

Geoheritage in Europe and its conservation

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ProGEO

(The European Association for the Conservation of the Geological Heritage)

The only record of the history of our planet lies in the rocks beneath our feet: rocks and the landscape are the memory of the Earth. Here, and only here, is it possible to trace the processes, changes and upheavals which have formed our planet over thousands of millions of years: the more recent part of this record, of course, includes the evolution of life, including Man. The record preserved in the rocks and landscape is unique, and much of it is surprisingly fragile. Today it is threatened more than ever. What is lost can never be recovered, and therefore there is an urgent need to understand and protect what remains of this our common heritage.

ProGEO objectives are:

- To promote the conservation of Europe's rich heritage of landscape, rock, fossil and mineral sites.
- To inform a wider public of the importance of this patrimony, and of its relevance to modern society.
- To advise, in our countries and in Europe as a whole, those responsible for protecting our Earth heritage
- To organise and participate in research into all aspects of planning, science, management and interpretation that are relevant to geoconservation.
- To involve all countries in Europe, exchanging ideas and information in an open forum, and taking a full part in conservation in a global setting, including the formulation of conventions and legislation.
- To work towards an integrated European listing of outstanding geoscience sites, thus enabling full support to be given to the work of other international bodies, as well as to national initiatives towards site protection.
- To achieve an integrated approach to nature conservation, promoting a holistic approach to the conservation of biological and physical phenomena.

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This book is dedicated to
 Gerard Gonggrijp, the founder and secretary of the
 European Working group (EWGESG).
 and
 George Black, the first president of ProGEO.

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AUSTRIA

Thomas Hofmann
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Introduction

Austria is an alpine country, 60% of its territory is covered by mountains. Due to the diverse geology the land has a great number of very diverse and geomorphologically highly-structured landscapes. The preservation of this unique landscape is important for Austrian tourism. As the Austrian Alps is one of the most important areas for geological research, geoscientists started in the middle of the 19th century to underline the necessity for preservation of the geological heritage. Nowadays, there are many legal possibilities for protecting whole areas, as well as unique features of the landscape. This results in protection of 42% of the Austria area. In some cases, one area is protected several times. Suggestions for protection of a site or an area may come from the man in the street. There is no separate law for the protection of geosites, but they may be protected within the laws of the nine federal states.

The first successful attempts at nature protection in Austria date back to the middle of the 19th century. In 1856, Franz Carl Ehrlich (1808-1886), curator at the Museum of Linz in Upper Austria, asked the “Assembly of German Scientists and Doctors” (=Versammlung deutscher Naturforscher und Ärzte) to buy some huge, exotic, granite blocks in the Helvetic Zone of Upper Austria, to protect them from quarrying activities. The scientists agreed, and bought these blocks, dedicating them to Leopold von Buch (1774-1853). An inscription on the largest says “Dem Andenken an Leopold von Buch geweiht, nach dem Beschluß am 20. September 1856 in der XXIII. Versammlung deutscher Naturforscher und Ärzte in Wien unter Mitwirkung zahlreicher Freunde der Naturwissenschaften in Deutschland, Italien Belgien, Frankreich, England“, that these blocks are dedicated as a memorial for Leopold von Buch, by a resolution in the meeting of 20th of September 1856. Thus the first geotope of Austria was saved for the future (Figure 1).

After the end of the Austro-Hungarian Monarchy in 1918, Austria was divided into nine federal states, including Vienna. Each of these states in the early 1920s and 1930s enacted particular laws,

such as for hunting or nature protection. As a result, the first natural monuments (Naturdenkmal) were protected by law. The first has the remains of a Quaternary terrace close to Ybbs (Schaumauer bei Holnstein an der Ybbs) in Lower Austria and was protected in 1925; then the “Blue Well” (Blaue Quelle) of Erl in the Inn-valley in Tirol in 1926; and the natural monument of “Bear Cave” (Baerenhöhle) in Winden in Burgenland in 1929.

Among geoscientists, Gustav Götzing (1880-1969), who was director of the Geological Survey (1937–1938 and 1945–1949), should be mentioned. He started in 1918 to announce the importance of geological sites (Götzing, 1927). In the second half of the 20th century, Walter Krieg (1930-2000), being a speleologist and later Head of the Museum of Natural History in Vorarlberg (Vorarlberger Naturschau), was very active in the field of nature protection. As a result of his activities, the smallest federal state of Austria has the greatest number of natural monuments.

Austria is located in southern Central Europe. Geographically, its territory encompasses both the Eastern Alps (which cover some two thirds of its surface area) and the Danube Region. Austria is a landlocked country of roughly 8.3 million people. It borders both Germany and the Czech Republic to the north, Slovakia and Hungary to the east, Slovenia and Italy to the south and Switzerland and Liechtenstein to the west. The territory of



Figure 1, The first (1856) geotope of Austria: a memorial to Leopold von Buch.

Austria covers 83,872 sq km. Its terrain is highly mountainous, due to the presence of the Alps; only 32% of the country is below 500 MASL. More than 60% is mountain, with summits reaching heights of more than 3,600 metres. Austria's highest mountain, the Großglockner, is 3,798 MASL in the so-called "Central Alps". This is also where the majority of the almost 1,000 Austrian glaciers are found. The longest river is the Danube, which flows W-E through Austria for some 350 km.

Austria's geographical position has long made it a crossroads for trade routes between the major European economic and cultural areas. Austria became fully involved in the European integration process when it joined the European Union on January 1, 1995.

Austria is influenced by a temperate and alpine climate. In the west and northwest the temperate Atlantic climate is felt more strongly, whereas the east is more influenced by a continental climate. Precipitation levels vary significantly along a W-E axis and with increase of altitude. The diversity of topographical and climatic conditions accounts for the country's abundant flora and fauna. Austria is one of Europe's most heavily wooded countries (47% of its surface area), making it the core element of the landscape. Around two thirds of the forest land are natural (3%), the rest is influenced by forest activities.

Today, Austria is a parliamentary representative democracy comprising nine federal states: Burgenland, Carinthia, Lower Austria, Upper Austria, Salzburg, Styria, Tyrol and Vienna (also the capital of the country) and Vorarlberg. (Elmer et al. 2007; Paar, 2003).

Although Austria is an "alpine" country, its north, in Lower and Upper Austria, includes some parts of the southern Bohemian Massif, representing a former fragment of northern Gondwana. Tectonically the Bohemian Massif consists of two units, the Moldanubian Zone in the west and the Moravian Zone in the east. The former consists of paragneiss overlain by a complex of variegated crystalline rocks, granulites and orthogneisses, while the latter exhibits low- to medium grade micaschists, metasedimentary rocks, orthogneisses

and the granite of the "Thaya Batholith".

Towards the south, the Molasse zone follows - comprising marine to brackish sediments of late Eocene (in Salzburg and Upper Austria) to late Miocene sediments. These sands and sandstones, marls and conglomerates overlie the crystalline basement in the north and were overthrust in the south by "alpine" tectonic units during Miocene movements.

The Helvetic Zone is today the northernmost "alpine" zone intercalated between the Molasse and the Flysch zones, in the south. Formerly the Helvetic Zone belonged to the southern part of the "old European Continent" where pelitic sedimentation predominated. Only in the very western part of Austria (in the hilly areas of Vorarlberg) is the Helvetic Zone well developed, whereas towards the east thrust slices and isolated klippen dominate the very narrow development of the zone.

In contrast to this, the Flysch zone is developed well in the east of Austria, close to Vienna. This has turbiditic deep-sea sediments ranging from the Cretaceous to the Paleogene, and belongs to the Penninic realm dominating wide areas in the western Alps (Switzerland). Southern parts of the Flysch zone are overthrust by Northern Calcareous Alps belonging to the East Alpine Nappe System. The Northern Calcareous Alps make up a very impressive landscape formed of different shallow-water limestones, (mostly) of Triassic age. This rather karstic mountain belt, which is rich in caves, extends for about 500 km from the western border of Austria to Vienna in the east. A series of tectonic windows within this belt shows the underlying rocks of the Flysch Zone and gives evidence for the thrusting of the Northern Calcareous Alps northwards.

The Northern Calcareous Alps are linked stratigraphically to the underlying Greywacke Zone in the south, displaying a sedimentary sequence from the Ordovician to the Carboniferous.

In western and in the eastern parts of Austria south of the Greywacke Zone huge complexes of different igneous and metasedimentary rocks are dominant. Most of them show a Variscan

metamorphic overprint, but even "alpine" metamorphism can be traced in some areas. Locally sedimentary Palaeozoic series (e.g. close to the city of Graz) are famous for their fossiliferous beds.

South of these units, the Periadriatic Line (also: Pustertal Fault, Gailtal Fault) is the tectonic boundary of the East Alpine Nappe System and the Southern Alps. The Carnic and the Karawanken Alps, in the Southern Alps, show rich fossiliferous sequences of the Palaeozoic rocks (Krenmayr, 2000; Schönlaub, 1997).

Protection

In total, approximately 42% of Austria is protected under one or more categories ("multiple protection") of nature protection.

The protection of areas, the protection of species and the ecologically sound use constitute the pillars of a comprehensive nature protection. The protected areas should maintain the biological diversity as well as the abiotic resources. Fourteen categories of site protection exist in Austria (Aubrecht & Petz, 2002). Nature Reserves, Protected Landscapes and Natural Monuments occur in all nine provinces. Other categories, for example, nature park or protected part of a landscape, only occur in one or a few provinces. An interactive overview is provided by the webportal www.geoland.at, offering free access to the important Geodata of all nine federal states.

All matters dealing with nature conservation are in the competence of the nine federal states. Hence, there are nine separate nature conservation laws, but no federal law providing the framework for detailed legislation by the federal states. Only the legal base for national parks is equally 'owned' by both the national government and the federal states.

The present nature conservation laws include the general obligation to protect and care for nature as the basis of life for mankind, fauna and flora. In addition to these general provisions, the provincial laws contain the following regulations:

Obligation to obtain permission for and give notification of projects dealing with scientific or infrastructural matters in nature (applies to all un-built-up areas of land).

Conservation of selected habitats (special areas protected under the general conservation laws).

Areas protected under nature conservation laws according to the various site protection categories including natural monuments. Conservation of animal and plant species (in general limited to those species not covered by hunting and fishing laws).

The legal authority in charge of the law for nature protection (Naturschutzgesetz) is the local district authority (Bezirkshauptmannschaft) within each federal state. Everybody is allowed to make proposals for protection of sites to this authority. These sites may be trees, avenues, caves, rocks, outcrops and so on. In the next step, the authority checks the proposals with an expert. The expert (Naturschutzsachverständige/r) may support this proposal or reject it, if they consider the proposal unworthy of protection. In the next step, the owner of the land of the proposed site is involved. Sometimes owners of protected sites may receive financial compensation, if the protection causes them financial loss.

The legal protection, as e.g. a natural monument, is usually done by a notice (Bescheid) which has then to be announced to the public in the official gazette (Amtsblatt) of the local district authority. In addition to this, the protected site or area has to be marked by a sign, so that everybody can see there is something special at the locality. Usually, legal protection means that these sites or areas must never be changed. For geological, mineralogical or palaeontological sites, this would mean that nobody is allowed to take any sample, even for scientific purposes. For such a use, someone has to make an official request to the local district authority. In some cases the notice of a protected site may include a list of persons and / or institutions (museums, Geological Survey, universities etc) who are allowed to take samples. Up to the present, (end of 2009) the term "geotope" is not mentioned in any law of the nine Austrian states.

There is no necessity for a specific law of geosite protection, as the laws of nature protection laws include all aspects even for a legal geological site protection (if necessary).

All kinds of protection (listed below) may include also geological, mineralogical, etc. sites (=geosites).

National parks have a special position within the Austrian nature conservation policy. They are significant not only for Austria, but are also of international interest. So far, six of Austria's regions that are most beautiful in terms of landscape and most valuable in terms of ecology have been designated as national parks. Two of them, Thayatal and Neusiedler See – Seewinkel cross the boundary with the Czech Republic and Hungary, respectively. Covering an area of 2,356 sq km, the national parks make up 2.8% of the Austrian federal territory (Paar, 2003). All national parks work together and have a common website: www.nationalparksaustria.at/

Beside national parks, nature reserves are among the most strictly protected areas in Austria. The protection regulations for each of the areas are laid down in special ordinances. Essentially, any intervention affecting natural ecology is forbidden. As regards farming and forestry, hunting or fishing, special regulations are laid down. In Austria there are currently 377 nature reserves. Their total area

is around 3,275 sq km, covering 3.8% of the federal territory (Paar, 2003).

The majority of the protected areas in Austria are protected landscape areas, covering an area of 9,120 sq km, or more than 10% of the country. These are, to a large extent, semi-natural areas with outstanding landscape features and a high recreational value. The objective of protection is to maintain the landscape's appearance and ensure recreation and tourism (Paar, 2003).

The objective of Austria's 47 nature parks, covering an area of approximately 4,000 sq km, is to convey knowledge on nature: accordingly, the main focus is placed on their educational and recreational value. In many nature parks, nature conservation is additionally combined with sustainable agriculture. In doing this an impetus is given to regional development (Paar, 2003). All nature parks work together in an association (www.naturparke.at).

In addition to the above mentioned nature protection categories, there are some others. such as:

- Protected part of landscape
- Natural monument
- Plant protection area
- "Quiet area/quiet zone"

Category	Number	Area (sq.km)	% of the national territory
European Protected Area (NATURA 2000)	148	10,244	12.23
Nature Reserve (Naturschutzgebiete)	441	2,979	3.55
Landscape Protected Area (Landschaftsschutzgebiete)	247	12,696	15.14
National Park (Nationalpark)	6	2,353	2.80
Protected Part of Landscape (Geschützte Landschaftsteile)	448	960	0.11
Nature Park (Naturpark)	47	4,030	4.80
Nature-Landscape Protected Area (Naturschutzgebiet)	4	506	0.60
Other Protected Areas [without natural monuments] (Sonstige Schutzgebiete [ohne Naturdenkmale])	41	2,617	3.12
All Categories*	1,382	35,520	42.35

* Overlaps between the different categories are not considered.

Table 1. Number and area of areas protected by nature conservation laws in Austria (© www.umweltbundesamt.at/umweltschutz/naturschutz/schutzgebiete/ December 2009)

All existing natural monuments (trees, avenues, waterfalls, geological outcrops,...) in Austria have been evaluated with regard to their geological interests. As a result, 641 of them are geologically very important. They have been described by Hofmann (2000) in a volume written in a plain language for a wider public. All these 641 legally protected geological natural monuments can be regarded as and fulfill the definition of "geosites". (Table 2).

Hofmann (2000) defined 569 of them as geological excursion localities worthy of protection.

Management

This chapter has a focus on (geo)touristic aspects of the management. Generally, all protected sites, independent of their category, are in some sense managed, monitored and / or evaluated.

The six Austrian national parks have the highest level of management. All of them have their own team focusing on education, research and tourism as well as on the preservation of nature. In recent years, they have become very important for nature tourism in Austria. This may be underlined by some examples: the Großglockner Hochalpenstraße is a panoramic road in the Hohe Tauern NP connecting the federal states of Carinthia and Salzburg. In 2008, more than 820,000 people travelled this route and thus visited the national park. Nationalpark Kalkalpen was visited by 255,000 people in 2008.

(<http://www.austriatourism.com/media/8998/Besucherszahlen%20in%20Sehensw%C3%BCrdigkeiten%202008.pdf>)

The national parks have a common website (www.nationalparksaustria.at/), as well as individual ones in German and English:

Nationalpark Thayatal: <http://www.np-thayatal.at/>

Nationalpark Neusiedlersee: <http://www.nationalpark-neusiedlersee.org/>

Kalkalpen National Park: <http://www.kalkalpen.at/>

Nationalpark Hohe Tauern:

State	natural monuments	geological excursions sites
Lower Austria	296	119
Styria	63	66
Upper Austria	75	59
Salzburg	61	56
Vorarlberg	66	64
Carinthia	33	69
Tyrol	32	63
Vienna	9	44
Burgenland	6	29
Total	641	569

Table 2. Number of legally protected natural monuments (HOFMANN, 2000) and geological excursions sites (http://www.geologie.ac.at/geo_exkursionen/start.htm) in the Austrian federal states.

<http://www.hohetauern.at/>

Gesäuse National Park:

<http://www.nationalpark.co.at>

Donau-Auen National Park:

<http://www.donauauen.at>

Nature reserves and protected landscape areas have preservation of natural ecology as their primary aim, though in some rare cases touristic management can be found.

Like national parks, nature parks are also very important for (local) tourism, especially for the recreation of families. Unlike national parks, they do not have such a diverse and professional management. Most of the people working there do so as volunteers. Some of the nature parks have individual websites, offering a diverse programme with many activities (for families). Some of them are very successful, such as, for instance, the Naturpark Blockheide, with about 120,000 visitors per year. In 2008, the Naturpark Hohe Wand had nearly 80,000 visitors, and the Naturpark Sparsbach about 45,000 visitors. All of them are in Lower Austria, more or less close to Vienna.



Figure 2: Map showing protected landscapes in Austria including National Parks, Nature Reserves, Nature Parks, Nature Reserves, Protected Parts of Landscapes and other protected areas. © Umweltbundesamt

(<http://www.austriatourism.com/media/8998/Besucherzahlen%20in%20Sehensw%C3%BCrdigkeiten%202008.pdf>)

Apart from the national parks which meet the international criteria of the World Conservation Union (IUCN), a number of other areas, like Ramsar areas, have received international recognition or are considered important (table 3).

Management differs from site to site. In some cases, the management is carried out by tourist authorities, in other cases, e. g., National Parks, there is a general management body. Sometimes single sites, like some large caves, have also their own management. A very successful example is the show mine Seegrotte Hinterbrühl (www.seegrotte.at), close to Vienna. The largest subterranean lake of Europe is visited by approx. 200,000 visitors each year. Among other sites, the show caves have perfect management, as they

are all listed at an international Website (www.showcaves.com). Other sites, however, are not continuously checked by local authorities and hence, are not well kept although legal inspection is required before visitors have free access.

In many cases, volunteers play an important role in nature protection. Financial support is given to a great extent by public promotions, coming either from the state or from the federal states or even from NGOs like the Austrian Alpine Association (Alpenverein, www.alpenverein.at). The latter, founded in 1862, plays an important role in nature protection and especially in managing huge areas in the alpine realm. The Austrian Alpine Association has 360,000 members, and 22,000 volunteers help to survey and take care of 40,000 km of alpine paths, 241 alpine refuges and more than 200 fixed-rope routes. This alpine infrastructure is used by about 3 million people year by year.

Category of Nature Areas	Number	Area (km ²)
Ramsar Area	19	12,226
Biogenetic Reserve	56	1,909
Biosphere Reserve	6	1,500
Areas with European Diploma	2	463
Important Bird Areas	58	12,442

Table 3. Number of Austrian areas being important, due to international conventions.

Education, tourism

The term “geotourism” is in Austria only used by geoscientists, tourism professionals do not use or even know this term, although they all know about the impact of geological features like show caves, waterfalls, national parks and so on for tourism.

Nature and thus nature and / or landscape protection is in Austria very important and has a great impact for tourism. Following the evaluation from Ribing (2009), for about 73% of tourists the “landscape” is the main reason to take a holiday in Austria; other reasons are: the fresh air / climate (58%), the mountains (53%), hiking trails (37%) and nature attractions (34%). About 8 to 9% of the gross domestic product comes from tourism.

Nature tourism or geotourism offers the opportunity for education, which is in many cases done by the local management of the sites (esp. national parks). In addition, local communities and tourist boards, museums, NGOs (e.g. Alpenverein, ...), the Geological Survey, universities and museums may provide further information. In all cases, the close cooperation with tourist authorities is highly appreciated, as it offers a guarantee for good information and a sustainable service for all users.

In recent years, a new category has internationally emerged: the geopark. They have the potential for raising public awareness for nature through education, and are intended to enhance the living conditions of the local population through geotourism and other economic measures. Every geopark in Austria represents an area of high importance for the understanding of the geological history and heritage of the eastern and southern Alps by showing a variety of spectacular rocks

and fossils of Palaeozoic, Triassic and Miocene ages, when key events occurred in the Alps. These treasures are of immeasurable public value and will be irreversibly lost if they are not to be protected in a proper manner. Geoparks may also serve as scientific research objects for the future.

Austrian geoparks have, like geotopes, no legal protection. They may include a number of legally protected natural monuments or other protected areas, thus building a geological frame.

As an example, the Naturpark Eisenwurzen (www.eisenwurzen.com) is first of all a nature park; as this area is rich of geological sites and caves and so on it is also a geopark. All geological phenomena are promoted by a team offering a lot of activities and an own website (www.geoline.at). The Naturpark Eisenwurzen belongs to the European Geoparks Network (www.europeanGeoparks.org). In 2009 in Carinthia, close to the Italian border, the Geopark Karnische Alpen (www.Geopark-karnische-alpen.at) was established and is also member of the Network. The Kulturpark Kamptal, being formerly also a geopark, was for some years ago a member, but is now neither a geopark.

To underline the importance of geological sites, an evaluation of geologically important excursion sites was made by the Geological Survey of Austria between 1999 and 2001 (www.geologie.ac.at/geo_exkursionen/start.htm). The idea is that excursion sites of national and international importance fulfil all demands of geosites, thus they may serve as candidates to be protected in the future. The result is a list of 569 geological excursion sites (see table 1). Some of these sites are already protected as natural monuments, and



others might be thus designated. Due to ongoing geological investigations, the list of geological excursion sites will increase.

Conclusion

The diverse geological and geomorphological heritage of Austria is at the beginning of the 21st century to a very high extent protected, which may be unique compared with other countries. In many cases geological and geomorphological features triggered the protection. They could and should now be used to address the importance of geology. Austria has a great potential for geoparks and for geotourism; the latter is being an important factor for tourism, although the word “geotourism” is not known.

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