



Draft candidate list of geosites representative of Central Europe

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Abstract. Draft candidate list of geosites representative of Central Europe is being elaborated under the framework of the GEOSITES programme, co-ordinated by IUGS in collaboration with the ProGEO Association. The Working Group of Central Europe has prepared a draft list which comprises 133 geosites and site-sets being representative of Middle European Lowland, Middle European Uplands, Bohemian Massif and Carpathians. Most of these sites is subject to legal protection. The national lists analysed on the background of geology and relief of particular regions still require adjusting as to reflect geodiversity of these regions. The proposed scheme for evaluation and selection of the sites, based on the published examples, arranges the procedure of formation of the national network of geosites of different ranks. The presented new concepts of protecting geological heritage suggest further international development.

Key words: geoconservation, site evaluation, selection, international concepts, Central Europe.

Zofia Alexandrowicz (1999) — *Wstępna lista proponowanych geostanowisk reprezentatywnych dla Europy Środkowej*. *Polish Geological Institute Special Papers*, 2:9–14.

Streszczenie. Europejska lista proponowanych wartościowych geostanowisk jest opracowywana w ramach programu GEOSITES, koordynowanego przez IUGS we współpracy z Asocjacją ProGEO. Powołana grupa robocza Europy Środkowej przygotowała wstępną listę, która zawiera 131 pojedynczych geostanowisk i ich zespołów reprezentatywnych dla Niżu Środkowoeuropejskiego, Wyżyn Środkowoeuropejskich, Masywu Czeskiego i Karpat. Większość z nich podlega prawnej ochronie. Listy krajowe, analizowane na tle budowy geologicznej i rzeźby poszczególnych regionów, wymagają uzupełnień w dostosowaniu do georóżnorodności obszarów. Zaproponowany schemat waloryzacji i selekcji stanowisk, oparty na opublikowanych przykładach, porządkuje kolejność czynności tworzenia krajowych sieci geoochrony o różnej randze wartości. Przedstawione nowe koncepcje programowe ochrony dziedzictwa geologicznego są zapowiedzią dalszego jej rozwoju w aspekcie międzynarodowym.

Słowa kluczowe: geoochrona, stanowiska, waloryzacja, selekcja, międzynarodowe koncepcje, Europa Środkowa.

Going back to the international events appealing for protection of geological monuments; two declarations have to be recalled. The first one was announced as a memorandum during the International Geological Congress in London — 1948. This declaration caused many participating countries to initiate or to develop inventory of valuable objects of an inanimate nature as well as to provide legal protection status for these sites. The second important document was the International Declaration of the Rights of the Memory of the Earth which was passed during the 1st International Symposium on Conservation of Our Geological Heritage which took place at Digne (France) in 1991 under the UNESCO patronage. This symposium was organized at suggestion of the European Working Group on Earth Science Conservation (EWGESC) that was formed in 1988 and that was later transformed into the European Association for the Conservation of the Geological Heritage (ProGEO) in 1993. The symposium in Digne was unquestionable success as it awoke public interest in this matter, promoted collaboration and fo-

cused the efforts of all kinds of geoscientists and practitioners on the modern protection of geological heritage.

Presently, arrangement of the network representative for tectonic structures, lithostratigraphy and geomorphology of particular European regions is the main task of the joint IUGS and ProGEO project GEOSITES (Wimbledon, 1996, 1998). The pan-European network should be composed of individual sites and areas with complexes of sites (site-sets). Neighbouring countries join together in working groups to select geosites that represent the most important regional features. One of the groups comprises the following regions of Central Europe: Middle European Lowland, Middle European Uplands, Bohemian Massif, and Carpathians. The representatives from Lithuania, Belarus, Ukraine, Poland, Slovakia, Czech Republic and Austria participated in the 1st Workshop which was held in Cracow on 14–17 October, 1997. The workshop aimed at presenting the draft national lists of the most valuable areas/sites from the above mentioned regions. Location of the country which comprises all the regions in question as well as participation in ProGEO activities, long tradition and significant achievements in geoconservation make Poland a leading

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country in its group. The Working Group of ProGEO for Central Europe is supervised by the Institute of Nature Conservation of the Polish Academy of Sciences in Cracow. An effective collaboration between the working groups from different parts of Europe will take place at the stage of comparison of selected areas/sites in geological regions of particular countries (Johansson *et al.*, 1997; Wimbledon, 1998). At present, particular countries designate their own lists of a standard importance.

The workshop was organized by the Institute of Nature Conservation of the Polish Academy of Sciences in collaboration with the Carpathian Branch of the Polish Geological Institute. It was financially supported by the National Fund of Environmental Protection in the programme of the Geodiversity Conservation in Poland co-ordinated by Polish Geological Institute. The workshop was also sponsored by Wieliczka Salt Mine.

Evaluation and selection of geosites

The framework of the geoconservation encloses sites/ areas proposed for protection on the ground of evaluation and selection. During each meeting of ProGEO Association the principles of creating the network of sites in particular countries were a permanent subject of discussions. The following criteria of site evaluation and selection can be proposed as a result of both the present authors considerations and published data (Alexandrowicz *et al.*, 1992, 1996; Actes du Premier Symposium..., 1994; Wimbledon *et al.*, 1995; Wimbledon, 1996; Special Issue..., 1996; ProGEO '97 Estonia Proceedings, 1997).

Evaluation. There are two aspects of evaluation; the first one refers to the main features of the region:

- features of the geological/geomorphological region,
- representativeness of geosites,
- persistence to transformation of outcrops and landforms,
- accessibility of geosites,
- aesthetic and cultural values.

The second aspect concerns all individual features of evaluated sites or areas according to their types:

- features of geological sites,
- features of landforms,
- features of structural/erosional landscape.

Selection. The above mentioned evaluation provides an insight into geodiversity as well as a rich material for the next stage of work — the selection. There are three steps in this procedure: basic selection, comparative selection and rank selection.

The basic selection of sites/areas (values and functions) is performed in particular regions with regard to three aspects: scientific, didactic and aesthetic/tourist.

The comparative selection is realized within each region and between particular regions to point out the most valuable and best accessible areas/sites.

The rank selection determines global, regional or local value of each site/area. The site/area is considered to be of the global rank if comprises at least one of the elements listed below:

- boundaries of main geological units (periods, events),

- stratotypes of global bio- and chronostratigraphic units,
- most important palaeontological sites,
- sites with standard examples of rocks and minerals,
- unique landforms and structural landscapes.

The site/area is considered to be of a regional (inter-regional, continental) rank if it comprises at least one of the elements given below:

- boundaries of regional geological units,
- stratotypes of regional litho- and biostratigraphic units,
- outcrops of rocks typical of the region,
- valuable tectonic structures,
- landscapes reflecting geological structures of the region,
- typical forms of the relief.

The site/area is of a local rank if it is selected out of many similar objects occurring in a given region. These are, i.a.:

- persistent and accessible geological outcrops,
- forms of erosional and structural relief,
- caves and other karst phenomena
- springs and sediments connected with water outflows,
- old mines and galleries,
- soil profiles.

The presented outlines of evaluation and selection should be used for development of geoconservation framework in particular countries and geological regions. The selection of the sites or site-sets (areas) for the Euro-List of Geosites ought to be made out of the objects of the regional rank while those of the highest (global) rank should be promoted for the World List of Geological Heritage.

Classification scheme of the selected geosites differ in particular countries. Sometimes the classification is wrongly treated as selection and evaluation while it should be their outcome. There are two approaches to classification of geosites:

- classification according to the fields of sciences such as: stratigraphy, palaeontology, structural geology mineralogy, geomorphology, etc.;
- classification according to genetic properties of the objects, including lithostratigraphic, palaeoecologic, tectonic, sedimentological, denudational ones, etc.

Classification principles are particularly important when inventing databases. The scope and gradation of information in the existing databases and in those in progress differ one from another in a wide range in particular countries (ProGEO '97 Estonia Proceedings, 1997). Due to the above and because of different way of coding the data, these bases are ineffectual when forming the international network as well as for comparative studies. Proposals aiming at development of a uniform geosite database take into account primary identifying data, primary geological data and secondary supporting data (Wimbledon, 1996, 1998; Johansson *et al.*, 1997). These two draft formats of the geosite databases only differ as to secondary supporting data. One format considers information referring to protection status and accessibility of localities (Johansson *et al.*, 1977) which is very important in promoting and development of geoconservation as a goal of ProGEO Association activity.

Evaluation and selection of the sites/areas at the national and geological region levels and a simultaneous development of compatible national databases contribute to consolidation of the position of the Earth Sciences Conservation in the system of nature protection. As a result it should lead to a faster implemen-

tation of the idea of the conference held in Malvern (UK 1993) to form an international convention on protection of geological heritage (Jacobs *et al.*, 1996).

Geological framework of geosites

During the workshop held in Cracow (October 1997) there were presented 131 single sites and site sets as candidates for the draft list of Central Europe; 131 localities are described in this issue of *Polish Geological Institute Special Papers* (Table 1).

The bedrock of Central Europe consists of a few geotectonic structures of different age (Fig. 1). The East-European Platform in the north-eastern part of the area is formed of Precambrian crystalline rocks covered with Palaeozoic–Mesozoic sedimentary formations. The Teisseyre–Tornquist's Line running across Poland from north-west to south-east separates the above mentioned formation from Caledonian–Variscan Platform composed of folded Palaeozoic formations covered with epicontinental deposits of Permian–Mesozoic–Cenozoic age. In the northern part of the region these structures are almost entirely covered with glacial and fluvioglacial deposits of the Pleistocene Scandinavian glaciations (Fig. 2). The rocks of the substratum are exposed at a ground surface in a few localities that are, as a rule, proposed for protection and given the highest priority in the lists. Some sites of this type are registered in the East-European Platform, mainly in Lithuania. These are outcrops of Upper Devonian, Upper Permian, Lower Triassic and Late Jurassic deposits rich in fossils. Some outcrops of Devonian dolomites are identified in Belarus.

The dominating elements in the network of geosites in northern and middle parts of Central Europe are deposits and landforms of Pleistocene ice sheets, mainly Vistulian (Weichselian) and Odranian (Saalian) glaciations (Fig. 2). The important outcrops of glacial and fluvioglacial deposits, typical landscapes with a whole variety of end-moraines, rafts of

pre-Quaternary rocks in moraines, kames, eskers and sub-glacial channels, lake-lands, glaciectonic deformations, cliffs of the Baltic coast, large areas of active coastal dunes, drumlin field and erratic boulder fields or single, largest erratic boulders as well as Holocene deposits are introduced to the European list as candidates from Middle European Lowland. Most of the above objects are already protected.

South of Middle European Lowland the Quaternary deposit cover is discontinuous. In the region of Middle European Uplands, westward of the Vistula river valley, there are exposures of the formations and structures of the Caledonian–Variscan Platform. In the Holy Cross Mts. the bedrock of Caledonian–Variscan orogenic cycles occurs on the surface and is accessible in numerous protected quarries and natural outcrops. The Holy Cross Mts. composed of Palaeozoic Massif surrounded with Permian–Mesozoic–Cenozoic deposits are the classic geological and educational work fields as well as a model of geoconservation in regard to the complex of standard localities. The other most valuable geological area of Middle European Uplands is the Lublin–Lviv Upland with Roztocze (Roztochya) Hills. Several outcrops of Albian–Upper Cretaceous–Lowermost Palaeocene deposits, situated along both sides of the Vistula valley between Zawichost and Kazimierz Dolny, present a unique succession in Central Europe. This upland is formed of Upper Cretaceous deposits, locally covered with Miocene sediments rich in fossils. The range of hills called Roztocze should be devoted more attention than hitherto as it is the area possessing very interesting geological elements and landscapes.

The Cracow Upland is situated within the monocline formed of Permian, Triassic, Jurassic and Upper Cretaceous deposits. Palaeozoic formations crop out along the southwestern margin of the monocline. Jurassic massive limestones shape the relief of the upland rich in tors and rocky valleys. Numerous, well documented geosites are important from scientific and didactic points of view.

The Variscan orogen rejuvenated in the Tertiary forms the

Table 1. Candidate sites and site-sets for the European List of Geosites of Central Europe: A — presented during the workshop in Cracow (1997); B — described in *Polish Geological Institute Special Papers* 2 (1999); voids denotes a lack of a given region in the particular country

Countries	Regions								Together	
	Bohemian Massif		Carpathians, Carpathian Foredeep		Middle European Uplands		Middle European Lowland			
	A	B	A	B	A	B	A	B	A	B
Lithuania							20	20	20	20
Belarus							10	10	10	10
Ukraine			5	7	10	4			15	11
Poland	—	8	21	25	32	36	15	15	68	84
Slovakia			3	—					3	—
Czech Republic	1	8	—	—					1	8
Austria	8	—	6	—					14	—
Together	9	16	35	32	42	40	45	45	131	133

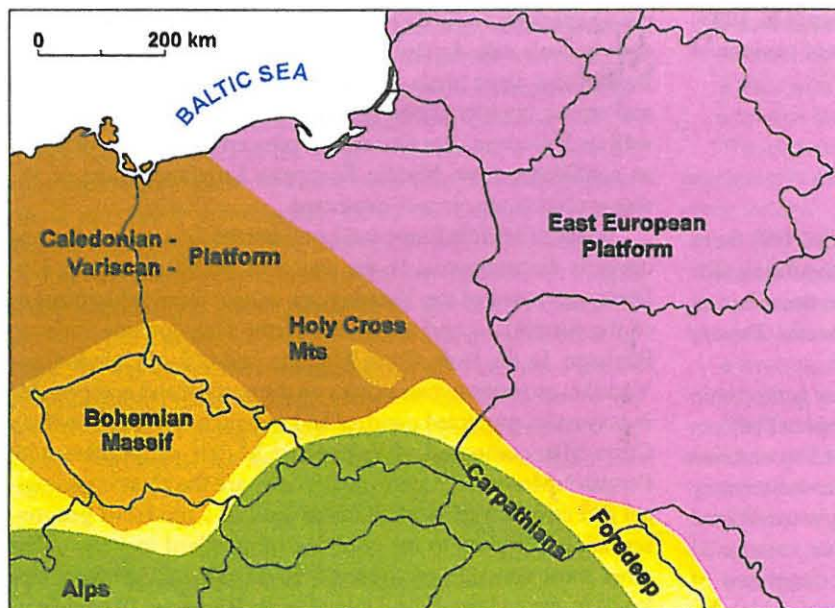


Fig. 1. Geological structural units of Central Europe (after Znosko, 1974, modified)

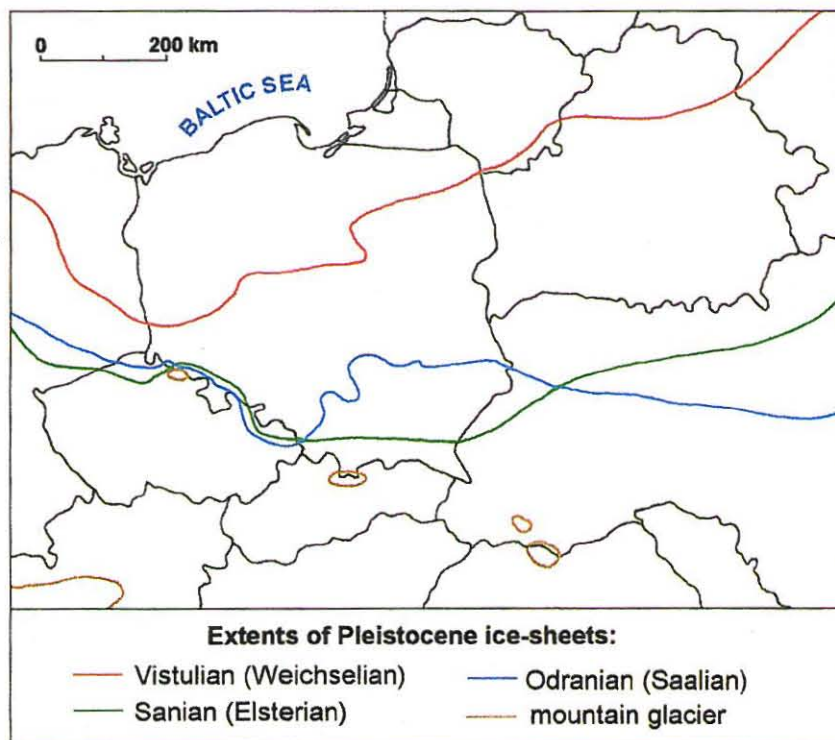


Fig. 2. Extents of some Pleistocene ice-sheets in Central Europe (after Mojski, 1993, simplified)

Bohemian Massif spreading mainly in the Czech Republic (Fig. 1). The Sudetes, at the Polish–Czech border, are the marginal, northeastern part of this massif. The Bohemian Massif is characterized by a large diversity of geological structures that comprise the formations from the Precambrian to Quaternary. Typical features of the Bohemian Massif are different tectonic structures clearly reflected in the relief as well as the presence of numerous types of rocks and minerals which have been used by man for many years. The mountain glaciers occurring here in the Pleistocene affected the relief of the Karkonosze Mts., the

highest, granite range in the Sudetes. A few areas comprising valuable geological objects, proposed for the Euro-list, represent only a tiny part of geodiversity of this region.

The mountain chain of the Carpathians is a part of the Alpine orogen (Fig. 1). It forms an arc from the neighbourhood of Vienna to the Danube Gap at the Iron Gate. In the considered area of Central Europe there are different parts of the Carpathians, including those of Austria, the Czech Republic, Slovakia, Poland and Ukraine. The highest massif of the Inner Carpathians are the Tatra Mts. The Early Palaeozoic and Carboniferous crystalline rocks associated with Variscan orogen form the core of Tatra Mts. The massif is partially covered with the nappes composed of Permian–Lower Cretaceous sediments. The relief was remodelled by Pleistocene mountain glaciers and in effect of periglacial climate. Another range of the Inner Carpathians which is outstanding due to its geology and rock landscape is the Pieniny Klippen Belt formed of strongly faulted Jurassic–Cretaceous formations. North of the Pieniny Klippen Belt there are the Outer Carpathians with complex of nappes of Cretaceous–Tertiary flysch deposits. The Carpathian Foredeep is filled up with Miocene sediments spread at the northern border of the Carpathians. The discussed geological region is only partially represented in the proposed Euro-list (Table 1). The majority of the geosites have been documented in the Polish Carpathians. The whole region being one of the most interesting in Europe is incorporated into Pan-European Ecological Network. The extended list of the important geological localities, when compared with the existing one, should be included to the register of the most valuable sites of nature.

The present-day network of geosites in Central Europe must be supplemented, especially with regard to such regions as Bohemian Massif, Carpathians and Lublin–Lviv Upland. In order to improve collaboration in the field of comparative selection of the sites proposed for the national lists, the Working Group of Central Europe has been divided into regional sub-groups. Each, final regional

list should adequately reflect the geodiversity of particular region and enclose the standard features.

Final remarks

The European list of geosites compiled by UNESCO/IUGS in collaboration with ProGEO Association is likely to be replaced by Geosites and Geoparks — a new concept initiated

by UNESCO in co-operation with IUGS. This programme should facilitate and promote the world-wide preservation of geological heritage, increase public awareness and support local and regional sustainable development. A geosite is defined as a geological heritage site of a restricted size. This definition corresponds with the term site in Geosites programme. A geopark presents a large area with important geological features and other values such as archeological, ecological, historical or cultural. The same meaning bear many areas selected for the Euro-list Geosites as the terrain characterized by site-sets (complexes of sites). According to the new concept, in each country necessary legal instruments shall provide a management policy or plan for the area functioning as a geosite or a geopark. Designated localities should (after Patzak, 1998):

a) include a single object or a mosaic of geological systems of special geological significance, representative of an area and its geological history, events or processes;

b) contribute to the conservation of significant geological features which provide information in various geoscientific disciplines such as: geology, geomorphology, soil science, glacial geology, hydrology, engineering geology, mineralogy, petrography, paleontology, economic geology and mining, sedimentology, stratigraphy, structural geology and volcanology;

c) provide means of exploring and demonstrating approaches to sustainable socio-economic development on a local or regional scale;

d) provide an opportunity for broad environmental education.

The International Geosites and Geoparks Board will be a significant contribution to the development of geological heritage conservation. A next step towards the progress in the work field of international conservation would be implementation of the concept of formation of the lithosphere (geosphere) reserves (Alexandrowicz & Wimbledon, in press), accepted in the declaration of the 2nd International Symposium on the Conservation of the Geological Heritage — ProGEO '96, Rome. The Lithosphere Reserve as the highest international category of the protection is parallel to the Biosphere Reserve established by the UNESCO-MAB Programme. The areas of the above rank should be selected out of the legally protected geoparks (areas

of complexes of geosites). The network of lithosphere reserves was proposed based on the examples from Poland and the United Kingdom (Alexandrowicz & Wimbledon, in press).

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