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The geological education within primary and secondary schools. The cultural diffusion as instrument of geological and environmental protection

L'educazione geologica nella scuola elementare e media. La diffusione culturale come strumento di protezione ambientale e geologica

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ABSTRACT – This paper describes an educational experiment carried out by ENEA-Municipality of Rome, the A. Manzoni primary school and G. Pascoli secondary school, aimed at developing an approach to the environment within educational continuity. The specific subject was the geological landscape of the Campagna Romana and its evolution through time. The applied methodology consisted in several phases: on the field work, undertaking of practical tasks, rousing of dynamic qualities (through researches, exchanging of roles, etc.) organization, motivated learning/motives of learning. The activities carried out aimed at achieving the following results: learning the meaning of territory and its changes through time, learning the meaning of environmental heritage and safeguarding it as an asset for the entire community and through interactive learning strenghten the feeling of belonging to the group. The students had different approaches according to school levels; those from secondary school developed the congnitive and scientific aspects, whereas those from primary school developed the fantastic aspects.

KEY WORDS: Geologic education, Primary and Secondary school.

RIASSUNTO – Nel presente lavoro viene descritta una sperimentazione condotta in collaborazione fra ENEA, Amministrazione Comunale di Roma, Scuola elementare «A. Manzoni» e Scuola media «G. Pascoli» di Roma, al fine di utilizzare la diffusione culturale come strumento di protezione ambientale, più specificatamente geologica, nei processi di continuità scolastica. L'argomento specifico è stato il paesaggio geologico della Campagna Romana e la sua evoluzione nel tempo. La trattazione è stata sviluppata perseguendo una metologia articolata nelle seguenti fasi: lavoro di campo, assunzione di compiti di realtà, attivazione di qualità dinamiche (ricerca, ribaltamento dei ruoli), organizzazione, conoscenza motivata/motivazione della conoscenza. Queste attività sono state condotte con l'obiettivo di raggiungere i seguenti risultati: acquisizione del concetto di conoscenza del territorio e dei suoi cambiamenti nel corso del tempo, acquisizione del concetto di patrimonio ambientale e della sua protezione, come bene comune e quindi godibile da ciascuno, ed infine promozione del senso di appartenenza al gruppo in una dinamica di conoscenza ed interazione. Il risultato finale è consistito in una differenziazione tra i diversi stili di approccio: gli studenti della scuola media hanno infatti sviluppato gli aspetti cognitivi e scientifici del tema, mentre gli alunni della scuola elementare hanno sviluppato gli aspetti immaginari e fantastici.

PAROLE CHIAVE: Educazione geologica, Scuola media ed Elementare.

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1. – INTRODUCTION

This paper deals with an educational experiment carried out by ENEA, Municipality of Rome, primary school "A. Manzoni" and the secondary school "G. Pascoli" of Rome (Italy).

The project is aimed at providing some basic knowledge on the environment within educational continuity.

Therefore the students involved were from the fifth grade of primary school (V elementare) and the first grade of secondary school (I media) (Joint Project of Environmental Education "Ragazzi 2000-Dispersione Scolastica") since in Italy many students drop out of school before the age of fourteen.

The knowledge people has of the environment usually refers to the present, since the majority of them lack any geological knowledge. They ignore that the natural surroundings are the result of geological, morphological and climatic processes which lasted millions of years.

This basic knowledge is essential to the comprehension of the amount of time involved in the creation of the unique features of the natural surroundings, as well as the priceless value of the Planet Earth.

2. – METHODOLOGY AND AIMS

The final scope of the project was to:

– learn the meaning of territory and its changes through time;

– learn the meaning of environmental heritage and its safeguarding as an asset to the entire community;

– create the feeling of belonging to the group through interactive learning patterns;

– highlight both the experiences and the attitudes of each student as well as of the group;

– stimulate a fantastic and imaginative approach.

Some general aims were achieved thanks to the analytical structure of the project, such as:

– a multidisciplinary approach: the subjects of study were approached from different specific points of view (RIGHETTO, 1993), so as to provide the students with an interdisciplinary learning pattern.

– Learning the scientific methodology: since geology is not based on mathematically verifiable processes, a scientific methodology is necessary to enable geologists to recognize and describe in the most similar way the same phenomena worldwide. Particularly for the mountains, whose creation none of us could have witnessed because of the amount of time involved, the need to find close analogies between cause and effect, that is to say a scientific methodology, is clear.

– Experimentation as an instruments to discover the landscape : the environment presents continuity and transformation processes (SEMERARO, 1992); the former being recurrent give the possibility to interpret the environment; the latter show that recurrency is not necessarily repetitive, but ruled by the Universal laws. Hence, the educational aim is to provide the students with a dynamical view of culture, that may increase the capacity to cope with the unknown and the unforeseable.

– Learning to differentiate the environments: very often the environmental differences between mountain and hill, city and country, marsh and lagoon, are not considered from the proper scientific point of view. Therefore, on the field analysis of the different environments in the Roman area have been suggested. The differences between them and the complexity deriving from the sequentiality and the overlapping of several different environments through geological time have been pointed out. This was an attempt to increase the awareness of such "geodiversity" in order to better safeguard it.

The choosen subject was the geological landscape of the Campagna Romana and its evolution during the last two million years. The lessons concerned the following subjects:

– introduction to the definition of dynamic landscape in relation to endogenous and exogenous processes;

– description of the geologic landscape of the Campagna Romana and its evolution in the last two millions years. The main phases of the evolution of the Campagna Romana have long been known (CONATO *et alii*, 1980; De Rita *et alii*, 1988; DE RITA *et alii*, 1993; DE RITA *et alii*, 1993a; FACCENNA et alii, 1995; MALATESTA & ZARLENGA, 1986; MARRA & ROSA, 1995; MILLI & ZARLENGA, 1991). They can be defined as an overall withdrawing of see-water up to its present position, by a progressive but not continuous uplifting of the continental platform. The overlapping of glacial phenomena have determined raises and falls of the sea level of about 120 m, dated with certainty 0,6 my, as well as the volcanic activity, which began in the Roman area between 0,5 and 0,6 my.

The project activities were carried out sequentially, each one with a different objective, so providing a dynamical interaction between the different subjects, as recommended by SEMERARO (1993) and SIMEONE (1993).

PHASE I – Proposed subject and its description

After having defined the subject, the "scientists" and the teachers outlined it with the support of audio-visual materials, suggesting the students and the teachers to work on an in-depth paper on the subject.

PHASE II – On the field work

The present morphological features of the landscape and those indicating ancient landscapes (such as fossiliferous deposits, outcrops of volcanic and sedimentary rocks, etc.) have been pointed out and described, to help the students, through the "undertaking of practical tasks", understanding the analytical relations between "causes and effects". In order to identify the most significant present and ancient features of the landscape, an excursion to the most interesting and accessible key sites was also organized, about a month from the beginning of the study.

PHASE III - Students' activities on the subject

In this phase the students carried out activities (such as researches, exchanging of roles, etc.) improving their capacity to cope with the unknown aspects of things and increasing their organizing abilities.

3. – CONCLUSIONS

The didactical project has been carried out as planned. The involvement and the interest of both students and teachers has allowed to reach valuable results from an educational point of view.

The students had different approches according to school levels: those from secondary school developed the cognitive and scientific aspects, whereas those from primary school pupils developed the fantastic aspects

A great amount of material, such as papers, drawings and diagrams, maps, plastic models and posters (fig. 1; 2; 3; 4; 5; 6; 7), were produced by the students, and shown in a school exhibit called " Dalla Fantasia alla Geologia" (From Fantasy to Geology) which was organized at the end of the school year in the "A. Manzoni Elementary school". Furthermore, an informative students' journal will be published by "The Municipality of Roma Assessorship for the Environment". This journal, to be distributed in other Rome schools, would represent a valuable instrument in the promotion of environmental knowledge.

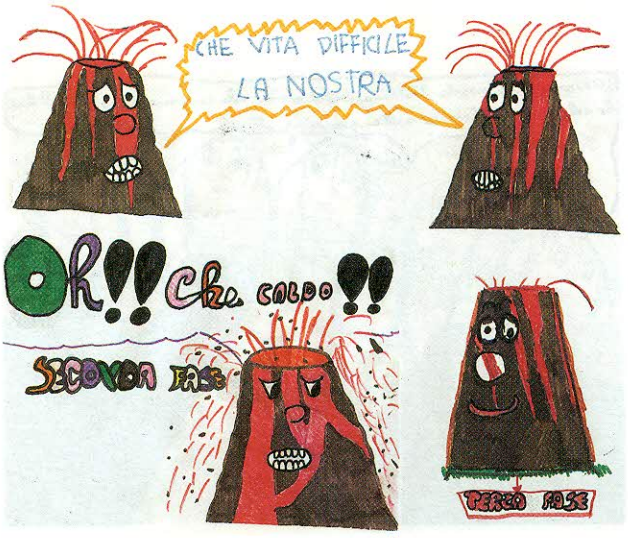

Fig. 1. – Rappresentazione da parte degli scolari delle tre fasi del Vulcanismo Albano.

– Fantastic picture of pupils showing the three phases of the Alban Volcanism. (Bubbles: High: "How difficult our life is!"; Low: "Second phase- It's so hot!").

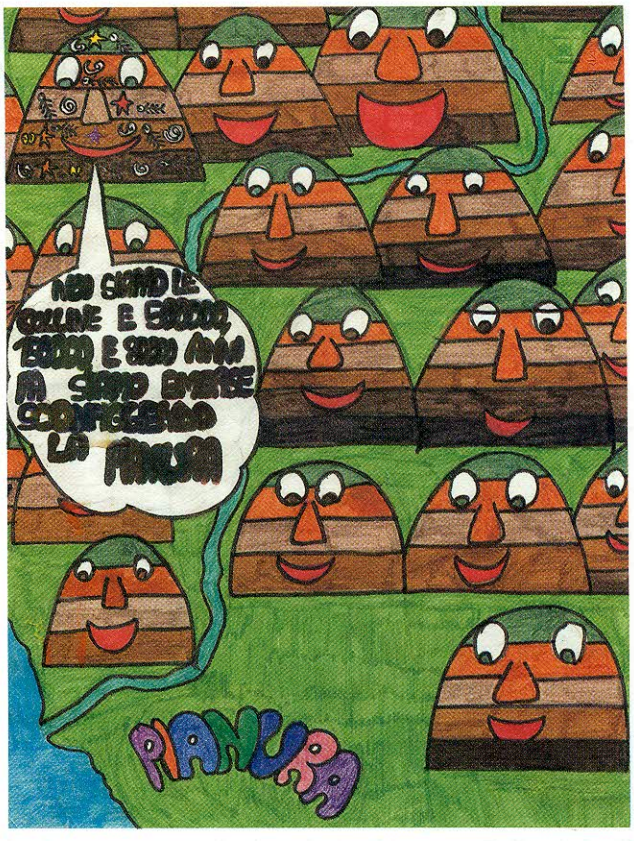

Fig. 2. – Il disegno evidenzia il livello di comprensione da parte degli scolari delle fenomenologie che hanno condotto alla formazione del paesaggio collinare e come esso contenga informazioni riguardanti la geologia.

– The picture highlights the level of understanding of the pupils of the phoenomena that produced the present landscape with hills and plains. Finally the geological information about ancient landascapes, inside the hills. (Bubbles: "We are the hills that 50.000, 150.000 and 800.000 years ago were uplifted, defeating the plain").

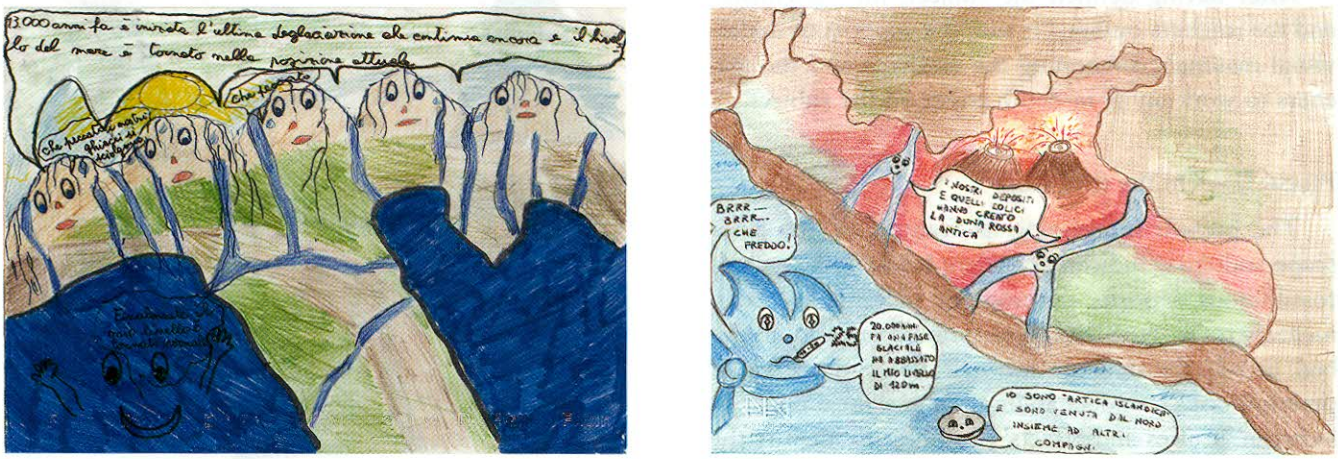

Fig. 3.-4. – Il disegno mette in risalto la comprensione dei fenomeni glaciali nella loro globalità. Nel disegno 3 infatti è rappresentata la fissazione delle acque nei ghiacciai alpini, mentre nella 4 sono illustrati sia l'abbassamento del livello marino, sia la presenza di faune fredde nel Mar Mediterraneo durante i glaciali.

– The picture highlights the understanding of the global glacial phoenomena. In fact in picture 3 the increase of the Alpine glaciers is shown. In picture 4 the low stand of the sea level and the presence of Northern fauna in the Mediterranean sea, during glacial phases, is shown. (Bubble Fig. 3: "Marine water is evaporated and is fixed in the glaciers, so we have a low sea level stand up to - 120 m". Bubbles fig. 4: Rivers: "Our deposits together with aeolians have created the Old Red Dune"; shell: "I am the Arctica islandica and I arrived here from the North with other friends"; Tirrhenian sea: "Brr, brrr, it is very cold!, 20.000 years ago a glacial phase produced a low stand of sea level of 120 m").

Fig. 5.-6. – Il disegno evidenzia il grado di comprensione dei fenomeni interglaciali. Nella fig. 5 sono infatti illustrati i fenomeni che accompagnano una deglaciazione, mentre nella 6 la risalita del livello marinno e la presenza di Faune Senegalesi nel Mar Mediterraneo durante il Tirreniano.

– The picture highlights the pupils understanding of the interglacial phoenomena. In fact in fig. 5 the melting Alpine glaciers are shown, while in fig. 6 the raising of the sea level and the presence of the Senegalese Fauna in the Mediterranean Sea, during the Tyrrhenian, are shown. (Bubbles fig. 5: "10.000 years ago the last deglaciation started and continues today. The sea level arised to the present altitude"; glaciers: "what a pity! we are melting". Bubbles fig. 6: "Tirrhenian sea: it's so hot! 125.000 years ago, during an interglacial phase my waters became very hot"; black shell: "I am a Senegalese mollusc and I arrived from Morocco with many friends to this hot water").

Fig. 7. – Rappresentazione fantastica dei ricercatori che hanno curato la sperimentazione.

– Fantastic representation of the researchers who carried out the experiment (Bubble: "The geologists have found the fossil Arctica islandica; this species lives today in the Northern seas").

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The state of some pleistocene geosites located near a spreading big city. The case of the Rome area (Italy)

Lo stato di alcune località pleistoceniche localizzate nei pressi di una grande area urbana in espansione. Il caso di Roma (Italia)

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ABSTRACT – The Pleistocene continental deposits, outcropping in the present urbanized area of Rome, are localized along the Tevere and Aniene valleys and in the coastal area. They were known from the last century because of rich vertebrate and mollusc fauna, as well as human remains and Palaeolithic artifacts. Some of these localities have been of paramount importance to increase knowledge on the evolution of the Rome area during the Quaternary. Researches over the last 30 years, have revealed new fossiliferous deposits and resulted in new interpretations on the geology and biochronology of the faunal associations of the area. Unfortunately in many cases some of these deposits have been destroyed by increased urbanization or it is currently impossible to reach and to study some protected but unmanaged localities.

KEY WORD: - Geosites, Pleistocene, Fossil assemblages.

RIASSUNTO – Depositi pleistocenici di ambiente continentale affiorano nell'attuale area urbana e periurbana di Roma, lungo le Valli del Tevere e dell'Aniene e lungo la costa. Essi sono conosciuti fin dal secolo scorso per la presenza di ricche faune di vertebrati e di molluschi e per la presenza di resti umani e di industrie preistoriche. Alcune di queste località sono di importanza fondamentale per lo sviluppo delle conoscenze sull'evoluzione geologica dell'area romana e più in generale del Quaternario. Le ricerche degli ultimi trent'anni hanno consentito di scoprire nuovi depositi fossiliferi e di dare nuove interpretazioni sia alla geologia dell'area, sia alla biocronologia delle associazioni faunistiche. Sfortunata-mente, alcuni depositi sono stati distrutti dall' espansione urbana, mentre altri non sono più visibili perchè protetti e non gestiti e pertanto irraggiungibili.

PAROLE CHIAVE: – Siti geologici, Pleistocene, Associazioni fossili.

1. – INTRODUCTION

The Roman area presents three types of geosites: lost sites, protected sites (either managed or unmanaged) and lastly unprotected sites. Here we shall only discuss about the lost and the protected, but unmanaged, sites. The former indicate the high risk of geosites destruction in high urbanized areas. The latter indicate that site protection may hinder research, resulting temporary loss of information.

2. – "LOST" SITES

Among the most important destroyed sites, from a scientific and historical point of view: Redicicoli, Sedia del Diavolo, Monte delle Gioie, Saccopastore and San Cosimato must be mentioned.

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Fig. 1. – La sezione di Torre di pagliacceto presso Torre in Pietra (Roma).

– The Geosite at Torre di Pagliacceto, near Torre in Pietra (Roma).

Redicicoli geosite: in a gravel quarry in the fifties, under the field level, BLANC collected a rich mammal fauna. The faunal association, recently reviewed, seems to correspond to a time span referable to Jaramillo magnetic event (CALOI *et alii*, in press). Since the site is destroyed, it is impossible to analyze palaeomagnetism of a layer of clays underlying the fossiliferous gravels and verify the occurrence of the Cassia erosional phases (sensu AMBROSETTI *et alii*, 1972), correlatable to the "great glacial" (SHACKLETON & OPDYKE, 1976).

Monte delle Gioie and Sedia del Diavolo geosites: these two sites situated on the middle terrace of the lower Aniene River Valley are of great importance to the geological and stratigraphycal setting of the area.

Monte delle Gioie was discovered in 1869 and was already destroyed in 1936 by urbanization. The Sedia del Diavolo area was a tuff quarry, today urbanized (CALOI *et alii*, 1980; SEGRE & SEGRE NALDINI, 1984; CALOI *et alii*, in press).

The fauna collected from these localities is particular for the great amount of primitive subspecies of *Dama dama* (DI STEFANO & PETRONIO, in press). The occurrence of the modern fallow deer is an important bioevent correlatable to the isotopic stage 7. The fossiliferous levels are likely younger than the erosional phases related to the isotopic stage 8.

Saccopastore geosite: the importance of this deposits lies in the discovery of two human skulls, showing neanderthalian features, respectively in 1929 and in 1936 (6 years later than the end of the works in the quarry). The skulls were found in a level of clays, outcropping in a quarry of gravels, on the lowest terrace of the Aniene river. The deposit was located approximately 2,5 km from Porta Pia, in an area between Rome and Città Giardino, and that today, despite the urban settings, is a very densely built area near the Nomentana street. Fossiliferous levels with mammal bones and leaves have been recognized overlaying and underlying the levels with the skulls. Considerations on the stratigraphycal and the palaeontological available data on the deposits allow to refer the faunal associations to two different climatic periods of the isotopic stages 5. The analysis of the new data about the fauna and biochronology underlines still open questions on the correlation among "glacial period" after BLANC, erosional phases (sensu AMBROSETTI *et alii*, 1972) and the cold climatic oscillation in the examined area. In this area strong interactions among tectonic and volcanic activity, erosion and oscillation of the sea level have to be considered.

San Cosimato geosite: in this site Conato et al. (1980) founded "San Cosimato Formation" related to the isotopic stage 11 and containing a vertebrate fauna in the lower layers and a marine fauna in the upper layers.

The marine fauna in to valleys deposits increased its importance in Latium Pleistocene. Two years after the end of the research the type section even if far from the city was covered abd then destroyed by new urbanization.

3. – PROTECTED SITES

Among these we take into account three sites: Torre in Pietra (Torre di Pagliaccetto), Quartaccio (Vitinia) and Rebibbia- Casal De' Pazzi (Roma).

Torre in Pietra (Torre di Pagliaccetto) geosite (fig. 1): the geological section of Torre di Pagliaccetto was first discovered and studied by BLANC (1955) and later analyzed by a team of researchers co-ordinated by MALATESTA (1978) and by BIDDITTU *et alii* (1984). Lithic tools and vertebrate bones and leaves (CALOI & PALOMBO, 1978), referable to two different stages of the Middle Pleistocene, occur in two main levels (m and d). This deposit has a great biochronological and palaeoanthropological importance too (CALOI & PALOMBO, 1988).

In 1996 the Soprintendenza Archeologica of Rome started the works of the site maintenance; this site could have an educational value in the future.

Quartaccio (Vitinia) geosite: this locality is one of the most complete geological sequence in the Campagna Romana (CONATO *et alii*, 1980). Four sedimentary cycles referable to Middle and early Late Pleistocene can be recognized: Ponte Galeria Formation, S. Cosimato F., Aurelia F. and Vitinia F., which are interbedded pyroclastic flows from Alban Volcanic district.

The site of Vitinia was the first to be protected by Roman Archaeological Superintendence for its own geological significance (FABBRI & ZARLENGA, 1996).

From Vitinia Formation a rich fauna (mammals and continental molluscs) and lithic tools referred to the isotopic stage 7, have been discovered and studied (CALOI *et alii*, 1983). In spite of its great value this site was not adequately managed. This resulted, a few years from its discovery, in the impossibility set the stratigraphical boundaries among the different sedimentary cycles (especially for the upper part of the sequence).

Rebibbia-Casal de' Pazzi geosite: it is an example of protected site which will be included in a project for the organization of a local museum. This locality, placed on the middle terrace on the left side of the Aniene river Valley, was discovered in 1981 by researchers of Roman Archaeological Superintendence. The stratigraphical setting seems to be similar to the Sedia del Diavolo one. Mammal bones and lithic tools come from the gravels and sands level overlaying lime and the pyroclastic deposit.

Being a part of a museum will allow the preservation of this important geotosite in a very urbanized area of Rome, will be a great educational opportunity and will give the possibility for further studies.

4. – CONCLUSIONS

Increased knowledge on Quaternary geology and on palaeontology, makes multidisciplinary analysis fossiliferous deposits and geological sections possible. The state of the art of the protection and conservation of unprotected sites in the Roman area, such as the main Middle Pleistocene fossiliferous deposits and geological sites outcropping along the Tyrrhenian coast (the area of Ponte Galeria quarries and along the Aurelia road), indicate that it is necessary to protect more sites or they will be destroyed in a few years because the expansion of the city in the future, as it happened in the past.

Educational projects on the previously protected geosites (open air museum, co-operation with universities, research centres, associations and schools), instruments to increase the awareness among institutions and citizens on the evolution and the natural history of the territory, may be useful.

Therefore if it is necessary to protect sites from destruction in a high risk environment, such as the urban system, management on the protect sites is urgent. This would enable the scientific community to new reasearches and the people access to an unknown element of the Italian geological heritage.

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Geoconservation and environmental education

Geoconservazione ed educazione ambientale

HLAD B. (*)

ABSTRACT - Public ignorance of geology as a science of investigating structure and processes of deciphering the Earth's history from its rock record and of applying that knowledge is not to be underestimated. This is the consequence of two-way communication gap between geology and society. If the public awareness of geology is low, so too is the level of concern amongst geologists for the social context in which their science is done (WOODCOCK, 1995). One of the most powerful instrument to overcome such a situation is environmental education on different levels which should include much more of geoconservation topics.

KEY WORDS: Environmental education, geoconservation

RIASSUNTO - Tale lavoro evidenzia l'ignoranza del pubblico nei riguardi della geologia, intesa come scienza che investiga la struttura della Terra, e cerca di ricomporne la storia evolutiva. Questa è la conseguenza di una interruzione nella comunicazione bi-direzionale tra la geologia e la società. Se la consapevolezza del pubblico verso la geologia è scarsa, così è pure il livello di interesse dei geologi verso il contesto sociale nel quale la loro scienza è divulgata (WOODCOCK, 1995). Uno dei più potenti strumenti per superare questa situazione è l'educazione ambientale ai vari livelli che dovrebbe trattare sia temi generali, sia gli argomenti specifici della geoconservazione.

PAROLE CHIAVE: Educazione ambientale, geoconservazione

1. – INTRODUCTION

Rio 92 was an important world event. It focused public attention all over the world on the crucial issues we have to face with as a world community. From it emerged some marvelous ideas and concepts like Sustainable development or Biodiversity. But in all documents there is missing something. Whatever happened to Geodiversity, the conservation of our geological and geomorphological heritage?

The general public perception of geology is as an academic and usually boring subject. This is far from the reality, of course. Geology is one of the most exiting and dynamic sciences of great relevance to our daily life. Not only because of the dramatic geological events such as volcanoes and earthquakes but also because of the rocks, minerals, fossils and other geological features beneath and around us. They all are not just ignored too often but even worse. They are also often abused. We need to extract many rocks and minerals from quarries to enable us to build houses and roads, to make tins of trade in gold... But do we have to create such monstrous quarries and mines, so many roads etc. everywhere without thinking of the environmental consequences. Why don't we take more care of our precious landscapes? Geology is a discipline which has much to contribute to the research into the consequences of human impact on nature. As well as is ensuring understanding of range of the features and how natural features and processes are interlinked and how they influence social processes and how social processes impact on nature.

Agenda 21 is a document which gives an important role to environmental education. There needs to be an opportunity for geology and geoconservation to assume a bigger role in the frame of environmental education.

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2. – AIMS AND PURPOSES OF GEOCONSERVATION

The aim of geoconservation is to conserve the natural and cultural elements of our geological heritage including:

1. the historical records of nature and human history;
2. unrenewable natural resources;
3. the collections of minerals, fossils, rocks and bores;
4. geotopes - geological/geomorphological features as well as geological/geomorphological processes are also the crucial abiotic basis of the biotopes and landscapes.

In Slovenia a geological site may be protected for monumental, reserve, biotopic, scientific, educational and recreational purposes. To achieve the aims and purposes more efficiently there needs to be more cooperation and communication between nature conservation profession, scientists, the other professions, administration and societies.

To improve the geological/geomorphological heritage situation there is need to:

- gather relevant information from the range of the scientific results for the conservation and planning purposes and researches;
- use scientific information in the decision making process and formulate recommendations for action;
- publish scientific results both in professional and popular publications;
- promote interpretation and education programmes.

3. – COMMUNICATION ISSUES IN GEOCONSERVATION

3. 1. – Professional Geoconservation service

In Slovenia the only professional geoconservation service that exists is within the central government administration for nature conservation and in a few regional institutes for natural and cultural heritage. Such a small state organization cannot hope to cope with all the various professional, administrative and educational nature conservation issues. To overcome such a situation there needs to be stronger support also from the scientific world as it is now. But there is a lack of scientific interest in nature conservation, especially in geoconservation. This is one of the reasons why there is very little scientific and academic logic in the present process of assessing the requirements of nature conservation, including geoconservation. Nature conservation study, especially in geoconservation is only a recent development in universities and hardly exists at all as an interdisciplinary study. Occasionally it is to be found within other subjects (i.e. geography, landscape architecture) but only because of the interest of a few individuals.

3.2. – Public and Geoconservation

Although the general public supports nature conservation (including geological heritage) in principle, there still exists a general disinterest in conservation issues as well as a distrust of nature conservation policies. And not quite without reason. The major drawback of the current Slovenian nature conservation legislation is that it is declaratory and that its definitions are not clear and precise enough. Little or no attention is paid to issues such as financing systems, compensation, incentives procedures and the enforcement of nature protection legislation. And the systematical approach to environmental education within the relevant ministries has not been developed yet.

Nature conservation problems increase all the time. There are insufficient people in the nature conservation service to deal with mounting issues ranging from planning and implementation to education. In addition there are the usual economic and social factors, which inhibit the development of geoconservation, which is often seen as negative and restrictive. The economic recession is also an usual problem for the nature conservation and environmental protection agencies who have to accept that they are seen as obstacles in the economic development and market forces. We have to face with the fact that nature conservation in general (including geoconservation) is often seen as a luxury that can only be afforded by "rich" countries. This fact is a big challenge also for the environmental education issues.

3.3. – Terminology

Environmental issues often elicit the overdramatic use of negative terms like "threatening" or "destruction". This holds the public's interest for a short time, but constant repetition creates boredom and even diverts people from the real geoconservation as well as other nature conservation issues. Some terms become part of colloquial and everyday language but they often lose their real meaning and are misunderstood. A typical example is the term "ecology" which is often wrongly used by politicians, journalists and others to mean the environment or nature. They will speak of the "ecologisation of the society or economy" (Erz, 1994). The public soon begin to undervalue geoconservation and other nature conservation issues, especially:

- if discussions are not based on sound and correct (general geological and other naturalistic) information;
- if the arguments are too generalized;

- if everything is reduced to argument or exaggeration;
- if scientific and professional language is not explained in simple terms.

3.4. – Scientific community

A major communication problem exists because of the usual prejudices of the scientific community regarding the publication of popular articles and papers. These are supposed to "damage" one's scientific reputation. The problem is exacerbated in such a small country as Slovenia where scientific publications in our native language do not reach the requirements for broader international arena. Consequently scientists increasingly publish in foreign languages. This is supported by the Ministry for Science and Technology as to the detriment of national publications (periodical, monographies, articles). The Slovenian public is missing out! There needs to be a balance. The results of scientific work should be published in the Slovenian language to promote public interest in the environment. The importance of general public should not to be underestimated. It will support sciences (including applied sciences like environmental science) only if people know and understand what is happening in their own environment. The local environment should not be regarded as less "eminent", but as the most important! We should be aware that local people strongly identify with their local environment. They have an ownership of local nature and geology. They care for it. This can be a powerful factor in the cause of environmental understanding and protection. Like in other nature conservation matters there needs to be improved communication between geoconservationists and the decisionmakers, planners, civil servants, scientists and the broader public. Published scientific results, discoveries and ideas should be well prepared and clearly presented. The conservation issues should also be presented in a more positive way.

3.5. – Nongovernmental organizations

Professional and environmental societies also have inadequate communication with target groups (politicians, user groups, planners, journalists, schools, others). They should dedicate much more work to evaluation and physical planning policy and environmental education mainly through:

- representation of clearly thought - through viewpoints regarding the conservation issues which should include support from professional advisers and partners;
- adoption of more proactive positions with sound reasoned arguments (not just passive positions and reactive responses);
- emphasis on the small successes instead of the usual negative diatribes;
- creation of better coordination among societies and associations.

3.6. – Geoconservation and education

Species and habitat protection are now relatively awarded due importance but geological and geomorphological phenomena are generally neglected. Geoconservation lies in the shadow of "living nature" conservation and landscape conservation. However biodiversity depends on geodiversity as well. When only "living things" are discussed, this critical aspect can easily be overlooked. In Slovenia as probably elsewhere the term geological or geomorphological heritage is not accorded enough importance. The responsibility for rectifying this situation belongs to educational institutions and organizations with an educational remit such as the educational bodies, institutes, schools, the media, scientists and the nature conservation bodies. Their aim should be to adopt the following approaches from:

- a rational standpoint - explain the importance of the geological heritage including an understanding of Earth sciences, ecosystems, natural cycles, benefits for humans (including mineral resources, water supply, adequacy of building sites);
- an emotional standpoints - visual and other empirical values of geological/geomorphological phenomena which give the special values to the landscape, the value of geo- and biodiversity for the human spirit, arts, sport;
- an ethical and moral standpoint - judgements have to be made based on values adopted.

These approaches are crucial if we believe that our emotional and rational attitudes to nature are formed very early in the childhood. If we are to promote geoconservation what is needed:

- the development of a positive attitude to geological and other kinds of natural heritage in the preschool age (all small children love to play with water, pebbles, sand and mud);
- the introduction into the school curriculum of appropriate projects such as using school grounds to explore nature and cross curricular activities;
- the promotion of such issues in the education and training of teachers (at all levels from kindergarten, primary to secondary).

In Slovenia geological issues are inadequately presented in the primary and secondary school curriculum. A few hours may be dedicated to geology within other subjects like geography and biology, but do not reflect its importance in our daily life. For example

karst scenery and its limestone geology are famous throughout schools and universities and other countries. But in Slovenia our own children and our own public are mostly ill-informed about the importance of this precious landscape.

Also there are no specialized centres for educating adults in Slovenia such as the Academies für Naturschitz und Landschaftpflege in Germany or Field Study Centres in Great Britain. In order to reach all education levels we need to use all available technologies such as computer simulations, film documentaries and others. This way up to date and accurate information is clearly presented on the various earth systems so that issues can be explored and understood. To improve the perception of our geological heritage and its processes it is necessary to:

- show the significance of the continuing damaging processes on the whole natural structure and social environment. It is necessary to demonstrate the connection between geoconservation/geotopes and their crucial importance for human beings;
- to alert people about consequences of their own damaging economic and social activities. For example historical comparisons can be made using "before and after" photographs; or quarries can be seen as an eyesore or, if sited carefuly as a place of natural value at the end of its working life.

4. – ENVIRONMENTAL EDUCATION EXAMPLE

A good case study to illustrate the need for environmental education in geodiversity would be the karst. Slovenia has more than 40% its land area as karst. It would be very interesting to develop an interdisciplinary presentation of the geological and geomorphological evolution of such an area including the following points: different karstic, rock, mineralogical, paleontological, hydrological details; the life evolution from pioneer plants and animals on the surface as well as the numerous underground endemits and other today endangered species; the development of the human civilization from cave dwelling up to the present day with all the social and economic contrasts. Such as:

- using the caves to illustrate kinds of home; the changing landscape from the early beginnings of agriculture with deforestation to produce "completely naked" karstic areas which were later reforested;
- using trees for venetian navy;
- using and selling the ice from caves;
- the damaging use of stalactites and stalagmites for selling as souvenirs and for decorating buildings, chapels and monuments;
- unawareness of the increasing physical pollution on the karst surface and in the caves the chemical pollution of the water on the surface and in the caves which affects the drinking supplies;
- the development of caving as a sport with all its negative impacts.

Combining computer simulations and videos is needed to reinforce knowledge. Too often real life incidents are forgotten. If action is needed then information is required quickly. Personal perceptions about the changing environment then become clearer and more purposeful. This is critical if geoconservation issues are to be understood and good environmental decisions made. There is an underestimation of the threat to geodiversity which underpin much of our present economic and social way of life.

5. – CONCLUSION

The issues mentioned in this text are only some of the reasons why it is important to strengthen the role of environmental education in order to improve the people perception of geoconservation and other nature conservation issues. Currently there is growing interest in the earth sciences and in nature conservation. People are increasingly aware of the links between the health of the planet and the wellbeing of humans, between knowledge of the past and foresight for the future. Geologists, educationalists and administraters must get together to ensure that environmental education is included in any new geoconservation policies and programmes. A dialogue is needed even in this time of declining budgets for conservation bodies. Obstacles must be overcome if progress is to be made. Geoconservationists must identify themselves, publicise their concerns and argue their case. That way we may be able to sustain our geological heritage for following generations.

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Management of objects of geological heritage. Stepping into the future

Gestione degli elementi del patrimonio geologico. Passeggiando nel futuro

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ABSTRACT – Primary objective of management of objects of geological heritage is to contribute to adequate protection of isolated objects and enable making of profit. This can be achieved through appropriate coordination of fragmentary elements of geological offer, but we must bear in mind those unavoidable risks that have to do with profit.

KEY WORDS: Management, geological heritage, image.

RIASSUNTO – L'obiettivo primario della gestione degli elementi del patrimonio geologico è di contribuire ad una adeguata protezione degli elementi isolati e senza capacità di profitto. Ciò può essere ottenuto attraverso un'appropriata coordinazione di elementi frammentari di natura geologica, ma ci dobbiamo ricordare i rischi inevitabili che si corrono con il profitto.

PAROLE CHIAVE: Gestione, patrimonio geologico, immagine.

1. – INTRODUCTION

Geological heritage is receiving varied treatment in European countries, partly due to differing individual approaches and partly to preexisting notions concerning its value.

This situation resulted in a multitude of different classifications of geological objects based on different criteria and levels of observation (local, regional, national, international). All these systems of classification aim to make divisions within the database of geological objects and establish the facts concerning their condition and mutual relations, without venturing to examine further possibilities.

Establishment of ProGEO association for protection of geological heritage of Europe marked introduction of a complex approach to geological objects, including management (previously limited to individual cases) regardless of the value assigned to any particular object. However, in order to achieve full effects of management in this field, it is necessary to set in motion instruments, which will enable adequate integration of the objects of geological heritage and their management. Some of the instruments enabling such integration are administration (planning, organization, control), preservation and development.

Primary effects of articulation of management for the purposes of protection of geological heritage are to be expected in adequate protection of isolated geological objects, whereas as a secondary effect we may expect to make profit (directly or indirectly). In order to achieve desired effects it is necessary to complete proper research of geological objects and their classification, and also provide good coordination of fragmented elements of what is on offer in the field of geology.

We distinguish the following categories of users of geological heritage: professional researches; students and bachelor's degree holders; students of elementary schools and courses; amateurs and collectors; general public (ATTENBOROUGH *et alii*, 1991).

Although there is a variety of approaches in the existing (European) classifications depending on the country in which any particular classification is being used, we distinguish the following common categories:

– geological objects with scientific value;
– geological objects with educational value;

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– geological objects with unique contents at given level of observation;

– geological objects with aesthetic value;

– geological parks.

On the basis of these two classifications we may develop a unique functional system with the following elementary components (GUNN, 1979):

– information component which includes understanding of significance of promotion, i.e. all elements of a promotional mix, such as: image and presentation; promotion; marketing; information dissemination and publicity.

– people/visitors.

– traffic infrastructure.

– attractiveness.

– particular services (accommodation, catering, etc.).

The most important characteristic within this functional system, either preexisting (clearly visible specific feature on the basis of which an object has been placed in one of the above categories) or developed, regardless of the object category, is image. It is not an easy task to make use of the existing image of an object or create a new one if we bear in mind its direct relation to profit. What follows is a presentation of various types of geological objects and related images.

Geological Objects with Scientific Value

Compared to overall number of profiles (objects) within given territory, geological objects with scientific value are found in smallest numbers. Their protection is not questioned and the image is already developed in part. It is necessary to enforce the image by keeping the expert circles informed, and thus induce interest for research. Management is expected to provide promotion and propaganda, and management of geological objects in this category is based on adequate protection. Correct approach to this group of objects includes development of interest for research among experts in the country and abroad, further promotion of the object by means of exhibitions, propaganda materials, etc.

Djavolja varos is a group of pyramids formed in unconnected sediments, which fall in and form again. Due to its exceptional scientific value this object is registered in the IUCN list, and there is a curator taking care of its image.

Geological Objects with Educational Value

Geological objects in this category may belong to any typical profile, geomorphologic formation, etc., included in educational system. Management of these objects is based on adequate actions aiming at creation of image which is not expressed in profit, but stimulation of educational institutions (at all levels) to organize excursions and similar activities. That would contribute to development of future exponents of management in this field (students) able and willing to recognize and protect objects of this category. Geological objects with such contents may develop an image of a training polygon, where direct work on the object and around the object yields desired effects.

Geological Objects with Unique Contents at Certain Level of Observation

Uniqueness of contents of a geological object, in the form of fossils, minerals and other values, at certain level of observation, calls for isolation, taking an inventory and protection. Image of objects with such contents is already developed, and at higher levels of management such objects may be included in tourist offer of the region, so that future image can be shaped in accordance with intentions of the curator. This kind of approach may result in limited profit.

Examples are the following: hydrographic junction of the Balkan Peninsula - Drmanska glava, volcanic formation of Zvecani, the longest gorge in Europe - Rugovska klisura.

Geological Objects with Aesthetic Value

Geological object with aesthetic value can be a sub-category of one of the above categories or a separate category. Image of this kind of objects requires almost no extra effort because its is readily recognizable to a layman. However, management may help in labeling such object "a pearl of the region, county..." which can contribute to identification of other values in the region (especially biotop) and declaration of the protected object as a part of a national park or strict natural reservation... In this manner the original object is used for purposes of advertising the protected area.

Geological Park

A number of geological objects (values) concentrated in a small area, which demonstrate development of geological structures in certain period or epoch, is known as geological park and is equivalent to the economic concept of a park with a purpose. In such areas other values should be identified as well (biological, geo-archeological...) in order to help in

creation of high image and establishment of original environment for the purpose of achieving high profit rates. This can be achieved through legal protection of such resources and specification of special terms and conditions, such as the number of visitors, varying stimulation for tourists - old tree, geological object with aesthetic value, souvenir-specimens of sediment rocks and fossils, etc.

Complexity of elements involved in creation of image of a geological park as a destination is demonstrated in tab. 1.

The place of Druzetic is an example of geological park that illustrates complete development of upper Paleozoic in Serbia.

Finally, we must specify the negative effects to be expected or just prepared for:

– Management of most objects cannot fulfill its function if they are ruined or completely destroyed;

– Possibility of losses is closely related to profit, so that good and flexible image must be applied to minimize this possibility;

– It is necessary to introduce strict control, in certain cases in proportion to evaluation of the object;

– In areas which loose their original purpose or function due to introduction of regime of protection for geological heritage, the government must indemnify the local population;

– In case that certain geological object is being exploited for industrial purposes which belong to the primary sector, the management will face a difficult task, because it is necessary to allow possibility of utilization under certain regime only.

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TAB. 1. – Relation between demand and supply in creation of image of a geological park as a destination.

– *Relazione fra domanda e offerta nella creazione di immagine di un parco geologico come una destinazione.*

DEMAND
(Hierarchy of needs)
↓
MOTIVATION
(Psychological status, intellectual, cultural, social contacts and relaxation)
↓
PERCEPTION
(Preferences; Experience; Information)
↓
IMAGE
↑
TOURISM PRODUCT
(Presentation of geological image)
↑
RESOURCES/ATTRIBUTES
(Nature; Culture; Infrastructure; Conditions of stay; Activities; Human resources)
↑
SUPPLY

(Taken and modified from O. BAKIC, 1995)

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Una diversa strategia per la tutela dei beni ambientali

New strategies on natural resources protection

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RIASSUNTO – Ancor oggi in Italia la politica della conservazione è basata sui censimenti, e qualunque programma di tutela si esaurisce quasi sempre nella catalogazione, sempre più completa e precisa degli oggetti appartenenti alle classi da tutelare; queste metodologie, per quanto esatte ed approfondite, forniscono semplici elenchi di oggetti singoli, separati dal loro contesto di appartenenza.
Il problema che si pone è che l'avere individuato ed elencato tutti gli oggetti non è di per sè sufficiente a supportare scelte e decisioni di tutela, se non viene compiuta una operazione fondamentale di inserimento degli oggetti individuati nel loro sistema di riferimento. Infatti solo una visione di questo tipo permette di selezionare i modi più corretti di conservazione e d'uso avendo presente il significato, il valore ed il ruolo di ogni singolo elemento.
Un corretto approccio di questo tipo è stato utilizzato nel Piano Territoriale Paesistico della Regione Emilia-Romagna, in cui si è affrontata la lettura di tutto il territorio regionale nelle sue componenti e nei suoi equilibri, in modo da potere individuare, in funzione di situazioni territoriali etereogenee, modalità di gestione differenziate, capaci di impedire modificazioni tali da distruggere o alterare in modo significativo l'insieme dei caratteri che qualificano le diverse parti del territorio regionale e l'equilibrio complessivo del sistema.
In conclusione si deve quindi porre la domanda se sia giustificata una semplice politica di tutela per settori, nel momento in cui si riconosce l'esistenza di una complessità di sistema e conseguentemente l'impossibilità di tutelare isolatamente una determinata categoria di oggetti omettendo la visione organica dei rapporti e degli equilibri che questa categoria mantiene con le altre.

PAROLE CHIAVE: Geotopi, conservazione, censimento, gestione, cave.

ABSTRACT – Up to now the politics on conservation is based upon census and most programs of protection are only concerned about a collection and organization, though more and more complete and precise, of the items belonging to the categories object of protection; these methodologies, even though careful and thorough, end up in simple lists of the single items separated from their context.
To recognize and list all the items is not sufficient to support protection choices and decisions, yet it is necessary to refer them to a system. In fact this perspective allows the selection of the most correct conservation and use plans keeping in mind the significance, the value and the role of each element.
This correct approach is used in the "Piano Territoriale Paesistico della Regione Emilia-Romagna", the Landscape Conservation Plan of the Region Emilia-Romagna, where the whole regional territory is studied, including its components and their balances, so that a diverse management is possible for eterogeneous land situations. The aim is to avoid those changes that may significantly alter or destroy the whole of caracters that define the various parts of the regional territory and the whole system balance.
When it is recognized a complexity in the system, the consequence is that it is impossible to protect a single category of items excluding the interrelationships and the balances among different categories. Concluding, a simple politics of protection of individual items appears not justified anymore.

KEY WORDS: Geotopes, conservation, census, management, quarry.

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L'approccio alla conservazione, in Italia, è ancora fortemente incentrato sulla catalogazione delle più svariate categorie di beni, tanto che ormai tale attività ricognitiva non è più condotta solo dagli enti e istituti preposti, ma correda da tempo anche la maggior parte degli strumenti di pianificazione, in particolare quelli urbanistico-territoriali.

Una tale situazione, che potrebbe sembrare a prima vista ideale premessa per la tutela e la valorizzazione degli oggetti individuati nei repertori, in realtà nulla o poco incide sulle scelte di pianificazione, in quanto gli elenchi il più delle volte assumono il ruolo di allegato tecnico con funzione documentaria, non essendo stata effettuata nessuna scelta operativa conseguente ad una valutazione su come le singole emergenze partecipano alle dinamiche delle trasformazioni territoriali indotte dalle scelte di piano.

Questo fatto ha portato di conseguenza ad una situazione paradossale e cioè quella di territori ben conosciuti, puntualmente pianificati e soggetti a vincoli diffusi (di imposizione statale, regionale e comunale spesso tra loro sovrapposti) su oggetti e beni censiti e catalogati, nei confronti dei quali non si verifica di fatto nessuna conservazione bensì massicci interventi di trasformazione, anche distruttivi. Basti pensare ai corsi d'acqua occupati da infrastrutture, alle emergenze geologiche e botaniche cancellate dalle cave, alle aree archeologiche che vengono edificate, agli edifici storici interessati da trasformazioni improprie o da effetti diretti e indiretti derivanti dalla realizzazione di altre opere: la città di Roma è un caso emblematico a questo proposito.

È pertanto necessario interrogarsi sull'efficacia dell'azione pianificatoria e gestionale, in quanto appare di tutta evidenza come l'obiettivo di conservare i beni naturali e culturali non sia semplicisticamente raggiungibile con la redazione di censimenti, nè risolvibile con l'imposizione di vincoli «amministrativi» sugli oggetti che si ritengono meritevoli di tutela ma vada affrontata su altri piani e con un diverso approccio.

Nonostante l'indubbia correttezza dell'utilizzare una catalogazione il più possibile completa e precisa degli oggetti appartenenti alla categoria che si vuole tutelare, come momento iniziale d'indagine, non si può fare a meno di constatare come tali sistemi di catalogazione, pur sempre meno empirici e scientificamente più esatti, non producano nient'altro che un elenco di oggetti indifferenziato a cui è attribuito di fatto un valore sempre omogeneo.

A ciò si può aggiungere che molto spesso non sono chiari neppure i criteri con cui vengono formati i repertori; cioè sulla base di quali motivazioni alcuni oggetti siano ritenuti meritevoli di essere inclusi nei repertori medesimi ed altri no.

A questo riguardo non si può fare a meno di pensare come attualmente non esista ancora un'univoca definizione di geotopo, nè una sistematica universalmente condivisa, nè un approccio moderno alla conservazione e alla valorizzazione delle manifestazioni e degli elementi fisici del territorio, tutt'ora ancorate a concetti obsoleti e in sostanza privi di un reale significato quali il «bene geologico», «i monumenti geologici», «le rarità geologiche», termini rinvenibili nell'attuale, vetusta legislazione di settore.

La componente ulteriore da introdurre per una diversa gestione dei «beni» in genere, siano essi geologici o di altre categorie, è perciò quello del riconoscimento del significato, del valore (intrinseco e di contesto) e del ruolo di ogni singolo elemento rispetto al complesso degli oggetti presenti nel sistema di riferimento. In tale contesto sono possibili speculazioni sulla fragilità dei singoli oggetti considerati nei termini della dinamica del sistema naturale in cui sono inseriti ed in funzione del livello di pressione esterna cui questi sono sottoposti.

Un approccio di questo tipo è stato usato nel Piano Territoriale Paesistico della Regione Emilia-Romagna, in cui si è affrontata la lettura di tutto il territorio regionale nelle sue componenti e negli equilibri tra queste, in funzione della necessità di individuare, in presenza di eterogenee situazioni territoriali, modalità di gestione differenziate, capaci di produrre modificazioni tali da non distruggere o alterare significativamente l'insieme dei caratteri e dei connotati che qualificano le diverse parti del territorio regionale.

Secondo tale punto di vista i singoli «beni» non sono cosa diversa, disgiunta o comunque enucleabile dal substrato territoriale di appartenenza, ma più razionalmente un modo semplificato di rappresentare oggetti che di volta in volta assumono configurazioni e significati prevalenti sugli altri, in funzione sia di proprie caratteristiche intrinseche che del grado di partecipazione alla definizione della connotazione complessiva di un determinato territorio.

La geologia fissa infatti sempre le condizioni di partenza ed in rapporto al regime delle acque, agli andamenti climatici, etc. si determina la morfologia la quale, a sua volta, insieme a fattori diversi quali l'esposizione, la pendenza dei versanti e l'altimetria, concorre al disporsi dell'assetto della vegetazione e. ultima, interviene l'attività antropica che in un processo di andata e ritorno è condizionata e condiziona i fattori naturali di base.

Tornando agli elenchi, non solo le situazioni che si presentano nella realtà risultano difficilmente compa-

rabili, in quanto anche oggetti teoricamente omologhi assumono valore e significato diversi in rapporto al contesto (concreto e valutativo) in cui sono inseriti, ma questa conoscenza non fornisce neppure un valido supporto per la loro gestione, in quanto sempre singolarmente riferita a ciascun oggetto.

Si portano a chiarimento di quanto argomentato due casi di studio che sono stati affrontati nell'impostazione della pianificazione delle attività estrattive a scala regionale e che hanno incidenza proprio sui cosiddetti «beni geologici» riguardanti gli affioramenti ofiolitici e le emergenze gessose messiniane.

I primi, le «pietre verdi», per via del loro colore più caratteristico, costituiscono un'associazione di rocce comprendenti gli unici prodotti di origine magmatica affioranti nel territorio emiliano-romagnolo, testimonianza dell'esistenza dell'antico oceano della Tetide.

L'importanza di questi affioramenti è molteplice, dal valore scientifico per la ricostruzione paleogeografica e geologica del nostro continente, alle associazioni mineralogiche in passato spesso sfruttate industrialmente (talco e rame), alle associazioni botaniche e floristiche che vi allignano, anch'esse assolutamente tipiche a causa della particolare composizione chimico-fisica del substrato, alle preesistenze di natura antropica. I nostri antenati scelsero queste rupi per costruirvi villaggi, posti di osservazione e castelli, molti dei quali tuttora esistenti e ben conservati come ad esempio il castello di Bardi in Provincia di Parma (fig. 1).

I gessi messiniani testimoniano l'instaurarsi, circa 7 milioni di anni fa, di una serie di lagune evaporitiche lungo il margine appenninico in connessione a particolari condizioni climatiche; nelle quali si sono depositati ciclicamente notevoli spessori di sali dando luogo alla cosidetta «vena del gesso», come oggi noi la vediamo in forma di rilievi collinari e montani.

Gli affioramenti gessosi sono di eccezionale interesse naturalistico oltre che storico e archeologico; ad essi infatti si accompagnano forme e fenomeni carsici (grotte, doline, inghiottitoi, etc.), una flora tipica di ambienti freddi e della macchia mediterranea nelle parti sommitali delle rupi, una fauna molto varia e ricca, in particolare quella legata all'ambiente ipogeo (chirotteri), minerali gessosi, soprattutto i geminati e i limpidi cristalli a ferro di lancia esposti in tutti i musei del mondo, stazioni preistoriche e protostoriche (una per tutte la grotta e il sottoroccia del Farneto presso Bologna), giacimenti paleontologici, oltre a forme insediative assolutamente tipiche.

Il gesso è stato altresì storicamente utilizzato come materiale da costruzione dall'uomo (come ad esempio nell'antica cinta muraria di Bologna e nel basamento delle torri bolognesi) determinando intense trasformazioni del paesaggio originario.

La decisione finale a cui la Regione è pervenuta è stata, per i gessi messiniani, quella di procedere alla progressiva chiusura di tutte le cave esistenti concentrando l'attività in un unico polo regionale indentificato nella cava ex Anic di Riolo Terme e Casola Valsenio - Ravenna (fig. 2) e per gli ammassi ofiolitici di sele-

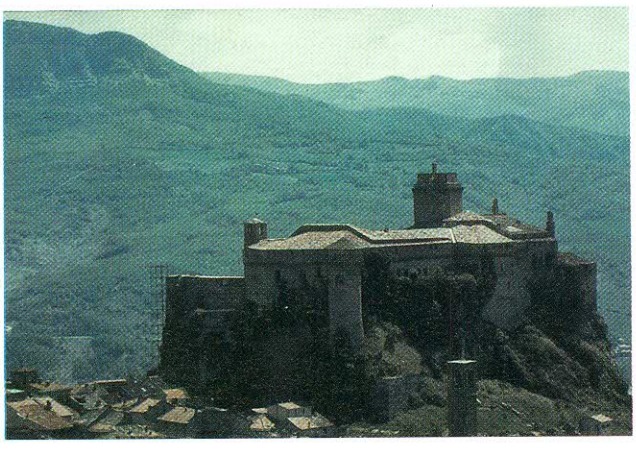

Fig. 1. – Il maestoso castello di Bardi (PR) domina l'alta valle Ceno dall'alto di una rupe di diaspro rosso.

– The stately Bardi castle overlooks the high Ceno valley from the top of a red jasper rock.

Fig. 2. – Le imponenti bancate dell'ex Cava ANIC di Monte Tondo (RA), unico polo regionale per l'estrazione del gesso.

– The grand reefs of the former ANIC Quarry at Monte Tondo (RA), the only regional pole for digging out of gypsum.

zionare per l'attività estrattiva gli affioramenti, posti in realtà territoriali anche molto diverse, il cui sfruttamento determinava nel complesso un impatto ambientale minore, ma soprattutto evitava la perdita dei caratteri tipici dei territori connotati dalla presenza di tali rocce.

A queste due scelte strutturalmente diverse, ma analoghe, dovendosi decidere in ambedue i casi quali affioramenti salvaguardare dalle attività estrattive, si è pervenuti attraverso una riflessione i cui fondamenti principali riguardano:

– l'esigenza di attribuire una scala di valori agli oggetti presenti nei repertori, che nasce da un bilancio complessivo, attento sia ai caratteri propri dell'oggetto che a quelli di relazione intrattenuta con gli altri oggetti appartenenti alla stessa categoria;

– la necessità di conoscere le dinamiche evolutive che determinano il grado di modificazione del sistema ambientale nel suo complesso;

– l'inefficienza di decisioni assunte di volta in volta sui singoli oggetti, che non consente di tenere sotto controllo la sommatoria delle trasformazioni autorizzate;

– l'opportunità di non porre le questioni solamente sotto un determinato profilo, ma di estendere le valutazioni al complesso delle opzioni possibili; ad esempio, non ridurre il problema del fabbisogno estrattivo alla sola scelta tra lo sfruttamento delle ghiaie e sabbie alluvionali ed i cosidetti materiali alternativi, ma affrontare tutti i settori che possono influenzare le decisioni finali come quello della progettazione, delle tecniche costruttive, dei capitolati speciali d'appalto, delle scelte dei modi di trasporto, etc.

In conclusione, si ritiene che oggi non si giustifichi più una politica di tutela «per settori» o «per punti di eccellenza», con riferimento a beni ambientali, culturali, naturali o paesaggistici, nel momento in cui si riconosce l'esistenza di una complessità più generale, di sistema, ma soprattutto in quanto non efficace a salvaguardare la fisionomia e la fisiologia di un qualsiasi territorio, il deterioramento complessivo del quale si riflette inevitabilmente anche su quegli oggetti che tanto accuratamente abbiamo catalogato.

Procedendo con l'impostazione attuale, l'unico risultato che si potrà ottenere sarà quello di produrre repertori che certificano lo scarto tra ciò che esiste ad una certa data con ciò che esisteva in epoche precedenti.

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Creation of a database of the geological heritage of Russia with use the computer information retrieval system

Creazione di un database del patrimonio geologico della Russia con l'utilizzo di un sistema informativo

VDOVETS M.S. (*)

ABSTRACT – For creation of a database of geological heritage sites (geosites) the itemized data list on geosites is developed. This list includes: the geographical location of the geosite, the history of its investigation, brief characteristic of the geosite, the type and subtype of the geological heritage, the level of significance using geological criteria, the official and proposed status of the geosite, a category of international registration, danger factors, the use of the geosite, non-geological importance, bibliography, etc. All of these data enable one to receive the comprehensive characteristic of a geosite. The data about geosites are stored in an information retrieval system (IRS). The system permits the correction of information, search on 20 most significant attributes and printing documents of various types by the user's inquiry.

KEY WORDS: Information retrieval system, database, geological heritage, geosites.

RIASSUNTO – Per la creazione di un database dei siti per il patrimonio geologico (geositi) viene sviluppata la lista dettagliata di dati sui geositi. Questa lista comprende: la collocazione geografica del geosito, la storia del suo studio, una breve descrizione del geosito, il tipo ed il sottotipo del patrimonio geologico, il livello di significatività utilizzando criteri geologici, lo *status* ufficiale e proposto del geotopo, una categoria di registrazione internazionale, i fattori di pericolo, l'utilizzo del geotopo, l'importanza non-geologica, la bibliografia, ecc. Tutti questi dati permettono di ricevere le comprensive caratteristiche di un geotopo.
I dati riguardanti i geositi sono archiviati in un sistema di recupero delle informazioni (IRS). Il sistema consente la correzione delle informazioni, la ricerca sui venti attributi più significativi e la stampa di documenti di vario tipo a richiesta dell'utente.

PAROLE CHIAVE: Sistema di recupero informazioni, campi dati, patrimonio geologico, geositi.

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1. – INTRODUCTION

In Russian Federation some federal acts dealing with the geoconservation were accepted. According to these acts geological heritage can be under the protection in a structure of protected natural territories of different categories: natural reserves, natural partial reserves, national parks, natural parks, natural monuments, health resorts and other kinds of sanitation territories, historical and cultural reserves, museums and museums complexes, archaeological monuments (LAPO & VDOVETS, 1996). The protected territories, including geosites may be of federal, regional and local significance.

In 1992 the Council for the Study and Conservation of the Cultural and Natural Heritage was founded at the Russian Academy of Sciences; geologists are among its members.

At present at the All-Russian Geological Research Institute (VSEGEI) a database and the map of location of geosites of Russia is being created (LAPO *et alii* 1993). The computer information retrieval system is developed for the creation of a database of geosites. Description of the geosite is realised by filling the list of itemized data. The Author has proposed the following list of itemized data on geosites:

1. The geosite number
2. The geosite name
3. The name of the spatially related group of geosites
4*. The name of a geological region
5*. The administrative address
6. Geographical position
7*. The number of the geological map sheet with scale 1:200000
8*. Co-ordinates
9. Elevation mark (in m)
10. Brief characteristic of the geosite
11*. The history of investigation of the geosite
12*. Scientific and training excursions to the geosite
13*. Accessibility
14*. The degree of exposure
15*. The type and subtype of the geological heritage
16*. The dominant type
17*. The geological age
18. Radiogeological age
19*. A category of protected territory
20*. The level of significance using geological criteria
21*. The official status of the protected territory
22*. The official status of cultural object
23. The document on the status
24*. The proposed status of the geosite
25*. A category of international registration
26*. Danger factors
27*. Protection category
28*. The use of the geosite
29*. Availability of an exposition on the geosite
30*. The places of storage of collections
31. Non-geological importance (the geosite may be also botanical, landscape, historical and cultural)
32*. Bibliography
33*. Key words
34. The author of the description

2. – DICTIONARIES

For the majority of items, labelled by asterisks, lists of variants which the author names dictionaries have been elaborated. Two types of dictionaries are distinguished: one with data coding and another one without it. Data input into electronic catalogue have been made from corresponding dictionaries by selecting required information. For the items which have no dictionaries (the geosite name, brief characteristic of the geosite, non-geological importance, etc.) a keyboard input have been used. The database structure is illustrated in fig. 1.

Let us consider some examples of dictionaries. The territory of Russia is divided into several regions according to geological structure. The dictionary 4 "Name of a geological region" includes all of them.

For creating dictionary 11 "History of investigation of the geosite" it was taken into consideration, that the geology began to develop in Russia since 1825. The Russian Geological Committee was established in St-Petersburg in 1882.

Dictionary 11
History of investigation of the geosite

Known before 1825
Described in the period from 1825 till 1882
Studied by famous scientists after 1882
Served as the base of creation of the new theory
The first find of geological phenomenon

The geosites may be used as the object of different kind of excursions. The dictionary 12 "Scientific and training excursions to the geosite" looks as follows:

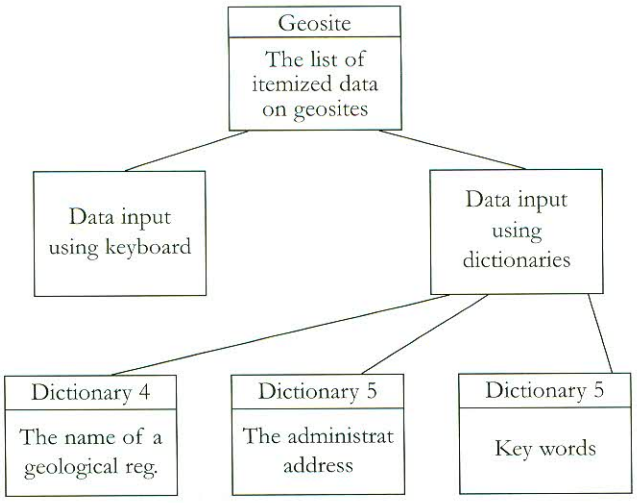

Fig. 1. – The database structure.

– *L'architettura logica del sistema informativo.*

Dictionary 12
Scientific and training excursions to the geosite

Excursions of International Geological Congresses (IGC)
Excursions of International conferences
Excursions of other conferences and congresses
Student training
Excursions and student training were not conducted
No data

For the organization of excursions to the geosite the accessibility should be considered.

Dictionary 13
Accessibility

Easily accessible (available to reach by common transport)
Accessible (one-day trip is necessary)
Difficulty of access (more then one-day trip is necessary)
Very difficulty of access (transport as a plane or a helicopter is necessary)

An important characteristic of the geosite is the degree of exposure. The appropriate dictionary looks as follows:

Dictionary 14
Degree of exposure

Full
Satisfactory
Not satisfactory
Artificial exposure

Dictionary 15
"Type and Subtype"

For creating dictionary 15 "Type and Subtype" it was taken into consideration that geological heritage has been classified into the types and subtypes according to specific geological disciplines (LAPO & PASHKEVICH, 1996). 16 types are established such as:

01. Stratigraphic
02. Paleontological
03. Mineralogical
04. Ore-Petrographical
05. Geochemical
06. Radiogeological
07. Neotectonic
08. Paleotectonic
09. Structural-geological
10. Cosmogenical
11. Geothermal
12. Paleoenvironmental
13. Geocryological
14. Geomorphologic
15. Hydrologic-hydrogeologic
16. History of geology and mining

Each of the types mention above is divided into subtypes. For example, ore-petrographical type (04) is divided on following subtypes: 0401 - localities of sedimentary rocks and ores; 0402 - localities of magmatic rocks and ores; 0403 - localities of metamorphic rocks and ores; 0404 - localities of coptogenic rocks and ores; 0405 - localities of hydrothermal-metasomatic rocks and ores; 0406 - localities of weathering crust and hypergenic ores.

Dictionary 16
Dominant type

The dictionary 16 "Dominant type" includes all of these types of the geological heritage. Usually several types are manifested in one geosite, moreover they have different ranges according to geological criteria.

The types which have the highest range in the geosite are considered as dominant ones.

Dictionary 17
The geological age

For creating dictionary 17 "The geological age" it was taken into consideration that the age is defined according to stratigraphic units: erathems for Precambrian (excluding Vendian), series for Vendian and Phanerozoic, divisions for Quaternary.

The dictionary 19 "Category of protected territory" looks as follows:

Dictionary 19
Category of protected territory

1. Natural reserves
2. Historical and cultural reserves, museums and museum's complexes
3. Natural partial reserves
4. National parks
5. Natural parks
6. Health resorts and other kinds of sanitation territories
7. Natural monuments
8. Archaeological monuments
9. Other kinds of protected territories
10. Not protected territory

The geological heritage is being ranked into levels of significance using geological criteria. The dictionary 20 includes all of these levels of significance.

Dictionary 20
Levels of significance using geological criteria

Global
Subglobal
Regional
Local

In accordance with the existing official status the dictionary 21 was created.

Dictionary 21
The official status of the geosite

Federal
Regional
Local
No official status

In some cases the official status may be recommended to be changed. For this purpose dictionary 24 is offered.

Dictionary 24
The proposed level of the geosite

World
Federal
Regional
Local

The geosite can have various categories of international registration. The appropriate dictionary looks as follows:

Dictionary 25
Category of international registration

1. The geosite is offered in the "Global Indicative List of Geological Sites (GILGES)"
2. The geosite is included in GILGES
3. The geosite is offered in the Database of Geosites
4. The geosite is included in the Database of Geosites
5. The geosite is offered in the World Heritage List (WHL)
6. The geosite is included in WHL
7. UNESCO Biosphere reserve
8. Territories, protected together with foreign countries
9. The geosite is not registered in any official international system

For organization of protection of geological heritage it is necessary to know the danger factors.

Dictionary 26
Danger factors

1. Mining
2. Construction

3. Danger of flood
4. Natural destruction
5. Change of thermal regime
6. Other kinds of economic activity
7. No danger

Geosites are classified in three categories of protection. The first category comprises those geosites that can be valuable both for commerce and sample collection. The second category of protection includes geosites with special scientific importance. The third category of protection covers geosites important for tourism and study. Dictionary 27 "Protection category" looks as follows:

Dictionary 27
Protection category

1. Especially strict protection
2. Limited protection without recommendation for tourism
3. Limited protection with recommendation for tourism

The geosites can be used for different purposes. With this object in view the dictionary 28 was created.

Dictionary 28
Use of the geosite

1. For research purpose
2. For organization of scientific excursions
3. For didactic purpose
4. For recreation purpose
5. For medical purpose
6. Not used

Sometimes there is a museum exposition on the geosite. For this case the dictionary 29 is offered.

Dictionary 29
Availability of an exposition in the geosite

1. Museum exposition on the geosite
2. No museum exposition in situ

3. – THE FUNCTIONS OF THE SYSTEM

The system works with computers IBM compatible, with an operating system MS DOS 3.3 and above, with RAM not less 640 Kb. Necessary volume of disk memory for the system is 3 Mb. The following languages are used: Clipper 5.01 and Microsoft C 5.1. The amount of writing is unlimited. The system is convenient in use. The dictionaries and list of itemized data on geosites can be edited and supplemented if necessary.

The system permits one to execute input, storage, editing, search for information, various variants of its output, printing of documents of different kinds. In the system the circuit of storage of the information, ensuring variable length of field and repeatability of fields is realised.

Data of items NN: 19, 25, 28, 29 see in corresponding dictionaries.

Data of item N15: 0305 - mineralogical type, subtype: localities of great diversity of minerals; 0402 - ore-petrographical type, subtype: localities of magmatic rocks and ores; 0403 - ore-petrographical type, subtype: localities of metamorphic rocks and ores; 1417 - geomorphologic type, subtype: prepared intrusive bodies; 1419 - geomorphologic type, subtype: tectonic landforms. Data of item N16: 04 - ore-petrographical type.

The information search in the electronic catalogue can be conducted on 20 the most significant attributes: the number of the geosite, name, region, administrative address, number of the map sheet, type and subtype, dominant type, geological excursions, accessibility, geological age, level of significance using geological criteria, category of protected territory, the official status, category of international registration, protection category, use, places of storage of collections, the author of the description, key words. The search with expansion, refinement, denying is possible. The example of description of the geosite Lapland Biospheric Reserve is given in Tab. 1.

The data exchange with local, regional and international systems is possible due to built-in format MARC. At present the author considers the possibility of presentation of this system in Internet.

The use of the proposed IRS will allow us to include unique information on Russia geosites into the World geological heritage, to provide their systematisation, more comprehensive study, and their conservation in the end.

TAB. 1. – Display view IRS by the example of geosite Lapland Biospheric Reserve

– Vista al video del sito Lapland Biospheric Reserve

GEOSITE INFORMATION

1 . Geosite number: **1**
2 . Geosite name: **Lapland Biospheric Reserve**
3 . Name of the spatially related group of geosites: **No**
4*. Name of a geological region: **Baltic Shield**
5*. Administrative address: **Murmansk Province**
6 . Geogr posit.: **Kola Distr. 5 km W from Monchegorsk**
7*. Number of the geological map sheet with scale 1:200000: **Q-36-III**
8*. Co-ordinates: **32°00/ E, 67°52/ N**
9 . Elevation mark (in m): **130-1100**
10 . Brief characteristic of the geosite: **Monchegorsk laminated massif with unique series of PR1 norites; AR gneisses, which are typical for Baltic Shield**
11*. History of investigation of the geosite: **studied by famous scientists after 1882**
12*. Scientific and training excursions to the geosite: **no data**
13*. Accessibility: **easily accessible**
14*. Degree of exposure: **full**
15*. Type and subtype of the geological heritage: **0305; 0402; 0403; 1417; 1419**
16*. Dominant type: **04**
17*. Geological age: **AR_1 - PR**
18 . Radiogeological age: **2500-2400 My**
19 . Category of protected territory: **1**
20*. Level of significance using geologica criteria: **global**
21*. Official status of the protected territory: **federal**
22*. Official status of cultural object: **no**
23 . Document on the status: **Act of government of RSFSR N 1201 15.11.1957**
24*. Proposed status of the geosite: **Word**
25*. Category of international registration: **7**
26*. Danger factors: **7**
27*. Protection category: **1**
28*. Use of the geosite: **2**
29* . Availability of an exposition on the geosite: **2**
30*. Places of storage of collections: **IGEM**
31 . Non-geological importance: **pattern of tundra ecol. system with diversity of animals; picturesque landscape**
32*. Bibliography: **Zapovedniki Evropeiskoy chasti SSSR (Reserves of the European Part of the USSR). Mysl Publ., Moscow, 1988, v. 1, 288 pp.**
33*. Key words: **reserve, Kola peninsula**
34 . Authors of the description: **A. Lapo, M. Vdovets**

CATALOGUE

Catalogue: **Geology**
Numbers of entered geosites: **1 - N** (1 of the last geosite)
Number of the current geosite: **1**

SEARCH ON

geosite number
geosite name
name of a geological region
administrative address
number of map sheet
type and subtype
dominant type
excursions to the geosite
accessibility
geological age
level of significance
category of protected territory
official status
category of int. registration
protection category
danger factors
use of the geosite
author of the description
key words
places of storage of collection

INQUIRY

inquiry N
selected geosites amoun

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