a stand at the Exhibition: *"Every Drop Counts"*.

This year's theme of the 12th Annual Conference on European Environment Policy was "Water". This is the largest environmental conference organized by the EU and seeks to raise awareness about protection of the environment. It provides a unique opportunity for discussion and exchange of experiences and good practice, since the audience is made up of officials from all levels of government, local, regional and national, as well as non-governmental organizations, scientists, technicians and representatives of companies in the environmental sector within the European Union and other countries. Every year some thousands of international experts in environmental management meet during the event.

The 52 stands at the Exhibition associated with the Conference included green business solutions, NGO activities, local and regional authorities, and European and international bodies. Debates, presentations and stands reviewed actions in water policy, the uses of this valuable resource and the elimination of water pollution. The presentations and documents of the conference can be downloaded *here*.

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An EU Policy response to the Water Framework Directive, the "Blueprint to Safeguard Europe's Water", has been developed to ensure good quality water in sufficient quantities for all legitimate uses: *http://ec.europa.eu/environment/water/blueprint/index_en.htm*. It will be issued in winter 2012.

EFG, together with five other European earth sciences and related organizations, organized a stand under the theme, "Water shapes most of Europe's geological heritage and landscapes". The main objective of the stand was to draw attention to the fact that sustainable water management should take regional geodiversity into account. Standard solutions for water problems are often based on models that do not consider geology, geomorphology, soils and history of the landscapes. In the models, the subsoil is frequently treated as a uniform medium. Furthermore, EU water policy should include the natural character of water bodies as part of our geological heritage. The handout "Geodiversity, an omission in EU policy" summarizes these messages and links to other EU legislation in which geodiversity can contribute to sustainable management. It can be downloaded *here*.

At the stand we met with officials, members of NGOs and the public. Everybody we spoke with seemed to agree with our messages. EU officials mentioned that they are working towards such improvements, as suggested in our stand, but part of the problem is that these issues are difficult to standardize and scientists as yet have not come forward with practical solutions.

The stand was prepared by the coordinator of the EFG Panel of Experts (PE) on Soil Protection and Geological Heritage, Ms Hanneke van den Ancker, with Dr. John Gordon and Miss Patricia Cortés, and supported by the coordinator of the EFG PE on Hydrogeology, Dr Marco Petitta.

The stand was co-organized by six European organizations that care for Geodiversity and Geoheritage: EFG (European Federation of Geologists), European Geoparks, EUCC (The Costal and Marine Union), IAG (International Association of Geomorphologists), EFS (European Federation of Speleologists) and ProGEO (The European Association for the Conservation of the Geological Heritage):

Figure 1: EFG stand with Patricia Cortés Polo, Office Assistant, Dr. Isabel Fernandez, EFG Executive Director and Dr. John Gordon, University of St Andrews, Scotland.

Figure 2: Patrycja Czerniak, EUCC-Integrated Coastal Zone Management and Hanneke van den Ancker.

- *EFG*: a non-governmental European umbrella organization of 21 national earth sciences associations, whose main objectives are to contribute to a safer and more sustainable use of the natural environment, to protect and inform the public and to promote more responsible exploitation of natural resources.
- *European Geoparks Network*: comprises 50 Geoparks in 19 European countries, that promote sustainable regional development by using that territory's geological heritage, primarily through the development of geotourism.
- *EUCC*: an association with 2700 mem-

bers and member organizations in 40 European countries, that is dedicated to conserving and maintaining healthy seas and attractive coasts for both people and nature.
- *IAG*: an international scientific, non-governmental and non-profit organization, whose principal objectives are development and promotion of geomorphology as a science through international co-operation and dissemination of knowledge of geomorphology.
- *EFS*: an international group of speleological federations to promote sport and scientific speleology with commissions and working groups (e.g. Commission on Cave Protection).
- *ProGEO*: a network of individuals and organizations from nearly all European countries, that promotes the conservation of Europe's rich heritage of landscape, rock, fossil and mineral sites, and informs and advises the public of the importance of this patrimony.

During the exhibition, the stand was staffed by Ms Hanneke van den Ancker (Coordinator Geoheritage NL and EFG PE Soil Protection and Geological Heritage), Miss Patrycja Czerniak (EUCC-Integrated Coastal Zone Management), Miss Jet Krantz (EUCC – Coastal Quality Label), Dr John Gordon (University of St. Andrews), Mrs Isabel Fernández (EFG Executive Director) and Miss Patricia Cortés (EFG Office assistant).

The exhibition included three posters with the headlines: "Water shapes our landscapes and soils", "Geodiversity influences Europe's cultural diversity and biodiversity" and "Knowledge of geodiversity is vital for sustainable water management". These messages were signed "We care about Geodiversity and Geoheritage", under the logos of the six organisations on the fourth poster. A rotating powerpoint presentation, "Six European / International organizations on Water, Geoheritage and Geodiversity", showed examples of the wide variety of activities of each group, with around 100 slides and illustrated with engaging photos. The examples included care in European Geoparks for heritage watersand landforms, education, tourism and sustainable management; the achievements of the EUCC integrated coastal zone management programme and the certification of European coastal communities through the quality coast label; and the cave protection and cave research programme of the EFS.

Figure 3: EFG Greenweek poster.

ProGEO, EFG and IAG added best practices linked to the interrelations between water and landscape and how to incorporate geology, geomorphology, processes and soils in sustainable water management practices, such as in Scotland's Geodiversity Charter and London's Geodiversity Action Plan. Examples came from all the different European regions, from Finland to Spain, and from Greece to Ireland. Care for Europe's geodiversity and geoheritage is crucial in relation to the globally increasing demand for clean drinking water, management of water-related hazards such as flooding and coastal erosion, climate change adaptation, development of renewable energy (hydro power) and opportunities for water-based recreation and outdoor activities with their benefits for tourism and people's health and well-being.

Other documents and leaflets available at the stand included:

- The EFG leaflet
- Special issues of EUCC's magazine on "Sustainable tourism: Looking for a sustainable destination" and the "Quality Coast Label"
- EUCC – "Integrated Coastal Zone Management: Our Coast", produced by the European Commission
- Scotland's Geodiversity Charter produced by the Scottish Geodiversity Forum
- Geoheritage NL leaflet
- IAG's leaflet on the book "Geomorphosites".

As well as Environment Commissioner, Janez Potočnik, who attended the Green Week exhibition, including our stand, we were visited by different companies and NGOs interested in linking their activities with ours and working together on geodiversity and the protection of geoheritage.

In conclusion, the visitors appreciated the issues addressed in our stand and we had stimulating discussions and exchanges of ideas. The EFG and partner organisations increased their visibility by participating in the Exhibition, explained their activities to many visitors interested in geology and the profession and improved their networks of contacts.

Interview with Spanish EurGeol title holder

*EFG Office**

In order to promote the European Geologist title, the Spanish Professional Geologists' Organization, ICOG, started in 2012 a series of interviews with Spanish EurGeol title holders. EFG publishes here one of those interviews in which Raul Sanabria reflects on the benefits of professional titles and his exploration experiences abroad. EFG plans to carry out similar interviews with title holders of other national associations for future issues of the European Geologist magazine.

Pour la promotion du titre de Géologue Européen, l'Organisation Espagnole des Géologues Professionnels (ICOG), a entrepris en 2012, une série d'interviews avec les EuroGéologues espagnols. La FEG publie ici l'un de ces interviews où Raul Sanabria rend compte des avantages à posséder une qualification professionnelle reconnue ainsi que son expérience des travaux d'exploration à l'étranger. La FEG a l'intention d'effectuer des interviews similaires avec des Eurogéologues appartenant à d'autres Associations nationales avec publication dans les prochains numéros de l'European Geologist Magazine.

El Ilustre Colegio Oficial de Geólogos (ICOG), empezó en 2012 una serie de entrevistas con eurogeólogos españoles con objeto de promocionar el título de geólogo europeo. La FEG incluye aquí una de esas entrevistas en la que Raul Sanabria reflexiona sobre los beneficios de los títulos profesionales y su experiencia en exploración en el extranjero. La FEG planea realizar entrevistas similares a eurogeólogos de otras asociaciones nacionales para próximas ediciones de la revista European Geologist.

Raul Sanabria

Graduate of the Complutense University of Madrid, Member of the Ilustre Colegio Oficial de Geólogos de España (ICOG), European Geologist (EurGeol) and Professional Geoscientist (P.Geo)

Are professional titles useful abroad?

The answer is very simple. Yes, of course. In the country where I am currently living, Canada, it is the most important thing a geologist can write on his business card. Canada is the "centre of the universe" for exploration and mining issues. This is due to the rich natural resources of this country and the infrastructure created around them; the latter includes education and the development and financing of projects. The super-specialization of the sector has brought companies to explore the world from here, with the latest techniques and knowledge. This is possible thanks to the creation of a single stock market, the TSX and the TSX-V, specialized solely in mining and exploration and supplying the sector's companies with capital, a government politically committed to the sector and promoting exploration and being pro-mining, as well as an efficient national geological service. Let's get back to the initial question, whether the professional title is relevant here. The title is "compulsory" for certifying that the exploration work is carried out with the most elevated quality and professionalism standards and the subsequent obligation of public dissemination of technical information for the investors. The latter is very much regulated by the stock exchange market of Toronto and has to be carried out by qualified professionals (Qualified Persons according to the standard NI43-101 in Canada or Competent Persons accredited by the Australian JORC, among others) who take, with their signature, responsibility for the mentioned information, without the least distortion or modification, a consequence of the Briex scandal in the 1990s.

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Could you explain to us why you applied for the European Geologist title?

For the same reasons explained above. After several years of work experience as an exploration and mining geologist, I decided to make the jump and to dedicate myself to exploration at a higher level. The professional title became imperative in order to be able to head the exploration department as Exploration Manager or Vice President, Exploration. Given these responsibilities and the requirement for companies to disseminate reports publicly as the stock exchange market obliges, arose the need of being a Qualified Person. As a European Geologist (EurGeol) I was logically considered as complying with the regulations that opened the door for applying to the P.Geo title at the APEGBC in British Columbia. This way, the experience I had gained, combined with the professional titles, means that I can design, carry out and report the results of exploration programmes at the majority of the world's stock exchange markets and work on all five continents.

Do you consider that these titles have an added value for finding a job?

For me personally it was useful for working at a higher level and especially in terms of remuneration. The responsibility of my signature is very great and, from there on, increases my appreciation. From being a field geologist splitting stones from one side to the other, I switched to directing my own team of geologists, engineers, drillers, etc. and being able to budget and design regional exploration programmes in different places and, what is most important, to be responsible, lately, for the discovery

« The title is "compulsory" for certifying that the exploration work is carried out with the most elevated quality and professionalism standards and the subsequent obligation of public dissemination of technical information for the investors. »

and dissemination of results in extremely regulated public channels. Without the title, I wouldn't have been able to reach the stage where I am now which is, I believe, the most important one in my professional career and where I was able to find, promote and finance with public funds my own discoveries, and have this way founded my own companies.

Currently a demand for geologists exists abroad. Would you recommend to geologists who are unemployed to look for work outside Spain?

On the path I have treaded across the world, I have identified regions which effectively lack geologists, at least in the exploration sector to which I am dedicated. Canada is, of course, an exceptional place where more than 50% of the territory has not yet been explored. Every year not only deposits but also new mining districts are discovered. From Canada onwards, they explore also Central America, South America, Europe and mainly western Africa. Australia is the second competitor where a lot of exploration is carried out within the country, mostly for iron and gold. Furthermore, cities like Perth are the starting point for exploration in western Africa, Madagascar, Indonesia and the whole of south-east Asia. Currently, I am working very actively in the exploration of Colombia which has lately opened its doors to foreign investments and that is a unique opportunity. The truth is that they don't have many geologists over there and the companies pay Canadian salaries for national geologists or those imported mainly from Peru.

Tell us about your experiences in Canada and Colombia.

The adventure started in January 2007 when I decided to jump to the other side of the Pond, to Vancouver on the west coast. The times were not very promising for the Spanish mining industry, in which I was working, and my possibilities within the company were quite limited. On the contrary, in that year there were a lot of job vacancies in both Australia and Canada. For different reasons, I opted for Canada and Cash Minerals Ltd. At the beginning, I spent seven months in Yukon, in the Werneckes mountains, searching for uranium in IOCG deposits, surrounded by Australians. It was an incredible experience. We resided one and a half hours by light aircraft from the closest little village and our daily means of transport was the helicopter. I was in charge of a camp of 25 persons, with two drilling rigs working 24 hours per day and 10 geology students making systematic samplings and mapping at the same time anomalies in the exploration of the valued black mineral, all this with few English abilities and living in canvas tents. It goes without saying that in summer the sun is up for 24 hours, that it was snowing in August and that spring only lasted ten days, and last but not least, there were bears, wolves and other wild fauna.

From there I started to look for gold on the west coast of British Columbia, in the "golden triangle" at the border with Alaska, with American Creek Resources Ltd. This is a whole world of glaciers and steep mountain ranges and some of the biggest and most spectacular porphyric gold, copper and epithermal deposits in the world. During this period, I applied for the European Geologist title in order to become a Qualified Person for a project and I also started the process to become P.Geo with the APEGBC. Thanks to this, I could carry out the exploration as Exploration Manager and could then become Vice President, Exploration. I was working in one of those places that you normally only see in documentaries (and they pay us to travel there), for two consecutive summers, 2008 and 2009. Two discoveries were made during this time, an epithermal system of intermediate sulfidation (gold-silver) and a copper and gold porphyry. We had three drilling rigs and a camp of 30 persons situated on a mountain surrounded by glaciers accessible only by helicopter during a limited period of three months in summer. With the same company, I also found a unique iron-vanadium deposit in British Columbia (Ironmist) in Barriere, in 2008.

« Without the title, I wouldn't have been able to reach the stage where I am now which is, I believe, the most important one in my professional career and where I was able to find, promote and finance with public funds my own discoveries, and have this way founded my own companies. »

Because of the financial crisis of 2008, the majority of the exploration companies didn't have any capital for exploration in 2009, including the one in which I was working. It was time to move towards a new opportunity. I was invited, as Vice President, Exploration, in March 2010, to found our own company, NorthernIron Corp, which arrived on the stock market in August 2011. The idea is to reopen the old Griffith mine (closed in 1986 with ¾ of its reserves still to be recovered) in the north of Ontario. After a summer of exploration we found a satellite deposit at the mine at only 14 km distance which will allow us to go for a scenario of two open pits and which we are currently drilling in order to define the reserves.

After two summers in the Red Lake Area, an opportunity came along. In Balmertown (Goldcorp), 50 kms from there is located one of the most important gold mines of the world. While looking for similarities in the regional geology, we found a very prospective area and started to do exploration, bibliographic studies and to add everything to a GIS. It turned out to be a good exploration basis which we investigated in May 2010. The result was that we found the same rocks, the same alteration, the same structures and finally gold! Immediately we demarcated the area, applied for the license and started to explore with our own money and at our own risk. Now that the group is fully involved in the search for gold and precious metals, we are starting to look for projects in new areas which are not very well explored yet, in order to add more projects and create a new company. Which place is better suited than Colombia in these days to find gold? After one year of field work and negotiations with miners we managed to buy two small-scale gold mines in the centre of Colombia. The combination of high-level epithermal deposits together with the Red Lake gold project gave rise to the creation of the CondorPreciousMetals company of which I am currently President and CEO.

In summary, these experiences are more than good, the possibilities are infinite and the limits are only created by yourself. The advantage of being here is that you discover that the world is not as big as it seems and you can't get bored because all projects are different and everybody here is dedicated to this. Thanks to professional titles, the prestige of geologists is recognized here, contrary to my experiences in Spain - even if it is painful to say this - where I dedicated myself to geotechniques in the engineering world. From here I invite geologists to become members of professional organizations, to specialize themselves and to apply for the professional titles of ICOG (I have the one specialized in Mineral Resources as well) and of the European Federation of Geologists (European Geologist, EurGeol) and if they go to Canada they should apply for the Professional Geoscientist title (P.Geo) or the equivalent in Australia if this is their choice. Afterwards the world will seem small to them. This gave to me a unique opportunity to evaluate projects not only in different parts of Canada but also in Mexico, Guatemala, Colombia, Argentina and Chile among others.

Book review:

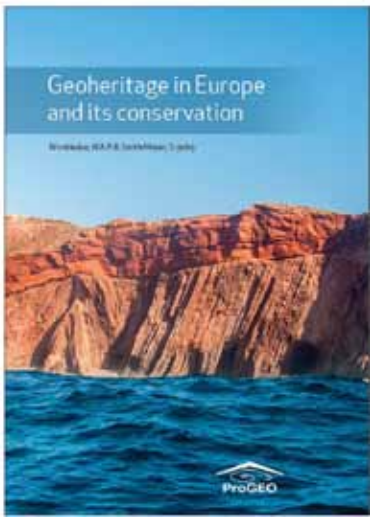
Geoheritage in Europe and its conservation

*Sylvia Smith-Meyer and Hanneke van den Ancker**

Geoheritage in Europe and its conservation
by W.A.P. Wimbledon & S. Smith - Meyer (eds.)

Expected date of publication: November – December 2012

How to order? Information on how to purchase the book are available on the ProGEO website: www.progeo.se.



Europe is diverse in geology, landscapes, countries and history. The new ProGEO book, Geoheritage in Europe and its conservation, gives an overview of the different situations re: geoconservation in Europe. It is the first time such an overview has been produced.

Contributions from 37 countries are arranged in alphabetic order. Each country has its own chapter of about 10 - 14 pages. Each chapter follows the same pattern and starts with a general introduction; a short overview of the most important geoheritage of that country and its history of geoconservation. These paragraphs are followed by a description of the geoconservation policies and strategies as well as the legal frameworks for protection. Practices and legislation vary considerably between countries, but there appears to be a mutual basis for geoconservation throughout the continent.

The text then proceeds with a concise description of the management of geodiversity and geological heritage, and the organizations that are active in these fields. Each chapter ends with literature, addresses, a summary and future challenges.

The book is published by ProGEO, the European Association for the Conservation of the Geological Heritage, a network that promotes the conservation of Europe's rich heritage of landscapes, rocks, fossils and mineral sites, involving all countries in Europe, exchanging ideas and information in an open forum, including the formulation of conventions and ideas for legislation. The book is co-dedicated to the late Dr. Gerard Gonggrijp of the Netherlands, who proposed the production of this book at the beginning of the 1990s. His early death prevented him from seeing the book become a reality. Gerard Gonggrijp was also one of the founders of "The Working Group for Earth Science Conservation", as ProGEO was called in its early days, and was its first executive secretary. He thought the book would be an important product in achieving the ProGEO aim of sharing information and that it could act as a source for inspiration for the different countries.

The political situation and legislative frameworks of the European countries will change over the years. The ProGEO website will regularly provide information to update the content of the book.

Book review:

An interview with Prof Dr Murray Gray about the new edition of his book: Geodiversity, valuing and conserving abiotic nature

*Hanneke van den Ancker**

In 2004, for the first time, a book with GEODIVERSITY in big capitals on its cover was published, by Wiley: *Geodiversity, valuing and conserving abiotic nature*. The book examined whether you could look at the physical environment of our planet in a similar way that the concept of biodiversity has done for the living elements of Earth. Since its publication, the author Dr. Murray Gray has been invited by many countries to explain and forward the idea of geodiversity and geoconservation, including USA, Canada, Norway, Netherlands, Portugal, Poland, Hong Kong & Malaysia. He is now Reader Emeritus at Queen Mary, University of London and Visiting Professor in the School of Earth Sciences at the University of Minho, Portugal. He has seen the beauty of geodiversity in many parts of the world and recognizes the numerous problems to be overcome for its sustainable management.

* Coordinator Geoheritage NL and Coordinator of the EFG Panel on Geological Heritage, info@geoheritage.nl

The second edition of his book will be published in the spring of 2013, a perfect moment to look back with the author on ten years of geodiversity.

The book led to the inauguration of a university undergraduate course on geodiversity and geoconservation at Queen Mary, University of London in 2005. Professor Gray is still involved in this course and in teaching the Masters course in Geoheritage and Geoconservation at the University of Minho, Braga, Portugal.

Figure 1: Dr. Murray Gray.

He is also the Chairman of the Planning Committee of a UK National Park and has been a local councillor in eastern England for over 20 years.

Geodiversity, valuing and conserving abiotic nature - 2013 edition

The book is divided into 15 chapters:

1. Defining Geodiversity; how the term geodiversity has grown since its first introduction in Tasmania and Australia in the 1990s by Kiernan, Sharples and Dixon.
2. Global Scale Geodiversity; explaining how the Earth's geodiversity evolved.
3. Local Scale Geodiversity; describing the variety of minerals, rocks, fossils, soils, landforms and physical processes.
4. Valuing Geodiversity: relating the different perspectives from which to value our geoheritage, the historical, the aesthetical, the economic, the tourism, the geosystem and ecosystem functions.
5. Threats to Geodiversity: an overview of the many threats.
6. International Geoconservation: an introduction to the organizations and geoconservation programmes operating at a global scale.
7. World Heritage Sites: explaining the principles behind the UNESCO scheme and the geological/geomorphologicalsites included in the network.
8. Global Geoparks; explaining the principles behind this growing network of geo-areas that use community support to promote geoconservation, education and economic development through geotourism.
9. National Geoconservation; reviewing the geoconservation programmes of many countries, including USA, Canada and throughout Europe.
10. The Wider Landscape; describing how geodiversity contributes to landscape beyond protected areas.
11. Geoconservation & Planning; explaining how the planning system can be a crucial tool in conserving geodiversity.
12. Geoconservation and Policy: explaining how policy initiatives can be a crucial way of conserving geodiversity.
13. Geodiversity & Geoconservation; describing how geoconservation should be based on preserving geodiversity and reviewing the methods of doing so.
14. Comparing and Integrating Geodiversity & Biodiversity
15. Conclusions

Your book starts with a quote by African conservationist Baba Dioum: "For in the end we will conserve only what we love. We will love only what we understand. And we will understand only what we are taught." Do you think this quote is still an important message for those involved in geoconservation? To get our audience to love the variety of geo-nature, what does this mean for our teaching of these issues?

Yes, I think the quote is important because without explaining the value of abiotic nature the public will not understand why it should be conserved and why limited public resources should be expended on doing so. As geoscientists we have not been good at explaining how geological research tells us about the evolution of the planet and its life and how modern societies could not exist without a geodiverse world. For example, about 15 different geomaterials are used to make a mobile phone.

Figure 2: Controversial planning/geoconservation site known as Birling Gap in East Sussex, England (summary on p.322). The photo shows the eroding Chalk cliffs, the staircase access to the beach and the terrace of houses, three of which have been demolished already. The site is an SSSI and visited on the course fieldtrip.

What will be different in the new edition of the book? What will be new?

There are now separate chapters on World Heritage Sites and Global Geoparks to reflect the growth in both the number and importance of these networks. The 'Valuing Geodiversity' chapter has been restructured around the 'ecosystem services' concept now prominent in nature conservation circles but which underplays the role of geodiversity. The description of geoconservation methods in Chapter 13 is among the other new aspects along with a general updating.

Where and how have we moved forward over the last ten years? What new issues have come up?

I know that in many countries, geoconservation has made significant strides forward though there is still much to do, particularly in the developing world where we are losing geodiversity (and biodiversity) every day. The global economic recession has not helped to increase resources for this work and in some cases has even meant severe cutbacks.

The 'Geopark' initiative has been very successful and promises to continue expanding. I think we remain too obsessed with protecting small geological sites (important though this is) and do not focus enough on respecting geodiversity in the wider landscape, for example in protecting the natural topography and designing authentic landforms in landscaping schemes.

What countries do you think have a modern approach to geodiversity and sustainable management?

Tasmania in Australia was the birthplace of geodiversity and continues to have an active group of researchers in the public sector and a government committed to the role of geodiversity.

The UK probably leads the world in geoconservation policy and practice though there have been recent setbacks. The geological community in Spain has made very important strides forward in recent years in ensuring that new nature conservation legislation includes geodiversity and in promoting geodiversity within the IUCN (international Union for the Conservation of Nature).

What do you think is the most important issue to pay attention to?

Each country (and provincial/regional government) should review its nature conservation legislation to ensure that geodiversity and biodiversity are put on an equal footing.

What could be the role of universities?

University degree courses in geology and geography could usefully teach geodiversity and geoconservation within existing or separate modules. There is also a need for additional Masters courses and research.

You have added a role in local government and national park management to your academic interests. What have you learnt from this?

My appointment as Chairman of a local government Planning Committee made me shift my research interests to the interface between planning and geomorphology. I could not and would not have written my book without that local government and planning experience.

News corner:
*Compiled by Isabel Fernandez Fuentes and Anita Stein**

34th IGC

The 34th International Geological Congress (34thIGC) took place in Brisbane, Australia, from 5 to 10 August 2012 with pre- and post-conference field trips. EFG was represented during this event by its President Ruth Allington, UK.

The Congress attracted a total of 6012 delegates from 112 countries. According to Neil Williams, the President of the 34th IGC, this was a very good outcome for the organizers, given the long distances most of the participants had to travel to get to Brisbane and the economic crisis currently faced by many countries. The Congress was also well attended by students from around the world.

As at previous IGC's, an impressive Technical Programme had been organized which included 3232 oral presentations covering a wide range of today's geoscience issues, as well as 5 Plenary Sessions with dynamic speakers, 24 Professional Development Workshops, 29 multiple-day field trips and 283 spaces occupied by exhibitors in the GeoExpo hall which completed the programme. The Brisbane Convention Center provided an impressive venue for the presenters and exhibitors. Neil Williams further states that the 34th IGC differed from former Congresses by its majority representation from new world countries, its focus on the private sector which is today the biggest employer for geologists and the strong interest expressed by politicians resulting in the organization of the first IGC Ministerial Forum.

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The European Federation of Geologists participated in the 34th IGC through a symposium on ***"Strengthening communication between fundamental and applied geosciences and between geoscientists and public"*** (Theme 1 of the Technical Programme, ***Geoscience for Society***, Symposium 6). The objective of this symposium was to discuss the benefits to be gained from a better understanding between geological communities. These include: incorporation of more relevant and informed education in applied geology and professional skills at university level; an improvement of industry competitiveness through more rapid conversion of research findings to applied technologies and methodologies; clear pathways and assessment criteria for geoscience graduates seeking to attain Professional Qualifications and their employers and mentors; and design of research projects and allocation of research funding based on a better appreciation of societal needs. The symposium was organised in collaboration with a number of other professional organizations with which EFG has developed important working relationship: American Geological Institute (AGI), American Institute of Professional Geologists (AIPG), Australian Institute of Geoscientists (AIG), Geoscientists Canada and International Union of Geological Sciences (IUGS).

According to EFG President Ruth Allington, the symposium was extremely well supported and attended by a core group of more than 50 persons. Delegates were impressed by the quality of the papers and the smooth organisation.

The symposium was subdivided into two sessions: *Framing the Issue: Academia - Industry Linkages, some examples.*

Speakers:

- Peter Bobrowsky, IUGS SG;
- Oliver Bonham, CEO Geoscientists Canada;
- Ross Large, AIG;
- Tim Baker, Geological Survey Of South Australia;
- Wayne D Pennington, AGI President

and, *Cross Communication in Geoscience and Education in Geosciences.*

Speakers:

- Barbara Murphy, AIPG President;
- Luca Demicheli, SG EuroGeoSurvey;
- Suzette Kimball, USA-USGS, United States Geological Survey, Deputy Director;
- William J. Siok, AIPG Executive Director;
- Roberto Greco, Olympiad Earth Sciences;
- Ruth Allington, EFG President.

The chair of the first session, Oliver Bonham, CEO of Geoscientists Canada - the organization of the provincial and territorial professional associations that regulate geoscience practice in Canada – confirms that he was "very happy to have collaborated with colleagues at EFG, AIPG and AIG to help organize and participate in this special session at the 34th IGC in Brisbane. Geoscience is a truly global profession, and with the public's expectation of professionalism in all that we do as scientists - wherever in the world - IGC offers the perfect venue to explore broad and challenging worldwide issues facing our profession. The special session on ***"Strengthening communication between fundamental and applied geosciences and between geoscientists and public"*** was timely, topical and effective." Bonham further asserts that "as geoscientists we all know the empirically bridge that exists between the outcomes of primary Earth science research and their application in the day-to-day work of all practitioners, but we seldom take time to reflect together on how critical good two-way communication across this key bridge really is. We also needed, yet again, to continue to challenge ourselves about how better to communicate with the public about the vital services that geoscientists provide to society every day." He finally commends "the effort made by EFG to initiate and organize this symposium. The range of talks that it attracted and the discussion it provoked were rewarding

for all concerned. It was a pleasure to have been involved and we look forward to further collaborations in the future, including at the next IGC in Capetown, South Africa, in 2016."

Barbara Murphy, President of the American Institute of Professional Geologists (AIPG), who co-chaired the second session, commented: "What was very evident were the common global issues that we professional geoscientists share and the role our organizations have as the voices for the profession of geology. Our session, *Cross Communication in Geoscience*, included six talks that focused on the importance of communicating what geologists do, on the need for common global academic and professional standards in part to increase the public awareness of the important role of professional geologists, to improve public perception and trust in geologists, but also to encourage students to enter the geosciences and to have a better understanding of the educational background they need to become a professional geologist. The session Cross Communication in Geoscience seemed to really represent what the 34th IGC was about as an international gathering of geoscientists communicating amongst each other and sharing their enthusiasm and knowledge of their field of geology but also realizing the importance of communicating with the public the importance of what we do." Barbara also enjoyed working with EFG, CG, AGI, and AIG in the organizing of these sessions and looks forward to working together on other efforts for the geosciences profession.

In addition, EFG President Ruth Allington participated in the meeting of the Affiliated Organisations of IUGS. This meeting helped to intensify the contact with partner organisations and the executive of IUGS and initiated, as a final point, the kick off of the new ***"Task Group on Global Geoscience Professionalism"***. The mission of this new TG will be to provide practical support for the whole community of professional geoscientists, for example by providing information (probably in form of a portal with information on relevant national and regional websites) about working in particular countries and continents (different educational requirements, residency rules and registration/licensure requirements and procedures) (for more information see article below).

Other networking activities included the presentation of the EFG/EGS photo competition prize book to other co-chairs and invited speakers at the symposium, as well as discussions with delegates of other geoscience organisations (YES, EuroGeoSurveys, IUGS, etc.).

In conclusion, the symposium was co-organised by EFG, and the presentations given as well as other networking activities helped definitively to raise the profile of EFG in an international forum. In the words of EFG President Ruth Allington: "personal contacts with the IUGS executive and representatives of other Affiliated Organisations were very helpful in establishing EFG as part of the international geosciences 'family' and in spotting starting points for collaboration and new projects at international level, for the benefit of the profession and wider society".

More information: *www.34igc.org*

New IUGS Task Group on Global Geoscience Professionalism

Subsequent to the successful symposium on ***"Strengthening communication between fundamental and applied geosciences and between geoscientists and public"*** co-organized by EFG at the 34th IGC at Brisbane, a new Task Group (TG) has been created at the IUGS on Global Geoscience Professionalism.

The starting point for this new Task Group is the idea that, in general, the majority of those who define themselves as professional geoscientists work in industrial/applied sectors, but professionalism is just as important in the academic and teaching arenas, which tend to fall outside the purview of professional registration and oversight. Raising the profile of professionalism and gaining acceptance of its importance amongst the academic and research communities is vital if their work is to truly serve society. It is rapidly becoming accepted that excellence in practical and professional skills go hand-in-hand with excellence in scientific research.

To ensure that the international geoscience community is engaged in this transformation of its profession and to enable IUGS to secure itself as the logical home of the professional dimension of the Earth sciences over time, it has been proposed that a new IUGS Task Group entitled the *Task Group on Global Geoscience Professionalism* is formed.

The purpose of the *Task Group on Global Geoscience Professionalism* will be:

- To provide a specific international forum for discussion of matters of common concern and interest among geoscientists and geoscientific organizations involved in professional affairs, at the local, national and international level;
- To act as a resource to IUGS on professional affairs in the geosciences as they may influence and impact "Earth Science for the Global Community" in general - both now and in the future;
- To offer and provide leadership and knowledge transfer services to countries and geoscientist communities around the world seeking to introduce systems of professional governance and self-regulation in the Earth sciences;
- To facilitate a more 'joined up' geoscience community fostering better appreciation by academics and teachers of the professional skills that geoscientists need in the workplace, and facilitate better communication between academic and applied communities leading to more effective application of research findings and

technology to applied practitioners and development of research programmes that truly address urgent issues;
- To provide geoscientists in all areas of professional practice and at all stages of their careers with practical guidance and support on professional matters;
- To continue and increase over time the provision of symposia and technical sessions to allow for exchange and knowledge transfer at IGCs and other events for those involved in, and impacted by, the evolution of professionalism in the geosciences. Examples of such exchanges are:
  - The European Federation of Geologists sponsored workshop ***"Issues for geologists in the 21st century – mitigation of man's influence and serving society's needs"***, held at 33IGC in Oslo in 2008; and
  - The symposium on ***"Strengthening communication between fundamental and applied geosciences and between geoscientists and public"***, held at 34IGC in Brisbane in 2012
  - In addition, the sponsoring organisations for this proposed Task Group have collaborated on International Professional Geology Conferences held every four years, the most recent being in Vancouver, Canada in January 2012, under the theme ***"Earth Science – Global Practice"***.
- To act as a resource to members of IUGS, and others, of material and speakers to present to geoscience groups – in particular young Earth scientists - around the world on professional practice and registration matters (including geoscience practice standards and guidelines, and reporting standards, codes of ethics and conduct, and professional registration.)

The sponsors of the new TG are:
- European Federation of Geologists (EFG)
- Geoscientists Canada
- American Institute of Professional Geologists (AIPG)
- Australian Institute of Geoscientists (AIG)
- South African Council for Natural Scientific Professions (SACNSP)
- El Colegio de Geólogos de Bolivia (College of Geologists of Bolivia)

The EFG office in Brussels has agreed to serve as the initial secretariat for the Task Group, and the office of Geoscientists Canada in Vancouver has agreed to be responsible for setting up and maintaining the website. One of the first actions will be to broaden the geographical basis of the group and to increase its communication. We will continue to inform you on the progresses of the Task Group in the following issues of the GeoNews.

PERC

PERC PAN-EUROPEAN RESERVES + RESOURCES REPORTING COMMITTEE

The Pan-European Reserves & Resources Reporting Committee, PERC, is the European equivalent of the Australasian JORC, SAMREC in South Africa and similar reserves reporting standards bodies in the USA, Canada, and Chile, and with them is a constituent member of the Committee for Mineral Reserves International Reporting Standards (CRIRSCO - *www.crirsco.com*). Representation on PERC covers major and minor mining sectors, industrial minerals, aggregates, coal, the investment and financial community and the professional accreditation organizations, including the Institute of Materials, Minerals, and Mining (IOM3), the European Federation of Geologists, the Geological Society of London, and the Institute of Geologists of Ireland.

The PERC reporting standard is recognized by ESMA (the European Securities and Markets Authority), together with other CRIRSCO-aligned standards, for use in reporting mineral reserves, mineral resources, and exploration results on markets within the European Union, and is also accepted for reporting on stock exchanges in Canada. Because of the close similarity of all the CRIRSCO-aligned reporting standards, including the same classification system and the same set of standard definitions, it is also very simple to translate reports from one standard to another.

Since December 2011, a caretaker crew of PERC officials composed by Paul Gribble (acting secretary), Ruth Allington (acting treasurer) and Stephen Henley (acting chairman), and a few others have been preparing the reconstitution of PERC in a new formal structure and the relocation of the organization to Brussels.

A revised constitution for the new PERC has been prepared to replace the old 'terms of reference' and to provide a formal framework within which it will work in future, established as a Belgian not-for-profit non-governmental organization. According to these new statutes there now exists a 'core' membership nominated by and representing the four parent organizations, with four members for each organization. These four parent organizations are the European Federation of Geologists (EFG), the Institute of Materials Minerals and Mining (IMMM), the Geological Society of London (GSL) and the Institute of Geologists of Ireland (IGI). The list of members is currently being completed by a list of 'Special Adviser' members representing the industry sector.

According to the agreements with PERC, EFG provides an accommodation address and office facilities. Furthermore, EFG currently provides to PERC secretarial and administrative services with regard to the creation of the new not-for-profit organisation under Belgian law which is likely to be fully constituted by the end of 2012.

More information: *www.perc.co*

Developments on the PanGeo project

David Norbury with contributions from Isabel Fernández (EFG) and Maraina Osihn (UNISDR)

Geohazards in the built environment can be dangerous and costly, yet information about these phenomena can be difficult to obtain. The PanGeo project is aimed at generating information on urban geohazards and making this information freely available online[1].

Geohazards include natural and man-made phenomena that make the ground unstable and cause it to move. These include earthquakes, landslides, mineral workings, fluid abstraction and recharge, shrink and swell clays, compressible or collapsible deposits and landfill.

The outputs from the project are made by integrating:

- Terrain motion measurements derived from satellite radar image processing
- Geological and geohazard information held by national geological surveys
- Polygonal land cover and land use data contained within the GMES Urban Atlas[2].

The users of the service are anticipated to include:

- Government and local authority planners and regulators concerned with managing and controlling development and risk
- National geological surveys and geoscience institutes who collect and disseminate geohazard data for public use
- Policy makers concerned with assessing and comparing risks across the territory
- The public

A total of 52 towns within the Urban Atlas are being processed within the PanGeo project; these represent 13% of the EU population. The remaining 205 towns within the Atlas are targeted for similar processing after the project.

This project fits neatly alongside the United Nations International Strategy for Disaster Reduction (UNISDR) campaign "Making Cities Resilient – My City is Getting Ready!"[3] which was launched in May 2010. The Campaign addresses issues of local governance and urban risk. With the support and recommendation of many partners and participants, and a Mayors Statement made during the 2011 Global Platform for Disaster Risk Reduction, the Making Cities Resilient campaign will carry on beyond 2015. Based on the stock-taking by partners and participating cities in the first phase (2010-2011) the campaign will continue and shift its focus to more implementation support, city-to-city learning and cooperation, local action planning and monitoring of progress in cities. The campaign will furthermore continue to advocate widespread commitment by local governments to build resilience to disasters and increased support by national governments to cities for the purpose of strengthening local capacities. To achieve these objectives, it will be necessary to develop global goals and targets that are applicable for all cities. Private sector partners will be targeted to support development of 'industry standards' and innovative urban risk reduction solutions. Based on the five priorities of the Hyogo framework for Action (HFA), a ten-point checklist for making cities resilient, that local governments sign up to, was developed. By doing so, local governments commit to implement disaster risk reduction activities along these Ten Essentials. Cities that have joined the Campaign are encouraged to conduct city-to-city learning and expert exchanges addressing building resilience at the local level. Cities can also join the Campaign as Role Model Cities, meaning that the city is very advanced in a certain area. Individuals can be appointed as Campaign Champions for their extensive work and knowledge within a certain area and the role of Champions is to connect with - and convince - government officials at all levels, high-profile thinkers, innovators and entrepreneurs whose activities can catalyse action to address those challenges. The Mayor of Venice, Mr. Georgio Orsoni, is so far Europe's first and only Champion.

A Handbook for Local Government Leaders has also been developed to provide mayors, governors, councillors and other local government leaders with a generic framework for risk reduction and points to good practices and tools that are already being applied in different cities for that purpose. It discusses why building disaster resilience is beneficial; what kind of strategies and actions are required; and how to go about the task. It offers practical guidance to understand and take action on the "Ten Essentials for Making Cities Resilient" as set out in the global campaign "Making Cities Resilient: My City is Getting Ready!". At present 1276 cities have joined the campaign worldwide. In Europe 403 cities have joined.

The resilience planning in this campaign does not cover all cities and also does not include geohazards. This is where the common drive with PanGeo comes in – to broaden the resilience planning to include geohazards. So those EFG members with an interest in geohazard mitigation should contact their local city to encourage them to take up on these initiatives for the benefit of society as a whole.

During the month of October EFG participated in various European events, which were celebrated in Brussels, in relation to geohazards:

- Disaster risk reduction takes into consideration that Climate Change Adaptation is an important topic for Geologists active in Natural Hazards. In this context the projects Terrafirma and PanGeo offer important tools for the users. In the context of the 10th European Week of Regions and Cities taking place in Brussels, on 9 October, EC DG Climate Action and EC

1 Information about the PanGeo project is at *http://www.pangeoproject.eu/sites/default/files/pangeo_images/documents/Brochure_version_7th_March_2012.pdf*

2 More information on the Urban Atlas is available at *http://www.eea.europa.eu/data-and-maps/data/urban-atlas*

3 More information on the Campaign is available at *http://www.unisdr.org/campaign/resilientcities/about*

DG Regional Policy organized the workshop on ***"Climate Change Adaptation and EU Cities"***. The United Nations Office for Disaster Risk Reduction presented the UNISDR Campaign during this event as one of the panellists. On 10 October, during the same European Week of Regions and Cities, EC DG Climate Action and UNISDR organized the workshop on ***"Community action for disaster resilience and climate change adaptation"***. Resilience to disasters and climate adaptation are increasingly important concerns of urban development policies. The implementation of development policies at a local level is crucial for achieving effective climate adaptation measures and managing new climate risks in urban settings.

- In the context of the project Terrafirma and PanGeo, EFG attended on 10 October, the workshop on ***"The growing use of GEMES across Europe's regions"***, organized by the European Parliament in Brussels. Members of the European Parliament together with representatives of the European Commission discussed concrete examples of regional space applications to support socio-economic and territorial challenges.
- In the context of the Floods Directive, EFG attended, as part of the European Commission Working Group on Flood (WGF), the workshop on ***"Climate Change Adaptation"*** celebrated on 17 October in Brussels. Currently, there is little contribution from Geology in the assessment and management of floods. EFG experts will work to fully integrate Geology in land-use planning to avoid unnecessary disasters. In the context of Climate Change Adaptation, Geology should be included in the national report to increase flood adaptation and to decrease uncertainty.
- Finally in the context of the 7FP and Horizon 2020, DG Research organized a workshop on ***"Social sciences contribution to natural hazards research: Towards better risk assessment and risk governance"***, 22-23 October, in Brussels. The scope of the meeting was to learn from the achievements and outcomes of EC projects, to address remaining open questions or barriers, future scientific priorities and interdisciplinary work. To move towards a better risk assessment and risk governance it is necessary to move from emergency management culture to the culture of risk management, including prevention.

Further information about the UNISDR campaign can be obtained from Mariana Osihn *osihn@un.org*.

Further information on the PanGeo project can be obtained from David Norbury (EFG) at *david@drnorbury.co.uk*.

EGU

Hanneke van den Ancker

Annual meeting 2012

The EFG – Panel of Experts on Geological Heritage co-organized the first session on Geodiversity in the European Geosciences Union meeting of 2012, Vienna: "Geodiversity and Geoheritage in University Education and Research".

The annual meeting of the European Geosciences Union (EGU) - General Assembly is one of the important conferences for earth scientists employed by universities and research institutes. It is organized in Vienna, in April by the Copernicus Office. The 2012 EGU meeting attracted more than 11,000 participants and had more than 4,400 oral sessions and 9,000 posters presented in 530 scientific sessions. Participants came from 95 countries, and more than 30 per cent of the participants were students.

For some years we had been discussing the organization of a session on geodiversity and heritage in this event, to bring these issues under the attention of young scientists. In 2012, with support of the EFG board and the universities of Lausanne and Amsterdam, we submitted a proposal that was accepted by the EGU board. We combined the contributions under the following topics:

- university teaching programmes
- regional geoheritage studies: inventory and classification
- geodiversity and methods
- geoheritage, tourism and cultural heritage
- geodiversity, nature management and spatial planning

Abstracts of the presentations and the posters can be downloaded from: *http://meetingorganizer.copernicus.org/EGU2012/oral_programme/9732*

The session was very lively and a success. Thus, we decided to again try and organize a geoheritage – geodiversity session for EGU-2013. This time the University of Lausanne has taken the lead, and EFG PE Geological Heritage is one of the co-organizers. The proposed session theme will be roughly similar to that of the EGU-2012 meeting: how to improve geoheritage and geodiversity teaching and studies in universities and research institutes, and their importance for sustainable land management. Too few EFG members participated in the EGU-2012 session; we hope their number will grow in EGU-2013.

Call for abstracts on geoheritage/geodiversity for the EGU 2013 session

The call for papers for this session opened on 10 October 2012. Uploading abstracts stops on 9 January 2013. Financial support can be requested, if one meets the requirements, through submitting the application form before 29 November. EGU deadlines are strict and are not extended.

More information: *www.egu2013.eu*

ONLUS "WATER for HAITI" Project

By Carlo Enrico Bravi

In May 2010 issue n°29 of EUROPEAN GEOLOGIST Magazine (pages 39-40), it had been announced a Water Supply Project that GsF Italy Onlus was about to start, having accomplished a preliminary mission to HAITI just after the tremendous earthquake (Jan. 2010), which had completely destroyed large areas of the Country.

The Project has been called "WATER for HAITI".

A second mission has been performed in February 2011. Things had been somewhat changed in one year time, international aid had already provided some water supply systems, so that our Initial Project has been adapted to more recent situations and needs.

The most difficult task of collecting the necessary funds has then started, luckily finding a very helpful partnership with some Rotary Clubs in England (Stratford-upon-Avon District), who have put in place a so called "Matching Grant Project", which has involved more Clubs and Rotary International.

Meantime also some private Italian Institutions have contributed with significant donations, so that in June 2011 the final "WATER for HAITI" Project (Phase 1) could be designed and planned.

As GsF interventions were addressed to poor areas, where electricity does not exist, only "Solar Systems" have been foreseen.
A door to door collection of different items to be sent to Haiti has been organized.
In October 2011 a GsF Container has been shipped to Haiti with lots of donations (dresses, shoes, camp tents, kitchen wares, school equipments, etc.) to be distributed to poor populations by local Rotary Clubs, in addition to seven complete "Solar Systems" (submerged electric pumps, solar panels, supports, pipes and all kinds of accessories), to be installed in drilled water wells.
Quite a time, with many difficulties, took the fact that the Container could be available to us, after its arrival to Port-au-Prince harbour!!

Drilling works have started in mid February 2012 and the Phase 1 of the Project was completed in the first decade of May 2012.

In LEOGANE area two water wells, both at a depth of 60 meters, have been drilled in GUERIN Village and PETIT PARADIS Community.
The drilled water well in Guerin has been equipped with two "Solar Systems". It is producing around 30 cubic meters /day of good drinking water distributed to users by four public fountains, serving a population of around 1.000 people. The drilled well in Petit Paradis, equipped with one "Solar System", is producing 12/13 cubic meters/day of good drinking water, serving a population of 700 inhabitants by means of n.° 3 public fountains.

In MONTROUIS area two water wells - both at a depth of 60 meters - have been drilled: one in the Market Place and the other in the Bogne Community.
Both are equipped with one "Solar System", producing each an average of 12 cubic meters water daily. The water distribution to users is guaranteed by two public fountains, each well.

Both in LEOGANE and MONTROUIS area we have had a very good help by local people, who are quite happy with the realized installations, which have considerably improved their standard of living, as water is now for them available at a good reaching distance.

The total cost of Phase 1 of the Project, up to present time, has been of Usa $195.314.
GsF Italia - Onlus - is now looking forwards to collecting more funds to "enlarge" the Project (Phase 2).

Figure 1-3: One of the public fountains in the Village of GUERIN (Leogane - HAITI); The public fountain in the Market Place - MONTROUIS - HAITI; Drilling operations in Petit Paradis (Leogane - HAITI).

If interested for more information, please contact:

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Submission of articles to European Geologist magazine

Deadlines

- The Editorial Board of the European Geologist magazine welcomes article proposals in line with the topics agreed on by the EFG Council.
- The call for articles is published twice a year in December and June along with the publication of the previous issue.
- Deadlines for submitting article proposals (title and content in a few sentences) to the EFG Office (*info.efg@eurogeologists*) are respectively 15 July and 15 January. The proposals are then evaluated by the Editorial Board and notification is given shortly to successful contributors.
- Deadlines for receipt of full articles are 15 March and 15 September.
- The articles are peer reviewed and finally, reviewed by a native English speaker.

Notes for contributors

Articles for publication in the magazine should be submitted electronically to the EFG Office. These should be no longer than 3000 words including illustrations.

Each article should be laid out in the following manner:

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- A short abstract (not exceeding 120 words) in English, French and Spanish (translation to French and Spanish can be provided by EFG).
- Main text without illustrations (illustrations should be sent separately).
- Acknowledgements.
- References.

Where there is a reference list at the end of the article, entries must be laid out as follows:

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All correspondence regarding publication should be addressed to:
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EFG broadly disseminates geology-related information among geologists, geoscientific organizations and the private sector which is an important employer for our professional members, but also to the general public.

Our different communication tools are the:
- EFG website, *www.eurogeologists.eu*
- GeoNews, a monthly newsletter with information relevant to the geosciences community.
- European Geologist Magazine, EFG's biannual magazine. Since 2010, the European Geologist Magazine is published online and distributed electronically. Some copies are printed for our members associations and the EFG Office which distributes them to the EU Institutions and companies.

By means of these tools, EFG reaches approximately 50,000 European geologists as well as the international geology community.

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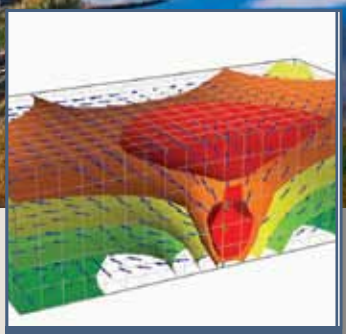

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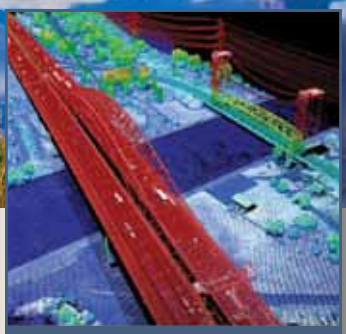

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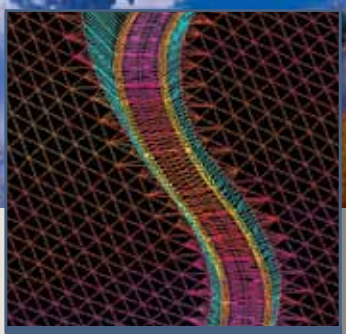

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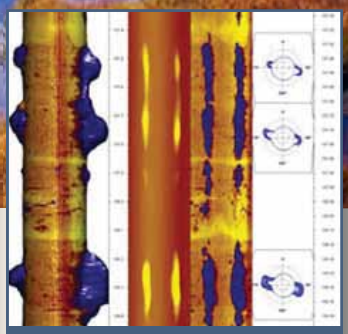

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