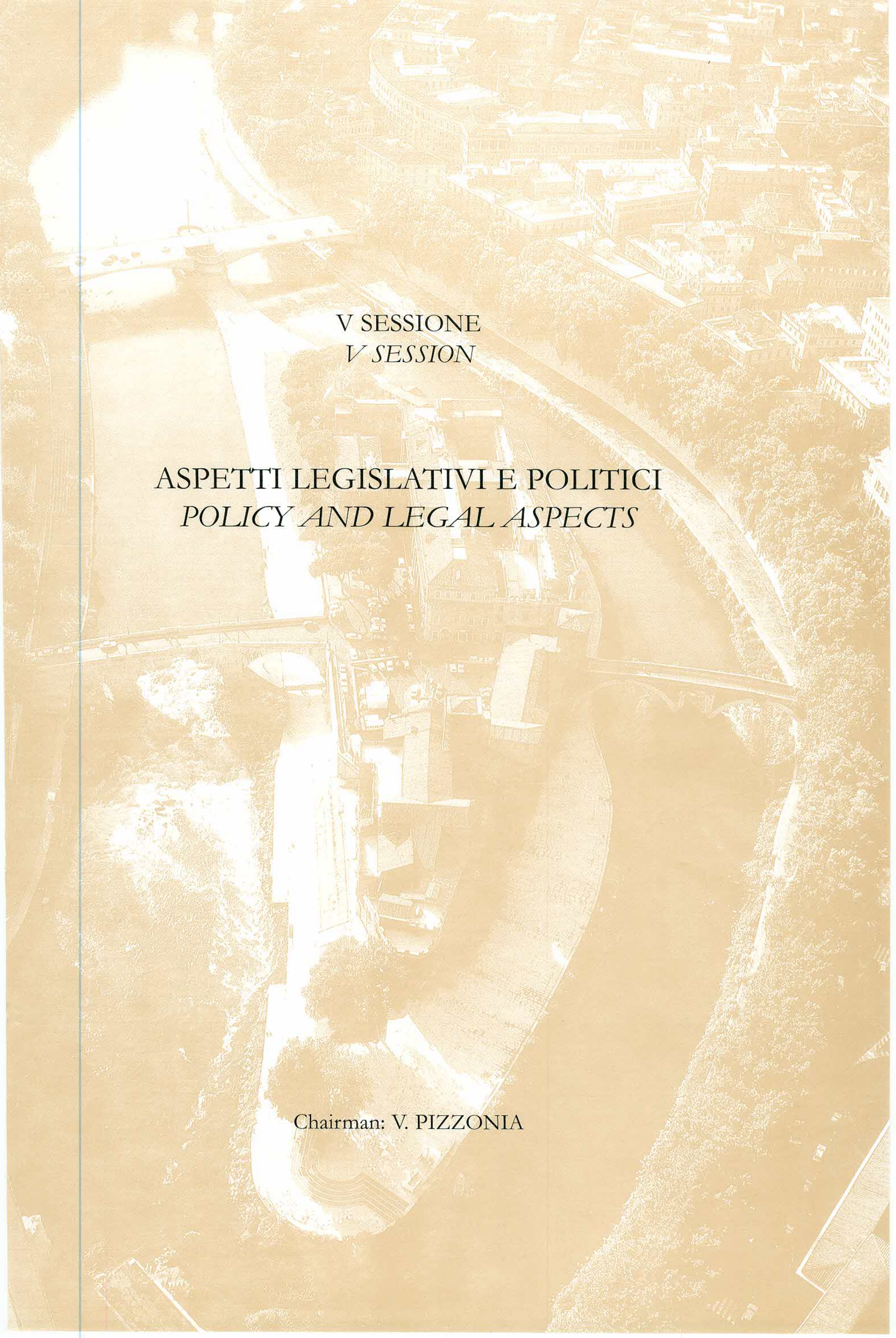

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# ASPETTI LEGISLATIVI E POLITICI
# *POLICY AND LEGAL ASPECTS*

Chairman: V. PIZZONIA

*Mem. Descr. Carta Geol. d'It.*
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# The concept of world lithosphere reserves
# *Il concetto di riserve della litosfera terrestre*

ALEXANDROWICZ Z. (*) & WIMBLEDON W.A.P. (**)

ABSTRACT – Selected national parks and other protected areas or groups of sites of the considerable values with regard to geological and geomorphological features should be favoured by the international support. The lithosphere reserve is proposed by the Authors as an international category parallel to the biosphere reserve established by the UNESCO - MAB Programme. A network of lithosphere reserves with defined targets and principles of creation cauts be an effective way of promoting of the geological heritage both in the world and national systems of nature conservation. The concept of the lithosphere reserve as a new international category is presented by the proposed networks for Poland and United Kingdom.

KEY WORDS: nature conservation, lithosphere reserve, Poland, United Kingdom.

RIASSUNTO – Una selezione di parchi nazionali ed altre aree protette o gruppi di siti di valore considerevole dal punto di vista delle caratteristiche geologiche e geomorfologiche dovrebbe essere favorita dal sostegno internazionale. La riserva della litosfera è proposta dagli Autori come una categoria internazionale parallela alla riserva della biosfera stabilita dal Programma UNESCO - MAB. La rete delle riserve della litosfera con obiettivi definiti puó essere un modo efficace per promuovere il patrimonio geologico nei sistemi di conservazione della natura nazionali e mondiali. Il concetto di riserva della litosfera, come una nuova categoria internazionale, è presentata per mezzo delle reti proposte per la Polonia ed il Regno Unito.

PAROLE CHIAVE: Conservazione della natura, riserva litosferica, Polonia, Regno Unito.

## 1. – INTRODUCTION

Geoconservation, internationally, is at early stage of activity: it is still about making contacts between countries recapitulating and expounding national achievements in conserving inanimate nature, and starting to fix and realise common targets. Contrary to this, animate nature conservation has been supported by numerous conventions, organisations and international programmes.

In general, inanimate nature consists of all those "constant" elements resulting from events which took place in the geological past; this part of nature is not fully appreciated, when conservation programmes are being set up. Geoconservation itself concerns the Earth's historical record, and, as well as this heritage, contemporary, present day abiotic environments. The latter are undergoing natural and anthropogenic changes and these have important influence on the state and diversity of flora and fauna. Defining nature conservation priorities and evaluating the progress of its development depend, among other things, on the application of different rules, types of designation and methods of protection on local and international scales. Popularisation, publicity and publication of research programmes contribute greatly to creating social awareness, including the need to support definite targets in nature protection.

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To popularize biotic nature conservation - different forms of influence are applied: one of these has been the setting up of biosphere reserves within the Man and Biosphere programme - initiated in 1968 during the UNESCO Biosphere Conference. Biosphere reserves comprise ecosystems which are representative of the main vegetational bioms occuring in the world. First of all, these reserves ought to serve scientific research focussed on forecasting and controlling changes in the biosphere. About 300 reserves exist, but their distribution within the continents is irregular: a particular concentration exists in Europe. They are characterised by being relatively small areas with considerable natural differentiation/diversity.

Geoconservation has been applied in particular countries through the protection of national networks of selected sites: localities are regulated by law and many comprise relatively small areas, often single objects, sites or monuments. Complexes of geological and geomorphological features (geocomplexes/terrains) are frequently not included. They are perhaps protected in the areas of national parks, landscape parks or in the other categories of large-space protection, where the value and role of inanimate nature are only marginally recognised, being treated as a background for the biosphere. At present, there is no special protection category covering large areas, geocomplexes, which are essential in demonstrating major and characteristic features in geological regions and also for showing natural endo- and exogenic processes. These areas may or may not be of high animate nature value.

Geologically and geomorphologically active zones which demonstrate the continuous evolution of the interior and the surface of the Earth are, or should be, particularly predestined to be distinguished in the world nature conservation system. Formal separation of a new category of protection called lithosphere reserves is here suggested, to preserve in a systematic and global fashion those areas of the greatest importance for the Earth sciences. Creation of reserves would generally be limited to nationally protected areas. Such sites might fall within existing biosphere reserves or other protected areas, including national parks, but their creation, research programmes thereon, and management and action plans would need to be specifically aimed at, cater for, their abiotic character and values. Recognition of lithosphere reserves might depend on the Geosites project to define a global context for selection and documentation (O'HALLORAN *et alii*, 1994). Creation of lithosphere reserves, just as with biosphere reserves, would need to be based on international agreement within UNESCO and areas should form an international network with defined targets and tasks.

## 2. – LITHOSPHERE RESERVE AS THE PROPOSED CATEGORY

### 2.1. – TARGETS AND PRINCIPLES

Lithosphere reserves will be equivalent to the biosphere reserves in the world system of nature conservation. The aims and principles of their creation correspond to biosphere reserves (BATISSE, 1982).

Lithosphere reserves should fulfil the following requirements:

- conserving diversity of geological and geomorphological elements within geosystems providing physical and organic continuity of evolution of the Earth's interior and its surface, together with contemporary natural and anthropogenic processes;
- protecting natural surfaces, subsurfaces and submarine zones for geological and geomorphological research;
- giving educational and training opportunities in the Earth sciences, including specializations connected with geoenvironmental protection.

According to the above mentioned targets, lithosphere reserves must first of all have the following specific features:

- representative examples of selected natural geocomplexes and of particularly valuable sites, natural landscape reflecting the main elements of geological structure, as well as landscapes transformed by different farming use or mineral exploitation, provided that these areas can be restored and subjected to natural processes in their further formation;
- suficiently large areas comprising the different lithostratigraphic units of a defined geological region.

In order to function properly the lithosphere reserve should be permanently protected and provide educational, training and research opportunities, and also be useful for monitoring causes and the rate of change and transformation of the geological environment. After the example of biosphere reserves (BATISSE, 1982), lithosphere reserves might consist of one or few central zones and theirs buffers. Scientific stations, fields of investigations, settlements, tourist and training centers should to be localised within buffer zones. Scientific stations, fields of investigations, settlements, tourist and training centers should to be localised within buffor zones. Space arrangement of reserve zones would, first of all, depend on former, detailed evaluation of geological structural elements and relief, and on the focussed, detailed estimation of the state and possibilities use of the area.

### 2.2. – General Classification

Areas of various degree of nature originality preservation may be qualified for the lithosphere reserves. They would comprise natural outcrops, structural landscapes, artificial rock exposures and forms of relief transformed by human activities. The traditional/historical areas geological investigations and of scientific hypotheses documentation are particularly noteworthy. Traces of mineral exploitation from the past with cultural monuments are also important when reserves are planned.

Lithosphere reserves represent three types of environment: superficial (surface), subterranean and submarine. Some of the reserves could even comprise the elements of all three environments, but they would be mainly be the superficial ones.

Superficial lithosphere reserves are those areas where numerous and various forms of relief, formation outcrops (including the sites of fossils), structures, minerals, active processes and often geological phenomena occur. The reserves are accessible to various educational purposes and a wide range of scientific studies.

Subterranean lithosphere reserves are zones where natural and artificial objects occur; respectively, caves and other systems of natural drainage belong to the first type, and historical, well preserved mines - to the other. Safety regulations would limit their scientific and didactic use.

Submarine lithosphere reserves comprise littoral and sublittoral zones of particular configuration. These zones illustrate situations of different sediment and erosion processes. This type of reserve would serve mainly for scientific studies.

The above mentioned kinds of reserves undergo various types of dynamic change, which should be the main subject of monitoring and studies. Changes are either permanent or periodic and may depend on climatic conditions, as is often the case with weathering and erosion processes. They can also be episodic, sometimes catastrophic, when for instance they result from earthquakes or volcanism.

The proposed lithosphere reserves can be pointed out as areas particularly suitable for geological and geomorphological research leading to the estimation of environmental change and evolution controlled both by natural processes and human impact.

### 2.3. – Proposition Of The Lithosphere Reserves

#### 2.3.1. – *Poland*

The protected areas network is well developed in Poland and consists of particularly interesting areas where their geological structure and relief are concerned (Alexandrowicz *et alii*, 1992). There are 7 biosphere reserves comprising the national parks and the animate nature reserves (fig. 1) (Breymeyer *et alii*, 1994). Three of them are transfrontier i.e. Polish-Slovak, Polish-Czech and Polish-Slovak-Ukrainian. Three biosphere reserves are planned in Poland. Only some of the presently existing and proposed biosphere reserves fit the programme outline for the proposed category of lithosphere reserves. If the international system of nature conservation legally accepts this category, the following 12 protected areas should be taken into consideration as lithosphere reserves (fig. 1).

Tatra National Park (fig. 1, no 1).

The Tatra Mts are the highest in the Carpathians. Their core consist of Precambrian metamorphic rocks and Variscan granite overlain by Triassic-Cretaceous sedimentary formations (mainly limestones and dolomites) forming nappes overthrust norhtwards. The glacial relief with cirques, U-shaped valleys, hanging valleys, lakes and moraines is well developed. The timberline is situated about 1550 m a.s.l. and the highest mountain ranges reach 2500 m a.s.l.

Pieniny Klippen Belt, including the Pieniny National Park (figg. 1, no 2; fig. 2).

The Pieniny Klippen Belt is situated at the northern border of the central Carpathians. This is a zone of steep folds, thrust faults and strongly dislocated overthrusted nappes. The geological structure is formed of Jurassic and Cretaceous deposits. The most typical are limestones and radiolarites of the Pieniny succession (deep-sea sediments) and limestones abounding with crinoids and other fossils of the Czorsztyn succession (shallow-sea sediments) as well as marls with *Globotruncana* and flysch. Rocks of different resistance form a very picturesque landscape with numerous deep valleys and gorges. The famous antecedent Dunajec water-gap is particularly interesting from a geological point of view.

Babia Góra National Park (fig. 1, no 3).

Babia Góra (1725 m a.s.l.) is the highest range of the Outer Carpathians formed of flysch, mainly of the thick-bedded Magura Sandstones. The whole northern slope of this range is a high rocky head scarp with large block fields and colluvial ridges in a few small lakes. The timberline is about 1360 m a.s.l. while at the top of the ridge-crest periglacial microrelief is noted.

Bieszczady National Park (fig. 1, no 4).

The Bieszczady Range is a part of the Eastern Carpathians. They are mainly formed of the Oligocene flysch (the Krosno Beds), characterised by thick-bedded sandstones alternating with shales. The uppermost part of this range is above the timberline situated at 1100-1150 m a.s.l. Block fields and several types of current marking and trace fossils from this area have been described.

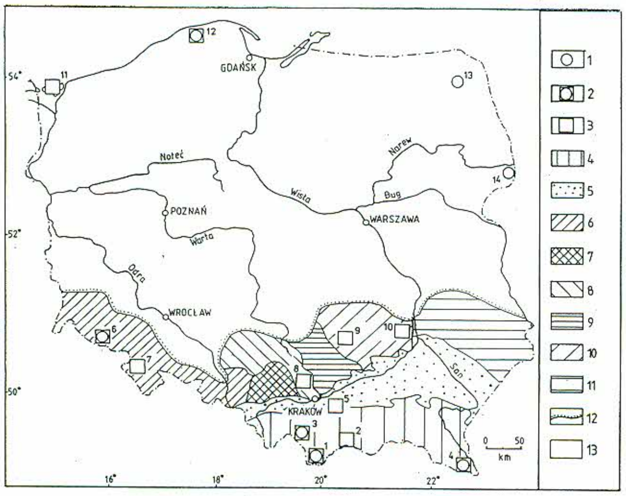


Fig. 1. – Proposed lithosphere reserves and existing biosphere reserves against the backgroud of the geological regions of Poland. 1 - biosphere reserve, 2 - biosphere and lithosphere reserve, 3 - lithosphere reserve; 4 Carpatians: Tatra Mts - crystalline rocks and Mesozoic deposits, Pieniny Klippen Belt - Jurassic and Cretaceous carbonate sediments, Outer Carpathians - Cretaceous-Palaeogene flysch, 5 - Carpathian Trough - Neogene sediments, 6 - Sudety Mts - Precambrian and Palaeozoic rocks, Triassic and Cretaceous deposits, 7 - Upper Silesian Basin - Upper Carboniferous sediments, 8 - Cracow-Silesian Monocline - Mesozoic deposits, 9 - Miechow Syncline - Upper Cretaceous sediments, 10 - Holy Cross Mts - Palaeozoic, Triassic and Jurassic rocks, 11 - Lublin Basin - Upper Cretaceous sediments, 12 - southern border of Quaternary cover, 13 - Polish Lowlands - deposits of Pleistocene Glaciations.

*– Riserve della litosfera proposte e riserve della biosfera esistenti rispetto all'insieme delle regioni geologiche della Polonia. 1 - riserva della biosfera, 2 - riserva della biosfera e della litosfera, 3 - riserva della litosfera; 4 Carpazi: Monti Tatra - rocce cristalline e depositi del Mesozoico, Pieniny Klippen Belt - sedimenti carbonatici del Giurassico e del Cretaceo, Carpazi Esterni - flysch del Paleogene-Cretaceo, 5 Fossa Carpatica - sedimenti Neogenici, 6 - Monti Sudeti - rocce del Precambriano e del Paleozoico, depositi del Triassico e del Cretaceo, 7 - Bacino Silesiano Superiore - sedimenti del Carbonifero Superiore, 8 - Monoclinale Cracoviano-Silesiano - depositi del Mesozoico, 9 - Sinclinale di Miechow - sedimenti del Cretaceo Superiore, 10 - Monti di Croce Santa - rocce del Paleozoico, Triassico e Giurassico, 11 - Bacino di Lublino - sedimenti del Cretaceo Superiore, 12 - confine meridionale della copertura del Quaternario, 13 - Bassopiani Polacchi - depositi delle Glaciazioni del Pleistocene.*

Salt Mine "Wieliczka", National Monument of History, placed on the First International List of the World Cultural and Natural Heritage by UNESCO (fig. 1, no 5).

Salt manufacturing in the vicinity of Wieliczka near Kraków dates back to the Neolithic period. Salt mining began in the Middle Ages. At present, the mine is about 300 m deep and has over 200 km of galleries, 2000 chambers and 26 surface shafts. The mine work is nowadays limited and will be terminated. The subterranean museum and tourist trail with famous monuments of mining, the network of geological documentary sites and the nature reserve "Crystal Caves" are the principal objects of conservation. Promoting the first underground national park status of the mine should be the priority. The Salifarous formation of the Miocene (Badenian) extends as a narrow strip along the northern border of the Carpathians. The salt deposit is bipartite. The lower, stratified and folded part is covered by megabreccia with huge salt blocks.

Karkonosze National Park (fig. 1, no 6).

The Karkonosze Range with Mount Œniegka (1602 m a.s.l.) is the highest one in the Sudety Mts. It

Fig. 2. – Pieniny National Park, the main range of mountains - Upper Jurassic-Lower Cretaceous limestone formations. (Photo by Z. Denisiuk).

*– Parco Nazionale Pieniny, la principale catena di montagne - formazioni calcaree del Giurassico Superiore-Cretaceo Inferiore. (foto di Z. Denisiuk).*

is formed of the Upper Carboniferous granite. The Tertiary planation surface elevated during the Alpine orogenic movements is transformed by glacial processes. Cirques with lakes, moraines and block fields formed during the last glaciation are the typical features of the landscape. Numerous groups of picturesque tors enrich the relief. The timberline is presently about 1250 m a.s.l.

Góry Stokowe National Park (figg. 1, no 7; fig. 3).

Platy mountains unique in Poland and one of the few in Europe presents the tableland (900 m a.s.l.) bounded with rocky scarps rising 300 m above the neigbouring depressions. The relief reflects the geological structure. Two levels of mountain planations are formed of thick layers of cross-bedded sandstones (Cenomanien-Coniacian) divided by the complex of fossiliferous marls. The lower one is crowned with a lot of isolated tors and rocky walls, while two rocky towns are developed within the upper level.

Cracow Upland - Ojców National Park and surrounding nature reserves (fig. 1, no 8).

The Cracow Upland is formed of Devonian and Lower Carboniferous carbonates, Upper Jurassic limestones, Upper Cretaceous marls and Miocene clays. Mesozoic formations dip gently north-eastward as a monocline dislocated by several faults, bordering troughs and horsts. Tectonic structures are distinctly reflected in the relief. Abrasion surfaces overgrown with stromatolites can be observed as traces of Cenomanien and Turonian transgressions. Narrow rocky valleys and gorges as well as numerous limestone tors are the typical features of the landscape. The rich karst scenery developed in several phases encloses a bulk of caves, rock shelters, hollows, lapies and springs.

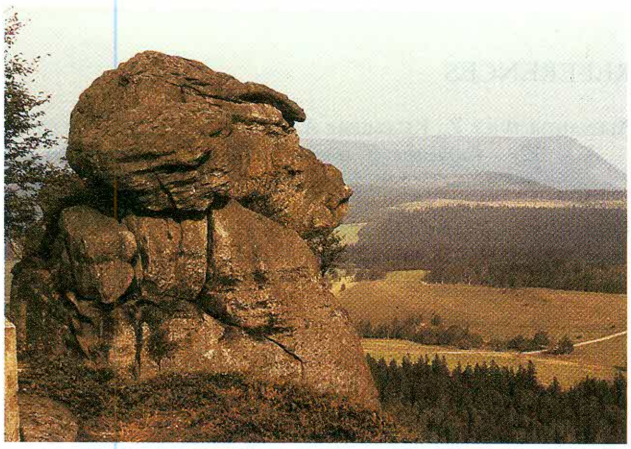

Fig. 3. – Góry Stokowe National Park, Sandstone tor (Upper Cretaceous). (Photo by Z. Alexandrowicz).

*– Parco Nazionale di Góry Stokowe, picco di arenaria (Cretaceo Superiore). (foto di Z. ALEXANDROWICZ).*

Kielce Upland – Holy Cross National Park and nature reserves and monuments in Chêciny – Kielce Landscape Park (fig. 1, no 9).

The Kielce Upland encloses he Palaeozoic massive of the Holy Cross Mts (612 m a.s.l.) and surrounding Mesozoic formations. The range of geological history from Cambrian to Quaternary is unique one in Poland. Numerous protected old quarries are used for geological and environmental teaching. Stratigraphic sequences of different deposits with rich fossil fauna, typical examples of sedimentary and tectonic structures as well as traces of mineralization can be observed. The relics of old mines are historical monuments. Karst phenomena are developed within carbonate formations. Large block fields of Cambrian quartzites formed by periglacial climate during the last glaciation are the typical features of the relief of the Holy Cross Mts.

Krzemionki Opatowskie Nature Reserve and National Monument of History (fig. 1, no 10).

The old Neolithic mine of flints is situated within the large outcrop of Jurassic (Upper Oxfordian) limestones. Numerous shafts, galleries, excavations and mining tools are preserved there up till now. The mine was down to 11 m deep covering a vast area (about 700 shafts). The miners' work traces date back to the Funnel Beaker Culture (4500-5000 B.P.). The underground tourist trail and the museum have been arranged.

Wolin National Park (fig. 1, no 11).

The park is situated in the Wolin Island including the sublitoral zone of the Pomorze Bay. The ridge of terminal moraine (115 m a.s.l.) connected with the latest phase of the last glaciation is the main element of the relief. It is bordered with high cliff. A few huge blocks abounding in fossils occur within the moraine and crop out in the old quarries. Active abrasion and acumulation processes can be obsereved along the sea shore.

Skowiski National Park (fig. 1, no 12).

Different types of environment such as dunes, peatbogs, swamps and sea shore developed in the mentioned area. Mobile dunes up to 56 m high forming a sandy spit cutt off the ancient bay of the Baltic Sea and created Leba and Gardno Lakes. Still active eolian processes, expressed by the typical relief and causing the movement of dunes (a few meters high) are the dominant feature of the Park of the unique value in Europe. Relics of buried soils, peats and trunks are traces of the landscape transformation during the Holocene.

2.3.2. – *United Kingdom*

Britain lacks national parks in the sense that the phrase is used most countries, they are not areas set aside specifically for nature conservation, but planning authority areas with distinctive landscape and scenic characters (often determined by geology). So for Britain we cite examples of group of sites and terrains which appear relevant to the discussion, both inside and outside the parks. Below are briefly listed some few tentative suggestions for lithosphere reserves in line with the outline aims given above. For simplicity, all areas noted are of classical importance in the development of geology, and are localities which are well documented.

Westphalian (Upper Carboniferous Coal Measure) section - Swansea, Neath, and Brecon Beacons National Park.

These are outcrops in valley-side crags and multiple complementary stream sections in the uplands and upland fringes of the South Wales Coalfield, many sections, cumulatively comprising many hundreds of meters of section, in riverine and floodplain sediments with coals and marine bands. They constitute the best accessible sections in Europe for the Westphalian B-D interval.

Landovery (lower Silurian) type area, Dinefwr.

Many forestry tracks, stream sections, road cuttings and hillside crags combine to provide the type sections for the lowest beds of the Silurian. The mosaic of sites makes it possible to maps the three dimensional depositional history this key area.

Upper Jurassic - basal Cretaceous (Kimmeridge, Portland, Purbeck and Wealden strata) of the east coast of Dorset.

Includes multiple Sites of Special Scientific Interest/Heritage Coast and the historical type areas for various chronostratigraphic and rock units. A range of geological and coastal geomorphological features are available for study. These are classic sites for the study of Mesozoic stratigraphy, faunas and environments, charting the marine to non-marine Jurassic-Cretaceous transition.

Variscan Front, tectonic structures of South Wales and Pembrokeshire Coalfields.

Two areas, one in the Pembrokeshire National Park, in many kilometres of eroding coastal cliffs, and in crag outcrops in the Brecon Beacon National Park, further east, exhibit the Variscan front and other major structures in deformed Carboniferous and Devonian rocks, including some of the first mapped terrains globally, by Logan and de la Beche. Superlative sections allow detail study of these Variscan terrains which occur here with no younger cover.

Silurian – lower Devonian earliest vascular land plants – Pembrokeshire National Park, Dinefwr, Breck-nock, Brecon Beacons National Park.

Continuous coastal sections, isolated quarries and hillside crags and scarps afford many kilometres of outcrop of late Silurian and early Devonian shoreface and non-marine sediments. A variety of sites chart the appearance of land floras, vascular and non-vascular, and the first radiations of such plants. In the upland areas glacial landscapes are superbly developed.

Coastal geomorphological features Chesil Bank and Lulworth area - Dorset.

Classic depositional and erosional landforms have been studied here for 150 years, including the double tombolo of Chesil Beach (a pre-Holocene remnant beach) and Portland harbour beach. The Lulworth, Durdle Door and Mupe arch and stacks are text-book examples of differential coastal erosion.

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LIV (1999), pp. 353-360

# Provocative thoughts on earth heritage conservation or 'does protection of life form an obstacle to overcome for EHC?'

# *Riflessioni provocatorie sulla Conservazione del Patrimonio della Terra ossia 'la forma di protezione della vita è un ostacolo da superare per la Conservazione del Patrimonio della Terra?'*

JACOBS P. (*)

ABSTRACT – In the mainstream of environmental care, Earth Heritage Conservation (EHC) is slowly but steadily progressing. According to recent developments in various countries as exemplified by (mainly European) initiatives, EHC is about to become common knowledge in the geological community. However, as it still lacks a broad and solid scientific base, EHC's future development might suffer from being too 'site-focused'. To answer questions about (and beyond) EHC, the need for a rationale and a strategy is urgently felt.

In this paper, the author communicates his personal ideas about the actual position and the role of EHC in the broader framework of the international concern about the 'quality of life' and the way to achieve this goal. It is the author's believe that EHC only represents a small but specific part of the important role that geology will have to play in the 3rd millennium. The various aspects of geology's future role and its actors are outlined. A comparison between the biology and geology idioms in conservation matters is drawn, and a way is indicated to raise public awareness.

KEY WORDS: Role of geology, Earth Heritage Conservation role, strategy, challenge.

RIASSUNTO – Nella corrente principale della cura per l'ambiente, la Conservazione del Patrimonio della Terra (EHC) sta lentamente ma costantemente progredendo. Secondo i recenti sviluppi in vari paesi, come spiegato dalle iniziative (principalmente europee), l'EHC è prossima a diventare una conoscenza comune della comunità geologica. Però, poiché manca ancora un'ampia e solida base scientifica, lo sviluppo futuro dell'EHC potrebbe trarre svantaggio dall'essere troppo «focalizzato sul sito». Per rispondere alle domande sulla (e oltre) l'EHC, si sente un urgente bisogno di una analisi ragionata e di una strategia.

In questo articolo, l'autore comunica le sue idee personali circa la posizione attuale ed il ruolo dell'EHC nel più vasto panorama dell'interesse internazionale circa la «qualità della vita» ed i modi per raggiungere questo traguardo. È convinzione dell'autore che l'EHC rappresenti solo una parte piccola ma specifica del ruolo importante che la geologia dovrà svolgere nel terzo millennio. Vengono delineati i vari aspetti del futuro ruolo della geologia e i suoi attori. Viene tracciato un confronto tra gli idiomi della biologia e della geologia in materia di conservazione e viene indicata una strada per attirare l'attenzione del pubblico.

PAROLE CHIAVE: Ruolo della geologia, ruolo della Conservazione del Patrimonio della Terra, strategia, sfida.

## 1. – THE 'MODERN TIMES' PLAGUES

Are geologists selfish people, or is there a narcissus hiding in each of us? Or are we masochists? One could think so if one considers the amount of complaints from geologists about quarries and sections being destroyed or filled in with water or waste. And what is our reaction about depletion of mineral, hydrocarbon or water resources? Or pollution? Or do geologists consider themselves as just poor scientists who continuously failed to provide an adequate answer in prediction of earthquakes, landslides and volcanic eruptions? Is our contribution to 'global change' and 'sea level rise' successful? Honestly, do we not feel a bit guilty for having done not enough to solve these 'modern times' problems?

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The last five decades are characterized by unlimited economic growth. Geologists were deeply involved in both exploration and extraction. But did we care about non-renewable resources or sustainable development? Did we consider extraction aftercare? Did we adapt our extraction techniques? In my opinion, the answers to these questions will form the overall challenge for the new millennium: clean up the mess mankind (including geologists) made.

## 2. – AN IMPORTANT ROLE FOR GEOLOGY

In this overall challenge, geologists will play an important role, internally as well as externally.

### 2.1. – INTERNALLY

#### 2.1.1. – *Industry and the private domain*

Internally, we will have to reorientate our education programmes in an environment-friendly way, far away from the 'unlimited resources values' we sticked to until now. Academia and geological surveys will have to take on a major part of this task. But above all, we will have to reorientate our exploration and extraction techniques. Here, the role of academia and industry is of paramount importance. For those who are not familiar with the latest developments in industry, it might look strange to learn that industry is seriously considering to drastically change its strategy and policy in the years to come. Prevention and risk assessment is high on its agenda. Just a few examples to illustrate industry's new attitude, certainly inspired by economic and financial survival on the one hand, but also by concern about the environment and public awareness and control on the other:

• in the search for giant hydrocarbon fields, the BP exploration branch now takes into account a risk assessment of '10 000 years no-event' for upper-slope conditions (HILL, 1996);

• reorientation of 'research and development' into 'enhanced oil recovery (EOR)' and prevention resulted in multiplication of the financial efforts for oil exploration by a factor of 5;

• actually, multinational mineral companies discuss internally a drastic change in mining policy (WARIN, 1996);

• experts of the British Geological Survey (BGS) calculated the storage capacity of porous sandstone formations under the North Sea to be large enough to store 800 gigatons of $CO_2$ from North Sea gas and oil production for the coming 800 years; respecting actual criteria, the absorption of the European $CO_2$-emission could compensate for the greenhouse effect, and thus contribute to the restoration of ecological balances to levels active before disruption.

#### 2.1.2. – *Academia and the public domain*

The private sector is apparently preparing to assume its responsibility in its own economic and industrial domain. This implies that academia will have to cover the field of prevention against natural risks in the public domain. We will have to increase considerably our efforts in natural hazard prediction and risk assessment. If Governments want to protect their populations from floods, earthquakes, landslides and volcanic eruptions, they will have to invest in fundamental and applied geological research in these vital issues.

In the near future, the demand for engineering and applied geology initiatives in the wide field of public protection and prevention will increase:

• natural hazards risk assessment (prediction of earthquakes, floods, volcanic eruptions, landslides);

• environmental constraints on large constructions in civil engineering, and site investigation;

• important (if not radical) changes in exploration and extraction techniques.

### 2.2. – EXTERNALLY

But there is also a role for geology to play externally. Whether they like it or not, geologists will have to open up to society. We will have to realize that outside the closed world of geology, there is another world, completely different from our's. To be understood, we will have to make use of the media, the economic impact of geology possibly being the vehicle. However, if the public only ever hear about geology in the context of conflict with other interests with which they may be more familiar (and thus to which they may consequently be more sympathetic), the image of geology in general (and EHC in particular) may not benefit. As we have nothing to gain from conflictual situations, academia in synergy with industry should promote, initiate and stimulate initiatives (e.g. sustainable development) in all fields related to geology.

## 3. – ENVIRONMENTAL PROBLEMS AND THE QUALITY OF LIFE

Environmental problems of all kind (natural risks like floods and droughts, desertification, global change, ozon depletion, ...) are considered nowadays as serious threats, disequilibrating irreversibly the fragile balance of life forms, that ultimately could lead to extinction of both fauna and flora. Mankind reacted by protecting endangered species (including ourselves!) but without taking away the causes of threat. And moreover, geology did not provide an adequate answer to natural hazards (like earthquakes, volcanic eruptions, ...), that were looked upon as scientifically interesting phenomena or curiosa rather than a 'matter of life or death' for the population concerned.

But man-induced environmental problems (non-renewable resources, demographic explosion, food production, pollution, monument deterioration, ...) could in the end also dramatically reduce the quality of life. Mankind's reaction resulted in social and cultural protection, including monument conservation.

## 4. – THE ROLE OF EARTH HERITAGE CONSERVATION

This knowledge spread widely and provoked a drastic change in mentality, that resulted in a worldwide concern for conservation of biodiversity and of natural and man-made ecosystems or habitats. It made cultural and biological conservation more popular and a first-order priority. But unfortunately it did not raise public awareness for Earth Heritage Conservation (EHC) (a few exceptions not mentioned).

Honestly, what have we been doing in EHC up to now? A historical overview illustrated with a panoply of European EHC examples and developments as a result of different (philosophical) approaches and accents (JACOBS et alii, in print), shows that we mainly have been busy with protection of stratigraphy, palaeontology and some geomorphology. Although there is nothing wrong with that, we kept ourselves happy with the preservation of 'dead material'. (For the outside world, rocks are dead material). So why is EHC not (yet) popular? As EHC deals with 'the life of dead rocks', it does not protect 'life from extinction', nor does it increase the 'quality of life' if too site-focused. Therefore EHC is not a hot topic on the political agenda. So the question is: perhaps protection or conservation of 'life' in general acts counterindicative for EHC in particular because EHC has nothing to do with life?!

We also preached to the converted, and we think we owe it to ourselves to continue to do so by multiplying our national and international examples of EHC as an important task for academia and geological surveys. We will have to learn from biologists in the way they succeeded in passing to the public their message of 'protection and conservation of the biological quality of life'. Complementary to this 'biological and cultural protection of life', we will have to find a way to translate our message into a geology idiom of 'protection and conservation of economic and industrial quality of life', of which obviously geological surveys and industry will be important messengers and actors.

## 5. – DEMAND FOR A STRATEGY

These quotations demand not only for a scientifically based rationale, that is currently being developed (WILSON, 1994), but also for a clear and well-defined strategy. As biologists and landscape conservationists already did, perhaps EHC-conservationists should use 'conservation of cultural heritage' as a vehicle. The latter:

I) is not connected to 'protection of life from extinction' as such;

II) is connected with 'historic aspects of human activities' (like arts, buildings and monuments, economic activities, ...);

III) calls upon a combination of aesthetic feeling and academic thinking;

IV) deals with 'quality of life' as there is a close connotation with economic and social aspects (like touristic values initiating local economic development, or linking up with industry to assure sustainable development for an ever increasing number of people in the 3rd millennium).

## 6. – PROGRESS

Geologists deal with time. Therefore, they should be interested in the last 5000 years of Earth history, and in the way its development was determined by the ascent of mankind and its behaviour. We certainly made technological progress, but what about knowledge? Did our knowledge progress? What were the major breakthroughs, in geology e.g.? Honestly, we had to wait for the theory of 'plate tectonics' to start to understand the relationships between phenomena like earthquakes, volcanics, orogenies, sea level fluctuations and sedimentation as being part of one and only 'living-earth system'.

And that's just what made biology attractive: it deals with a living world. People think that geology mainly deals with a 'dead world', which does not look very appealing to them (except for a few bona-fide amateur-geologists collecting fossils and minerals). For the moment geology is not in a position to compete with biology for public interest.

> 'Natural landforms create the environments within which the diverse flora and fauna live. Rocks provide the soil and influence the drainage conditions of biological habitats. Biological and geological forms and functions are inextricably linked to create a series of natural systems of immense richness and diversity' (ELLIS, 1996, p. VIII),

In spite of the above knowledge, pure geological considerations are mostly overlooked or neglected for various reasons. Perhaps because we didn't plead our environmental geology arguments convincingly enough.

## 7. – ECONOMIC AND INDUSTRIAL IMPACT OF GEOLOGY

Geologists need to find ways to address the public through the media by demonstrating the economic and industrial impact and importance of geology (ore, water and hydrocarbon exploration are probably good vehicles). The man-in-the-street is not interested in rocks as such (exception made for the collectors), but might be interested in what's inside rocks and the hidden role they play in his daily life. This role exemplifies the economic impact of geology on the quality of life. Undoubtedly there is a lot of concern about the conservation of this quality of life, and people are willing to make sacrifices to maintain it at the highest possible level without further disequilibrating fragile balances. This attitude might provide us an ideal opportunity to stress the importance of our profession by illustrating at every occasion what the contribution of geology is and could be in all attempts to maintain this high-level quality for people in the industrialized world, and to higher the quality level for people in the less-industrialized world.

## 8. – THE CHALLENGE OF THE 3RD MILLENNIUM

The challenge for the 3rd millennium is to bridge the gap between the 'haves and the have-nots', by raising the quality of life for the have-nots without loss of quality for the haves. This movement does not only pose a problem of quality, but also a problem of quantity. It forms a huge challenge for mankind, and as geologists we have to be aware of the fact that there is an important and decisive role to be played by geology:

- the energy and mineral resources demand will probably continue to increase in order to assure the quality of life for a constantly increasing number of people;
- pollution clean-up will be of paramount interest if we want to keep this planet viable and restore the fragile ecological equilibrium, actually out of balance due to irreversible processes induced by human behaviour.

Oftenly, ecology and biological conservation came in conflict with economic priorities. This does not need to be the case with EHC as industry is progressively answering the social and ecological requirements of society. Strengthening links with industry will create new possibilities for EHC, that will increase public awareness and guarantee equal opportunities for a quality life to everybody in an internationally interdependent world. Geology and EHC can not stand aside at the moment that philosophical discussions try to formulate a new rationale for a 'world-in-rapid-motion'. Biology (not only through protection and conservation of fauna and flora, but also through recent developments of biotechnology and biochemistry) succeeded surprisingly in participating in and influencing these discussions substantially. Beyond any doubt geology might contribute significantly to this debate by introducing EHC in its broadest sense (i.e. including sustainable development, non-renewable resources, site investigation, groundwater and soil pollution sanitation, etc.).

## 9. – A HOLISTIC VIEW ON PLANET EARTH

EHC does not stand alone; it only forms a constituting part of a holistic view on 'Planet Earth'. In 'Earth Heritage Conservation', (WILSON, 1994, mainly p. 156-157) a definition of EHC is outlined that is embedded in a holistic view with a strategy:

> 'Simply defined Earth Heritage Conservation (EHC) is concerned with the maintenance of landforms, natural and artificial exposures of rocks, and sites where geological processes can be seen in action today. But why should we value our Earth Heritage? We value the physical and biological resources that sustain

the activities of society. We exploit these resources to provide ourselves with food, water, heat, shelter and transport. But we also value the planet's physical resources in a cultural sense. This is because we wish to continue to seek the means to advance our knowledge of processes both in the past and at the present time. Equally importantly, we value the beauty of the physical world as an inspirational and aesthetic resource. Thus we have two value sets which sometimes conflict with each other. One is concerned with the exploitation and conservation of physical resources as commodities and the other with conserving them as 'heritage'. The latter set of 'heritage values' is inextricably linked to our own history as a species, because not only do we find beauty in unspoilt wilderness and landscapes, but we also value landscapes – both rural and urban – which we have created.

Figure 1 summarizes the distinction between the extractive and cultural physical resources of the Earth; a similar diagram could be drawn for biological resources. There is now much debate about physical resources conservation in the context of sustainable development, which is development that meets the needs of the present without compromising the ability of future generations to meet their own needs. This debate is relevant to our cultural heritage too, and so Earth Heritage Conservation can be defined as being *concerned with sustaining the part of the physical resources of the earth that represents our cultural heritage, including our geological and geomorphological understanding, and the inspirational and aesthetic response to the resource.*

The landscape and its geological foundation provide the essential framework upon which all aspects of natural and semi-natural environments are built, controlling such critical features as topography, microclimate, water distribution and soil type. Natural features are a vital part of the world's heritage, and conservation of this heritage ensures that future generations can continue to learn about the geological history of the planet and their immediate environment through education and research, and that the public can enjoy the beauty of natural physical features.

A broad view of the role of geology and landscape in conservation takes into account sustainability, landscape conservation, local conservation and community initiatives, site conservation and public awareness, and international conservation. All these themes underline the duty of care that the geological profession has in conserving the cultural resource, which contributes to the preservation of the environment and enhancing the quality of life.

For EHC to succeed nationally and globally, both geologists and non-geologists need to be persuaded about the merits of the following justifications for conserving sites:

• because we are committed to preserving our heritage for the future;

• to allow research for the advancement of science and for the success of industry;

• to train Earth scientists;

• to provide an essential teaching facility for schools;

• as a focus for substantial leisure activities (collecting, caving, walking, etc.);

• because sites have aesthetic, amenity, historical, cultural and wildlife value.'

## 10. – CONCLUSION

Nowadays, environmental problems of all kind are considered as serious threats, which could ultimately lead to extinction of vulnerable or irreplaceable forms of fauna and flora, or reduce the quality of life. Reaction of mankind has resulted in protection of endangered species and in social and cultural protection including monument conservation, but without taking away the causes of threat. And although progress has been made, up to now geology was not able to provide an adequate answer to natural hazards (like earthquakes, volcanic eruptions, ...) as well.

These 'modern times' plagues provoked a worldwide concern for conservation of biodiversity and of natural and man-made ecosystems or habitats, and tur-

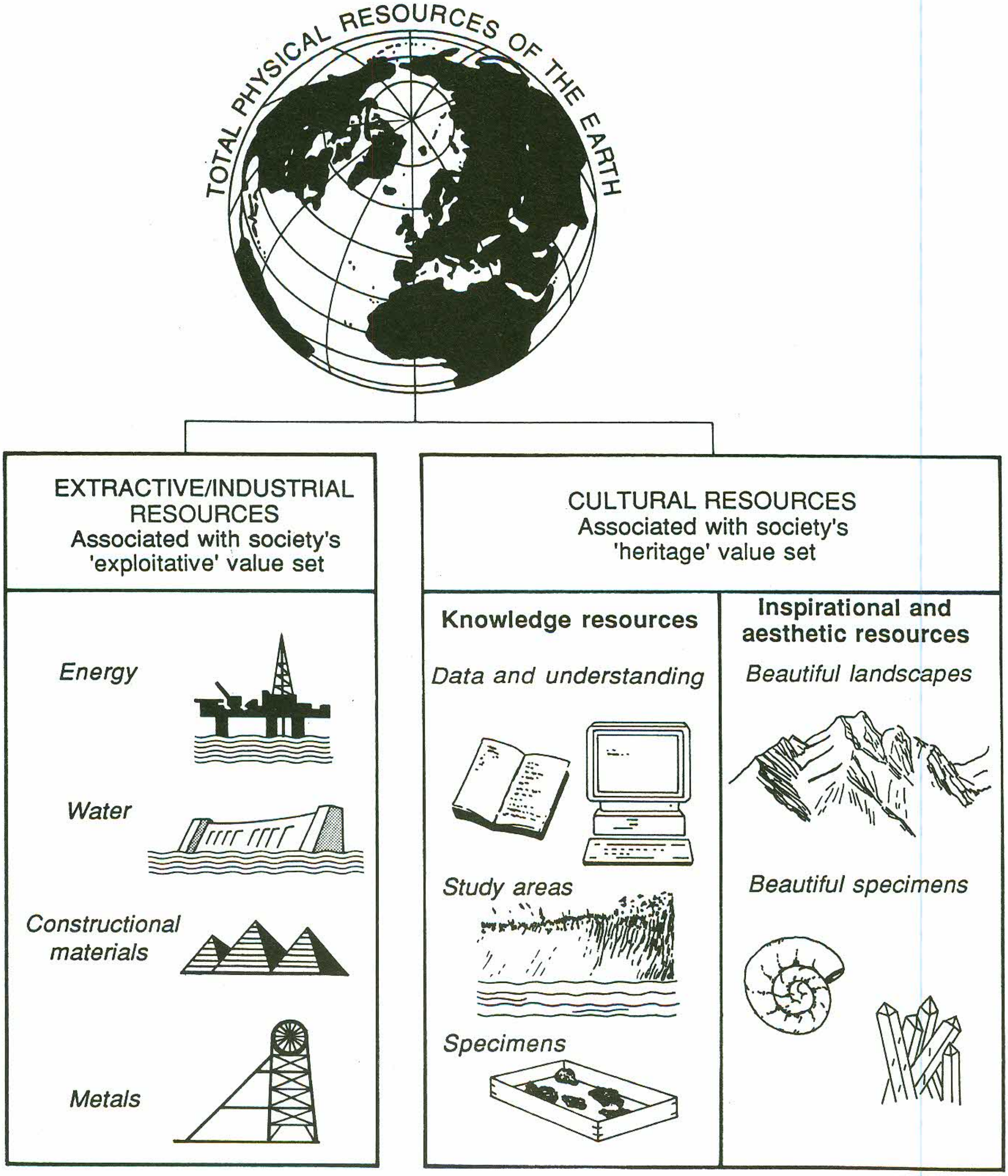


Fig. 1. – The extractive and cultural physical resources of the Earth (from WILSON, 1994).

– *Le risorse estrattive e culturali fisiche della Terra (da WILSON, 1994).*

ned cultural and biological conservation into a first-order priority, especially in the industrialized countries. Stimulated by steadily growing public control, these countries are capable technically and financially to invest in their own economic and industrial survival in order to maintain their quality of life at the highest possible level.

Unfortunately quality of life did not raise public awareness for EHC (a few exceptions not mentioned). As EHC deals with 'the life of dead rocks', it is not an appealing 'protect life from extinction' project, nor does it increase the 'quality of life'. Therefore EHC is not a hot topic on the political agenda yet.

To achieve this goal, a clear and well-defined strategy is necessary. Perhaps EHC-conservationists should use 'conservation of cultural heritage' as a vehicle because the latter:

I) does not suffer from a 'protection of life from extinction' syndrome;

II) but is connected with 'historic aspects of human activities' like arts, buildings and monuments;

III) calls upon a combination of aesthetic feeling and academic thinking;

IV) and deals with 'quality of life' as it connotes with economic and social aspects.

For the moment geological interest is only present in the subconsciousness of the general public. It should therefore be lifted to the surface through well thought-out education and strategy to stimulate and increase public awareness. Sites of geological and geomorphological significance surely play an illustrating and thus important role in this process, but should not be treated as 'stand alone' objects. Before these 'books of geology' can be read and the 'library' understood and considered as an integral part of our heritage, we will have to teach the public the way they should read them. In this respect, EHC is part of a holistic geological view on 'Planet Earth', based on the profound but sometimes invisible or hidden influence that geology exerts on our daily life.

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# Geological heritage of Northwestern Russia: experience in conservation

# *Il patrimonio geologico della Russia Nord-occidentale: l'esperienza nella conservazione*

SYSTRA Y.J. (*)

ABSTRACT – The paper discusses some problems in the protection of tremendous geological heritage in NW Russia – a territory which lies primarily in the eastern part of the Fennoscandian Shield. In the past 5-6 years a number of new wildlife areas as well as nature and national parks was created there. Some of them have many valuable geological sites. However, to reliably protect the region's abundant and diverse geological heritage, long-term work should be done to reveal and delineate territories of scientific interest and to provide a legislative basis for their conservation.

KEY WORDS: Geological heritage, Precambrian, geological diversity, deep processes.

RIASSUNTO – Questo articolo tratta di alcuni problemi nella protezione del grande patrimonio geologico nel nord-ovest della Russia – un territorio che si estende principalmente nella parte orientale dello Scudo Finnoscandinavo. Negli ultimi 5-6 anni sono stati creati in quella zona un certo numero di riserve così come parchi naturali e nazionali. Molti di loro contengono siti geologici di notevole valore. Però, per proteggere in modo affidabile il notevole e vario patrimonio geologico della regione, dovrebbe essere sviluppato un lavoro a lunga scadenza per rivelare e delimitare i territori di interesse scientifico e per fornire una base legislativa per la loro conservazione.

PAROLE CHIAVE: Patrimonio geologico, Precambriano, diversità geologica, processi profondi.

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The northwestern part of the Russian Federation lies on the oldest Archean and Proterozoic strata in the eastern Fennoscandian Shield. Here, cristalline rocks cover an area of over 350 thousand square km in the Murmansk region, the Republic of Karelia, the northern part of the Leningrad region and the western part of the Arkhangelsk region (fig. 1). South and southeast, the Precambrian basement is overlain by a Vendian - Paleozoic subhorizontal platform cover.

In the last 50000 years the region was repeatly covered with 2-3 km thick continental ice. The last event during which the ice gradually retreated took place only 17-9,3 thousand years ago. There are many sites where the glacier moved and stopped and where temporary watercourses and ice lakes were formed in

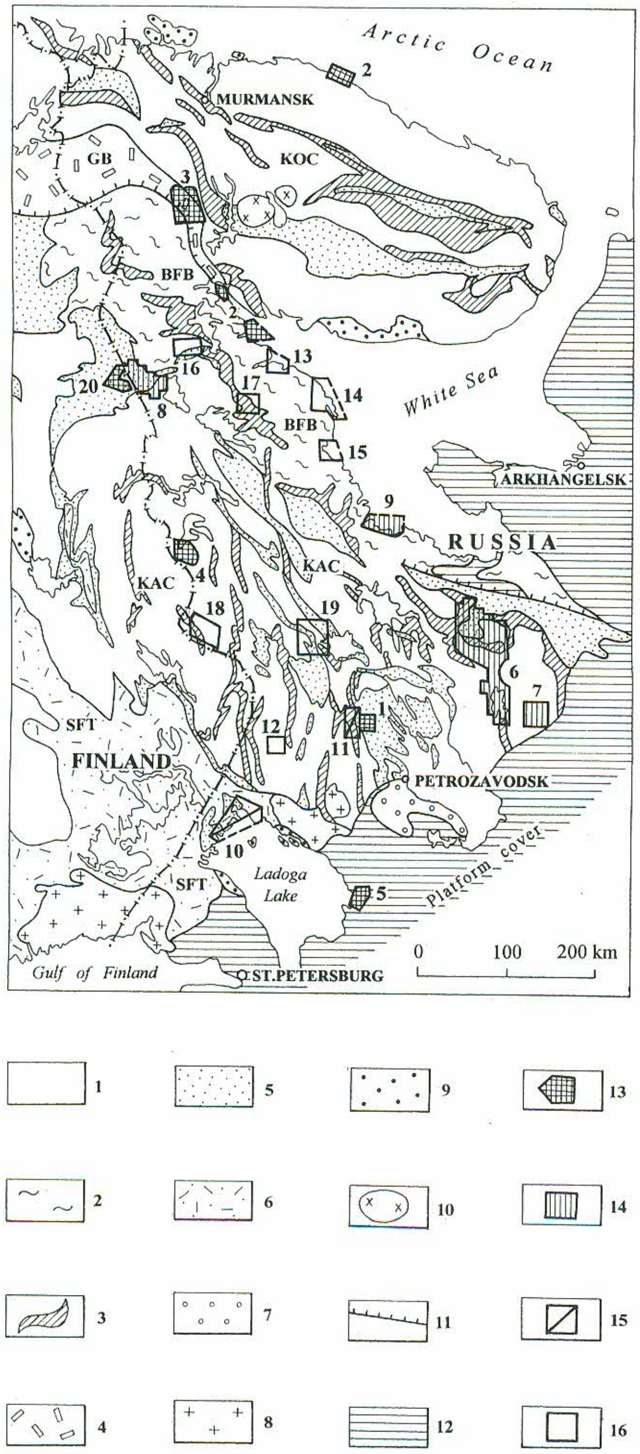


Fig. 1. – The map of the main protected and planned to protect nature territories with geological heritage objects in NW Russia.
Early Archean: 1 - basement granite and diorite gneisses, in some places with relicts of sedimentary - volcanic rocks; 2 - migmatized gneisses and amphibolites of Belomorian series. Late Archean: 3 - Lopian greenstone belts. Early Proterozoic: 4 - granulite belt; 5 - Karelian complex of sedimentary and volcanic rock; 6 - Kalevian flyschoidal sediments; 7 - Vepsian sandstones and quartzites. Late Proterozoic: 8 - Rapakivi granites; 9 - sedimentary - volcanic sequences. Paleozoic: 10 - Khibiny alkaline massifs. 11 - big thrust zones, 12 - Vendian - Paleozoic platform cover.
On map: KOC - Kola craton, KAC - Karelian craton, GB - granulite belt, BFB - Belomorian folded belt (terrain), SFT - Svecofennian terrain.
Protected territories: 13 - created before 1990; 14 - established after 1990; 15 - in the stage of creating; 16 - new planned areas.
Numbers on map show protected territories: 1 - Kivach Reserve, 2 - Kandalaksha Reserve, 3 - Lapland Reserve, 4 - Kostomus Reserve, 5 - Nizhnesvir Reserve, 6 - Vodlozero National Park, 7 - Kenozero National Park, 8 - Paanajarvi National Park, 9 - Soroka Nature Reserve, 10 - Ladoga Skerries Nature Park, 11 - Hirvas State Geological Reserve, 12 - Tolvojarvi Nature Park, 13 - Keret Nature Park, 14 - Kalgalaksha Nature Park, 15 - Pongoma Nature Reserve, 16 - Kuukasjarvi Geological Reserve, 17 - Hisovaara Geological Reserve, 18 - Tuulijarvi Nature Reserve, 19 - Jelmozero Nature Reserve, 20 - Oulanka National Park (Finland).

*– Mappa dei principali territori protetti o in procinto di essere protetti come patrimonio geologico nel NO della Russia.*
*Archeano antico: 1 - Basamento granitico e gneisses dioritico, in alcune zone con resti di roccie sedimentarie-vulcaniche; 2 - gneiss migmatizzati e anfiboliti della serie Belomorian. Tardo Archeano: 3 - Zone a pietre verdi di Lopian. Proterozoico antico: 4 - zona granulitica; 5 - complesso Kareliano costituito da roccia sedimentaria e vulcanica; 6 - Depositi flyshoidi Kareliani; 7 - Arenarie e quarziti Vepsiane. Tardo Proterozoico: 8 - graniti Rapakivi; 9 - sequenze sedimentarie-vulcaniche. Paleozoico: 10 - Massicci alcalini di Khibiny. 11 - Zone di grande fratturazione, 12 - Piattaforma di copertura Vendiana Paleozoica.*
*Sulla carta: KOC - Kola craton, KAC - Karelian craton, GB - zona granulitica, BFB - Zona a pieghe Belomoriana, SFT - terreno svecofennian.*
*Territori protetti: 13 - creati prima del 1990; 14 - stabiliti dopo il 1990; 15 - in fase di creazione; 16 - nuove aree programmate.*
*I numeri sulla mappa indicano i territori protetti: 1 - Riserva di Kivach, 2 - Riserva di Kandalaksha, 3 - Riserva di Lapland, 4 - Riserva di Kostomus, 5 - Riserva di Nizhnesvir, 6 - Parco Nazionale di Vodlozero, 7 - Parco Nazionale di Kenozero, 8 - Parco Nazionale di Paanajarvi, 9 - Riserva Naturale di Soroka, 10 - Parco Naturale degli Scogli del Ladoga, 11 - Riserva Geologica di Stato di Hirvas, 12 - Parco Naturale di Tolvojarvi, 13 - Parco Naturale di Keret, 14 - Parco Naturale di Kalgalaksha, 15 - Riserva Naturale di Pongoma, 16 - Riserva Geologica di Kuukasjarvi, 17 - Riserva Geologica di Hisovaara, 18 - Riserva Naturale di Tuulijarvi, 19 - Riserva Naturale di Jelmozero, 20 - Parco Naturale di Oulanka (Finlandia).*

Quaternary time. Aesthetically, drumlin fields and many esker ridges form a beautiful landscape. Such territories should be special attention. Some of them form part of the wildlife areas and national parks opened lately. Others, e.g. the Tolvojarvi area, Karelia, provide a basis for the territories to be protected. In the future, close attention will be given to the conservation of the Quaternary geological heritage and the protection of rare, well established forms and unique sites in densely populated areas and in places where they are in danger.

Some glacier-polished, surprisingly fresh Precambrian rocks are unique witnesses of early stages in the Earth's evolution. The Precambrian heritage is represented by various geological processes, e.g. near - surface sedimentation and volcanism, the formation of intrusion, dyke and vein zones at shallow depths, the developing of intrusive bodies covering an area of about 1000 square kilometres and deep-seated zones that suffered granulite-facies metamorphism and ultrametamorphism. Considering the fact that all primary and repeatedly superimposed folding as well as metamorphic and igneous processes were manifest over a time span of almost 2.0 Ga from Early Archean (ca. 3.5 Ga ago) to the end of Early Proterozoic time (ca. 1.7 Ga ago) and that there existed considerable lateral differences in their intensity between one or another area, one can imagine the diversity of the region's geological heritage.

Attempts made in the late 1980s to decentralize the management system which existed in Russia, provided an impetus to conservation activities. In some parts of Russia, e.g. Karelia, land can now be sold or rented on a long-term basis. Additional efforts are, therefore, needed to boost nature protection activities here.

The region discussed is of great interest for the study and preservation of the Early Precambrian heritage. There are no other territories in Europe where Archean complexes are exposed so extensively.

Until 1990, the region had only 5 small strict nature reserves (fig. 1) to protect rare and endangered species of plants and animals, sometimes a nature beauties (fig. 2, A). The main problem in protecting Russia's geological heritage is that all strict nature reserves are supervised by the Federal Ministry of Environment, national parks are managed by the Russian Federal Forest Service and nature parks, wildlife areas and reserves by local forest departments and committees for the environment. There are no geologists in their staff. Therefore, even in national parks and wildlife areas unique geological sites are not used for educational purposes or as beautiful tourist attractions.

In 1995, a new Federal Law "On Specially Protected Natural Territories" came into effect. For the first time, all issues pertaining to the protection of valueable sites such as geological and paleontological areas and sites are covered in a law. However, even these territories will not be supervised by local geological committees. Instead, they will be controlled by nature protection and forests.

Thanks to Karelian enthusiasts, we have proved that geologists must also be involved in the protection of new territories of nature reserve and special scientific interest. The protected areas created in the past five years are the Vodlozero National Park (almost 0.5 million ha) at the boundary between the Republic of Karelia and the Arkhangelsk region, the Paanajarvi National Park (103,3 thousand ha) at the Finnish-Russian border, Kenozero National Park in the Arkhangelsk region and the Soroka Nature Reserve on the White Sea coast (fig. 1), where various landscapes and ecosystems are now protected together with numerous Precambrian and Quaternary sites of geological interest.

The Paanajarvi National Park, which lies in the Karelian craton - Belomorian terrain (folded belt) suture zone is one the most interesting geological territories in Northern Europe (fig. 3). The unconformable Archean-Proterozoic contact extends across the park without any traces of thrusting.

Here, the Early Proterozoic sequence is one of most complete in the region (fig. 2, B). Researchers believe that the Kivakka layered massif is the most representative such kind intrusive body in Europe. Both Archean and Proterozoic granitic intrusions are known in the area. South of the park, Archean diorites constitute the big Paajarvi uplift, which remained stable throughout the entire geological history, and are only cutted by numerous dykes and intrusive complexes. The uplift forms the northern terminus of the Karelian craton.

Various gneisses with amphibolite lenses and stringers are exposed northeast of Lake Paanajarvi. They are strongly folded and migmatized - the trait characteristic of the entire Belomorian terrain.

The park is also remarkable for a variety of noncoeval rupture dislocations. The earliest deep-seated fracture zones are traced by Olanga Group layered peridotite-gabbro-norite intrusions. Fragments of deep fault zones scattered among gneisses indicate small ultramafic (olivinite) bodies that are presumable 1.96 Ga old.

Younger strike-slip faults, formed after the latest folding as narrow, 100-150 m deep depressions to which the hydrographic network of the region is confined, are well-defined in rugged low mountain relief. In these 50-200 m wide and many kilometres long zones the rocks are strongly foliated, sheared and broken. Small folds, kink-zones, local lineations etc. are formed. The cracks are most commonly mineralized, and total fissuring is much greater here than outside the zones. The deepest (128 m) Paanajarvi Lake is confined to a tectonic dislocation.

The Paanajarvi National Park has unique nature. Because of rugged topography the park's territory is unequally exposed to sun light. Therefore, many northern and southern plants, whose areal lie much farther north or south, respectively, co-exist there. Mountains Nuorunen and Kivakka display Europa's souternmost tundra. The park can thus be recommended for inclusion into the UNESCO World Natural Heritage List.

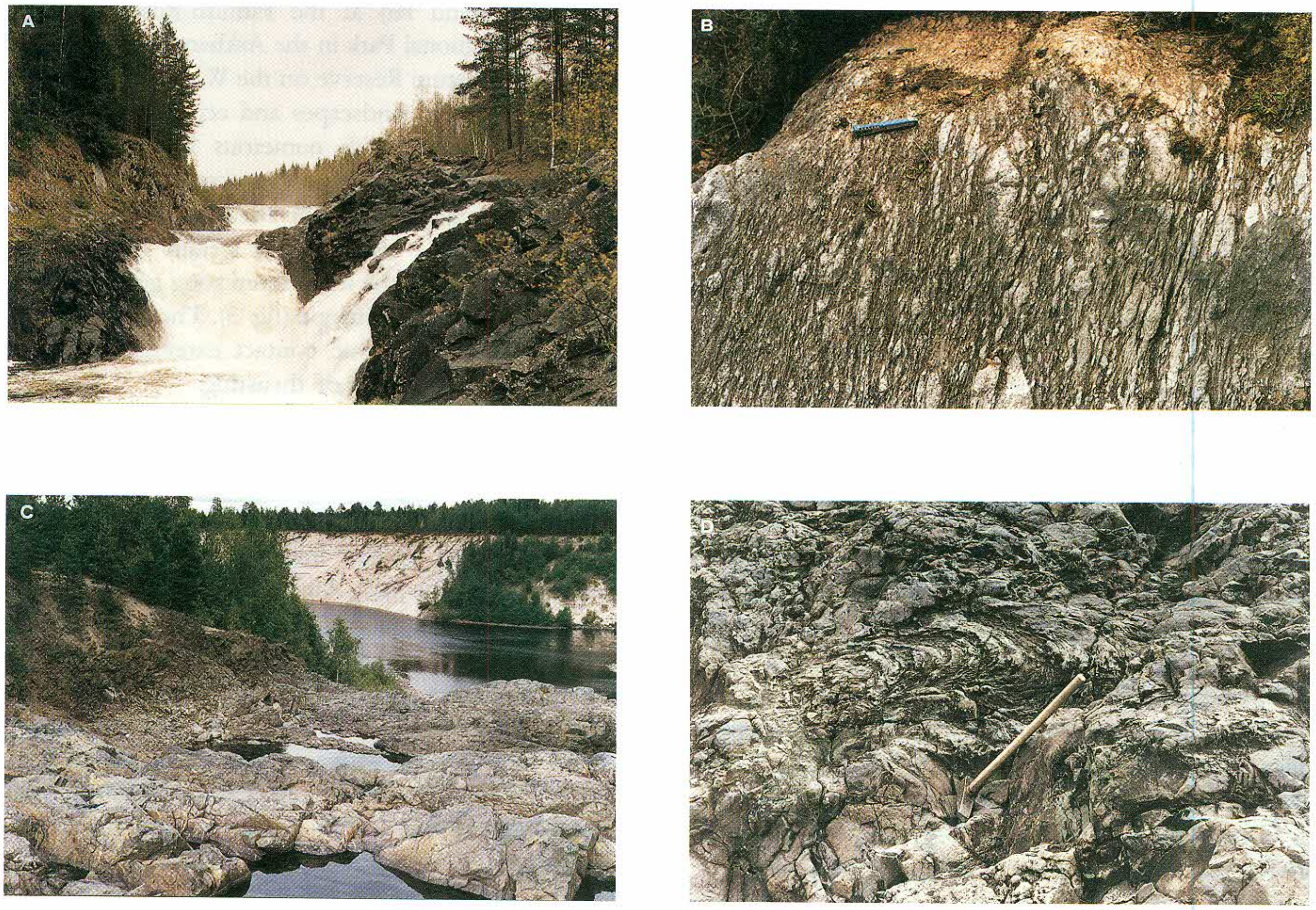


Fig. 2. – Geological monuments in protected areas of the Republic of Karelia, NW Russia.
A - waterfall Kivach on Suna River in Early Proterozoic basalts (ca. 2.2 Ga). Kivach Strict Reserve.
B - Early Proterozoic quartz porphyry's agglomerate lavas (ca. 2.45 Ga). Eastern end of Lake Paanajarvi. Paanajarvi National Park.
C - Early Proterozoic (ca.2.2 Ga) eruptive centre in basalts. Hirvas village. The old bed of river near the Paljeozero Power Station. Hirvas State Geological Reserve.
D - The same. Well exposed lava flows near the eruptive centre.

*– Monumenti geologici nelle aree protette della Repubblica di Karelia, Russia NO.*
*A - Cascata di Kivach sul Fiume Suna nei basalti del Proterozoico antico (ca. 2.2 Ga). Riserva Rigida di Kivach.*
*B - Porfidi quarziferi del Proterozoico antico (ca. 2.45 Ga). Limite orientale del Lago di Paanajarvi. Parco Naturale di Paanajarvi.*
*C - Centro eruttivo del Proterozoico antico (ca. 2.2 Ga) in basalti. Paese di Hirvas. Il vecchio letto del fiume vicino alla Centrale di Paljeozero. Riserva Geologica di Stato di Hirvas.*
*D - Idem. Flussi di lava ben evidenti vicino al centro eruttivo.*

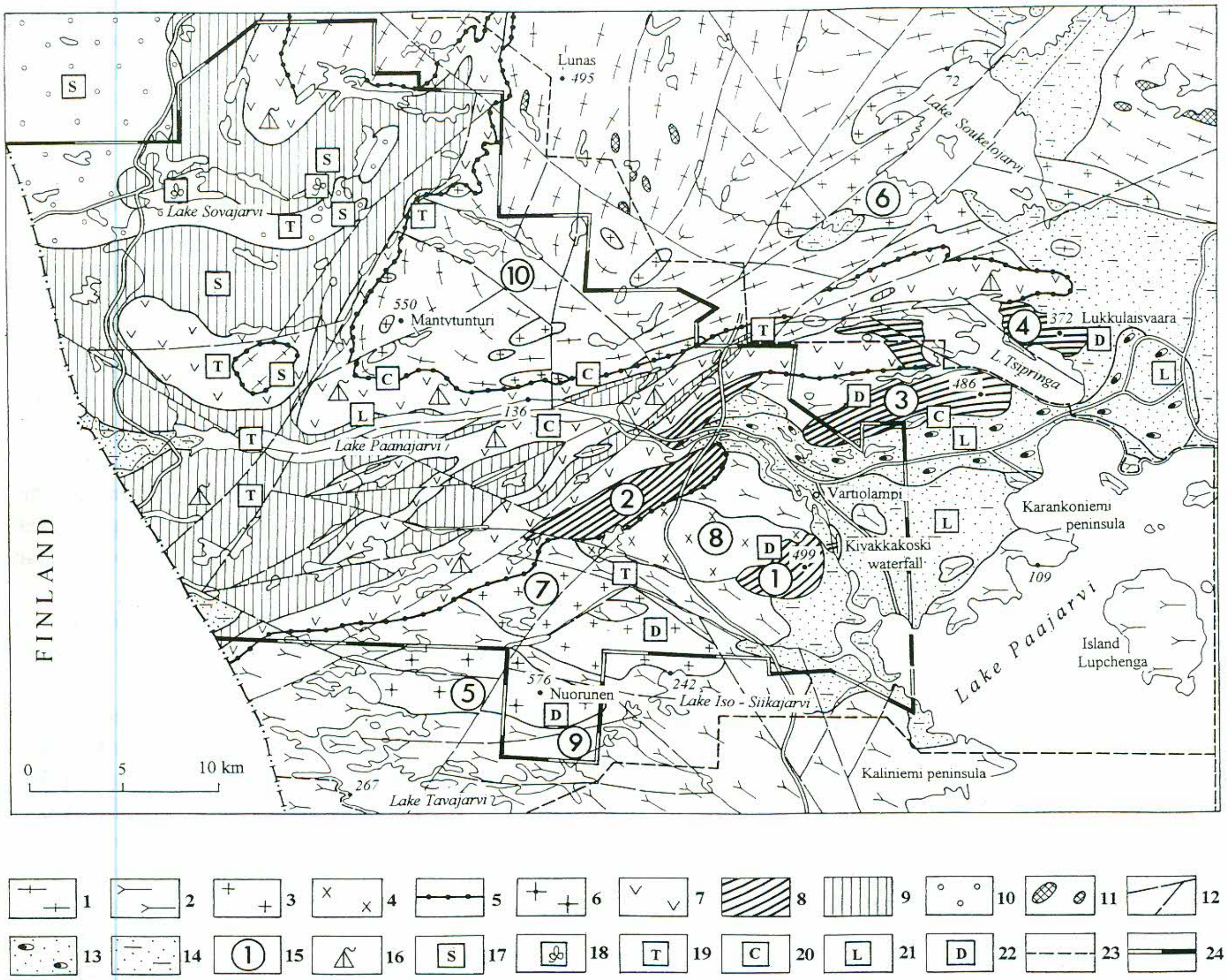


Fig. 3. – Geological map of the Paanajarvi National Park and its surrounding.
Early Archean (older than 3.15 Ga): 1 - gneisses and migmatites of the Belomorian series, 2 - Tavajarvi diorite complex. Late Archean (3.15 - 2.65 Ga): 3 - Soukelojarvi type granite, 4 - granosyenite, 5 - Archean - Proterozoic boundary, Early Proterozoic (2.45 - 1.90 Ga): 6 - Nuorunen type granite, 7 - Sumian quartz porphyrys and andesitic basalts, 8 - layered peridotite - gabbro-norite intrusions, 9 - Jatulian sediments and sandstones, 10 - Ludicovian sediments and volcanites, 11 - bodies of metaolivinite, 12 - main strike-slip fault zones. Quaternary sediments of fluvioglacial deltas (13) and planes (14), 15 - the most interesting geological objects: 1 - Kivakka massif, 2 - Komettovaara, 3 - Tsipringa, 4 - Lukkulaisvaara, 5 - Nuorunen, 6 - Soukelojarvi, 7 - Kaunisjarvi and 8 - Jyvajarvi massifs, 9 - Tavajarvi diorite complex, 10 - Belomorian gneisses and migmatites.
Sites of geological interest: 16 - volcanic textures and sequences, 17 - sedimentary sequences, 18 - stromatolites, 19 - tectonic monuments, 20 - contact relativships, 21 - beautiful landscapes, 22 - dyke swarms, 23 - the boundary of near-park protected zone, 24 - the national park boundary.

*– Mappa geologica del Parco nazionale di Paanajarvi e dei suoi dintorni.*
*Archeano Antico (più antico di 3.15 Ga): 1 - gneiss e migmatiti della serie Bielomorian, 2 - Complesso dioritico di Tavajarvi. Tardo Archeano (3.15 - 2.65 Ga): 3 - granito del tipo di Soukelojarvi, 4 - granosienite, 5 - limite Archeano - Proterozoico. Paleozoico antico (2.45 - 1.90 Ga): 6 - granito del tipo di Nuorunen, 7 - Porfidi quarziferi e basalti andesitici di Sumian, 8 - intrusioni stratificate peridotitiche - gabbriche - noritiche, 9 - sedimenti e arenarie di Jatulian, 10 - sedimenti e vulcaniti Ludicoviane, 11 - Corpi di metaolivinite, 12 - Zone di faglie trascorrenti. Depositi del Quaternario di delta fluvioglaciali, (13) e piani (14), 15 - i più interessanti elementi geologici: 1 - massiccio di Kivakka, 2 - Komettovaara, 3 - Tsipringa, 4 - Lukkulaisvaara, 5 - Nuorunen, 6 - Soukelojarvi, 7 - Kaunisjarvi e 8 - Jyvajarvi massicci, 9 - Complesso dioritico di Tavajarvi, 10 - gneiss e migmatiti Bielomoriane.*
*Siti di interesse geologico: 16 - tessiture e successioni vulcaniche, 17 - successioni sedimentarie, 18 - stromatoliti, 19 - monumenti di natura tettonica, 20 - superfici di contatto, 21 - meravigliosi paesaggi, 22 - gruppi di dicchi, 23 - il confine della zona protetta intorno al parco, 24 - il confine del parco nazionale.*

Legislative acts, required for the opening of the Ladoga Skerries Nature Park and the Hirvas State Geological Reserve, are now under way. The former has a big variety of Proterozoic rocks with Archean granite-gneiss mantled domes that constitute the Ladoga series. The park has over sixty sites of geological interest. The Hirvas area is structurally unique: there, Archean scarps and compressed Proterozoic structures were formed at the Archean-Early Proterozoic boundary. Of great interest is the fact that three noncoeval Early Proterozoic complexes rest here on each other with angular and structural unconformities. They all lie on the Archean basement with crusts of weathering.

Also of interest is indication of long volcanic activity apparent at one site.

Volcanic centres of three ages: Late Archean (ca. 3.0 Ga) and Early Proterozoic (ca. 2.4 and 2,2 Ga) lie in a circle with a radius of less than two kilometres. The youngest were the first eruptive centres found out in Precambrian rocks of Karelia (fig. 2, C and D). Thus, volcanic activity lasted here discontinuously 800 million years.

New protected territories are being successfully formed in the Arkhangelsk region near the Karelian boundary, where the Kenozero National Park and some nature reserves as wildlife areas were get up. In the Murmansk region, the Enijarvi and Kutsa wildlife areas will be re-opened in the former Finnish territory. The latter has some geological sites of utmost interest such as the Vuorijarvi alcaline massif with numerous dykes, Proterozoic multiple folded rocks in the Nivajarvi area etc.

Although structurally complex geological sites are often significant in terms of nature conservation, it is not enough to set up reserves and national parks. To protect the geological heritage, one must know regional geology as well the characteristics of each structure, site and monument to be protected.

It would be perfect if all type sections and sequences, the most typical representatives of intrusive and dyke complexes, rare mineralization zones, folded and rupture units typical of every epoch and all Precambrian traces of ancient life were preserved for future generations of geologists. Preliminary calculations have shown that in NW Russia there are a few thousand ancient Precambrian sites and territories of regional and interregional significance; many sites are of local interest.

In the next few years new protected geological territories will be established along the Russian - Finnish border, around the White Sea etc. Although special protected territories are being successfully created in NW Russia, it is desirable to outline an international project to form a network of protected geological sites and territories for the entire Fennoscandian Shield.

This network could be formed by national sites of scientific value in Finland, Sweden, Norway and Russia.

The educational aspect of wildlife conservation is highly important for local population, schoolchildren and youth. Geology and geological sites are understood only by specialists. A lot of time and effort is needed to teach people, who see rocks every day, read their beautifuf history written in an old stone book. The educational level of aboriginal population and primarily youth is important for the state and protection of the environment and the natural (geological etc.) heritage in the near future.

It is essental that nowadays regions of Russia have relevant laws to provide a protected territory status for one or another site with due regard for the interests of aboriginal population.

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# Destroying of geotopes - examples from Slovenia
## *Devastazione dei geotopi - esempi dalla Slovenia*

PAVLOVEC R. (*) & POHAR V. (*)

ABSTRACT – The present article deals with examples of threats to the geotopes in Slovenia. In one of the cases an important geotope was uncovered. Other examples represent geological specialities that cannot be protected for economical reasons (quarries, mines). Furthermore, the destroying of geotopes by geologists as well as amateurs and general public is very dangerous as well. It can be prevented only by an appropriate education.

KEY WORDS: Geology, geotope, geological heritage.

RIASSUNTO – Questo articolo si occupa di esempi di devastazioni ai geotopi in Slovenia. In un caso c stato scoperto un geotopo. Altri esempi rappresentano le specie geologiche che non possono essere protette per motivi economici (cave, miniere). La devastazione dei geotopi da parte dei geologi o dei collezionisti e del pubblico in genere c molto pericolosa. Es'sa pun essere prevenuta solo per mezzo di una appropriata educazione.

PAROLE CHIAVE: Geologia, geotopo, patrimonio geologico.

## 1. – INTRODUCTION

Apart from a wide range of geological curiosities already under protection, there exists in Slovenia a series of geological places of interest and it would be rather useful to safeguard them as well as to establish different categories of protection. It is not always feasible just by introducing administrative measures. And last but not least, economical reasons prevent the protection of some geotopes. Sometimes the protection has even affected the preservation. People were informed about the places, they started to visit and devastate them partially or entirely. Only an appropriate education of general public and also of some geologists might solve the problem. In this respect Slovenia has not reached a satisfactory state.

## 2. – CASES FROM SLOVENIA

### 2.1. – PALAEOLITHIC STATION

Potoèka zijalka is an important high mountain prehistoric finding place of aurignacian hunters. It is situated at the southern slope of the Olševa mountain at the height of 1700 m, close to the border between Austria and Slovenia. The discovery of this Palaeolithic station is very important. In the year 1928, professor Brodar went as a mountaineer to the Olševa mountain. When he passed by Potoèka zijalka he came across a pile of excavated cave bear bones. Believing that the cave bear bones are closely connected with the traces of a human being, he started with systematic excavations. He discovered one of the most important Palaeolithic stations then in Europe. Thus, a "poaching researcher" must have unintentionally shown the way to prof. Brodar. It is an interesting example how looting of an important geotope led to the discovery of a Palaeolithic station.

Regarding the number of bony nibs (130) Potoèka zijalka belongs to the richest aurignacian finding places in Europe. In the time when it was discovered such sites were classified to the cool period according to French standard. However, the level above the sea plus the cultural and palaeontologic finds of Potoèka zijalka proved the warm climate and a forest nearby. In

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this way it helped to classify the Würm glacial period to stadials and interstadials. It is also important for the stratigraphy of the Upper Pleistocene.

As uncontrolled excavations are still occurring, the closure of the entry of the cave is being considered. The same holds true for another important Palaeolithic station Divje babe in the central Slovenia. (BRODAR S. & BRODAR M., 1983; TURK *et alii*, 1989).

## 2.2. – MINES

The protection of geotopes in mines meets special problems. Considering the beauty and the special forms of the wulfenite, the site represents an important geotope. However, the site could not be protected during active mining. Similar problems occurred in some other mines, too. In Stari trg near Trepèa (Kosovo), there are more than 100 different minerals of beautiful crystals and associations, such as sphalerite, flint, calcite, arsenopyrite. Perhaps the almost transparent vivianite is the most precious among the above mentioned stones.

Melica, a mine of lead and zinc ore in the north of Slovenia, was closed down. In the mine, wulfenite (lead molybdenum oxide named after the botanist F.X. Wulfen) can still be found on the traces of the entire ore deposit. Extraordinarily beautiful yellow, reddish, or a bit brown lamellate crystals from Melica are well known. Crystals as cubes, pyramids and dipyramids are very rare. Extended dipyramids are extremely hard to find.

Protection of these important geotopes in mines is a special problem. In Melica, the protection of some tunnel parts containing wulfenite is being discussed by the local authorities. Some of the most beautiful items have been inserted in the mineralogical collections, though. (KRIVOGRAD, 1978; ŠTRUCL, 1978).

## 2.3. – GEOLOGICA PATHS

In Slovenia educational paths, i.e forest-paths, forest-geological and geological paths are very popular. They are arranged, marked and have printed guides. So far, the foresters have been taking care of most of them. Yet, right now, it is not clear who is going to be in charge of them in the future, because new systems are being introduced. Entirely geological paths usually belong to the level of communities. Now an enlargement of the partially protected area near Ljubljana is under way. Fossils have been found in the Upper Triassic limestones (such as type-locality of the species *Trigonodus carniolicus*), moreover, this area boasts of interesting tectonic forms, karst phenomena and stones used for decorative purposes. The arrangement of a geological park is being considered, too. Now, already, finding fossils is rather hard as many collectors are really keen on taking them away from the finding places.

Some years ago the Geological Institute of Ljubljana, helped by the Association of Friends of Minerals and Fossils from Trliè, started to trace a geological path across Slovenia. According to this ambitious plan the path should even be prolonged to the parts of the former Yugoslavia. Yet the work was stopped already in the middle of Slovenia and only two sections have been finished. A printed guide is available for the first section, only.

Such popularization of geology results in a great danger for the finding places of fossils, minerals and other curiosities. Sometimes general public is faced with the geotopes, but is not able to appreciate them properly. In this way some finding places were destroyed and the specimens have been sold. Protecting most of the geotopes is, physically, not possible. Laws, regulations and control of their implementation in the solitary nature do not help much. The only possibility is the education of people how to keep and esteem the geotopes and other interesting places in nature. (BUSER, 1987; MAJCEN *et alii*, 1944; PAVŠIÈ, 1987).

## 2.4. – QUARRIES

Interesting geotopes are frequently found in the quarries. However, stopping the works for their sake is not possible. In Èrni Kal near Trieste, there is a great quarry in Eocene limestone. Blasting sometimes opens filled karst caves. In one of them, they have found the tools of a Neanderthal man and in an other there were bones of some Pleistocene animals that are very scarce in Slovenia. These are: horse – *Equus caballus*, rhinoceros – *Dicerorhinus kirchbergensis* and others. In the limestone they have found the biggest snail in Slovenia so far – *Campanile giganteum*. Nests, lens and other forms of foraminifers give interesting palaeoecological data.

The works in the Èrni Kal quarry are going on, gradually destroying valuable geotopes. The only solution is the protection of the waste area in the quarry and continuous control of the newly opened surfaces. (BRODAR, S., 1958; MIKU *et alii*, 1995; RAKOVEC, 1958).

## 2.5. – MUSEO COLLECTIONS

As an example, we shall mention one of the best preserved mammoth skeletons in Central and West Europe. In the year 1938, Mamuthus primigenius was found in Nevlje near Kamnik (BUDNAR-LIPOGLAVŠEK, 1944; KOS, 1939). The skeleton is located in The Slovene Museum for Natural Sciences. Individual parts of the skeleton have started to decay rapidly and they are being restored. In this way, the «artificial» geotope will be rescued from complete decay. However, this is not the case of the almost complete skeleton, decaying unfortunately, of a mastodon *Mammut borsoni*, which was discovered in Velenje and is nowadays exhibited in the Velenje Museum. Its restoration is not yet under way. (RAKOVEC, 1968).

## 3. – CONCLUSION

There are many problems that have arisen during the protection of geotopes. Considering different possibilities and ways how to protect them is necessary. Apparently, destroying is not always harmful and protection is not always useful. We have to care about the geotope after it has been defined. In connection with the announcement of a geotope we have to name a competent holder, responsible for its regular maintenance who will also receive adequate financial means for it. At the same time we have to carry out the education and inform the government and other bodies about the importance and value of geotopes. In Slovenia, this has not yet been arranged properly.

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# Efforts towards an international "geoconvention": Convention focused on the Diversity of Geosystems, Geoprocesses and Geotopes

## *Sforzi verso una «Geoconvenzione» internazionale: una Convenzione focalizzata sulla Diversità dei Geosistemi, dei Geoprocessi e dei Geotopi*

STÜRM B. (*)

ABSTRACT – At first, a brief overview shows the recent endeavours undertaken in favor of an International Geoconvention. In order to give an impression of the potential effects of such a convention, a possible structure of contents is outlined. Conclusion: The still weak position and the slight or even missing integration of geoconservation into relevant policy spheres as e.g. physical planning on one hand and the increasing pressure on sensitive geosystems and worthful geotopes on the other hand, shall give rise to strengthen the efforts towards an International Geoconvention.

KEY WORDS: Geoconservation, international convention.

RIASSUNTO – All'inizio, una breve panoramica mostra i recenti tentativi intrapresi in favore di una Geoconvenzione Internazionale. Al fine di dare un'idea dei potenziali effetti di una tale convenzione, viene delineata una possibile struttura dei contenuti. Conclusioni: La posizione ancora debole e la scarsa o addirittura assente integrazione della geoconservazione negli ambienti rilevanti della politica, come ad esempio la pianificazione della natura da un lato e la pressione crescente sui geosistemi sensibili e sui geotopi di rilievo dall'altro, dovranno produrre una intensificazione degli sforzi verso una Geoconvenzione Internazionale.

PAROLE CHIAVE: Geoconservazione, convenzione internazionale.

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## 1. – EFFORTS WHICH HAD ALREADY BEEN UNDERTAKEN UP TO NOW:

• *The declaration of the 1st International Symposium on the Protection of our Geological Heritage* (Digne, France, 1991) requests all national and international authorities to take into consideration and to protect the geological heritage by means of all the necessary legal, financial and organisational measures.

• *The resolution of the Malvern International Conference on Geological and Lanscape Conservation* (Great Malvern, Great Britain, 1993) stresses to the first time explicitly, that there is a need for an international geoconvention and that justification for, potential scope and objectives of such an agreement should be examined in depth.

• *The resolution of the 1st International Subregional Meeting on Conservation of the Geological Heritage in South-East Europe* (Sofia, Bulgaria, 1995) underlines the need for the full integration of geotope protection in national and european legislation and in initiatives for biodiversity and landscape conservation as well.

• During the *1st ProGEO General Assembly* (Sigtuna, Sweden, 1995) a first framework approach of an International Geoconvention was presented (STÜRM, 1995).

## 2. – ARE THE RECENT ENDEAVOURS SUFFICIENT, OR SHOULD THEY BE STRENGTHENED?

It's obvious, that the resolutions and declarations of our meetings are hardly perceived by relevant governmental bodies and non-governmental organisations as Planning Associations, Environment Protection Organisations, Nature and Landscape Conservation Organisations and so on.

Conseqently our position and influence within the struggle of interests, which determine the development of our natural environment is still by far too weak. Two examples for this:

**Physical Planning** (Town and Country Planning): Apart from some encouraging examples, geoconservation is still scarcely or at least not sufficiently integrated in physical planning, although physical planning offers powerful tools for coordination and for steering the spatial development (STRASSER *et alii,* 1995; STÜRM, 1991; 1994; 1995; WRIGHT, 1994).

**Regional development Policies**: Regional policies gain more and more importance, but this strategic context is hardly influenced by geoconservationists. Recent regional policies pursue development strategies with a considerable potential for geotope protection. A good example are the general statements of the "*ALPINE CONVENTION*" generally agreed in 1991. This international convention aims at the safeguarding of the natural, social and cultural diversity of the alpine regions and the sustainable use of their resources. Our objectives and endeavours fit perfectly in that strategic context. The Alpine Convention would have offered good opportunities to introduce different aspects of geoconservation. But we missed that chance during the initial phase, probably mainly due to our fairly weak constitution, rather than to a lack of knowledge.

This weak position of geoconservation and it's weak influence on significant policy spheres contrast with the still growing pressure on geospheric values as valuable and sensitive geosystems, geoprocesses, geotopes and geosites.

## 3. – WHAT CAN WE EXPECT FROM A GEOCONVENTION?

Is an International Convention able to improve our rather unfavorable situation and to make geoconservation so effective as bioconservation (biosphere focused conservation)?

A possible **structure of contents** shall make the vision of a geoconvention better conceivable:

### PREAMBLE

#### Definition of the conventions's key-subjects

For example:

- Geoconservation.
- Geological heritage.
- Geosphere.
- Geosystem.
- Geoprocess.
- Geotope.
- Geosite.

#### Objectives

For example:

- Promotion of the sustainable use of the geosphere and the protection of geotopes.
- Integration of geoconservation into relevant policy spheres like physical planning etc.
- Improvement of the legal basis for geoconservation.
- Improvement of conservation procedures and techniques.
- Creation of international awareness and responsability.
- Stimulation of international cooperation and coordination.

#### Principles for interaction whith relevant policy spheres

For example:

- Geoconservation by physical planning, nature and landscape conservation, environmental impact assessment etc.
- Implementation strategies.

#### Statutory tools and procedures

For example:

- Criterions, guidelines, procedures for identification, documentation and evaluation of subjects of international significance.
- Directions and rules for supervision and control of progress.

- Principles for coordination and information exchange between Signatory States and International Organisations, like e.g. *UNESCO*, *IUCN*, *IUGS*, Statutory bodies of existing relevant International Conventions, like the *"WORLD HERITAGE CONVENTION"*, the *"BIODIVERSITY CONVENTION"* etc.

**Statutory bodies**

For example:

- Standing committee and other involved bodies.

**Ancillary measures**

For example:

- Fund rising and financial support.

**Final clauses**

For example:

- Ratification and amendment procedures.

We can expect no miracles by an International Geoconvention. Such a convention will bring not more and not less than all other already existing similar conventions, as e.g. the *"BIODIVERSITY CONVENTION"*. But this is certain, a specific convention focused on geospheric values would serve as backbone for our activities and thereby help us to gain more hearing; that means more influence on decisive decision making processes and last but not least more support by the international community.

An other aspect: Until nowadays most of the geoconservationists do their work on a voluntary basis. A Geoconvention could help to transform geoconservation into an official public task. Such a stable operational basis is absolutely necessary if we want to achieve our common general aim, the sustainable use of the geosphere and the durable protection of its geotopes, before it's too late.

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# The geoconservation in Greece: legal basis-existing situation
# *La geoconservazione in Grecia: la situazione attuale della legislazione*

THEODOSSIOU-DRANDAKI I. (*)

ABSTRACT – The idea of geoconservation and the registration of representative sites was undertaken for the first time at the Institute of Geology and Mineral Exploration in 1982, an attempt that didn't continue until 1995 when a new working group was established in order to: a) compile systematically a complete network of the most representative greek geotopes, b) find out how geoconservation appears into the greek legislation, c) promote the idea of geoconservation.

KEY WORDS: Geoconservation, Grece, legislation.

RIASSUNTO – L'idea della geoconservazione e la catalogazione dei siti rappresentativi fu presa in considerazione per la prima volta all'Istituto di Geologia e dello Sfruttamento Minerario nel 1982, un tentativo che non è continuato fino al 1995, quando è stato costituito un nuovo gruppo di lavoro con lo scopo di: a) compilare sistematicamente una mappa completa dei più rappresentativi geotopi greci, b) verificare come la geoconservazione venga considerata dalla legislazione greca, c) promuovere l'idea della geoconservazione.

PAROLE CHIAVE: Geoconservazione, Grecia, legislazione.

Greece due to its geographic position on the convergence area of two tectonic plates presents a complicated geological structure and great variety of geoforms and formations. It's our duty for the sake of the international scientific community and the entire world to record and promote them.

The first attempt for a registration of natural monuments, according to the existing legislation, was undertaken, in 1982, by the geologists of the Institute of Geology and Mineral Explorations, under the supervision of Dr. I. Bornovas director at that time of the Geology and Geological Mapping Department.

A report for about 50 sites, having in a rough way the concept of geotopes, was compiled, accompanied by topographic maps and deposited at the Ministry of Civilization.

This effort didn't continue. Since 1995 a working group for geoconservation has been composed at IGME, having as primary objectives:

*a)* To examine the situation in Greece regarding the conservation of geological-geomorphological heritage.

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*b*) To promote the idea of geoconservation.

*c*) To make a list of geotopes, worthy preservation, in national, balcanic and european level. Geotopes should be selected in order to compose a network of the geology of the country.

*d*) To interfere for the enacting of relevant legislation at the authorities and the European Union, in collaboration with other organizations in the field of geoconservation.

The registration forms have already been distributed to IGME's geoscientists with detailed guide lines and soon they will circulate widely in the whole greek geological community and to the foreign geoscientists working in Greece, translated in English and French.

At the same time, we are trying to compile a geographical information system in order to have digital information. We prepared also a CD commented for the students and the public. This form was addressed as well to the geologists of IGME for the updating of 1:50.000 geological maps.

For filling in the forms, we insist in the idea of the network of sites, because, till now, several of the areas declared for protection have been chosen randomly without a systematic study. Saying network, I mean these representative sites from which the geology of the country can be extracted.

But the idea of network is not an easy thing to do. How to start creating a network?. Starting recording f.i. only the volcanicity and creating a network of volcanic sites? Or only the terrace systems? Or for instance, all Jurassic formations? etc. That, means we tried to find a unit for the network in order for us to start and become familiar with it gradually.

But difficulties never stop. Because if we start f.i. with representative terrace systems, the geoconservation would become an affair of quaternarists for some years and the geologists involved would be very few. So we decided to start compiling a form with a lot of informations to be filled in each geologist for his own field of research, no matter in which topic of geology or geomorphology but always with the idea of representativity and network to play the first role. Thus, the sites can afterwards be compared enabling us to create a cadastral out of them.

But difficulties with the network don't stop even here. In order to create a network in balkan, european or international level, we have, to standardize, as far as possible the forms. They should contain common precise specifications, having conceived the meaning of the network in the sameway, so order that the sites can be compared in that level in order to compile a geographical information system and a relational D.B. We need a functioning network of information and contacts between us in order to build a systematic network of geotopes. In that way I hope that everything will get better for the geoconservation issue.

If we have a look at the greek legislation, we realize that till the end of the past century (we should take into account that Greece winned its independence after the greek revolution in 1821) only certain law decrees were enforced, referring to the state's will to establish a physical environment protection policy. In this century by a law of 1932 on antiquities, still in force, and its supplementary law of 1950, the possibility of declaring certain areas as landscapes of special natural beauty was established. That is the reason that Archaeological Service is still authorized for the protection of natural areas.

By a 1937 law, provided for the establishment of up to five National Parks as areas of special protective Status, it is mentioned for the first time, among other things, "the conservation of geomorphological formations". In 1969, this law incorporated into the Forest Code and amended on, by a Law decree of 1971, provides, among other things, the possibility of Natural monuments to be preserved. Therefore the forestal Service is authorized for Natural monuments protection, as well as for the application of this law resulted in the declaration of 10 National Parks, 19 aesthetic forests, 5 Natural Monuments.

The first constitutional regulation for the protection of the natural environment is laid down in article 24 of 1975 constitution.

Consequently, in 1986 the legal framework of the natural environment protection is renovated with the law 1950. In this law, the category of natural formations, landscapes and landscape elements to be protected is mentioned. The Ministry of Planning, Environment and Public works is responsible for the application of this law. Therefore, civil engineers and architects are often authorized for the protection of natural environment.

Besides, there are also the international conventions and more precisely in the case of Greece, the convention for the protection of the World Cultural and Natural heritage of 1971, ratified in 1981 with a national law. Thirteen very famous monuments have been characterized as worldwide cultural monuments. Only two of them (Meteora and Athos mountain) are both natural and cultural monuments according to this law.

Based on this legislation, the categories of the areas mentioned above have been enlisted in a protection status. It cannot be said, however, that the variety of the natural characteristics occurring in Greece, is covered effectively by law. The Greek nature is privileged with representative biotopes and geotopes enclosing particular geological, geomorphological and physiographic formations or unique landscapes of superb beauty and special physiognomic and cultural features.

The percentage of areas under protection in Greece, is very low. Half per cent according to my sources. Possibly the lowest in Europe.

Furthermore, effective protection and rational organization has not been ensured yet, even for the areas already enlisted in the protection status. Their significance and value as well as the necessity for special treatment and management have not been evaluated accordingly.

As it is evident from the above briefly presented legislation, geological formations, geoforms, geotopes and geoconservation are not properly reported. All references are very general. Therefore geologists are not authorized for the conservation and protection of what they know better than anyone else.

In Greece the idea of geoconservation in not very spreaded.

With our efforts things are changing and geoconservation is getting it's true dimensions.

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