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*Foreword*

# Union fait la force

*by Dirk De Coster, Acting President*

Fellow Geologists,

As usual ,the second magazine of 2007 announces the end of another working year for the European Federation of Geologists. A time to look back on past activities in 2007 and forward to future events in 2008.

2007 was not only a year of confirmation but it's also clear that we are still in progress. Thanks to the efforts of the Brussel's Office, our EU delegate and the Panel of Experts, the EFG is being regarded as a full partner within the different organizations of the EEC. More and more, the EFG is asked for its opinion on matters concerning geology. This was outlined by the assignment of Stand 1 in the Green Week 2007 exhibition, "Past lessons, Future challenges". You can read more about this in the article by Isabel Fernandez and Peter Whiteside in the magazine. You'll find also an article from Herald Ligtenberg about the very successful conference on Geohazards at the end of May in Rome, where we have to thank the Consiglio Nationale dei Geologi for their excellent organization.

During the succeeding General Assembly, we were delighted to welcome Serbia and Russia as new member states. During the same meeting it also became obvious that while more and more associations are joining our Federation, we are enduring some growing pains. We have to work continously toward a more professional organization. Statutes and regulations not older than 5 years are already outdated. Procedures for council election and application for the Title of European Geologist should be rewritten emphasizing the importance of having a National Vetting Committee and, in the long term, a National Licensing Body in each member state. This should be achieved with imput from every member state of our Federation and involves responding to the questions and demands from our secretary-general. Regarding the Federation, as a Belgian citizen, I would say "Union fait la Force".

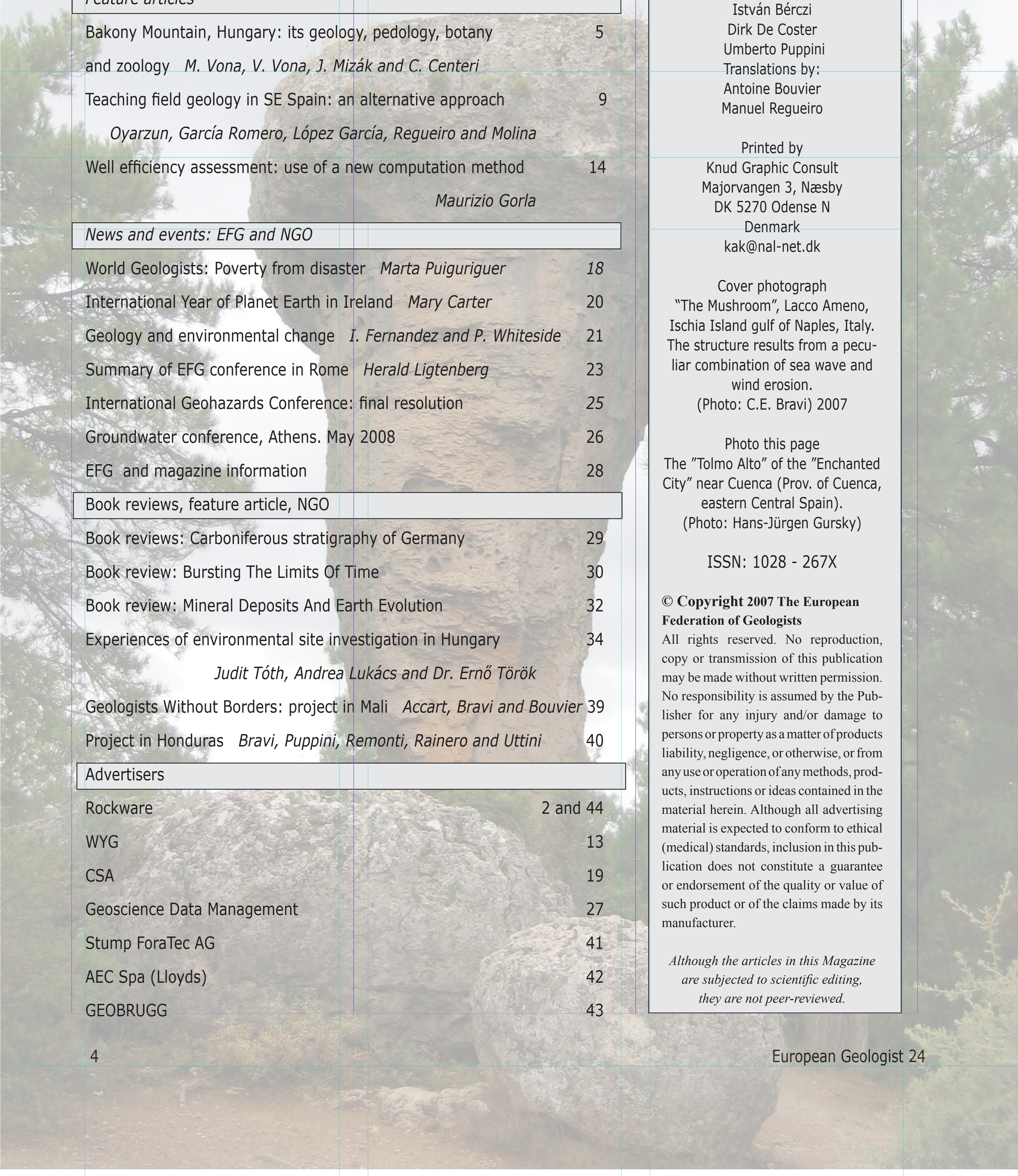
I would also like to mention the very successful TAEIX meeting in Sibiu in October. Almost 75 participants from 25 countries joined us in the 3-day workshop on "Geodiversity for the sustainable development of regions". Once again, it showed the important role EFG has to play in bringing geologists together and making them aware of future developments in using geology as a tool for sustainable development. Unfortunately time was too short to publish an overview of the results of the workshop in this magazine.

This brings us to 2008 which will be a very busy year for us geologists, being the International Year of Planet Earth. The Global Launch Event is scheduled for February 12 and 13 2008 in Paris. It should be the ideal occasion for all National Associations not only to emphasize the importance of Geology in today's society but also to promote themselves.

I hope all of you can participate as much as possible in the national events organized. Perhaps you can get some inspiration from the article by Mary Carter about "The international Year of Planet Earth in Ireland". I would also like to invite you at the end of May to the conference which will be held in Athens around the theme of Groundwater; you will find the ammouncement in this magazine. This conference will precede our general assembly. There will also be the 33rd International Geological Congress in Oslo at the beginning of August. EFG will take part in 2 workshops "Workshop 17: Sustainable mineral resource management" and "Workshop 21: Issues for geologists in the 21st century – mitigation of man's influence and serving society's needs".

Finally, we are co-organizing the 3rd International Professional Geology Conference which will be held from September 21 to 25, 2008 in Flagstaff, Arizona, USA. It will be an excellent opportunity to meet geologists from around the world to discuss the different themes of "Training, Credentials and Continuing Professional Development of the Global Professional Geoscientist" (AIPG-sponsored), "Professional Ethics and the Global Geoscientist"(CCPG-sponsored), "Expanding International Influence and Reach; Overcoming Challenges and Mapping Successful Strategies" (EFG-sponsored).

I would like to thank all geologists who in the course of 2007 have promoted geology on a daily basis working as a professional and wish all our members a healthy and successful 2008.



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Cover photograph
"The Mushroom", Lacco Ameno, Ischia Island gulf of Naples, Italy. The structure results from a peculiar combination of sea wave and wind erosion.
(Photo: C.E. Bravi) 2007

Photo this page
The "Tolmo Alto" of the "Enchanted City" near Cuenca (Prov. of Cuenca, eastern Central Spain).
(Photo: Hans-Jürgen Gursky)


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# Bakony Mountain, Hungary: its geology, pedology, botany and zoology

*by Márton Vona[1], Viktória Vona[1], József Mizák[2] and Csaba Centeri[1]*

The Eperjes Hill is situated in the heart of the Bakony Mountain, Hungary. Geological and soil profiles, land use, vegetation and insects were described in a less than 1 sq. km. area. The Eperjes Hill can be characterized by carbonate-rich platform formations. The periglacial loess fills the southern side of the hill. There were significant changes in the land use, most of the area was covered by forest in 1783. During the 20th century the proportion of forested areas decreased. Pedological investigations revealed Luvisols, Cambisols, Leptosols and Colluviums. The Eperjes Hill can serve as a geological study site.

La colline des Eperges est située au cœur de la montagne du Bakony, en Hongrie. Sur moins d'un kilomètre carré, ont eu lieu des levés géologiques, des études de sols et d'occupations de sols ainsi que des relevés botaniques et entomologiques. La colline des Eperges peut être caractérisée par des formations riches en carbonates. Le loess d'origine périglaciaire recouvre la partie méridionale de la colline. Des modifications importantes ont concerné l'occupation des sols puisque la majorité du secteur correspondait à une forêt en 1783. Pendant le 20ème siècle, la surface des zones boisées a rétréci. Des recherches pédologiques ont révélé la présence de luvisols, de cambisiols, de leptosols et de colluvions. La colline des Eperges peut être utilisée comme un site géologique test.

La colina Eperjes está ubicada en el corazón de la montaña Bakony en Hungría. Se han descrito los cortes geológicos y los perfiles de los suelos, el uso del suelo, la vegetación y los insectos en una superficie de menos de 1 km2. La colina Eperjes se caracteriza por formaciones de plataforma carbonatada. La parte sur de la colina está rellena por un loess periglaciar. Hubo cambios significativos en el uso del suelo, ya que la mayor parte de la zona estaba cubierta por bosques en 1783 pero durante el siglo 20 la proporción de zona boscosa disminuyó. La investigación pedológica ha revelado la existencia de luvisoles, cambisoles, leptosoles y coluviones. La colina Eperjes puede servir como una zona para estudios geológicos.

The Eperjes Hill is situated in the Carpathian Basin, in the heart of the Bakony Mountain, on the Eastern side of the Veszprém-Győr highway, in the synclinal axle of the Trans-Danubian Middle Mountain Range , next to Olaszfalu village (Fig. 1). Detailed research was carried out on less than 1 sq. km. area. Geological and soil profiles, vegetation and insects were described in the area (Császár *et al*., 2002). The hill is Mesozoic limestone and the foothills are characterized by slope loess.

The climate of the examined area is slightly cool, slightly moist. The average annual precipitation is usually above 750 mm, the average annual temperature is 9.0 - 9.5°C, the amount of sunshine is 1850 -1900 hours.

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*Figure 1. The location of Eperjes Hill (Eperjes-hegy) in the Transdanubian Mountains*

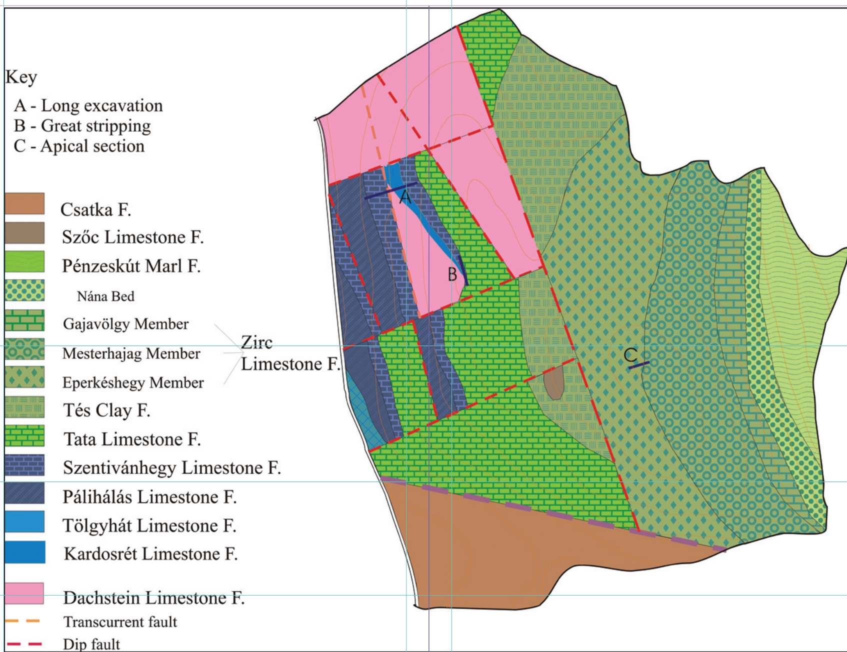


*Figure 2. Geological overview map of the Eperjes Hill with the position of the profiles, A, B and C*

To develop the Eperjes Hill, the local government of Olaszfalu prepared a landscape-use plan and reconstruction of the surface mining site on the hill in 2001 (Gellai, 2001a, b). The field work started in 2002. The main aims of the project were to provide scientific data for a study trail on the Eperjes Hill, giving full geological, pedological and botanical descriptions as well as an introduction to the landscape. This way the main landscape components were introduced in a detailed way, showing their interconnection.

**Materials and methods**

Császár (1988) prepared 3 geological profile drawings of the Eperjes Hill. These profiles were opened in 1964: EH-A and EH-B (Hosszú-árok = Long-pit) and EH-C (Tetői szelvény = Plateau profile). These geological profiles brought public awareness to the Eperjes Hill; thus the number of geologist visitors increased.

During our investigations we examined the available military survey maps of 1783, 1852, 1882-1929 (scale: 1:28800), the basic maps of 1951, 1970 and 1982 (scale: 1:10000) and the aerial photographs of 1960, 1977 and 2001. Aerial photographs provide interesting details about the history and the changes of the vegetation of the area in the last 40 years.

Pedological investigations were done with Pürckhauer type core sampler (Finnern, 1994). Soil thickness data were collected with a special metal needle that was prepared at the Szent István University, and tested on the Eperjes Hill. During the pedological investigations, the aim was to prepare a 1:5000 scale soil map.

Botanical descriptions were done following the Braun-Blanquette methods in three replicates.

**Results**

*Geological description of the area*

The area examined belonged to one of the ridges, in an uplifted position, of the Tethys Ocean, forming its Western slope in the Mesozoic era. The hill slope was built up from various, mainly Middle and Upper Mesozoic, maritime formations. These formations are described in three geological profiles (Fig. 2).

*Description of EH-A profile*

EH-A profile is situated on the Western slope, heading through a North-West basculating fault. West of here a Jurassic sequence can be found with an almost continuous slope and basin facies. It starts with a Mid-Jurassic ammonitico rosso facies, lenticular Tölgyháti Limestone Formation that can be found on the surface at the bottom of the slope. From this formation the "Pálihálás" Limestone with Kimmeridge saccocome was formed with continuous transition. It has ammonitico rosso facies, too. The next layer is the "Hierlatz" facies of the Szentiván Hill Limestone, the Szélhegyi Limestone Division, rich in ammonites, crinoidea and brachiopoda.

Only shreds of Jurassic formations can be found on the ridge, east of the basculating fault in the research pit (Fig. 2). On the surface, in ridge-edge position, scarp breccia type Hettang "Kardosréti" Limestone Formation forms the basis with blocks that contain white, yellowish or pinkish, 4-8 mm diameter oncoids. In its various orientation crevices and in smaller blocks, a light red, Middle-Lias "Hierlatzi" Limestone Formation (rich in crinoids) can be found.

In some parts of the profile (filling in the gap of the "Kardosréti" Limestone and in the eastern part of the profile) a 6-7 m thick, strongly lacunar "Szentivánhegyi " Limestone can be found (Haas *et al*., 1988). It is basically micrite based, poor in macrofossiles and rich in gap filling horizontal layers rich in Calpionella species.

*Description of EH-B profile*

Northwest of the profile, in EH-B (Fig. 2) similar to the eastern part of the previous profiles (east of the basculating fault line) an extremely lacunar Jurasic - Lower Cretaceous sequence can be found, 3 m above the Triassic (Dachstein Limestone) and Liassic platform limestone ("Kardosrét" Limestone) and "Hierlatz" Limestone blocks.

In the western part of the area "Dachstein" and "Kardosrét" Limestone can be found everywhere on the surface, forming 3 m thick breccias. The formation of the local "Szentivánhegy" Limestone is the same as the one on the eastern part of the EH-B ("Long-pit"). In its overlying bed and in other places, continuously above the blocks of Dachstein Limestone, after a considerable undersea deposit interstice, a tabular, brachiopod, crinoid Tata Limestone Formation has settled that is a characteristic formation of the southwestern slope of Eperjes Hill.

*Description of EH-C profile*

The EH-C profile on the so-called "Tető" (plateau) starts with natural cliffs and continues with man-made clearings (Fig. 2) revealing the younger Mesozoic features of Eperjes Hill (strongly karstic Urgon facies of "Zirc" Limestone Formation). In its lower member, the rudist mussels (mostly Agriopleura species) can be found in rock forming amounts. Orbitolinas appear in this layer but most of them are characteristic of the Middle Cretaceous member.

The Middle Albai "Tés" clay marl is only known from drillings, situated between the Tata and Zirc Limestone. This is the starting member of the Middle Cretaceous deposit layer that follows the formation of the Tata Limestone and the dry period. Below the clay marl east of the Eperjes Hill in the karstic bolsons of Dachstein Limestone, smaller lens of the "Alsópere" Bauxite were formed. On the lower part of the East Eperjes Hill appear the upper debris members of the "Zirc" Limestone mainly composed of Echinoidea species. This is followed by the Late Albai period (Stoliczkaia dispar zone) when the (at least) 150 m eustatic (global) water level rise resulted in the formation of the glauconitic "Pénzeskút" Marl rich in ammonites.

**Reconstruction of the geologic history**

Based on the brief description of profiles EH-A, Eh-B and EH-C, the genesis of the Eperjes Hill can be summarized (Fig. 3). The basement is characterized by the carbonate-rich platform formations, the "Rhaet" Dachstein Limestone and "Lias" "Kardosrét" limestone, the later formed in deeper water platform. In the Sinemur, the carbonate platform was broken up and the fragments sank unevenly. This is the time of the formation of the "Hierlatz" Limestone, basically appearing in crack fillings. During the Early Jurassic, on the forming palaeo-slope of the western side of the hill, a decreased unconformity succession was developed. A characteristic member is the "Toarc" anoxic event resulting in the manganese ore appearing on the surface of the "Kardosrét" Limestone. On the palaeoslope almost all elements of the Middle and Upper Jurassic succession were developed.

At the edge of the ridge, spatial differentiation increased with the opening of the Ligur Ocean in the Middle Jurassic period that caused the collapse of most of the steep cliff and the huge blocks of the "Dachstein", "Kardosrét" and "Hierlatz" Limestone were accumulated as scarp breccia along the bottom of the slope (Császár *et al*., 2002). According to Galácz and Vörös (1989), the formation of the breccia is Late Jurassic but sedimentology does not prove their theory. Above the megabreccia, an unconformable layer of the Upper Jurassic and Lowest Cretaceous "Szentivánhegy" Limestone and/or the "Apt" "Tata" Limestone was formed, forming a barely 300-400 m wide zone, but still overlapping the breccia zone to the east.

The formation of the "Tata" Limestone was followed by the synclinal formation of the Trans-Danubian Middle Range Mountain, the area was changed to terra firma and – during the Middle Albai – the bauxite accumulation of the karstic surface.

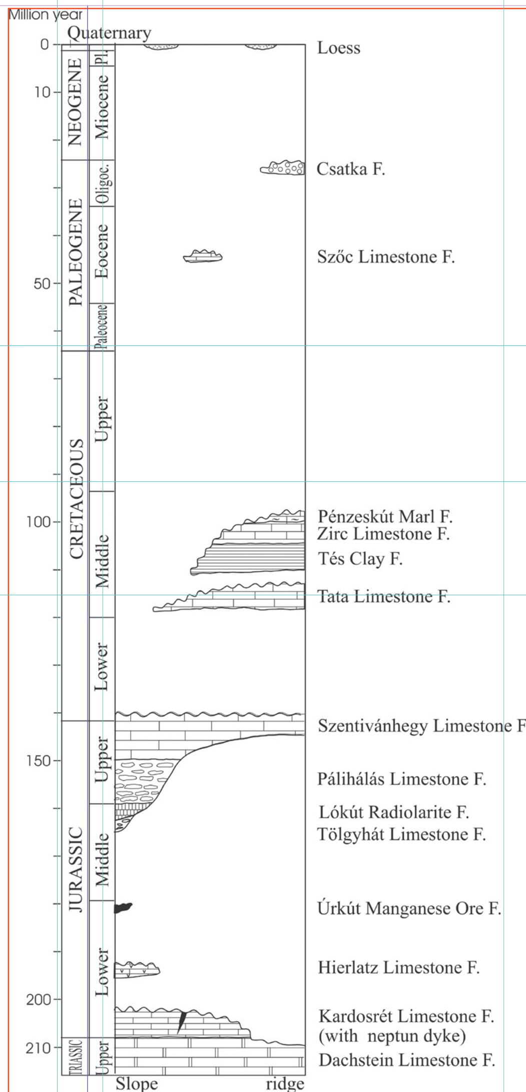


*Figure 3. Geological succession of the Eperjes ridge and its western slope*

The eastern transgression was introduced by lacustrine-paludal sediment formation, followed by "Urgon" facies carbonate platform formation and fast choking. The youngest member of the sediment cycle is the formation of the hemipelagic "Pénzeskút" marl caused by the Late Albai eustatic sea level rise.

There is almost no sign of younger events. Nummulites species appears in the soil as the sign of the Eocene west of the plateau, while south of Eperjes, the Oligocene "Csatka" Formation is known. The periglacial loess fills the southern side of the Eperjes Hill.

**Land use change, historical resources**

On the first military survey map (1783) the area was covered by forest with no sign of pastures or meadows.

On the second military survey map (1852) the area was covered by pastures and it was partly used as arable land. Forests were only left in the plateau region and at the foothills. Based on the new pedological investigations we can state that shallow soils were used as pastures and deeper brown forest soils were used as arable land.

The third military survey map (1882) was renewed in 1929. The proportion of the forests decreased, most of the hill being used as pasture. Single trees were left on the pastures, important from the point of view of landscape and nature protection.

Based on the analyses of the 1951 (scale: 1:25000) map there was no change in the vegetation. There are signs of illegal mine pits on the hill. They were not visible on earlier maps. We date the degradation of the Eperjes Hill from this time.

The whole surface of the hill is pasture with trees on the first (1960) aerial photo. The group of trees and bushes can be easily separated.

Degradation of the area continues until 1970. We can separate smaller mine pits and two bigger mines on the east side on the 1970 map. The decrease of pastures is also visible.

There are visible changes in land use and vegetation on the second aerial photograph (1977). Grazing ceased and natural reforestation is visible on the southern side of the hill. The area of bushes is increasing, together with the reforestation as part of the natural succession. The photo shows the landscape wounds caused by illegal mining. Geological profiles (EH-A, B, C) opened by the Geological Institute of Hungary (MÁFI) in 1964, became visible. The same tendency of reforestation and growing mining activity can be seen on the 1982 map.

Further changes can be detected on the 2001 aerial photograph. Geological profiles are covered by bushes and can hardly be recognized. The southern slope of the hill is reforested, with the earlier single trees on the pastures surrounded by bushes.

**Pedological investigations and vegetation mapping**

During the investigations we mapped

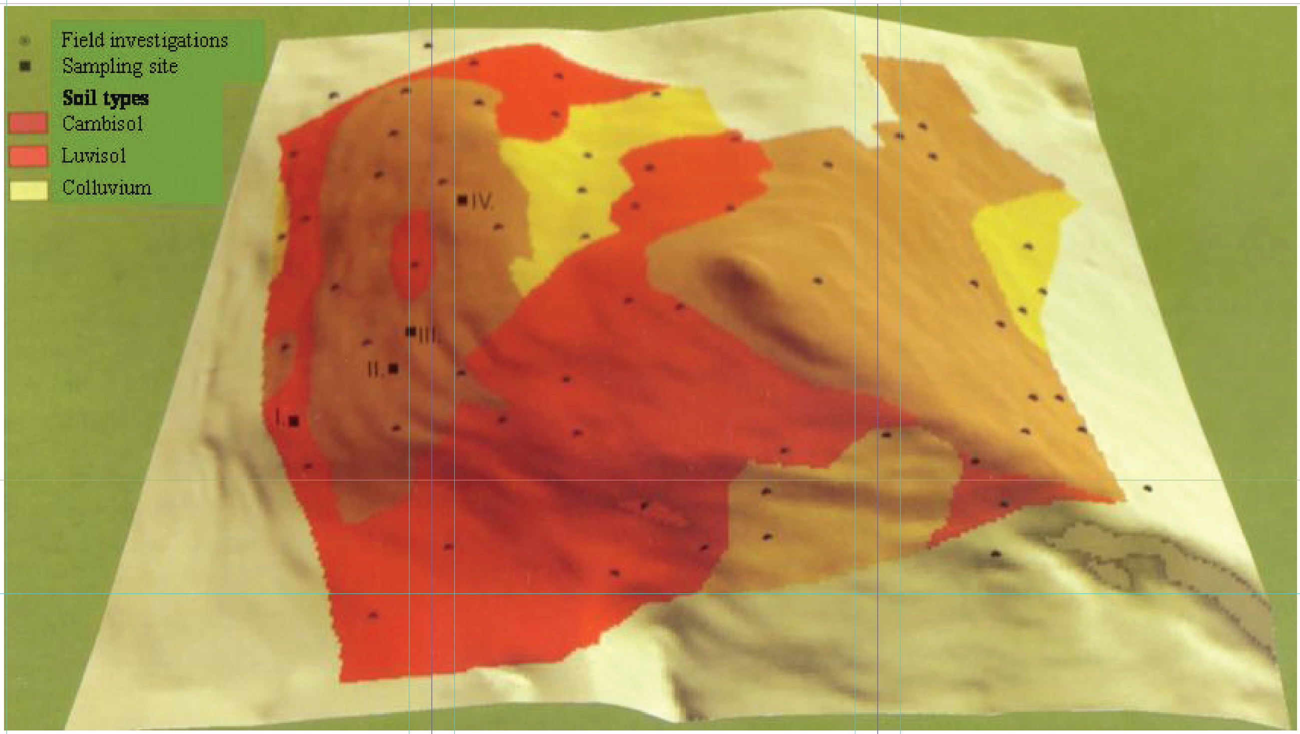


*Figure 4. Three-dimensional soil map of the Eperjes Hill (Luvisols in red, Regosols in brown and Colluviums in yellow.*

Luvisols, Cambisols, Leptosols and Colluviums (Fig. 4). Luvisols were mainly under the forests. Where there are meadows on the aerial photographs, we mapped shallow soil types (called rendzina in Hungary and the surrounding countries).

At the time of investigation, soil and vegetation are related in the area. The reason is that the hill was not under use except for mining after grazing ceased. The hill has undergone natural revegetation and forest did not grow on areas (naturally) where there were shallow soils because of the peculiar water regime in these areas (easily dries out). During the detailed vegetation mapping we described four, well distinguishable meadow vegetation types in an area with shallow soils. These findings suggest that plant-soil relations should be further investigated (Penksza 1992, 1995a, 1995b).

The following plant associations were found on the area: Quercetum petraeCerris and Querco petraeae-Carpinetum forest associations with *Rosa canina*, *Rubus spinosa*, *Rubus* ssp. species; and Cleistogeno-Festucetum rupicolae and *Festuca valesiaca* dominant meadows.

**Options for recultivation, land use**

Living in the Hungarian countryside is not easy since there is a decreasing chance of finding a good job. This is the reason why people move to bigger cities. Meanwhile there are increasing numbers of people who want to spend their weekends and holidays in remote areas, far from cities.

The Eperjes Hill offers the possibility of starting grazing again that not only provides job opportunities for shepherds but for other local people, too. The Eperjes Hill can be used in a complex way; it can serve as a geological study site and can introduce biological and cultural values. The beauty of the landscape and landscape wounds can be examined together. Traditional land-use in a semi-natural, semi-cultural landscape can be very attractive for visitors.

As a first step we created a study tour that forms the main part of a nature park. It introduces the geological history of the hill, the soil types and the characteristic vegetation. With the re-introduction of grazing, a sustainable way of traditional land use could be possible.

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# Teaching field geology in SE Spain: an alternative approach

*by Roberto Oyarzun[1]*, Emilia García Romero[1], José Angel López García[1], Manuel Regueiro[1,2] and José Antonio Molina*

The Department of Crystallography and Mineralogy (Complutense University, Madrid) carries out every year a field geology course in San José – Rodalquilar (Almería, SE Spain. The region of Almería offers a unique opportunity for the teaching of field geology because of the variety of contrasted geologic scenarios: 1) Alpine metamorphic complexes; 2) Miocene sedimentary basins; 3) Miocene volcanic rocks including world-class pyroclastic deposits of almost every possible type; 4) epithermal gold and industrial minerals deposits; and 5) a second-to-none large fault zone (Carboneras Fault Zone, Serrata de Níjar). However, what makes different our field geology course is the fact that the students, in teams of 3 to 4 members, simulate a professional survey. Given that most students will end up working for companies, it is important that they receive some practical training before they leave the university.

Le Département de cristallographie et de minéralogie de l'Université de Madrid effectue chaque année une sortie/cours de géologie sur le terrain dans le secteur de San José – Rodalquilar (région d'Almeria, au Sud-est de l'Espagne). Cette région offre l'occasion unique d'un enseignement de géologie de terrain en raison de la diversité des contextes géologiques, très contrastés : 1) les formations métamorphiques complexes des Alpes, 2) les bassins sédimentaires miocènes, 3) les roches éruptives du Miocène comprenant tous les types de dépôts pyroclastiques répertoriés, 4) l'or de type épithermal et les dépôts de minéraux industriels, 5) une zone de failles majeures (zone faillée de Carboneras, Dentelle de Nijar). Cependant, ce qui fait l'originalité de ce cours de géologie est que les étudiants, par groupe de 3 ou 4, accomplissent un travail équivalent à une étude professionnelle. En considérant que la plupart des étudiants vont travailler au sein de compagnies, il est important qu'ils reçoivent une formation pratique avant de quitter l'université.

El Departamento de Cristalografía y Mineralogía de la Universidad Complutense de Madrid realiza anualmente un curso de geología de campo en San José – Rodalquilar (Almería, Sureste de España). La región de Almería ofrece una oportunidad única para la enseñanza de la geología de campo ya que en ella encontramos una gran variedad de escenarios geológicos: 1) complejos alpinos; 2) cuencas sedimentarias del Mioceno; 3) rocas volcánicas del Mioceno con extraordinarios ejemplos de diferentes tipos de depósitos piroclásticos; 4) yacimientos epitermales de oro, yacimientos de bentonitas, alunita, y zeolitas; y 5) una gran zona de falla (Zona de Falla de Carboneras, Serrata de Níjar). Sin embargo, lo que hace diferente nuestro curso de campo es el hecho de que los alumnos, en equipos de 3 o 4 miembros, simulan estar realizando un trabajo profesional. Dado que la mayor parte de los alumnos acabará trabajando para alguna empresa, nos parece importante que reciban alguna formación práctica antes de que acaben la carrera.

***"Education should include knowledge of what to do with it …" (Anonymous)***

The province of Almería in southeast Spain offers a unique opportunity for the teaching of field geology because within a relatively small area, one may find a variety of contrasted geologic scenarios: Alpine metamorphic complexes of Palaeozoic to Triassic age, Miocene sedimentary basins, a Miocene volcanic block comprising a whole calc-alkaline suite with andesites, dacites and rhyolites, superb pyroclastic deposits of almost every possible type, epithermal gold and industrial minerals deposits (bentonites, zeolites, alunite), and a second-to-none fault zone running ENE-WSW (Carboneras fault zone) (Fig. 1). The Department of Crystallography & Mineralogy (Faculty of Geological Sciences, Complutense University; Madrid) has been running a field geology course in this realm for seven years. We conduct a regional survey followed by detailed mapping of specific zones. So far, nice mapping within a beautiful geological scenario; however, what makes these activities different is the fact that the students, in teams of 3 to 4 , simulate a field survey for either an exploration (Kondor Mining Co.) or an Environmental company (Terra Green GmbH), both fictitious companies (Fig. 2).

The training takes place within the hilly semi-arid environment of the Cabo de Gata - Níjar Natural Park. The small coastal town of San José (Fig. 1) has hotels and a youth hostel, as well as a couple of small supermarkets from where food and water for the daily work can be bought. The town also has restaurants, pizzerias, pubs, and a small but nice beach and marina. Almería is one of the last relatively large and relatively unspoilt stretches of the Spanish Mediterranean. Together with Sorbas, a few kilometres inland, this is surely the driest region of Europe with barely 150 mm of rain a year. Unsurprisingly, trees are thin on the ground, being restricted to

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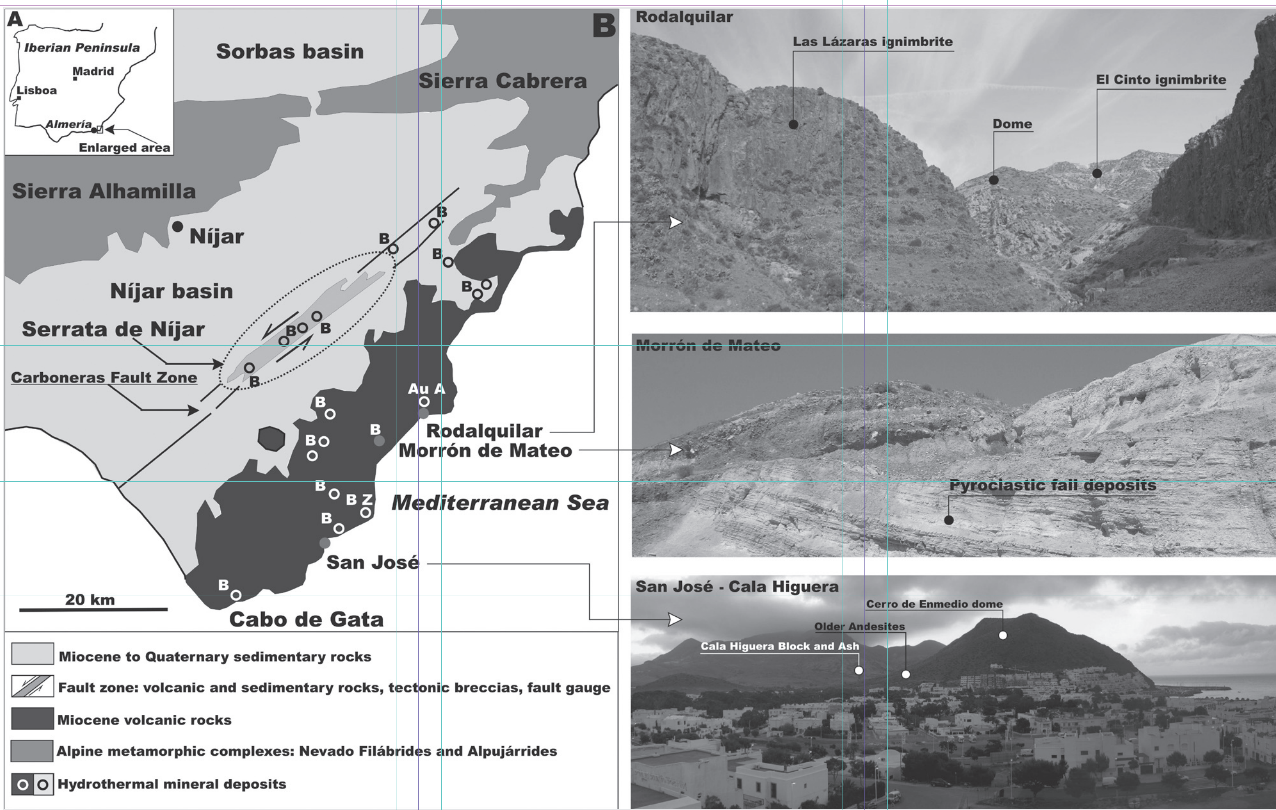


*Figure 1. A: Location of the study zone within the Iberian Peninsula. B: Simplified scheme depicting the major geological units of the region and mineral deposits (A: alunite; Au: gold; B: bentonite, Z: zeolite). On the right: images from the study zones*

ramblas and irrigated areas. The cabo de Gata – Níjar Natural Park is home to some 1,000 species of vascular plants, around 12% of the total figure for Iberia, the vast majority of which is xerophytic and halophytic. Particularly characteristic is the fan dwarf palm (palmito) the only native palm in Europe (Iberia Nature, 2007).

**Geological setting and field activities**

The study region is characterized by the following geological units (from north to south) (Fig. 1): the Miocene Sorbas basin, the Alhamilla Sierrra with Alpine metamorphic complexes; the Níjar basin, the Serrata de Níjar (carboneras) fault zone, and the Cabo de Gata volcanic block. The older rocks are those of two of the most important Alpine complexes of southern Spain: Alpujárrides and Nevado Filábrides. These units were intensively folded during late Oligocene - Early Miocene, and later underwent extensional collapse through major detachment systems in Middle - Late Miocene time (e.g., Doblas and Oyarzun, 1989; Platt and Vissers, 1989). The latter episode was accompanied by important calc-alkaline volcanism (andesites, dacites, rhyolites) and sedimentation within evaporitic sedimentary basins. The volcanic block is NE-SW oriented and comprises (from south to north) (Arribas, 1993): andesites ('Old Andesites'), ignimbrites, breccias, and the domes, ignimbrites dacites to andesites from the Los Frailes Volcanic Complex (Middle Miocene); ignimbrite facies (El Cinto and Las Lázaras), fall deposits, and domes of Tortonian age: the Rodalquilar caldera, with strong alteration (hydrothermal and supergene) and epithermal gold-alunite mineralization (Oyarzun *et al*., 1995; Arribas, 1992). Subsequent large (40+ km) ENE-WSW sinistral wrench faulting during uppermost Miocene (Carboneras Fault Zone: CFZ) (Huibregtse *et al*., 1998; Keller *et al*., 1997) gave rise to the formation of one of the most remarkable morphological features of the Níjar - San José sector, the so-called Serrata de Níjar, a compressive duplex characterized by large-scale pervasive deformation of the Miocene sedimentary and volcanic units. Thus, the Serrata de Níjar can be regarded as an uplifted tectonic block formed within a transpression zone developed along the CFZ. From the structural viewpoint the Serrata de Níjar duplex is characterized by a dominance of P- over the more relatively common R-type shears (Keller *et al*., 1997) (P and R nomenclature after Passchier and Trouw, 1998). The sedimentary units (limestone and gypsum beds) were intensively folded, whereas the volcanic rocks were either tectonically brecciated or transformed into massive zones of fault gouge (García Romero *et al*., 2006). The fault gouge consists of cm- to m-scale bands of a very fine clay-rich matrix with mm- to cm-scale clasts (Keller *et al*., 1997).

The students first have an introduction to the regional geology and gather data for a cross section that comprises from NW to SE: the Alpujárrides Complex near to the town of Níjar, the Serrata de Níjar fault zone, and the volcanic block. After this helicopter-view work is completed, the teams are distributed within three main field zones labelled as (from north to south): Kondor 1, 2 and 3. This local geology part of the work (at the detailed scales of 1: 2,500 and 1: 5,000) takes place at the Rodalquilar volcanic caldera (Kondor 1), the Morrón the Mateo - Presillas Bajas sedimentary and pyroclastic outcrops (Kondor 2), and the Cala Higuera zone (Kondor 3) along the border of the Los Frailes volcanic complex (Fig. 1). Each lecturer specifically supervises one or two teams in the Kondor 1-3 zones (Fig. 1).

**The reasons for two fictitious companies**

Given that most students will end up working for companies (only a minority will follow a university research career), it is important that they receive some practical training before they leave the university. Although every single company that hires geologists has its own methods and procedures, we can teach some basic skills that may be useful later. Thus, we combine the teaching of field mapping with the building up of a professional attitude towards the time invested in the field activities. The writing of a report for a company (with a specific style) is another of the priorities of this field course. These are matters that are seldom dealt with during the teaching of geology. To simulate a professional scenario, we created two companies, and in order to provide a more cosmopolitan environment, we decided that both fictitious companies should be foreign. Thus, the Kondor Mining Co. became a South African company founded in 1895 that runs initial gold mining operations in the Witwatersrand. We tell the students that at present the Kondor Mining Co. is an important, global mining company running exploration programmes for gold and base metals around the world. On the other hand, Terra Green GmbH is a German company founded in 1988 that works on environmental impact evaluations and land reclamation in abandoned mining sites, operating on a European scale.

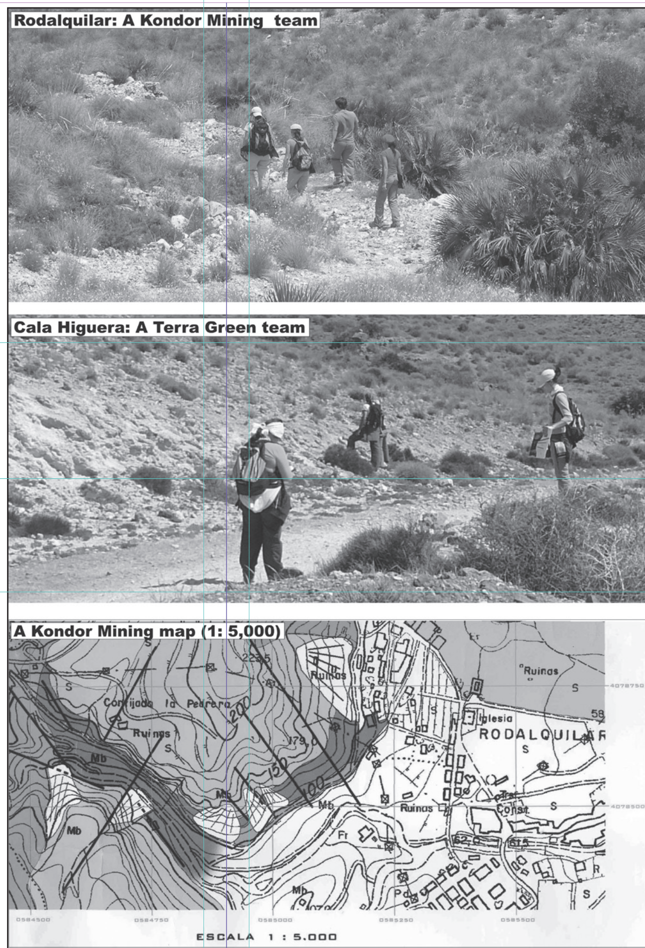


*Figure 2. Kondor Mining and Terra Green teams working in Rodalquilar and Cala Higuera respectively (June, 2007). Below, segment of a geological map of Rodalquilar made in June 2005 by a Kondor Mining Co. team (M. Alcázar Torralba, V. Blanco Alonso, E. Delgado Ventura and E. Domínguez Cuesta)*

**On team building**

> ***"Modern society and culture continues to become more fluid and dynamic. Factors contributing to this include the communications revolution, the global market and the ever-increasing specialization and division of labor. The net effect is that individuals are now required to work with many different groups of people in their professional as well as personal lives. Joining a new group and immediately being expected to get along with them is somewhat unnatural. People have developed methods to help people adapt to the new requirements. All kinds of companies face the same difficulties. As yet there is no generally agreed solution to the problem - it may not even be possible given the thousands of years of cultural evolution that brought us to our present behavior patterns" (Wikipedia, 2007)***

Geology, for whatever reason, favours individualism. Although there is nothing (basically) wrong with this, in society we seldom work as lone wolves but as wolf packs in which cooperation is needed and prized. In this respect, if we want to prepare students for the real world, team building must be an essential part of the training. Thus, the final report must be written by a team of 3 to 4 students, that may or may not agree on either the style of the report, or worse, the conclusions. This is an essential part of the exercise, because success or failure will much depend on cooperation. We nevertheless control individual achievement by means of an initial test on the geology, economic geology, and environmental setting of the study zone, and the quality of each field notebook. Preparation for the initial test is gained from the Internet by means of a specific web page that contains vital geologic and environmental information for the field activities: *http://www.ucm.es/info/crismine/San_Jose_web/index.htm*. The page includes (among others) the following documents: a virtual trip through the zone, an introduction to rock types, a global picture of the volcanism, the environmental setting, and a document on how to write the report. The students also receive a DVD that includes the contents of the web page plus geologic videoclips (recorded by the lecturers), orthophotos, and maps of soils and vegetation.

**On the importance of a report**

> ***"From the day you walk into university until the day you leave, there are many reports you'll have to write. As a student, these reports might be the bane of your life - but the truth is, you'll have to write them no matter where you go. From a simple work assessment report to the high-flying technical write-up, reports are a common form of workplace communication. You may have to write a report to a 'client' or an assessing manager. Report writing is an essential skill for professionals; master it now and writing reports won't have to be a pain" (UNSW, 2007)***

The above paragraph summarizes our views regarding this important part of the work. The report that the students must produce includes a series of items.
General, for all teams:

- 0. Cover: indicating title and authors. 1. Index: indicating chapters and pages.

2. Abstract: brief and informative, 300 words. 3. Introduction: 3.1 Aims, 3.2 Location and access to the zone, 3.3 Climate and physiography, 3.4 methods. 4. Regional geological setting: 4.1 Main geological units, 4.2 Tectonic and structural setting. 5. Local geology (assigned zone): 5.1 Description of volcanic, sub-volcanic and sedimentary units, 5.2 Stratigraphic column, 5.3 Structure.

Those who choose the Kondor Mining option:

- 6A. Economic geology: 6.1 History of mining activities in the zone, 6.2 Mineralization types, 6.3 Geology of the ore bodies, 6.4. Alteration (hydrothermal and/or supergene), 6.5. Potential environmental impacts.

Those who choose the Terra Green option:

- 6B. Environmental impact derived from mining activities: 6.1 History of mining activities in the zone, 6.2 Environmental mineralogy, 6.3 Location and characterization of abandoned mineral dumps, 6.4 Potential impacts on the local vegetation, 6.5 Solution proposals, 6.6. Other impacts (visual, water and soil contamination), 6.7 Conservation of vegetation.

General, for all teams:

- 7. Conclusions, including recommendations, 8. References.

The students have three weeks to write the report and during this time they are closely monitored. They bring drafts that are corrected by the team of lecturers until a minimum standard of quality is reached. Apart from the text and figures the report must include a regional cross section, a map of the assigned zone, and a local stratigraphic column and cross section. No important errors are allowed to be present in the last four items.

**Final remarks**

This is a fieldwork experience that has worked remarkably well along the years. Every year brings new ideas that become incorporated in the following season. For example, given the importance of the flora and vegetation of the zone, a botanist was added to the team in June 2007. This lecturer taught the students subjects such as conservation and geobotany. We must bear in mind that one of the most peculiar Mediterranean areas is that of the SE of the Iberian Península, where the semi-arid climate controls the occurrence of shrublands as natural potential vegetation. This vegetation is constituted by a floristic combination unique to Europe. In this thorny shrubland, phytogeographic elements, whose origins can be traced to the lower Cretaceous, grow together, such as Maytenus europaeus (harto) and Ziziphus lotus (azufaifo). Also, there are Cainozoic elements such as Fagonia cretica or Lycium intrincatum (cambrón), and xerophytic elements such as Periploca laevigata (cornical) related to the arid phases of the Messinian. Geobotanically, we found intimate spatial relationships between plants and rocks, for example that of Genista umbellata with dacites from a block and ash complex in Cala Higuera. The important thing regarding this is that the students were able to see this relationship and trace it throughout the outcrops in Cala Higuera.

Although it is not our intention to teach others how to run a field geology course, we nevertheless believe that sharing this experience may help to improve teaching in times in which environmental issues are becoming progressively important. Geologists have a lot to say on these matters, and it is up to us to incorporate and combine geology and environmental mapping. Besides, we insist on the importance of team building and report writing as essential chapters in the education of students. Finally, although sedimentary, plutonic, and metamorphic rocks can be found almost everywhere in the EU, volcanic outcrops are rather scarce, and if we ask for a combination of volcanic rocks, mineralizing processes and environmental issues, Almería is the only answer.

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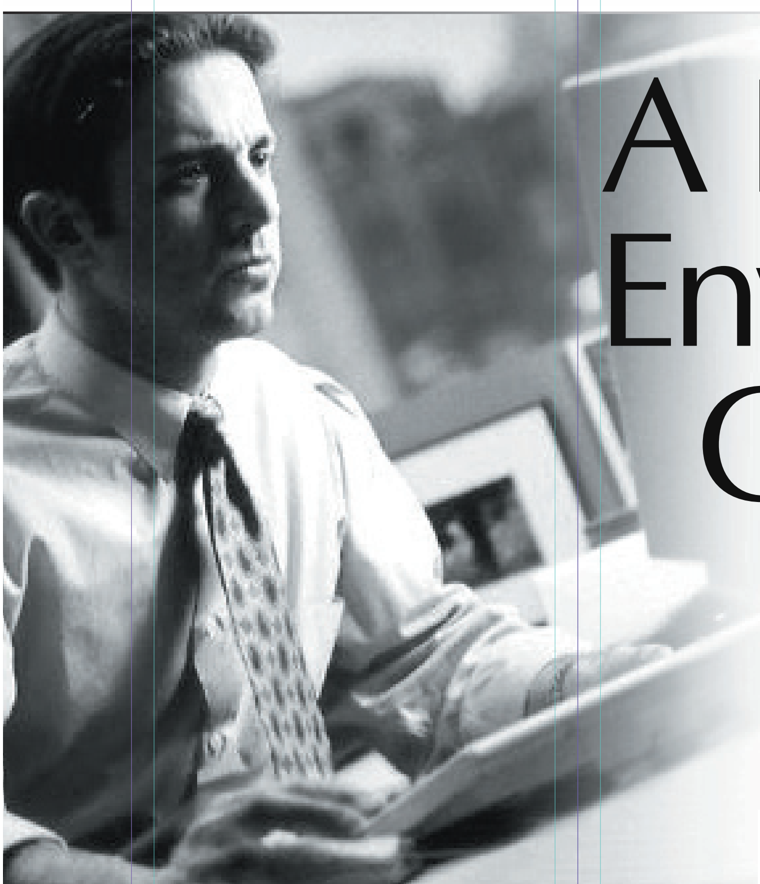

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# Well efficiency assessment: use of a new computation method

by Maurizio Gorla[1]

This paper provides a new method to evaluate, in a numerical way, the efficiency of pumping wells, in terms of degree of turbulent flow, called "Turbulence Index Method".The new basic formula is: T.I. (standing for turbulence index) = $[(C \times Q^2)/s] \cdot 100$, where C is the head loss coefficient related to turbulent flow (expressed as $m^2/s^5$), Q is the rate of discharge (expressed as $m^3/s$), n is the exponent number, assumed to be equal to two, and s is the drawdown measured in the pumping well (in meters). The proposed method seems to be confirmed by field data (more than one hundred water wells were tested) and, in particular, it seems to be able to identify the cases of well inefficiency due to flawed well completion.

L'article fournit une nouvelle méthode d'évaluation, sous forme numérique, de l'efficacité de pompage de puits, en terme d'écoulement turbulent, appelée "méthode de l'indice de turbulence". La nouvelle formule de base est: I.T. (Indice de Turbulence) = [(CxQ2)/s].100, où C est le coefficient de perte en tête, relatif à l'écoulement turbulent (exprimé en m2/s5), Q, le taux de décharge (exprimé en m3/s), n, le nombre en exposant, supposé égal à 2, et s, le rabattement mesuré dans le puits (en mètres). La méthode proposée parait être validée par les résultats des tests (plus d'une centaine de puits ont fait l'objet de mesures test) et, en particulier, il semble possible d'identifier les cas de puits inefficaces en raison d'une construction défectueuse.

Este artículo proporciona un nuevo método para evaluar, de un modo numérico, la eficiencia de los pozos de bombeo, en términos del grado de flujo turbulento, denominado "Método del Índice Turbulento". La nueva fórmula básica es: I.T (índice de turbulencia) = $((CxQ^2)/s)x100$, donde C en el coeficiente de pérdida de carga relacionada con el flujo turbulento (expresado en $m^2/s^5$), Q es la velocidad de descarga (expresada en $m^3/s$), n es el exponente, que se asume igual a 2, y s es el descenso del nivel medido en el pozo ( en metros). El método propuesto parece confirmarse con los datos de campo (más de cien pozos se han medido) y, en especial parece permitir identificar los casos de ineficiencia de los pozos debido a una terminación defectuosa del pozo.

The aim of the present paper is to propose a new method to evaluate in a simple numerical way the hydraulic efficiency of water wells, in terms of degree of turbulent flow. The new method developed has been called T.I.M.. The acronym stands for "Turbulence Index Method" (Gorla, 2004).

The success of this new formula has been confirmed by field data (137 wells were tested) and, in particular, compared with the already existing methods ("C" Coefficient and "W.E." Well Efficiency) has shown a better capacity to solve difficult or doubtful cases.

The use of the T.I. method allows evaluation of the degree of hydraulic efficiency in 99 % of the wells tested .

**The concept of well efficiency**

With reference to the "ICID" water dictionary, well efficiency is defined as "the ratio of the theoretical drawdown in a well (determined from the Q-s data) divided by the actual drawdown obtained from the well completion test data".

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Commonly speaking, we can state that a water well is efficient when (at the same time):

- it gives a noticeable discharge
- it shows a small drawdown
- it has a minimal hydraulic head loss.

Briefly, a pumping well is most efficient when it is affected by a limited turbulent flow. That is to say: well efficiency is best when the components ds', ds'' and ds''' are very small (Fig.1).

Apart from the natural environment in which a well is located (i.e. type of aquifer, its litological and structural characteristics etc.), some factors related to completion and development can even strongly affect the "functionality" of a water well.

The most important ones are:

- well screen features (type, slot, length, screened area)
- gravel packing features (presence or absence, grain size, thickness)
- well development features (type and method of tool used, time of development).

Moreover, a water well can be considered developed when:

a. specific drawdown increases in direct proportion to the discharge Q (Fig. 2)
b. the experimental curve s/Q – Q is not concave (Fig. 2)
c. specific capacity Q/s no longer increases (Fig. 3).

**Previous methods to calculate well efficiency**

Two existing methods, which have been used for a long time all over the world, are:

a. C coefficient method
b. Well efficiency method.

The first one was chosen by Walton and de Marsily as a parameter of reference for taking into account the degree of functionality of the slots and the role played by turbulent head losses.

According to this idea, the higher the value of C, the higher the inefficiency of the water well.

In Table 1 we can see the "C range of values" with respect to a well's condition.

The second method was introduced by Jacob (1946) in the form of a ratio between the percentage of drawdown due to "still" head loss and the percentage of drawdown connected with "tumultuous" head loss.

The Jacob's equation is:

$$WE = \left[\frac{B \cdot Q}{B \cdot Q + C \cdot Q^2}\right] \cdot 100 \ (\%)$$

where:

BQ = portion of drawdown due to laminar flow head losses

$CQ^2$ = portion of drawdown due to turbulent flow head losses (primarily through the gravel packing and the screens, called slot loss).

**A new method to calculate well efficiency**

The new method proposed is based on the computation of a Turbulence Index T.I., through an expression written as:

$$T.I. = \frac{C \cdot Q^n}{s} \cdot 100 \ (\%)$$

where:

C = head loss coefficient related to turbulent flow (expressed as $m^2/s^5$)

Q = rate of discharge (expressed as $m^3/s$)

n = exponent number, assumed to be equal to 2

s = drawdown measured in the pumping well during a pumping test (in meters).

As regards the exponent number, the assumption to put n = 2 is due to:

- in Bernouilli's equation, the term connected to flow velocity is elevated to 2
- in Rorabaugh's expression, the assertion n ≠ 2 has no analytical demonstration
- last but not least, in this way the "dimensionality" of the T.I. formula is respected.

As regards the C coefficient, two different methods were used to get a value for this parameter. Then, the two groups of numerical results were compared.

The first way to calculate the C parameter is the Bierschenk's graphical method: this kind of procedure gives the factor C as the slope of the straight line s/Q versus Q (C = tan α, Fig. 4).

The second method used, was the Castany's analytical formula, given as:

$$C = \frac{(s_2 \cdot Q_1 - s_1 \cdot Q_2)}{[(Q_1 \cdot Q_2) \cdot (Q_2 - Q_1)]}$$

where $Q_1$, $Q_2$, $s_1$ and $s_2$ are the discharge and the drawdown values of the first and second step of a pumping test.

The "C factor" is so calculated in coupled steps, using the Q and s data derived from a Step Drawdown Test SDT.

**Application of the new method: results and conclusions**

By applying Gorla's formula T.I.M., we came to these conclusions.

*Point 1*

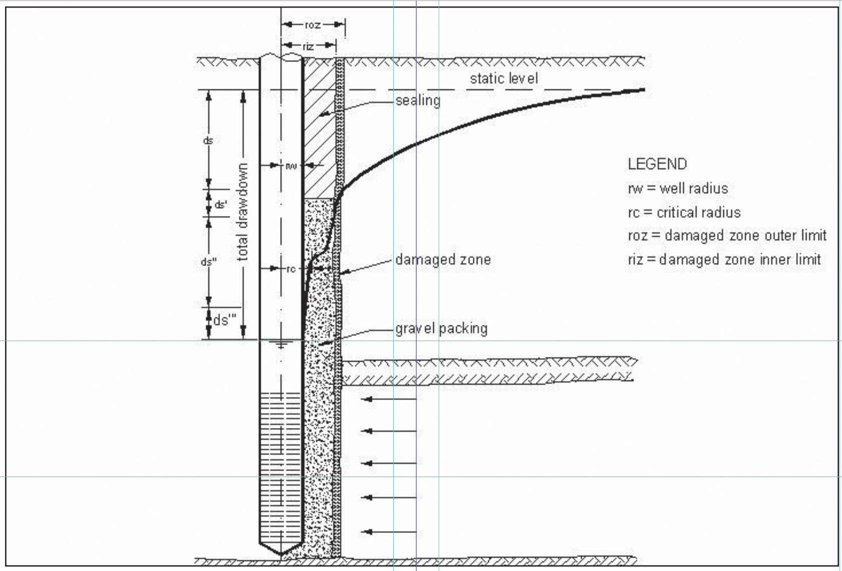


*Figure 1. Main components of well's drawdown*

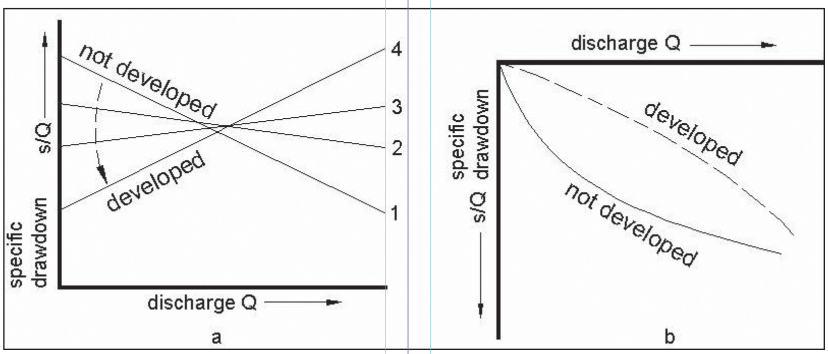


*Figure 2. The meaning of ¨developed¨*

To achieve good and correct results, it is necessary to have at least 3 couples of Q-s data at our disposal, better 4 up to 6.

*Point 2*

Field experience has indicated that, in order to carry out a "good" step drawdown test, it is absolutely necessary to settle:

- value and time length of the first step (15-20 % of the testing wells showed a negative value for the first "coupled C")
- characteristics of the pump (HP, type of starter - inverter is always expedient!)

These "imprecisions" can affect the quality of the whole pumping test.

*Point 3*

One step ahead, now let us focus on differences between the two kinds of "C factor" !

The data available are for 137 wells and Table 2 highlights that more than 50 % of the wells tested have a high or very high difference between C calculated analytically and C derived graphically.

Moreover, the value of C analytical is often higher than C graphical, (Table 3).

*Point 4*

Now let's speak about T.I.M.Gorla's Turbulence Index was evaluated using both the formula with C graphical and the equation with C analytical.

| Values of parameter C ($s^2/m^5$) | Well's conditions |
|---|---|
| C < 2000 | Efficient, well developed |
| 2000 < C < 4000 | From slightly inefficient to poor |
| 4000 < C < 14000 | Inefficient: clogged or deteriorated |
| C > 14000 | Highly inefficient: not recoverable |

*Table 1.*

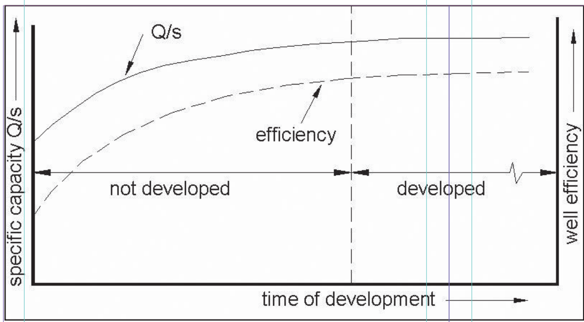


*Figure 3. Relationship between well efficiency and time of development*

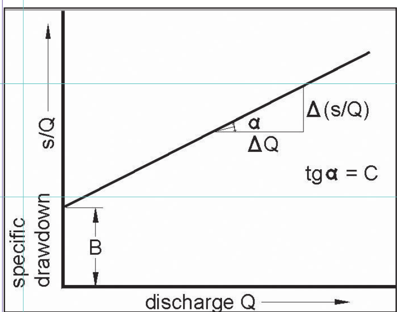


*Figure 4. Bierschenk method*

| N° of wells with $C_{anal.} - C_{graph.}$ | | |
|---|---|---|
| = 0 | 5 | 65 |
| < 10 | 11 | |
| 11-50 | 21 | |
| 51-100 | 8 | |
| 101-200 | 20 | |
| 201-400 | 16 | 72 |
| 401-800 | 19 | |
| 801-1000 | 4 | |
| > 1000 | 33 | |

*Table 2.*

| N° of wells with | |
|---|---|
| $C_{anal.} < C_{graph.}$ | 50 |
| $C_{anal.} = C_{graph.}$ | 5 |
| $C_{anal.} > C_{graph.}$ | 82 |

*Table 3.*

| | |
|---|---|
| n° 116 wells show a regular rising trend | |
| n° 1 well shows a regular decreasing trend (malfunction of the pump or insufficient length of the drawdown step) | |
| n° 5 wells show a sinusoidal trend | |
| n° 7 wells show a "bell-like" trend (critical discharge at the II° step) | |

*Table 4.*

In this way, we can state that:

1. using "C graphical" data, we obtained: 126 positive and 11 negative values of T.I. 2)
2. using "C analytical" data, we obtained: 129 positive and 8 negative values of T.I. 4)
3. we also observed the trend of the T.I. values, evaluated with the "C analytical method", only for the positive 129 wells, (Table 4)
4. with the data at our disposal and considering only the poor and/or inefficient wells (n° 89 wells), we have:

- total matching of C – WE – TI for 27 wells (30,3 %)
- good matching between C – TI for 39 wells (43,8 %) but, in particular, only 22 wells are inefficient for both the methods and 3 poor for both (complete matching for 28,1 %), while 12 wells are inefficient for C and poor for TI and only 2 viceversa
- total matching between WE – TI for 68 wells (76,4 %)
- "disagreement" between C and TI for 33 (inefficient for C, efficient for TI) +12 ( efficient for C but inefficient/poor for TI) wells (50,5 %)
- "disagreement" between WE and TI for 21 wells (23,6 %), a) between $WE_{graph}/TI_{graph}$ = 18 wells (20,2 %) and b), between $WE_{anal}/TI_{anal}$ = 13 (14,6 %)
- 15-20 % of the wells for which the pump available for the test was "wrong" (too powerful, old etc.)
- 8 negative values of turbulence index (T.I. analytical) can be explained in terms of poor development or, see Table 5

5. the table and the diagrams (Table 6; Figs 5 and 6) clearly indicate the differences existing among the computational methods used. In particular, the evidence that "T.I. analytical" is able to give the best performance using Gorla's formula, reducing the number of uninterpretable wells (Table 6 and Fig. 5), as well as those which become poorly efficient or inefficient at the third or fourth step of a pumping test (Fig. 6)
6. the reason why "T.I. analytical" is better than other methods is because:

- it is the most reliable one (only 1 % of the wells tested cannot be "interpreted"!, while the other methods can reach even a 8-10 % of doubtful cases)
- it considers together the three parameters of interest for a step drawdown test (C, Q and s)
- it is the easiest one (C, Q and s can be computed at the end of the test, in the yard)
- it is able to detect a situation of poorness or inefficiency long before other methods.

**Conclusions**

The proposed method seems to be confirmed by field data (more than one hundred of water wells were tested) and, in particular, it really seems to be able to identify the cases of well inefficiency due to a flawed well completion.

Nevertheless, having tested a huge number of wells, for every aquifer type (unconfined and confined, alluvial and karstic), we could say that our formula was completely vindicated.

The data available has permitted the development of a table of reference, in which the percentage value of the Turbulence Index has been related to the well's condition (Table 7).

*Issue accepted for the 32nd International Geological Congress (Florence, 2004) as an Oral Presentation in the session: "G09.01 - Groundwater in porous media".*

| N° of Well | $C_{12-34}$...trend | Possible cause |
|---|---|---|
| 1 | Neg./pos. | The pump has a great power and it doesn't work in a right way at low discharge rates |
| 2 | Pos./neg. | Reached the critical discharge |
| 3 | Neg./pos. | Idem n° 1 |
| 4 | Neg./pos. | Idem n° 1 |
| 5 | Always neg. | ? |
| 6 | Always neg. | ? |
| 7 | Neg./pos. | Idem n° 1 |
| 8 | Pos./neg. | Reached the critical discharge |

*Table 5.*

| Method | % of efficient wells | % of inefficient wells | N° of not "interpretable" wells |
|---|---|---|---|
| $C_{graph.}$ | 42,1 | 38,9 | 11 |
| $C_{anal.}$ | 45 | 38,7 | 8 |
| $WE_{graph.}$ | 67,2 | 13,1 | 15 |
| $WE_{anal.}$ | 61,6 | 19,2 | 12 |
| $TI_{graph.}$ | 55,6 | 16,7 | 11 |
| $TI_{anal.}$ | 55,8 | 22,5 | 2 |

*Table 6.*

| Turbulence Index values (%) | Well's conditions |
|---|---|
| TI < 10 | Very high efficiency, very low well losses |
| 11 < TI < 20 | High efficiency, low well losses |
| 21 < TI < 30 | Discrete efficiency, not negligible well losses |
| 31 < TI < 50 | Limited efficiency, quite high well losses: required "re-development" to reduce TI |
| 51 < TI < 65 | Inefficient well, very high well losses |
| 66 < TI < 80 | Not acceptable well losses: well very difficult to recover |
| TI > 81 | Highly inefficient: bad completion and development, well not recoverable |

*Table 7.*

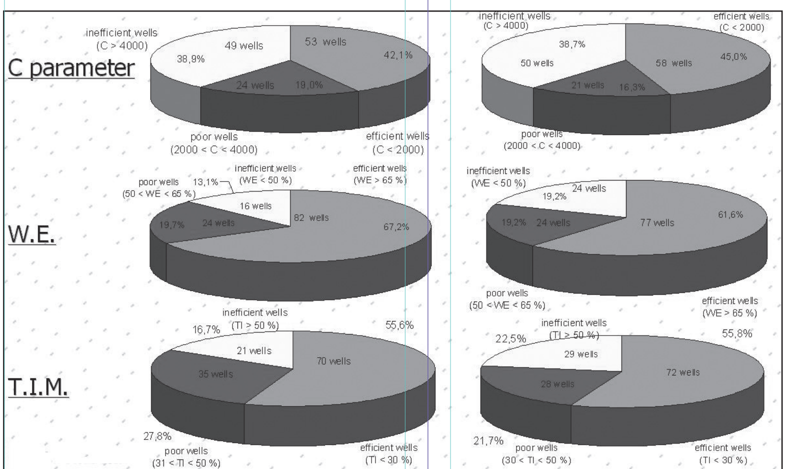


*Figure 5. Comparison of the "pies"*

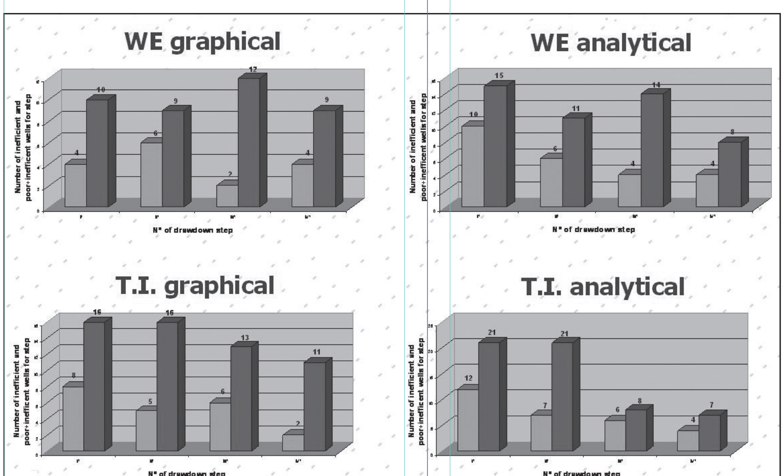


*Figure 6. Comparison of the histograms*

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# Poverty from disaster: natural disasters and development cooperation

*by Marta Puiguriguer*[1]

World Geologists developed in 2007 an outreach and awareness programme under the heading: Poverty from disaster: natural disasters and development cooperation. The programme has been financed by the Catalonian Agency of Cooperation for Development with the support of the Catalonian Association of Professional Geologists. The programme has two distinct parts: a publication and a conference.

Pendant l'année 2007 Geólogos del Mundo a développé le projet de sensibilisation et divulgation « Pauvres par Désastres. Les désastres d'origine naturelle et la coopération au développement », financé par l'Agence Catalane de Coopération au Développement et appuyé par le Collège de Géologues de Catalogne. Le projet comprend l'élaboration d'une publication thématique sur les désastres naturels et la réalisation d'un Atelier de Divulgation.

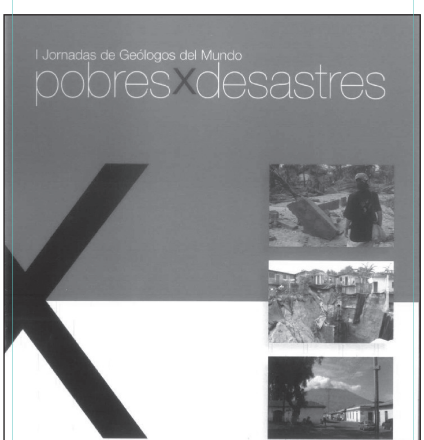
Geólogos del Mundo ha desarrollado, durante el año 2007, un proyecto de sensibilización y divulgación bajo el título: Pobres x Desastres. Los desastres de origen natural y la cooperación al desarrollo, financiado por la Agencia Catalana de Cooperación al Desarrollo y con el soporte del Colegio de Geólogos de Cataluña. En dicho proyecto se presentan dos partes distintas, una expuesta en una publicación y en otra, la realización de unas Jornadas.

The programme intended to develop a set of outreach and awareness actions and activities, to divulgate and analyse global problems resulting from natural disasters which have devastating social and human effects. It also intended to supply a tool for publicizing the human, economic and social costs that such disasters represent for Society in general and for impoverished countries in particular. Disasters at local levels have been especially targeted (floods, landslides) those which altogether represent higher losses, are less well known, drastically affect social development and are scarcely shown in the media.

The programme is framed in a socio-economic context defined because of insufficient attention and bad policies in the management of natural disasters, policies which today are mainly focused in emergency actions and not in prevention or risk preparation. This situation has resulted in the last few years in economic and human losses higher than all losses produced by wars and other types of disaster.

Two things have emerged from this programme. One is the publication of a 110-page text with three chapters, ***Pobres x Desastres (Poverty x Disasters)***. The first chapter covers definition of natural hazards, components of the concept of geological hazard, some historical background on natural hazards and its socio-economic relevance and the effects of disasters upon society and its degree of resistance. The second chapter covers how to reduce the effect of natural disasters using risk management and includes a series of projects carried out by World Geologists in Central America, in particular in El Salvador and Nicaragua. The third chapter covers the main 21st century initiatives and trends in the prevention of natural disasters. At the end of this book there is also an appendix where the main geological hazards and the dangers they involve are detailed and described.

The second part of the programme involved the organization of a workshop on *Natural disasters and development cooperation*, which was carried out from 25-27 September at the Casa del Mar in Barcelona. The objective of the workshop was to create a space to work, discuss, give opinions and diffuse ideas dealing with the global problems that affect humans in natural disasters; also to divulgate the experience, methods and projects of World Geologists in Central America in the field of risk management and integrated environmental management, and to emphasize the role of geologists as well-prepared professionals trained to carry out cooperation




[1]Coordinator of the project

and development projects.

Several World Geologists experts gave presentations during the conference, together with members of other NGOs and institutions which have financed cooperation projects. The conference also benefited from the participation of the research group Risknat of the University of Barcelona and the Association of Professional Geologists of Catalonia. The sessions were divided into different thematic areas, discussions, conferences, workshops and short papers.

The publication ***Pobres x Desastres (Poverty x Disasters)*** has been published in Spanish and Catalonian and all those interested in obtaining a copy can request it from:
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*geologosdelmundo@icog.es*
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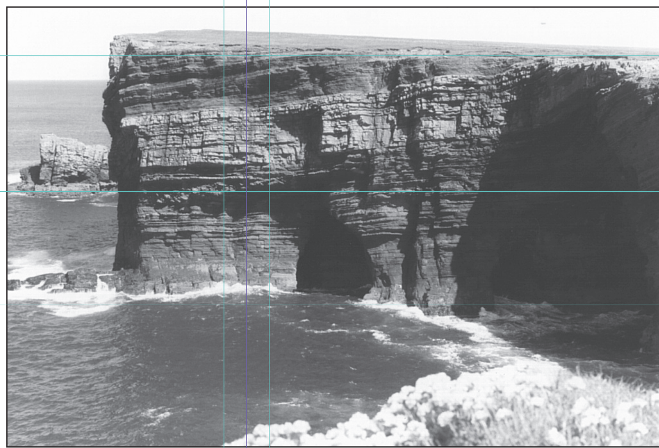
# The International Year of Planet Earth in Ireland…2008

*by Mary Carter*[1]

The International Year of Planet Earth is a worldwide initiative by UNESCO to explore the contribution of Geoscience to society. Ireland's programme is managed by the Geological Survey of Ireland (GSI) *www.gsi.ie*, with Royal Irish Academy (RIA) support *www.ria.ie*, and an Irish National Committee. Some of the events organized for next year are listed in the following paragraphs.

Planet Earth Lectures will be held throughout 2008 from which the general public can learn about key issues from leading scientists. Topics include climate change, water supplies, energy resources and Deep Earth.



*Downpatrick Head, Co. Down, N. Ireland*

**Competitions**

- One competition is being held by the Irish National Committee. "How Erratic is your block?" is aimed at transition year students (15 – 16 year olds) and closes March 2008. We hope it will be a first step to the BT YSTE (Young Scientist and Technology Exhibition) Project (January 2009) and is sponsored by the Irish Concrete Federation (ICF)
- Students! There is a Student's Competition for students between the ages of 18 and 22. Win a trip to Paris next February for the UNESCO opening of IYPE! Just write an essay on a suitable topic (*http://www.esfs.org/studentcontest.html*) and you could be invited. Students from around the world will learn about key Planet Earth issues.

We will have a Geoscience Award at the BT Young Scientist and Technology Exhibition in January 2009. You can find out more at our January 2008 stand.

**Exhibitions**

Exhibitions will include:

- Ship-based World Ocean Day (Marine Institute)
- A Naval vessel
- the National Museum of Ireland will host an exhibition
- National and UNESCO exhibitions, including "Ask a Geologist"! at the Geology Museum,TCD

**Other events**

- The Planet Earth TV series will show the Evolution of the Irish landscape through six thirty-minute programmes scheduled for autumn 2008. DVDs will be circulated to schools and this is being produced by Holocene Productions, and funded by the GSI under the Geoscience Initiative
- Walks and Talks will help people to get to know their countryside, and a full programme for Ireland and Northern Ireland can be found on *www.planetearth.ie* and will be added to throughout the year
- Planet Earth Week will run from 26th May to 7th June, and will feature Geoparks. It is coordinated by Breifne Mountains Ltd. *www.breifne.ie*. National Heritage Week will take place in September 2008, *www.heritageweek.ie*. Organized by the Heritage Council, this year will spotlight geological heritage
- For schools, rock sets and posters, funded under the Geoscience Initiatives, will be sent to secondary schools (Ireland and Northern Ireland) and an initiative by Geoschool Group, TCD.
- Ireland has earthquakes? To get more information, an expert from DIAS can be booked to visit a school. *www.dias.ie*
- Coordinated by the British Geological Survey, the One Geology project aims to create dynamic digital geological map data for the world at a target scale of 1:1 million. The geological map data will be made available as a distributed web service, using the latest web feature mapping approach. *www.onegeology.org*

To find out more, and check when and where events are happening go to *www.planetearth.ie*. You can register for the regular Newsletter @ *www.planetearth.ie* and look out for media coverage, press releases, newspaper features and geoscience magazines. An Post (Irish national postal service) is creating a set of Planet Earth stamps. There will also be attractive merchandise which will make ideal gifts and prizes.Ireland's programme of events will be launched in Dublin on 18 Jan 2008, and a major conference in Paris in February 2008 will launch the International Year of Planet Earth.

*GSI is a partner of the IYPE Corporation. www.planetearth.ie*

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Geological Survey of Ireland
Beggars Bush
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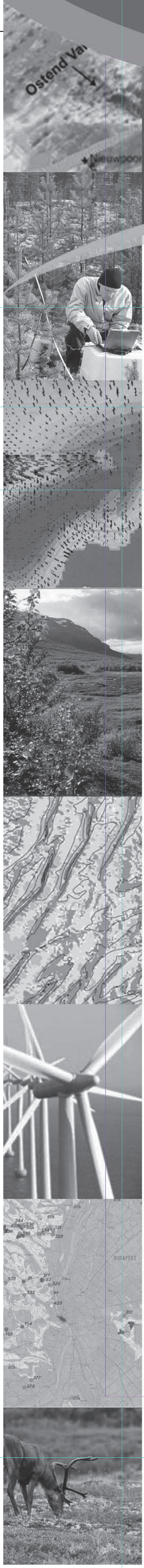
European Federation of Geologists

# Geology and Environmental Change




GREEN WEEK
changing our behaviour

## The role of geology in Environmental Impact Assessments (EIAs)

### Importance of a geological perspective in EIAs

Most types of development rely on natural geological deposits for their foundations and their stability. Many developments also have the potential to affect natural resources and to be affected by on-going natural geological processes. These processes, such as erosion and deposition, produce the physical environment, for example hillslopes, rivers and floodplains. The physical environment is colonized by flora and fauna resulting in the habitat and ecosystem, for example forests, wetlands and beaches. Occasionally the flora or fauna can then modify the physical environment, for example, beds of seagrass reduce natural seabed erosion, coral reefs trap sediment, etc. To develop a comprehensive view of the environmental impact of a project we need to understand the geology of the site. Geological study by a professional geologist is therefore an important component of EIAs.

### Examples of important geological factors in EIAs

An EIA examines the interaction of a proposed project with the existing environment. The geological processes active at a project site must be examined as well as the geological characteristics of ground in and around the project site :

- Active geological processes, such as landslides, earthquakes, radon producing rocks, eroding coasts and flooding can affect people and projects.
- Natural materials, such as cultivated topsoils, peat, beaches, mineral deposits, marine sand and gravel, etc are important both economically and from a conservation point of view.
- Water is easily affected, both in terms of quality and quantity. Apart from the obvious rivers and lakes, many important water resources are hidden in underground aquifers which can be geologically complex.
- Landscape features, which are increasingly important in conservation and leisure, include many settings where geological processes are actively reshaping the terrain, for example mountains ranges, deep gorges and river valleys, waterfalls, sea cliffs, caves, etc.
- Cultural heritage areas can include features of a geological nature ; for example designated sites of special scientific interest and archaeological sites such as prehistoric mining sites

## The role of geology in predicting future climate change

### Geological records of past climate change

Although evidence of past climates is preserved throughout the geological record, it is the record of the most recent geological past that is of greatest interest in predicting near-term future climate changes. Studying and understanding these geological records helps us to differentiate between natural and man-made effects on climate – which is vital if predictions of future climate changes are to be reliable. Major melting of the ice from the last ice age probably started around 18,000 years ago in response to a natural phase of global warming. Because of this and thermal expansion of the oceans, the sea level rose about 120 metres by about 6000 years ago. During this period of rapidly rising sea-level permanent coastal settlements would have been impossible, particularly in flat-lying ground around major rivers. But by about 6000 years ago, sea-level had stopped rising and a stable coastal zone existed. From this time onwards permanent coastal settlements became established and trading centres, cities and agriculture flourished. The post-glacial warming and resulting sea-level rise had not been a completely uniform process and in fact global temperatures have continued to vary, periodically becoming warmer or cooler, right up to the present day.

### Examples of geological indicators of climate change

Sediments and ice cores contain a number of different indicators of the climate at the time and location they were laid down. Some are more direct indicators than others but all parameters involve some degree of interpretation. Pollen and organic content provide indications of temperature and precipitation, and finely layered clays in lakes can indicate relative levels of seasonal erosion and deposition from which precipitation and temperature can also be inferred. The remains of particular animal species can be indicative of the climate. Inorganic indicators such as the ratio of different isotopes of oxygen can provide a good and continuous measure of temperature. Geological studies of these and other parameters are today supplemented by numerical computer modeling, which further enhances our understanding of the reasons for past climate changes and therefore improves our ability to predict future changes.

**European Federation of Geologists,**
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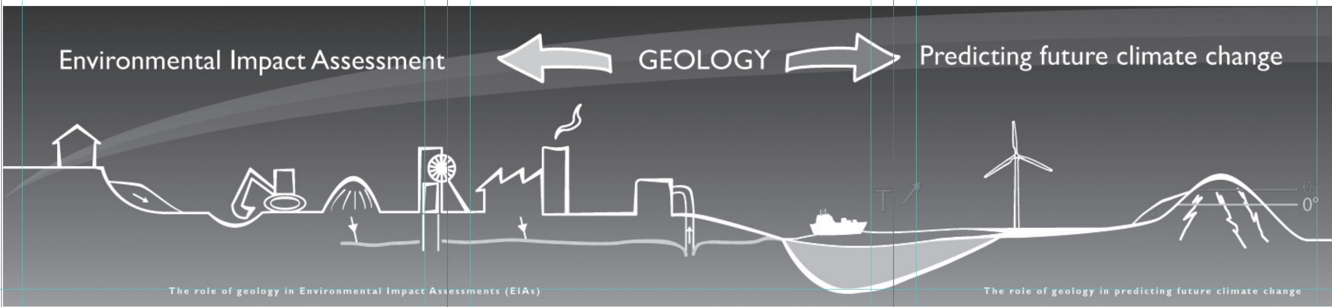



The EFG stand in the EU's Green Week 2007

# Geology and Environmental Change

*by Isabel Fernandez*[1] *and Peter Whiteside*[2]

The European Federation of Geologists participated in the European Commission's Green Week 2007 (June 12-15) exhibition: "Geology and Environmental Change" – appropriately, the EFG had Stand No. 1!

This year the theme of the annual event was "Past Lessons, Future Challenges". Some 4000 participants, including politicians, civil servants, business-people and conservation groups from around the globe gathered there. Debates, presentations and stands reviewed actions in environmental policy to date, and considered how the lessons of the past can be applied to current and emerging environmental problems, such as climate change and growing pressure on resources.

In the context of the event, EFG prepared a Stand "Geology and Environmental Change" (Photo) in collaboration with the EFG PE on Environmental Impact Assessment, coordinated by Mr Peter Whiteside. The stand presented the role of geology in Environmental Impact Assessments (EIAs) and in predicting future climate change.

- The role of geology in Environmental Impact Assessments (EIAs): to develop a comprehensive view of the environmental impact of a project we need to understand the geology of the site. Geological study by a professional geologist is therefore an important component of EIAs.
- The role of geology in predicting future climate change: studying and understanding geological records of past climate change help us to differentiate between natural and man-made effects on today's climate. This is vitally important if our predictions of future climate changes are to be reliable.

[1]EFG Office Director
[2]EFG PE on Environmental Impact Coordinator

In order to present these roles of geology, the stand included 6 posters with examples from Europe.

In the context of the Environmental Impact Assessment:

- Predicting contamination rate changes by modeling groundwater (Serravalle Scrivia), Italy. Provided by CNG, Italy. Authors: Puppini U., Remonti M., Restagno S., Trimboli M.
- Sustainable use of groundwater, and groundwater pumping in a dynamic environment, Finland. Provided by YKL, Seppo Gehor. Authors: Okkonen J. and Klöve B.
- Environmental geological map of Hungary. Provided by MFT, Author: Scharek P.

In the context of predicting climate change:

- The impact of the sea level changes on the Belgian continental shelf: the Quaternary geological evolution. Provided by UBLG, Belgique, Dirk De Coster. Authors: Mieke Mathys I, De Batist M.I, Baeteman C.
- Reconstruction of ancient climate : clues to the future, Sweden. Provided by SN, Vivi Vajda. Authors: Anjar J., Fernandez M., Jansson I.M., Jonsson, S.A., Noresten, B. & Persson, J.
- Climate change impact on the region alpine, Switzerland. Provided by CHGEOL. Author: Giuseppe Franciosi, Geotest.

We distributed information about the EFG: EFG leaflet, EFG Members, EurGeol. Title, EFG Manifestos, European Geologist magazine. Information about the Terrafirma Project was also distributed. During the exhibition we received support at the stand from the Swedish EFG Member, Ida M. Jansson from Lund University.

As a conclusion to the EFG's performance in Green Week 2007, we prepared and distributed during the exhibition, a leaflet (see previous page) with the message of the stand as well as a power point presentation.

# Summary of EFG natural hazards conference in Rome 25 May 2007

*by Herald Ligtenberg*[1]

Direct communication with European and national policy-makers is one of the main objectives of the European Federation of Geologists, especially to raise their awareness of the importance of geology to our society. On the subject of natural hazards we have made a lot of progress over the last five years, by means of several advice documents to the European Commission, presentations at an EC-organized congress, a manifesto and individual meetings with the EC. In this context we organized a one-day conference to discuss "*Reducing the risk of natural hazards in Europe by integrating knowledge and best practices from experts, insurance companies and policy-makers*". We are of the strong opinion that improved communication between the different disciplines and stakeholders is of significant importance.

The conference was attended by approximately 100 people, including representatives from the European Commission, the European Parliament, the Italian and French ministries of Environment, the European Space Agency ESA, the insurance association Asscom and geoscientific experts from national geological surveys and universities and consultancies from most EU countries and beyond (Ukraine, USA, Canada).

Mr. Dario Esposito, deputy major of Rome and working daily on the civil protection of Rome, opened the conference. Mr. Stefano Zappola, MEP for Italy, strongly expressed his view that professionals are the backbone of the European Union, in which Life-Long-Learning is an important pillar. The professional European Geologist title, as initiated and coordinated by EFG, fits very well with this view and should be firmer established and adopted as standard. An increasing trend in interest for the professional geologist title is observable, especially in relation to environmental issues (e.g. environmental impact assessments); in mining (the professional title is accepted by several international stock exchanges and is for example required for exploration licenses) and in geological research before construction takes place. Also in other fields of geology we see an increasing need for a professional title.

Mr. Carlo di Gianfrancesco from the Italian Ministry of Environment raised the issue of data communication, which is often difficult due to use of different software systems. He presented the latest development on landslide hazard maps in Italy, using a special system (OpenGIADA) to provide these maps for free to the public, through a web-based system. It is a great example of best practices that should be shared with other European countries.

Mrs Marta Moren Abat from DG Research gave a very good overview of the current status of research on natural hazards and a detailed insight in the Seventh Framework Programme of DG Research. The presentation was a very useful summary of EC projects and perspectives and is available through the EFG website (or contact the EFG office). The EFG board met with Marta Moren Abat in September 2007 and they have discussed follow up work and improved communication/ collaboration.

Marc Paganini from the European Space Agency ESA and David Norbury, representative for EFG in the ESA TerraFirma project gave insight into the advances that have been made using remote sensing data to monitor terrain movements in vulnerable areas, e.g. measuring mm-scale subsidence in densely populated places and showing its implications. The EFG is very pleased with its participation in the TerraFirma project, in which the EFG role is to provide input to guide the direction of the project, to promulgate its activities and to inform geoscientists across Europe as to what this technology can do to assist in delivering projects and protection of society.

Mrs. Frederique Martini from the French Ministry of Environment presented the work carried out by EXCIMAP, a European working group and exchange circle on flood risk mapping. This working group has actively steered the drafting


*Presentation from Spain, Tempio di Adriano, Rome (Photo: M. Regueiro)*

[1]EU Delegate for EFG and coordinator EFG expert panel on natural hazards

# News and Events 2007 - 2008

*The audience of the conference, Tempio di Adriano, Rome. (Photo: M. Regueiro)*

of the Floods Directive, that was recently adopted by the European Parliament (April 2007) and the European Council (September 2007). Representatives from the EFG expert panel on natural hazards have participated in EXCIMAP and have contributed to the incorporation of geological issues in the Floods Directive. The work by EXCIMAP will be followed up by focus on landslide hazard mapping and integration with other natural hazards (EXCILUP; for more information, please contact the EFG office).

Important with respect to future development was the contribution by the Insurance Association Asscom. Insurance companies are of course a very important element in the mitigation of natural hazards and they acknowledge the requirement for strong involvement of geologists in mitigation measures and prevention of natural hazards. Closer collaboration between professional geological organizations and insurance companies is recommended in working together with policy-makers and towards improved land-use management and mitigation measures in Europe.

The conference included interesting contributions by experts from different European countries. They presented the advanced stage in taking mitigation measures of several countries (Mr. Giuseppe Franciosi, Switzerland), innovative ideas and approaches for adapting to natural hazards (Mr. Ger de Lange, the Netherlands) and the need for improvement in others (e.g. landslides in Ukraine and Italy; ground water flooding in the UK, Mr. David MacDonald).

A great development on one of EFG's main objectives with respect to natural hazards was presented by Dr. Rosa Maria Mateos Ruiz (see also European Geologist 23, June 2007). Spanish regional territorial and land-use plans are now beginning to include requirements to include natural hazards in the planning. Several Autonomous Regions have already taken a first step by including in their land-use plans the requirement to consider natural hazards as essential factors to be taken into account when authorising land use. The Balearic Islands are among the Spanish regions with the most advanced legislation in terms of natural hazards and land-use planning. Since 1999, the islands' regional legislation has required all local authorities to draw up 1:25,000-scale susceptibility maps, including landslides, flooding and erosion. For any land-use planned for an area with a medium or high degree of susceptibility, a binding expert report on the real risk must be commissioned. In all cases it requires a ground geological investigation and most of the susceptibility maps have been generated by a geologist, with expertise in natural hazards. Recently, the new Spanish Land Bill has been approved and represents a national guideline that takes into account natural hazards in land-use planning. This legislation includes the requirement to draw up natural risk maps for all areas under construction planning. We hope that this initiation by the Spanish government will be adopted by other EU countries to protect their people from natural hazards.

The meeting was concluded by recommendations from the EFG towards policy-makers (see next page). Since there is often a tendency to concentrate on reaction to disasters, rather than taking preventive and mitigation measures, we have emphasized that hazard identification and risk reduction can significantly help in reducing the costs and effects of natural hazards. Especially:

- **Land-use management**: pro-active identification of risk zones, creating multi-hazard risk maps and fully adopting them in land-use management. It is recommended to create a European directive for national legislation to include geo-scientific investigations in land-use planning for areas identified to be at risk, as it is being introduced in Spain.
- **Creating awareness and education**: train land-use managers, policy-makers and disaster management teams in vulnerable areas.
- **Early warning**: strongly improve the use of and integration with observations from space and other early warning systems, as presented by ESA and the TerraFirma project.

The EFG and its expert panel on natural hazards will work on these three items in the near future, schedule meetings with the European Commission, and will report in this magazine on progress made. It is expected that similar one-day conferences will be held at national level. National Geological Associations are being motivated to organize similar conferences to raise awareness and start the discussion between national policy-makers, land-use managers, insurance companies and experts to work towards a safer country. Involvement of international experts and organizational support can be provided by the EFG.

At the end of the day, a final resolution of the conference was presented by Dr. Pietro Antonio de Paola, president of the Italian National Council of Geologists (CNG), and supported by the European Federation of Geologists (pp 25 - 26).

European Federation of Geologists and Consiglio Nazionale dei Geologi d'Italia

# International Geohazards Conference - Final Resolution

The European Geologists, convenening in Rome on 25 May 2007 for the International Geohazards Conference organized by the European Federation of Geologists and by the Consiglio Nazionale dei Geologi Italiani (Italian National Council of Geologists),

**Considered** the recent IPCC Report on Climate Change, which estimates an increasing trend of the Earth's temperature of 1.5 to 6°C and identifies a very likely value of +3°C by 2100, with the consequent melting of alpine glaciers and of polar ice and a sea level rise of 0.5 to 7 m (the minimum value being due to thermal expansion of the oceans only, without considering the melting of polar ice),

**Acknowledged** that the combustion of massive amounts of fossil fuels has raised the atmospheric concentrations of $CO_2$ to values comparable to those in the Pliocene age, bringing back, by about 4 million years, the process of transfer of atmospheric $CO_2$ to geological formations in the form of hydrocarbons,

**Recognized** that the growing number of hydrogeological disasters associated with more intense rainfalls, even in countries which have so far been spared (e.g. Sardinia recently recorded 500 mm of rainfall in a single day, a value comparable to the precipitation for a whole year), and that the increase in drought periods at given latitudes require the adoption of adjustment strategies at worldwide and local level, because even an immediate and unlikely reduction in greenhouse gas emissions will not stop ongoing processes, whose impact will last for at least 60 years,

**Considered** that future environmental scenarios have already been formulated for Europe and that such scenarios involve heavy economic and social consequences, such as:

- progressive deglaciation in the alpine chain
- processes of landsliding, erosion and desertification associated with long periods of drought and higher frequency of extreme weather and climate events
- shortage of water for hydropower generation, irrigation and, to a lesser extent, for drinking uses in some periods of the year
- reduced recharge of groundwater
- coastline change due to coastal erosion
- increase of saline intrusion into coastal groundwater,

**Considered** that the growing land-use for urban infrastructure and development exposes the populations of European countries to higher geological hazards, such as landslides, earthquakes, floods, volcanism, subsidence, coastal erosion, and desertification,

**Considered** that renewable and non-renewable geo-natural resources, such as water, soil, fossil fuels and minerals, are increasingly deteriorating owing to pollution and consumption patterns resulting from unsustainable resource management models,

**Considered** that the models for managing land and related risks, as well as the models for managing geo-resources are all conceptually biased, as they rely on a static perception of land and of the geological environment; in other words, they lack the dynamic component, which is the main cause of earthquakes, landslides, subsidence, floods and, partially, of climate change,

**Considered** that geologists have the scientific and cultural tools to correctly understand and predict the above mentioned dynamic phenomena, as well as to build the related geological evolutionary models,

**Considered** that these geological evolutionary models should underpin the processes of urban, land and environmental planning, of correct prediction and prevention of geological hazards, of sustainable use of geo-resources (water, soil, fossil fuels, geothermal energy and minerals), as well as the related land management models,

**Considered** also that, with regard to protection of populations from geo-natural hazards and to sustainable use of natural resources, there is a lack of a comprehensive and consistent regulatory framework within the EU and that, in such framework, geological modelling should have the purpose of formulating predictive scenarios of land dynamics and precede the stages of urban, land and environmental planning, design of civil engineering works, management of natural resources, planning and mitigation of natural risks.

**We Invite**

1. the European Parliament, through its President Hans-Gert Pöttering
2. the Council of Europe, through its President Angela Merkel
3. the European Commission, through its President José Manuel Barroso and Environment Commissioner Stavros Dimas,

- to issue unitary and integrated legislative instruments; such instruments should not only reduce emissions and promote sustainable development, but also and above all recognize that prevention and management of geological-environmental hazards, correct management of resources and land planning, all based on knowledge of the Earth's dynamics and on its geological modelling, are the key instruments of land management
- to extend the European Directive on floods, recently adopted by the European Parliament in April 2007 and by the European Council 18 September 2007; the Directive should also involve the prevention and management of all natural hazards (landslides, earthquakes, floods, drought, erosion, subsidence, etc.), the correct management of all geo-resources (water, soil, fossil fuels, geothermal energy minerals), as well as scientific-based processes of urban, land and environmental planning aimed at controlling anthropogenic pressures on vulnerability and resilience of geological systems
- to initiate a process of permanent consultation with European geologists, entrusting its coordination to the European Federation of Geologists and to

# News and Events 2007 - 2008

European Geological Surveys;

- to emphasize the professional capability of European geologists, recognizing that knowledge of land and of its evolution calls for specific know-how and skills and that this profession is of relevant public interest, as geologists have the needed scientific skills and therefore are capable of safeguarding land and communities
- consequently, to promote the recognition of the title of professional Geologist, by entering into an agreement with all European universities; such agreement should provide for homogeneous education and training requirements and give guidelines for Continuous Professional Development, with a view to fostering the practice and dissemination of the profession to the benefit of public and private communities and the free movement of geologists in the countries of the European Union.

*Approved in Rome – Tempio di Adriano, 25 May 2007*
*The European Federation of Geologists*
*The President*
*Istvan Berczi*
*The Consiglio Nazionale dei Geologi d'Italia*
*The President*
*Pietro Antonio De Paola*

## Conference

Geology of Alluvial Plains and Groundwater Management. Resources, Risks and Regulations (3Rs). The European Federation of Geologists and the Association of Greek Geologists are organizing an International conference to be hosted in Athens on 30 May 2008.

Because of its climatic and geomorphological conditions, the Mediterranean basin is prone to frequent droughts and floods, including violent seasonal runoff on dry river beds, some of which are used for human settlement. Forest fires and soil erosion are a frequent consequence of these events.

Water availability is one of the most pressing constraints on human development in the region: the increasing demands for both drinking and irrigation water from an ever-growing population are stressing groundwater and freshwater resources, while increasing numbers of tourists in the dry summer season exacerbate the problem. Due to rainfall depletion and infiltration, as well as irregularly-distributed water resources and over-exploitation, these resources have been progressively reducing since 2003, all over the Mediterranean region.

These demands have led countries in the region to maximize supply-side solutions to satisfy growing town population needs, quite often with poor understanding of the effects at the water catchment (basin) scale.

Today, due to their wide use, natural resources are over-exploited, affecting:

- over 50% of all freshwater wetlands
- over 70% of available fresh water
- a high percentage of river basin ecosystems.

These pressures affect forests, as well as the rivers themselves, some of which have been reduced to a seasonal trickle, or stagnant and polluted pools. Around 2,000 dams and water storage and distribution systems, with net water losses in excess of 30% from evaporation and infiltration, have fragmented river ecosystems, threatened minimum ecological water flows during droughts and reduced storage capacity as a result of siltation. Coastal fisheries meanwhile have shrunk, coastlines have eroded and river deltas have subsided, as nutrients and sediments are held back by dams.

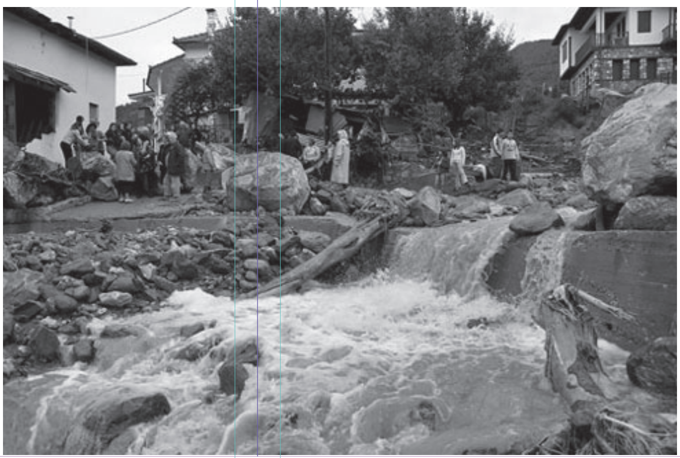
These adverse effects are expected to become more serious as a warming climate could likely result in desertification, higher erosion in watersheds and higher sea levels.

The introduction of the integrated river basins concept and the integration of surface and ground water stated in the directive 60/2000 are wise issues which aim to avoid, or at worst to ameliorate, these negative consequences.

This is a first call for papers. Abstracts of not more than 200 words should be submitted to the EFG office at: efgbrussels@gmail.com before 31 January 2008. Further enquiries can also be made to this e-mail address.

*Antonis Angelopoulos and Umberto Puppini*

*Cliff erosion, Santorini, Italy*



*Flooding in the village of Ano Stavros, Northern Greece: Sept. 2006*

# News and Events 2007 - 2008

European Federation of Geologists. International Conference

**Geology and Surface Water and Groundwater Management: Resources, Risks and Regulations (3Rs)**

Athens, Greece - 30th May 2008

Venue to be assessed – Address to be assessed

EARLY DRAFT AGENDA

| | |
|---|---|
| 8.30-9.00 | Registration of participants |
| 9.00-9.30 | Welcome by Authorities |
| 9.30-9.40 | EFG President report |
| 9.40-9.50 | Greek NA President report |
| 9.50-10.10 | EC DG Environment |
| 10.10-10.30 | EC DG Research |
| 10.30-11.00 | Coffee break |
| 11.00-13.00 | **Session 1 - Surface water: Channelled Flow (Rivers, Streams, Creeks) and Laminar Flow**<br><br>Consequences of heavy rainfall on land: flooding, river bank erosion, sheet erosion, landslides, etc.<br><br>Monitoring design<br><br>Good management practices and maintenance: aquifer recharge systems (ARS), containment basins, landscape improvment |
| 13.00-14.30 | Lunch |
| 14.30 – 16.40 | **Session 2 - Groundwater: Interflows, Perched, Shallow, Deep and Coastal Aquifers**<br><br>Consequences on groundwater due to natural and anthropogenic contamination migration, saline intrusion, overexploitation, etc.<br><br>Monitoring design<br><br>Good management and maintenance practices: aquifer recharge systems (ARS), integrated uses (GSHP coupled to contamination migration containment), improving irrigation practices, etc. |
| 16.40-17.00 | Toward a European common approach of natural hazards – EFG proposals to policy makers |
| 17.00-17.30 | Discussion |
| 17.30 | End of the Conference |

## Submission of articles to European Geologist Magazine

The EFG calls for quality articles for future issues of European Geologist. Submissions should be in English and between 1000 and 3000 words, although longer articles may be considered. An abstract of between 100 and 120 words should be included in English, French and Spanish. Articles should be sent via e-mail to the Editor at Harper-mccorry@tele2adsl.dk or on disc to Vordingborgvej 63, 4600 Køge, Denmark. Photographs or graphics are very welcome and should be sent to the Editor as tif or jpg files in CYMG colour. Further details may be found on the EFG website: www.eurogeologists.de

Deadline for submission 30 March and 30 September.

## Advertisements

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| | One Insertion | Two Insertions |
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| Full page (colour) | 820 Euro | 1320 Euro |
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| Preferential location | 25% plus | |
| Price for special pages: | | |
| Outside back cover (colour) | 1200 Euro | 1900 Euro |
| Second page (colour) | 1000 Euro | 1600 Euro |
| Second last page (colour) | 1000 Euro | 1600 Euro |

| Data for European Geologist Magazine | |
|---|---|
| Number of issues printed: | 6500 |
| Periodicity: | 2 times a year |
| Print mode: | Offset |
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| Published: | 30 May, 30 November |
| Advertisement delivered as computer file: | EPS, TIFF |
| For graphics remember to include fonts. | |

6500 issues of European Geologist are distributed among professional geologists all over Europe. They are sent to the European countries National Federations of Geologists, and these national organisations distribute them to their members. These include geologists working in companies as well as at universities.

Layout of the magazine is made in Adobe Indesign CS for PC.

**Method of payment:**

Invoice after publication

**Subscription Rates**: Annual subscription to the Magazine: 25 Euro

**Contact:**

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e-mail: Harper-mccorry@tele2adsl.dk
Tel: 0045 45831970

## European Federation of Geologists (EFG)

The European Federation of Geologists was established in Paris in 1980 during the 26th International Congress of Geology. In the same year the Statutes were presented to the European Economic Community in Brussels.

The Council of the EFG is composed of the representatives of the national associations of geologists of Belgium-Luxembourg (UBLG), Czech Republic (CAEG), Finland (YKL), France (UFG), Germany (BDG), Hungary (MFT), Iceland (GSI), Ireland (IGI), Italy (CNG and ANGI), Netherlands (KNGMG), Poland (PTG), Portugal (APG), Slovakia (SGS), Slovenia (SGD), Spain (ICOG), Sweden (N), Switzerland (CHGEOL), United Kingdom (GS), whilst the American Institute of Professional Geologists (AIPG) is an Associate Member. The EFG currently represents about 40,000 geologists across Europe.

**Mission**
To promote the profession and practice of geology and its relevance.

**Objectives**

1. To promote and facilitate the establishment and implementation of national arrangements for recognizing geologists who, through academic training and appropriate periods of relevant experience in the profession and practice of geology, are qualified to be designated as EurGeol.
2. To organize meetings and conferences to discuss issues related to the profession and practice of geology.
3. To co-ordinate the activities of member national organisations in preparing briefing papers on geological issues and presenting these to European bodies, national governments and other relevant organisations.
4. To maintain contact with the European Commission and respond in timely manner to requests for information.
5. To communicate, through meetings and other means, the relevance of geology to the resolution of issues of concern to society.
6. To promote the establishment of best practice for training of geologists.
7. To safeguard and promote the present and future interests of the geological profession in Europe, including:

- to guarantee the free movement of geologists in Europe, with the mutual recognition of their academic and professional qualifications by the adoption of the title of European Geologist (EurGeol.).
- to promote the harmonisation of education and training.
- to define and protect the title of geologist and related professional titles.
- to promote the code of professional ethics of the EFG.
- to provide advice and assistance to constituent member National Associations.

# Carboniferous stratigraphy of Germany: the state of the art

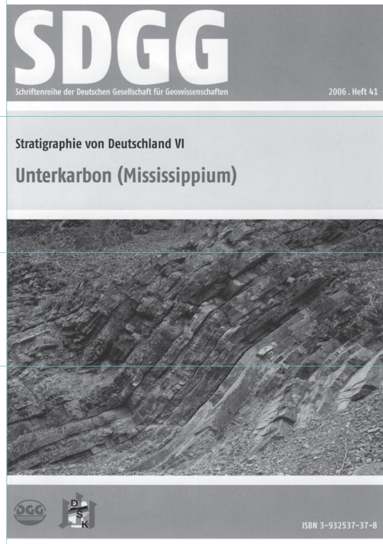
*Book Review by Hans-Jürgen Gursky[1]*

Stratigraphie von Deutschland V: Oberkarbon (Pennsylvanium)
Edited by Deutsche Stratigraphische Kommission

*(= Courier Forschungsinstitut Senckenberg, no. 254)*
*Published by Schweizerbart'sche Verlagsbuchhandlung, Germany.*
*Soft bound, ISBN: 3-510-61380-5*
*Date: 2005, 477 pages*
*Price: € 98,80*

Stratigraphie von Deutschland VI: Unterkarbon (Mississippium)
Edited by Deutsche Stratigraphische Kommission

*(= Schriftenreihe Deutsche Gesellschaft für Geowissenschaften, no. 41)*
*Published by Deutsche Gesellschaft für Geowissenschaften, Germany.*
*Soft bound, ISBN: 3-932537-37-8*
*Date: 2006, 590 pages*
*Price: €65*


Germany is one of the classical countries of stratigraphical research and standardization in Europe. Since the 19th century, many famous stratigraphers (and a huge number of further investigators) have addressed and continuously refined rock successions and their fossil contents in Central Europe. Many standard sections and classical fossil occurrences have been described, such as the Triassic trilogy of Buntsandstein, Muschelkalk and Keuper, the late Devonian Kellwasser crisis and the legendary *Archaeopteryx* of Franconia's Jurassic lagoon. It is even said that geologists once prepared a proposal to replace the eagle of the German national signet by a ceratite shell…

For many decades however, in contrast to and as a result of continuously sophisticated stratigraphical subdivisions and definitions, there has been a great general need for comprehensive and easily accessible up-to-date overviews of the major stratigraphical units in Germany. This knowledge gap is now bridged by the monograph "Stratigraphie von Deutschland" edited by Deutsche Stratigraphische Kommission, a member of the International Union of Geological Sciences (IUGS). In fact, this so-called "monograph" is a series of 20 volumes, each an authentic anthology, composed of numerous individual chapters and written by dozens of regional and palaeontological specialists. The series started in 1995 with the first Rotliegend volume; books are published in irregular stratigraphical order, and nine have been published up to now: Rotliegend of northern Germany (1995), Ordovician, Cambrian, Precambrian (vols I – III, 1997, 2001a, b), Cretaceous (2000), Keuper (2005), Silurian (2006), and the two Carboniferous volumes reviewed here. The Devonian volume is in print and the other ten are planned or already in preparation: Rotliegend Vol. II, Zechstein, Buntsandstein, Muschelkalk, Jurassic (two volumes), and Tertiary (four volumes). Please check the website of Deutsche Stratigraphische Kommission for further information and the latest news: *www.stratigraphie.de/monographie/index.html*.

Editing such voluminous and benchmark books is generally a hard job which requires an ideal vision, painstaking motivation by the authors, much diplomacy, and a strong will to carry on the project to a "happy" end. This was also the case with the Carboniferous volumes, whose planning dates back to 1984 and was enormously boosted by the reunification of the two Germanys in 1990. The first manuscripts were submitted in the early nineties (and later revised, where necessary) and the last chapters and updates were accepted in 2005, so that the Carboniferous volumes really reflect the modern state of the art and will (hopefully) be a representative reference for many years.

The Unterkarbon/Mississippium volume was edited by Dieter Stoppel, long-serving chairman of the responsible Subkommission für Karbonstratigraphie, and his successor Michael Amler. It includes 39 articles, written by some 40 authors and organized in nine major chapters. The starting four deal with historical, general stratigraphical and palaeogeographical aspects and refer to the vigorous international and national debates on definition and subdivisions of the Carboniferous system. Although the recently approved subdivision into Mississippian and Pennsylvanian is now being officially used in Germany, the traditional subdivision in the Tournaisian, Viséan, Namurian, Westfalian and Stefanian is maintained for practical regional reasons. About 260 pages are dedicated to all relevant fossil groups and their stratigraphical significance, and some other 260 pages cover the individual regional situation all over Germany.

The Oberkarbon/Pennsylvanian volume was finally edited by Volker Wrede, after several editor changes, and seemed threatened by the advanced decline of the German black-coal mining industry which is the result of the continuously dropping number of experts of the Late Carboniferous. Although a few years ago the Mississippian-Pennsylvanian boundary was internationally defined within the Central European Namurian stage, this volume generally includes the entire Namurian stage, for practical reasons, as stated above. The book consists of 28 individual papers, written by approximately 45 authors and grouped into four major chapters. The first and the third address stratigraphical definitions and subdivisions, chronometry and palaeogeography of the Late Carboniferous in Central Europe. The second chapter comprises some 140 pages and deals with the most important fossil groups. However, in contrast to what one might expect, the focus is on invertebrates, whereas the famous macroflora is only addressed in one article. The regional geology and stratigraphy is treated in detail in the fourth chapter (about 260 pages) and even includes the minor intramontane basins of southern and eastern Germany.

Both books are written in German, but all the articles have English abstracts which make their essence available to the broad international public. The books include hundreds of graphics, tables, sketches, maps, and fossil plates (partly in colour) so that they represent an enormous and valuable source of information. The books are soft but well bound, A4 format, and neatly printed. The prices are quite moderate, thanks to support from the German Society of Geosciences and the Senckenberg Society. Due to a change in publication policy of the latter, the stratigraphy monograph series had to shift to the new publisher, starting with the Mississippian volume.

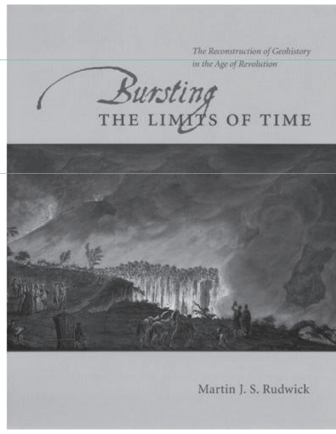
As is typical (and inevitable) for such voluminous and heterogeneous anthologies, and despite the admirable efforts of the editors to guarantee a maximum of well-balanced and complementary books, they span a wide range of aspects of the German Carboniferous stratigraphy, but can neither cover all the facets, nor be homogenized as they would be if written by a single author. And it is a pity that there is no subject index. However, the quantity of information is overwhelming, the state of the art is accurately represented, and the information is indispensable for everybody interested in European Carboniferous stratigraphy, at least for geological libraries. And if you hesitate to buy the books now, perhaps it will take another couple of decades before an improved version is available…

[1]Professor of Geology and Head of Institute of Geology and Palaeontology, Clausthal University of Technology, Clausthal-Zellerfeld, Germany.

## *Book review by David M. Abbott, Jr.[1]*

Bursting the Limits of Time: the reconstruction of geohistory in the age of revolution
by Martin S.J. Rudwick, 2005

*Published by University of Chicago Press*
*ISBN: 0-226-73111-1*
*Date: 2005, 708 pages*
*Price: €24 paperback*




In *Bursting the Limits of Time* Martin S.J. Rudwick explores the initial discovery that the age of the rocks and their contained fossils greatly exceeded human history and the development of the concept that there was such a thing as earth history. This exploration is more than the discovery of what John McPhee so wonderfully described as deep time, that millions or hundreds of millions of years were required to account for the Earth's stratigraphic record, it is the conceptualization that the Earth's geologic history could be worked out. This contrasts with the ahistorical view expressed by James Hutton with his famous, "no vestige of a beginning, no prospect of an end" (*Theory of the Earth*, 1788).

Rudwick's subtitle, "the reconstruction of geohistory in the age of revolution," helps place the book within its political historical context, which begins two years before the French Revolution that began in 1789 and the following Napoleonic Wars, plus a few years afterwards. More specifically, the book begins with the first ascent of Mont Blanc in August 1787 and ends with William Buckland's work with cave deposits, particularly that at Kirkdale, Yorkshire, in 1822. But during most of the period covered in the book, revolution within France followed by war between France and the rest of Europe, particularly Britain, was a political fact that affected the generally accepted beginnings of geological science, particularly in the anglophone world, which has mythologized these origins and given English geologists more credit compared to their European counterparts than we'd care to admit. Among other things, *Bursting the Limits of Time* helps correct these myths.

In the first part of *Bursting the Limits of Time*, Rudwick describes the "Republic of Letters" that existed prior to, during, and following the time covered by the book (although the character of the Republic of Letters was substantially changing as the book draws to a close). The Republic of Letters consisted of learned men who explored the sciences as we know them now and other lines of inquiry without bothering with the divisions between the sciences or between science and the humanities and social sciences that exist today. [1] These learned men were recognized as savants by themselves and their peers, as members of "an informal, invisible, and international" grouping that was independent of the civil government of their homelands. Most of the savants were in western Europe, but some were scattered about elsewhere, for example, Thomas Jefferson and Benjamin Franklin. Although wars were common throughout the period covered, they kept in touch by letters and the exchange of publications, and by visits, when such were politically possible. Many of the savants were associated with universities and national academies including those devoted to mining; England was a notable exception to this form of employment.

The intellectual world of the savants was divided into differing areas of study, but the subdivisions were very different from those of today. Areas of particular relevance included "natural history," essentially the description and classification of natural phenomena and natural objects of all kinds, and "natural philosophy" that concerned itself with the causal and mathematical relations between natural phenomena, as well as mathematics itself.

"Mineralogy" at the time concerned the description and classification of "fossils," which included all types of natural objects dug from the earth—hence fossil fuels. However, there was growing recognition that some of these objects were the remains of previously living animals and plants and the word "fossils" was beginning to change to its modern meaning.

Physical geography, the study of land

forms and their distribution, was the true field science of the time in contrast to mineralogy, which was primarily an indoor activity best undertaken at a major "cabinet" or museum and library where physical specimens or their pictorial proxies could be compared, although landscape paintings were the only way to "transport" the mountain ranges, river systems, etc. that were the subject of physical geography.

Geognosy was another major study of the earth at the time. Literally meaning "earth knowledge," geognosy added study of the third dimension to earth studies, particularly as exposed in mines, but also extended to areas without mines. The geognosts also recognized and began to correlate the sequences of rock beds, first locally and then more regionally. The fundamental sequences were the Primary rocks, composed primarily of crystalline rocks and frequently without apparent bedding, that were regarded as the oldest, and the Secondaries, the layered rocks, or in the informal terms still in use, hard rocks and soft rocks. Alluvium or unconsolidated surficial deposits were also recognized. These deposits were recognized as derivatives of the Primary and Secondary rocks, whose clasts they contained. There was a fourth class of rocks, the volcanic rocks, but whether basalt was always volcanic was a matter of debate. As with the other branches of earth studies, geognosy was descriptive. Its goal was not the reconstruction of geohistory, a point emphasized in 1787 by Abraham Gottlieb Werner, the famous Freiberg mining academy professor.

Natural philosophy differed from the other, descriptive earth studies. In attempts to emulate Newton's laying of the foundations of physics, various theories of the Earth were proposed and debated. The most commonly accepted theories invoked the sequential precipitation of rocks from primeval oceans, the Neptunist approach usually identified with Werner, but by no means exclusively his. Hutton's competing theory involved cycling from continent to ocean and back without beginning or end. These theories were not historical, particularly when contrasted with the revolution in ideas that soon followed. Instead, they were philosophical attempts at deriving "first principles" from which the observed natural phenomena would follow.

A word needs to be said about those savants studying theology at the time. This was a period when Biblical textual analysis, particularly in Protestant parts of Germany, was yielding useful results along with the study of the writings of other ancient cultures. It was well-accepted within the world of savants and beyond that the "days" of *Genesis* were metaphorical and not literal, that they might have covered thousands of years. The biblical literalism and fundamentalism we face today have far more political power now than they did at the end of the eighteenth century and the beginning of the nineteenth. Indeed the historical work of those like Archbishop James Ussher focused on correlating the history of the Jews as recorded in the *Old Testament* with the historical accounts of the Greeks, Romans, Egyptians, and other ancient cultures.[2] Pompeii had been discovered and those studying human history recognized that buildings and their inscriptions, statues, coins, pottery, etc. could provide useful historical information along with written records. Rudwick's central thesis is that the studies of the earth became historical by borrowing ideas, concepts, and methods from the historical study of humans. Rather than inhibiting the discovery of deep time, the religiously motivated studies of human history provided the intellectual approaches required to develop a sense of earth history. By carefully noting in which layers particular coins and inscriptions were found, details of human history could be recovered and correlated. Around the time *Bursting the Limits of Time* begins in 1787, a few naturalists were beginning to consciously apply these ideas to natural history.

By the beginning of the nineteenth century, the word "geology," originally introduced to describe theories of the Earth, was becoming used to cover what have been called earth studies above. Furthermore, the deficiencies of the various theories of the Earth became grounds for rejecting speculations regarding causes. The assembly of facts became the order of the day. The founding of the Geological Society in London in 1807 with its emphasis on Baconian observation over theorizing reflects the change.

During the 1790s, fossils, and particularly fossil bones became focal problems. Georges Cuvier moved to the National Museum in Paris, formerly the Cabinet du Roi, in 1795, which housed one of the most extensive collections of fossil and modern animal and plant specimens. Although earlier interested in invertebrates, Cuvier soon focused on quadrupeds and mammals in particular and became an expert in comparative anatomy. As more and more new specimens were unearthed, and/or came to Paris as spoils of war from advancing French armies, Cuvier was asked for his opinion. He was able to show that fossil mammoths, while closely related to Indian and African elephants, were a different species, one that he believed no longer existed. Although the world was not fully explored, it became increasingly clear that it was unlikely that some of the animals known only as fossils, particularly ones the size of mammoths, were lurking somewhere unseen by Europeans. The Lewis and Clark expedition through "unknown" parts of North America in 1803-6 was one of an increasing number of expeditions that encountered neither specimens nor local tales of animals like mammoths. Although the question of extinction was not settled, it became an increasingly supported idea. Early in the eighteenth century, Cuvier called for detailed studies of the Secondary sequences, particularly the younger Secondary formations—soon to be called the Tertiary—and their contained fossils as a research programme that would provide the data needed to answer a number of questions, and, in Cuvier's view, provide the basis for a history of the earth.

The Treaty of Amiens in 1802 brought an end to a decade of war for a brief period and allowed the savants to travel around Europe. Werner visited Paris and brought German geognostic ideas with him. Werner had identified a new series of rock masses, the "Transition" rocks between the Primaries and Secondaries. Four of Werner's former students identified a sequence of Secondary rocks extending across Europe from Cadiz to Moscow, thus extending the utility of mapping similar rock sequences. But geognosy gave no great attention to fossils at this point. Rock types were the major classification.

Although William Smith's geological map of England and adjacent areas was not published until 1815, his work was known to the English savants. Because Smith's work on canals provided him with continuous exposures, he was able to map the English Secondary sequence with its structural simplicity and this sequence, with recognized continental equivalents like the Chalk was becoming the world standard. But this sequence was not yet placed in geohistorical context and the resumption of hostilities during the Napoleonic Wars isolated England from the Republic of Letters to a greater degree than other countries.

Alexandre Brongniart, who was trained as a mining engineer, was appointed director of the Sévres ceramic factory. Among his duties was the location of suitable clay deposits and he took advantage of the Treaty of Amiens to visit England. Although he never got farther than London, he may well have heard of Smith's work of identifying formations by their contained fossils. For Smith, this was a means of recognizing structure, of geognosy, not an effort to explore geohistory. Brongniart also met Werner during the latter's visit to Paris. Brongniart was also becoming Cuvier's geological colleague in the mapping of the strata around Paris, which contained both the bones of interest to Cuvier and the clays of interest to Brongniart. Together they realized that fossils could contribute to the elucidation of geohistory, that the character of the fossils changed over time becoming increasingly like existing animals in the youngest deposits thus advancing beyond Smith's work. In working with these younger deposits, stratigraphically above the Chalk, they defined the Tertiary. They also recognized that the Tertiary sequences around Paris alternated between marine and fresh water deposits and developed early concepts of depositional environments. Brongniart's field work in Italy's Po valley reinforced his work around Paris and demonstrated the geographically widespread utility of his approach.

The last great question of the period covered in *Bursting the Limits of Time* was the study of cave deposits and their associated fossils, which differed from but were closely related to existing species. These studies brought geohistory closer to human history. William Buckland, the first professor of geology at Oxford, studied the hyena bones, scat, and the bones of the hyenas' prey in the cave deposits at Kirkdale, Yorkshire and brought geohistory closer to human history. The boundary between geological and human history was often equated implicitly or sometime explicitly with the Noachian Flood of *Genesis*. When giving his initial lectures at Oxford, the center of Anglican religious teaching and orthodoxy, Buckland was more explicit about the connection than he was in talks given elsewhere. But Rudwick points out that this probably reflected Buckland's bowing to the political realities of bringing science, particularly geology, to Oxford than it was his firmly held opinion.

By the time *Bursting the Limits of Time* ends in 1822, geohistory and its implied great amounts of time were reasonably firmly established within the geologic community. The end of the Napoleonic Wars allowed the leading geologists, particularly the British, to visit their savant colleagues, study their specimens, and visit their field sites. Nevertheless, as Rudwick points out in *The Great Devonian Controversy*, the use of fossils as the primary means of correlation was still not established in the 1830s. Adam Sedgwick, Roderick Murchison, and Henry De la Beche were arguing over rock type and particularly superposition more than they were over fossils in the debate leading to the establishment of the Devonian system.

*Bursting the Limits of Time* is a very different book from *Earth Time by* Douglas Palmer. *Bursting the Limits of Time* is big and heavy, printed on very high quality (*i.e.* lots of clay filler and coating) paper. More to the point, Rudwick again demonstrates why he is a leading voice in the history of geology. He carefully covers the work of the important savants during the period covered and explains what they did and did not do in bursting the limits of geohistorical time into deep time. His lively narrative dispels a number of common myths about the origin of deep time and the early development of geology. Werner can no longer be considered the chief Neptunist or "black hat" in the story, nor is Hutton, aided by Playfair, the "white hat." The English, particularly the gentlemen founders of the Geological Society, were not necessarily the leaders of geological research. Although *Bursting the Limits of Time* is not a quick read, it is both an enjoyable one and a must read for those interested in the history of geological concepts.

**(Footnotes)**

1 *Rudwick points out that the word "scientists" wasn't coined until half a century later.*

2 *The Rosetta Stone was found by the French in 1799 and captured by the British in 1801; it was subsequently housed and studied in the British Museum.*

[1] Consulting Geologist

## *Book review by David M. Abbott, Jr.*[1]

Mineral Deposits and Earth Evolution, edited by I. McDonald, A.J. Boyce, I.B. Butler, R.J. Herrington, and D.A. Polya

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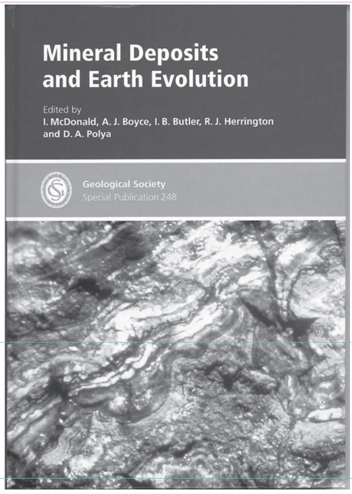


The study of mineral deposits generally seems separated from the study of general geology. Perhaps because so many of the first exploited deposits, particularly in the 19th and the early 20th centuries in the U.S. were epigenetic base and precious metal deposits of the western states, or were the Precambrian iron and copper deposits of Michigan and Minnesota, the geology of these deposits was viewed separately from that of the host rocks. Structural preparation, proximity to intrusions, and the tendency of skarns and the like to be found in limestones were the main considerations of host rock geology. Lindgren's highly influential *Mineral Deposits* (first edition 1913, fourth edition, 1933) directed attention at the various types of hydrothermal systems believed to be the source of most deposits. R.L. Stanton's 1972 *Ore Petrology* was among the first texts to really focus on mineral deposits as part of the surrounding geological environment, to consider that more thorough study of the host rocks was important. The preceding observations can undoubtedly be criticized for oversimplification and for ignoring the work of various authors who viewed one or more types of mineral deposits more globally. Nevertheless, it was not until the revolution in geological thinking that accompanied the development of plate tectonics in the late 1960s and 1970s that more global ore deposit model ideas became more widespread. With rare exceptions, like the restriction of banded iron formation ages to the late Archean and the implications these deposits had for atmospheric evolution, the study of ore deposit types and age distributions for providing important data and information on the geologic evolution of the Earth is relatively recent and is perhaps just emerging, if that, on the consciousness of those geoscientists whose specialty is not economic geology.

The book contains 13 papers dealing with various aspects of the title topic and which, with varying degrees of generality, provide the reader with current research on the contributions economic geology can make to the study of the Earth's evolution. The papers in the volume were presented at the 2003 Geological Society of London's Fermor Flagship Meeting, *World Class Mineral Deposits and Earth Evolution*, held in Wales.

The first paper by R.A.F. Grieve addresses the surprising number and variety of economically important deposits associated with impact structures, many of which are oil and gas reservoirs along with iron, gold, uranium, platinum group metals (PGM), base metals, diamonds, zeolites, diatomites, and other types of deposits. I found this a very eye-opening paper. It is followed by Hayward *et al*.'s paper on the effect of the Vredefort impact event on the Witwatersrand gold deposits of South Africa, which apparently provides a solution to the long-running debates between the placer and hydrothermal origins of the world's largest concentration of gold deposits.

A paper by M. De Wit and C. Thart describes the differing metallogenic signatures of 11 Archean cratons in the southern hemisphere based on a database of over 6,000 deposits in the former Gondwana supercontinent. They conclude that mineral deposit density and diversity appears to have decreased over geological time, although they acknowledge various constraints on their data.

The next paper by Groves et al., perhaps the paper best summarizing the overall title of the volume. Groves *et al*. point out that some deposit variation over time depends of the evolution of the atmosphere-hydrosphere-biosphere, like the unoxidized placer Late Archean-Early Proterozoic uranium deposits of Elliott Lake, Canada contrasts with the Mesoproterozoic unconformity-related deposits of the Athabasca Basin in Saskatchewan, and finally with the redox cell, sandstone-hosted deposits of Wyoming and the Colorado Plateau. The occurrence of other deposits types are controlled by tectonic setting and erosion rates. For example, the porphyry copper and molybdenum deposits form at relatively high levels in accretionary terranes and are thus relatively quickly eroded away, which explains their late Mesozoic to Cenozoic ages. Conversely, the greater thicknesses of Archean cratons and the deep level of emplacement helps explain the preservation the PGM deposits of South Africa's Bushveld Complex and the Stillwater Complex in Montana. These are only a few of the various examples Groves *et al*. present. If you're only going to read one paper in this volume, this is the one to read.

A paper by Harcouet *et al*. describes the thermal evolution of the Paleoproterozoic Ashanti gold-belt of Ghana. Harcouet *et al*. use the specific example of Ashanti to demonstrate that thermal conductivity and geobarometry place constraints on heat flow values in space and time, which have an effect on metamorphism and mineralization. Among other things, they suggest that heat flows may have been higher in the Precambrian.

The uneven distribution of giant gold deposits (>100 tonnes Au) in space (tectonic environment) and time, which is noted in preceding papers, is addressed in detail in a paper by Leahy *et al*. They review four fluid types, deep magma-dominated fluids, shallow magma-dominated fluids, multi-source fluids, and basinal fluids. Then they define six geodynamic orogenic terranes, some of which are favorable sites for giant gold deposits and others that are not. They use a database of giant gold deposits (as of 2000) as the basis for their findings. Leahy *et al*.'s database and general conclusions are quite interesting, not only in terms of giant gold deposits, but also in terms of the types of fluids that will affect other types of metal deposits (Mississippi Valley Type deposits) and even petroleum generation and migration. While not directly stating that they are doing so, Leahy *et al*. also present a major revision in the hydrothermal classification system initially developed by Lindgren and set out in his *Mineral Deposits*.

I did not find the papers by Lowry *et al*. on the use of sulphur isotopes to distinguish basement terranes in northern Britain; by Herrington *et al*. on reassessment of the tectonic zonation of the Uralides; by Farquhar and Wing on the terrestrial record of stable sulphur isotopes; and by Raiswell and Anderson on reactive iron enrichment in euxinic bottom waters of particular personal interest and they are more specialized than general treatments. Likewise a paper by Grassineau *et al*. on distinguishing between biologic and hydrothermal signatures via sulphur and carbon isotopes in Archean mineralization and the isotopic evidence for Archean life suffered because only two areas, the 3.8 Ga Isua Greenstone Belt of western Greenland and the 2.7 Ga Belingwe Greenstone Belt of Zimbabwe, were studied. Data from other areas with other dates would help extend the story.

I found the paper by Bluck *et al*. on the diamond mega-placers of southern Africa and the Kaapvaal craton more interesting. The paper describes a generic sequence of transient and retained placers in various parts of a weathering basin or craton, including residual beach deposits, and the ultimate submarine terminal placers. The reasons for the unique character of the Namibia-Namaqualand diamond mega-placers is explained after considering the weathering history of the world's cratons. Anyone interested in placer deposits of any kind should review this paper.

The final paper by Heinrich *et al*. on the constraints on the formation of porphyry copper (-gold) deposits from micro-analyses of fluid and melt inclusions is primarily based on studies at Argentina's Bajo de la Alumbrera deposit. Heinrich *et al*. conclude that "emplacement mechanism, magma-chamber dynamics, and possibly as additional source of sulfur are probably more decisive for the formation of a large deposit than sheer pluton volume and elevated Cu contents of the melts."

Some papers clearly presented more material on how particular mineral deposit types provide evidence on the Earth's evolution. As reflected in the foregoing synopses of the individual papers, I found some more interesting than others. Undoubtedly other readers with differing backgrounds and interests will be drawn to different papers. The overall idea that mineral deposits can provide information on the Earth's evolution from a variety of perspectives is worth emphasizing. A huge amount of geological data is collected at operating mines and this data can provide valuable information regarding questions beyond the immediate concerns of economic geology. This information is worth tapping.

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*Both of the above reviews by David Abbott have been printed in The Professional Geologist Bursting the Limits of Time, Jan/Feb 2007 Mineral Deposits, March/April 2007*

# Experiences of environmental site investigation in Hungary

*by Judit Tóth[1], Andrea Lukács[1] and Dr. Ernő Török[1]*

The aim of this article is to explain the Hungarian process of environmental state assessment and site investigation. Industrial experiences of state assessment and site investigation at hydrocarbon-contaminated sites are presented in details. We deal with the National Environmental Remediation Programme and also mention the current legislative background.

Le but de cet article est d'expliquer en détails le processus d'évaluation de l'état environnemental et d'analyse de sites définis, en Hongrie. L'expérimentation industrielle concernant l'évaluation du niveau de pollution sur des sites contaminés par des hydrocarbures est exposée en détails. Se trouve également abordé le Programme National de réhabilitation environnementale des sites avec mention du cadre législatif actuel.

El objetivo de este artículo es explicar el proceso de evaluación ambiental y los estudios in situ realizados en Hungría. Se presentan con detalle experiencias industriales de evaluación ambiental y estudios de campo en zonas con contaminación por hidrocarburos . Se analiza el Programa Nacional de Restauración Ambiental y la actual situación legislativa.

Environmental protection came into focus after 1989 in Hungary. Now, with present legislation, starting a new economic activity that carries significant risk of environmental contamination is not possible. One of the most important matters at present is the site investigation and remediation of remnant environmental damage from former contaminating activities. Contamination is classified according to source and harmful impact. Deleterious effects can be caused by the disposal of waste, former spoil-banks, sludge lagoons, slag-hills, railway-stations (e.g. liquid storage tanks, repair shops) and military sites as well as chemical plants, refineries, filling stations, airports, underground storage and delivery equipment (pipe works for transport of hydrocarbon products and storage tanks for various types of hazardous materials).

In Hungary the "polluter pays" principle holds, the government pays only for the non-revertible remediation. In order to support the tasks of the latter environmental remediation, the National Environmental Remediation Programme was established in 1996, which is a part of the National Environmental Programme. Completion of non-revertible remediation is coordinated by ministers in a framework of sub-programmes such as the "Closing of the former state-owned coal mines", "Recultivation programme of the termination of Hungarian uranium ore mining" of the Ministry of Economy and Transport, or the "Water Management Sub-programme" of the Ministry for Environment and Water. The 10 ministries, which participate in the programme, coordinate 19 sub-programmes. The number of contaminated sites coordinated by the National Environmental Remediation Programme is approximately 30 - 40000. Remediation of these may take decades.

One of the interesting results of the Programme is a record of contaminated sites, using a geoinformatic database. It can manage more than 70 environmental and other types of data per site, and it is possible to add more data in the case of strongly contaminated sites. The system is called FAVI-KÁRINFÓ (Hungarian abbreviation of Remediation Information System, part of the Environmental Registration System for Groundwater and the Geological Medium - FAVI). It is operated on the Oracle database and gives countrywide accessibility for those involved with remediation. It is available in the capital, Budapest, in the VITUKI Institute for Environmental Protection and Water Management, in the Ministry for Environment and Water, a part of the Environmental Protection, Nature Protection and Water Inspectorate (country-wide).

The database also serves as a source for reports and graphs. Using its geoinformatic function it can provide data for thematic maps, or it can give orders of priority for remediation, etc. Figure 1 shows that most sites in the remediation programmes are contaminated with hydrocarbons or their derivates.

Mineral oil and its derivatives are responsible for approximately 29% of the total of contaminated sites. Remediation sites which are contaminated with communal waste (15%) and pollutants of agricultural origin (dung) are also significant.

**Legislative background**

The legislative background for Hungarian site investigations and remediation dates from the 1990s and during subsequent years, the numbers of relevant laws have risen significantly. Governmental decrees regulate the required professional terms for performing environmental revisions, the mode of authorization and the content requirements of the final report. They also report on authorization procedures for environmental-effect investigation and unified environment-usage, activities connected to the performance of environmental-effect investigations and on the detailed rules of official proceedings related to these.

The aim of the governmental decree on the protection of groundwater is to determine the tasks, rights and obligations associated with ensuring and maintaining the good status of groundwater; the progressive reduction and prevention of the pollution of groundwater; a sustainable water use based on the long-term protection of available groundwater resources; the remediation of the geological medium (Govermental Decree No. 219/2004).

The limit values necessary to protect the quality of groundwater and the geological medium are contained in a joint decree of four ministries (Ministry of Environmental Protection, Ministry of Public Health, Ministry of Agriculture and Regional Development, Ministry of Traffic, Communication and Water Management).

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## The process of environmental assessment and detailed site investigation

*Site survey*

The assessment of environmental impact in Hungary can be initiated either by the relevant authorities or by legal persons concerned with some environmental case or problem. The National Inspectorate for Environment, Nature and Water (hereafter abbreviated as Inspectorate) in a given contamination carry out a site survey in order to verify the given information and data. It decides if the contamination demands measures on the basis of the attitude of the competent expert authority and the site survey. If so, it orders environmental measures, procedures and also remediation to begin. The decision of the Inspectorate contains indications of demand procedures, examinations in order to gain information about the pollutants and requested limits. In the decision the Inspectorate specifies who is obliged to do the site investigation, the areas concerned, the deadline for the submission of the final report and regulations for the investigation plan. During preparation assessments, primary tasks are collecting and estimating archive data at the same time as fieldwork.

*Site investigation, sampling*

In the course of fieldwork, drilling samples in accordance with relevant standards is a requirement. The numbers of sampling points primarily depends on the extent of the site and its geological structure. Depths of drill holes depend on the position of groundwater level. After reaching groundwater level, a further half meter is generally drilled. The most important part of on the spot investigation is sampling. The type of sampler is determined by petrology and groundwater. It is necessary to sample both soil/rock and water. Samples are generally taken using a screw auger or mud auger bit. In the field drilling diary, the exposed rock types with their main characteristics, sampling places and data referring to groundwater level are recorded. During assessment it is important to determine the direction and velocity of groundwater flow. Specification of groundwater flow in Hungary more frequently is made by geoelectric processes, for example on the basis of equipotential lines ("Mise-a-la-masse") method (Tóth, 2004).

*Measurements*

Detailed testing of sample materials are made in accredited laboratories. In case of rock and soil samples, organic solvent extract (OSE) and total petroleum hydrocarbon (TPH-GC) analyses are required. For the water samples TPH-GC, BTEX and PAH measurements are required, and for confined groundwater, heavy metal analysis as well.

*Representation on maps*

Using the analytical results of water and rock/soils samples from different depths, we can make isoconcentric maps (Fig. 2). The maps that are related to given periods can be applied for contaminant transport modeling as base data. The spreading and movement of a contaminant can be followed using analytical or numerical transport models. The contaminant transport models can help the understanding of the movement of groundwater flow systems and contamination as well as forecasting contamination transport, extent and concentration of the tail and the quantities of contaminated water. It can be used for determining remediation end-values, and also for monitoring well placing selection.

## Geological studies

*Previous data*

Study of the geological setting of the area and its surroundings is based on previous geological descriptions, data and research. In oil industrial activities, knowledge of the geology for a given area is concerned with the deep structure and stratigraphy; thus collecting data for the strata exposed directly to the hydrocarbon contamination is the most important task. Results of the geological investigations of the exploration wells for water, oil and other raw materials, as well as research drillings, must be taken into consideration when compiling the geology of the polluted area.

*Site investigation wells*

As stated previously, site drilling continues for a further half meter after groundwater level is reached. All the drills are completely documented involving the detailed geological description of the strata penetrated and the ground water level (both static and dynamic). Complete geological investigations are carried out on the soils from three or four wells in the polluted area. During these investigations grain size distribution measurement, water content measurement and analyses of water permeability are performed. Important additional knowledge of the geology of the area can be used and the classification of sensitive areas must be supplied. The geological data are summarized in 3D sections in the documentation (Fig. 3)

*Hydrogeology, groundwater*

Summing up the hydrogeology of the contaminated area is one of the most essential tasks. As contamination spreads down to some meters from the surface, pollution can be the most dangerous for ground water, especially on flat-lying plain areas, where the level of the groundwater can reach a relatively high position. Based on detailed geological analysis during the environmental site investigation, important conclusions, involving water storage and water permeability, can be drawn for the several meter thick series (some tens of meters in most cases), which is exposed to pollution. Water current trends, consequently the expected pollution movements in/with the ground water can be detected by current measurements on site. Direct observation of the subsurface water cannot be carried out during the short term investigation, but drainage of the hydrocarbon

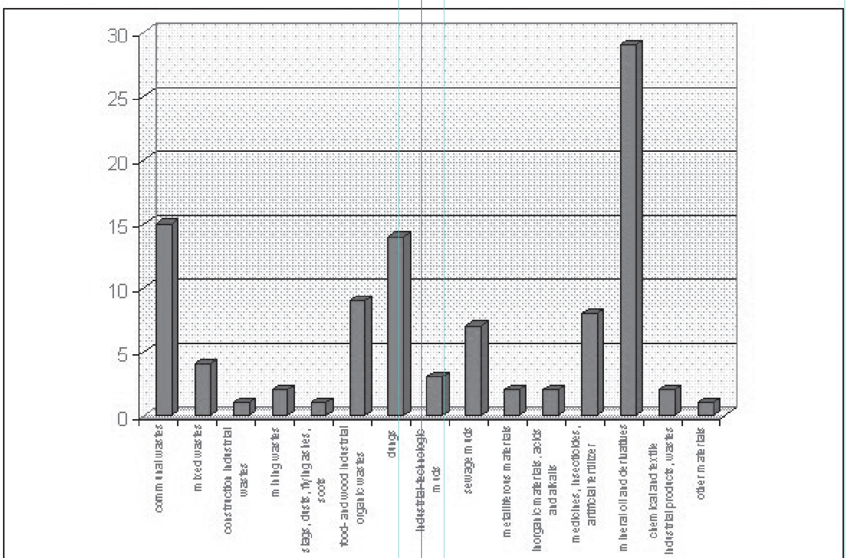


*Figure 1. Contaminated sites in Hungary, on the basis of pollutants, in percent (modified from VITUKI Kht., 2005)*

pollution, downward motion of the contamination into the subsurface water in the deeper regions cannot be excluded.

*Surfacewater*

A lower ground water level can be detected in hilly areas, as in Transdanubia or in the surroundings of the Eger oil field at the foot of North Mountain Ridge (N edge of the Great Hungarian Plain). In these areas contamination of the surface water plays a more important role and the risk of pollution, connected with hydrocarbon exploration and production, is higher. Study of the drainage area, the natural and artificial streams, pools and lakes is an indispensable part of the environmental investigation. Exact topographic, hydrological, even geological maps, previous data or hydrologic measurements and field investigation on site can help this research. During the environmental investigation, sampling and analyzing the surface water are required.

**Final report on site investigation**

Making a final report is a requirement according to the above mentioned decrees. This should contain: the necessary information for remediation in text form, complete with addenda. Accurate identification of the pollution source and contaminated area as well as data concerning the site users and owners; those responsible for the pollution, and those required to carry out remediation, plus the organization responsible for the site investigation and final report; description of land use and water in the polluted areas; a list of threatened natural, environmental and artificial elements; data available at the start of the site investigation, chemical composition of pollutants or description of previous site investigations or remediation; an outline of the geography, climate, geology, hydrogeology, living world, zones of nature and built environment conservation, constructions (built under investigation), investigation methods, samplings, on-site and laboratory analyses and results; a remediation target limit value (D) on the basis of detailed quantitative risk assessment; sensitivity categories of the area (Fig. 4).

In Hungary, areas of extremely high sensitivity in terms of groundwater status are: the zones of drinking, medicinal and mineral water supply sites; karstic areas where limestone, dolomite or marl can be found 10 m below the surface; a 2500 m broad zone from the edge of lakes; 1000 m broad beach/shore zone; aquatic areas that are under protection. Sensitivity areas in terms of groundwater status are where the value of recharge from precipitation averages more than 20 mm/year; areas where limestone, dolomite or marl can be found 100 m below the surface; areas where the top of the main porous aquifers can be found within 100 m of the surface; a 1000 - 2500 m broad shore zone from the edge of lakes and natural areas that are under protection.

The Inspectorate makes a decision about the acceptance of the final report and further tasks. It can demand continuance of the site investigation, determine site-specific pollution limit (E) and remediation target limit value (D). If the contamination exceeds the remediation target limit value (D), it can rule on the necessity of technical intervention and the making and submission of a technical intervention plan. It can order the interruption of remediation and monitoring if circumstances indicate that there is no need for further remediation, because of low concentrations of contamination (Tóth, 2004).

**Experiences of environmental assessment on hydrocarbon contaminated sites**

The almost 100 year old oil industry has involved noticeable environmental damage. There are only a small number of oil industrial establishments which have not caused soil and/or groundwater pollution.

In the previous decades hydrocarbons reaching the soil, rather than groundwater were not considered to cause damage. Neither the effects of the breakdown of hydrocarbons, nor remediation were explored.

This situation has changed. Apart from exceptional cases, environmental risk from the oil industry has significantly reduced because of increased attention and improvements in technology.

An important experience is the quite widespread view that Nature takes care of pollution by means of self-cleaning processes: within a few years pollution will disappear. Our experience is that contamination values considerably exceed the limits also on sites where activities have stopped decades before. By monitoring these, we can see that the untreated contaminations can hardly be detectable and but they remain for a long time.

It is also true that there are significant differences related to geologic conditions in Hungary. On the hilly, mountainous regions at Transdanubia and the environs of Eger, the groundwater level is low and the aquicludes mean a natural barrier in terms of contamination transport. On these sites contamination can be treated without lasting remnant pollution, by collecting spilled hydrocarbons and carrying out exchange of soil. It is characteristic also of the Transdanubia and Eger's area that in the hilly-mountainous regions groundwater movement is rapid and groundwater contamination often comes to an end and transforms into living-water contamination. Consequently in the case of the Transdanubian oil industry soil pollution rather than groundwater contamination should be considered.

On the Great Hungarian Plain, groundwater is near surface and inland waters develop there in some periods of the year. Hazardous events and intentional damage create conditions that are difficult to manage, and this is basically groundwater contamination. Soils are sandy in general with good water permeability. Groundwater is characteristically dead water, its level depending on the rainfall but horizontal transport is not significant. It often happens that pollution can find its way easily into groundwater and then free-float, polluting the soil from below. This type of groundwater contamination can only be treated by expensive remediation systems, taking many years and is very costly.

Hungary has unique rich thermal water reserves, which are exploited for medical use or serve as geothermal energy sources. Environmental investigations of the oil industrial buildings in these areas need most attention in order to protect and preserve the valuable water thermal sources. During the investigations in the Great Hungarian Plain where most of the water reserves can be found, the relationships between the groundwater and the subsurface water have also been researched. Due to the geological setting in the areas around the hydrocarbon reserves the TPH values of the groundwater cannot be compared with the areas where the environmental required limits show relatively lower values. According to the continuous maturational and transitional processes of the organic matter hydrocarbons can appear in any place, as a consequence of the migrational processes. For example in the area of Hajdúszoboszló, the hydrocarbons can migrate to the upper formations along the fault system.

The organic microcomponent composition of the groundwater and of surface water has to be taken into consideration in the areas of thermal water exploitation. Based on data in the literature, subsurface water samples (warmer than 65$^{o}$C) from sedimentary rocks contain natural volatile organic components (chromatographi-

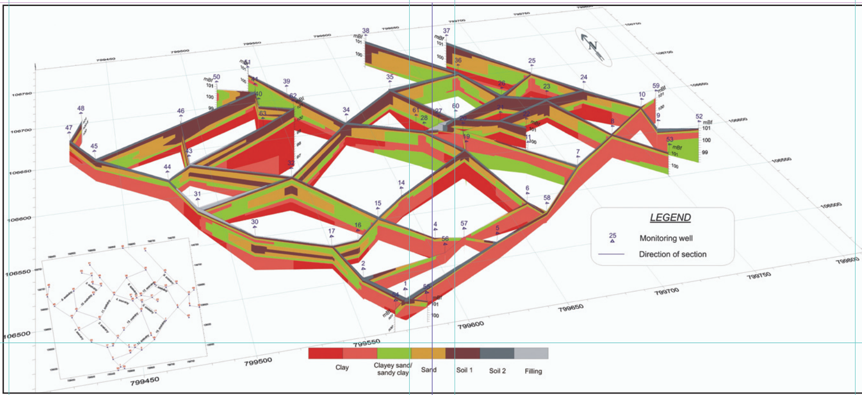


*Figure 2. Isoconcentric map of a contaminated site*

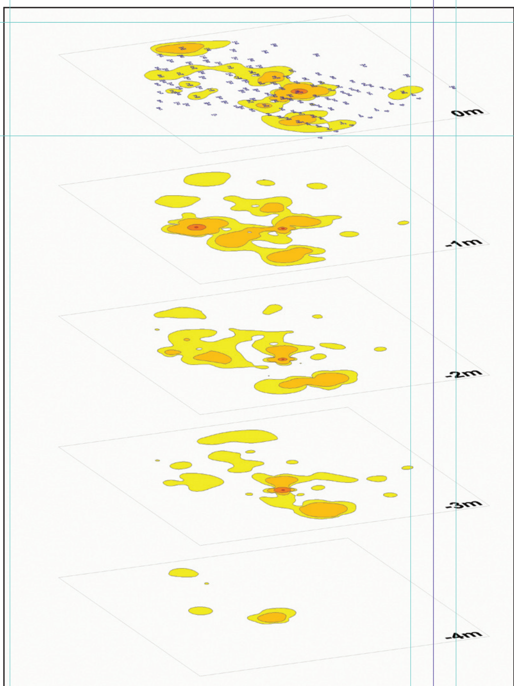


*Figure 3. Geological data summarized on 3D sections*

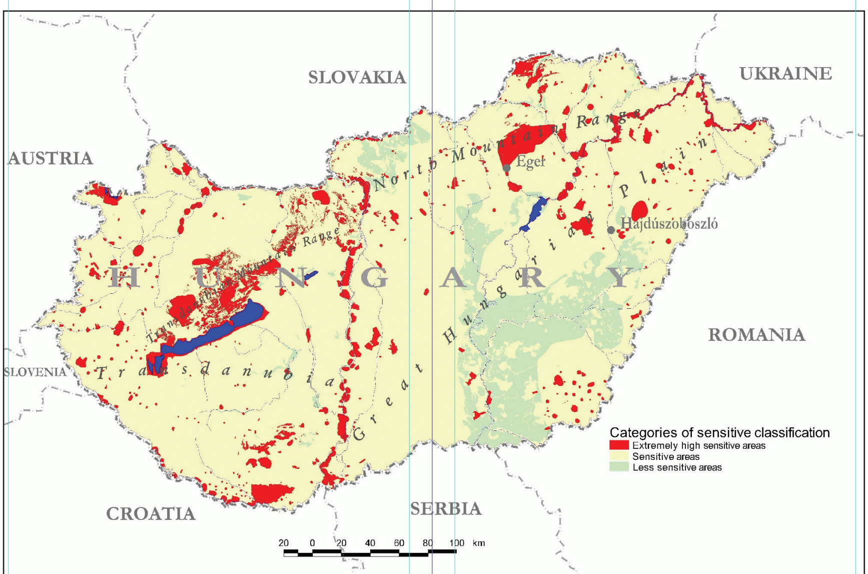


*Figure 4. Classification of areas sensitive in terms of groundwater status*

able) in relative higher quantity. These waters may contain high enough amounts of natural aromatic or phenol-like organic compounds that their use may be restricted. During environmental site investigations of hydrocarbon pollution in such areas, the organic geochemical analyses and correlation evaluations must be taken strictly into consideration.

In recent decades it is not so much oil contamination but pollution of the simultaneously recovered artesian water that has come to the attention of environmental investigators: areas polluted by barium, boron, arsenic, chloride can result from corrosion of the artesian water-pipelines. Economically adequate decontamination or remediation procedures for this type of pollution are not available at present; consequently use of groundwater may and have to be restricted.

During contamination treatment the effectiveness of the remediation strategy and processes can efficiently be supported by environmental and/or environment-medical risk analyses. Increasing numbers of relevant laws show the strengthening of environmental protection. The aim of the modifying of decrees is to comply with the European Union's principles.

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## *Ongoing Projects at present:*

### MALI

- ✓ *Construction of a water retention dam*
- ✓ *Drilling of 3 water wells equipped with solar pumps*
- ✓ *Digging of 6 traditional water wells*
- ✓ *Beneficiaries: about 5000 people*

### HONDURAS

- ✓ *Construction of 4 complete rural aqueducts (drilled water well + pumping system + water tank + water distribution to users)*
- ✓ *Lake Yojoa hydrogeological study*
- ✓ *Intervention in sanitation improvements*
- ✓ *Beneficiaries: about 8500 people*

## *Future Projects 2007/08*

### GAMBIA & TOGO

- ✓ *Water retention basin*
- ✓ *Drilling of 3 water wells equipped with solar pumps + water distribution systems*
- ✓ *Interventions in school sanitation improvements*

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# A GSF Project in Mali

*by Vincent Accart[1], Carlo Enrico Bravi[2] and Antoine Bouvier[3]*

The GSF Project in Mali (Madalaya district) was presented in EGM issue N° 22 (pp 23-24) aiming at supplying drinkable water to about 7000 people distributed over 5 villages located on a large dolerite batholith. This article deals with the results obtained at a global development level since beyond the initial demand for water through several drill holes with hand pumps, wells have also been dug, a dam built, the regional health centre supplied with electricity and water, a women's garden provided with water well and fenced, and the school furniture partly replaced.

The 5 villages of Madalaya, Tamaratinty, Yahinane, Tiffé et Djanfa (Kayes Region, in the West of the Country) are isolated between hills made of dolerite, seen on the surface as boulders, which make the village access very difficult to any vehicle.

The annual rainfall of about 800 mm., allows a water supply through shallow wells during 4 or 5 months after the end of the rainy season. In February most of the wells become dry, which forces the women to stop gardening and to walk several kilometres to get water from a distant drilled hole.

Through a demand expressed by the *Association de Développement de la region de Madalaya, ADVM,* in Paris, GSF got a financing grant from the Nando Peretti Foundation in Rome, to drill at least one positive hole in each village site.

A GSF hydrogeological reconnaissance followed by a geophysical survey carried out by a Malian Bureau (BREESS) lead to the selection of a few favourable drilling sites, where conductive axis are assimilated to watered drains, characterized by a local thickening of the weathered and fractured dolerite (15 to 20 m thick at most).

To extend the period of well use, a small dam was also built, aiming at recharging the local discontinuous aquifer and in the meantime to create an artificial water basin.

In the villages of Madalaya and Tam aratinty, previous drilled holes fitted with *India* hand pumps were out of use or providing a meagre yield (a few hundred litres) due to several tube leakages. Using a maintenance kit and spare parts (piston, rod, tie bolts) purchased by GSF, a local technician has repaired 2 pumps.

But after several weeks of use and despite the pumps' strong constitution, both of them were broken again, due mainly to a rough use of the pump lever arm.

This result and the very poor maintenance from the local technician, has convinced GSF to propose a solar pumping system (submersible electric pumps and solar panels), surely more expensive than the hand pumps but easier to keep running (panel cleaning only).

Following the wish expressed by the villagers, it was then decided to reduce the number of drilled holes to 4 and to dig one traditional well per village, at an appropriate location (convergence of geophysical results and local requirements) or to install a solar pump in the rare permanent wells.

Due to the fact that the drilling rig was unable on a rough track to reach the Djanfa village, only 3 drilled holes, about 40 to 45 m deep, have been executed, 2 of which yielding 3 $m^3/h$ (Madalaya, Yahinane), while one was negative at Tamaratinty. In this village, after a failure at a well site to find water within the dolerite, it was decided to bring an old borehole into use again and to replace the broken *India* pump with a solar pump. This was accepted after a pumping test showing a constant yield in the range of 1 $m^3/h$.

New wells dug in the other villages were positive and to match the falling water table during the dry season, the well bottom was dug at least 5 m below the existing water level. This was performed using professional well sinkers and blasting devices to break and remove dolerite boulders.

The cemented well was then protected by a metallic cover made of two semicircular articulate plates.

The selected solar pump is the Italian Solaflux (made by Fluxinos srl in Grosseto), delivering either 0.8 $m^3/h$ or 1.6 $m^3/h$, depending on the local need.

Water tanks, with a capacity varying from 2000 to 4000 litres, were installed on concrete pillars, about 4 m high.

Water distribution to some borne fountains, through buried PVC pipe, has required digging narrow trenches filled up with clayey sands. This task was carried out by the villagers, under GSF supervision. A 300 m long trench brought water to the Health Centre, located on a slightly elevated lateritic exposure at the village fringe. Photovoltaic panels were also installed on the Health Centre roof, to provide light to the treatment room and keep the refrigerator running for medicine.

Because women in any village are in charge of water supply to meet their family needs and are also eager to earn some money, they have created some "kitchen gardens", where they grow vegetables partly for their own consumption and the rest for sale in the market. After selecting a favourable spot at the garden edge, a

*Water supply project in Madalaya village and surrounding areas, Kayes Region, Mali Republic, Africa* traditional well to provide water to the "gardens" was successfully dug. GSF has provided all the well-building materials: cement, iron, cover plates, and has also supplied the fencing metal net and iron poles, to prevent meandering animals from eating the salads and tomatoes.

After a visit to the Madalaya school which is traditionally located on the outskirts of the village, the Project Supervisor decided to replace all the collapsing benches (invaded by devouring termites) and to build a concrete floor to stop the insect invasion.

To conclude, a successful development Project in Western Africa depends on several parameters:

- the existence of a structured local association (here, ADVM) with a responsible person trusted by local authorities, the village chief most of the time
- a permanent resident, representative of the Project, in charge of the technical and financial aspects. The position was taken by a young mining Engineer, who has lived in Madalaya village most of the time, Vincent Accart
- the local participation of villagers: artisans and workers and also people in charge of expatriate accommodation
- a good balance between the Project objectives and the actual needs expressed by the population
- the completion of undertaken actions: for example not only drilling holes or digging wells but distributing water at borne fountains
- taking into consideration local priorities not defined in the initial programme: in our case, for example, building a dam, supplying electricity to the Health Centre and replacing the school furniture.

This objective adjustment has of course implied a certain flexibility from the financing body, with whom all Project modifications and integrations are always planned.

This kind of "integrated Project", as it has been briefly described, surely has greatly contributed to improving the living standard in the five involved Villages, while the villager work commitment during the Project execution, will surely be a positive element for the follow up and duration of the Project.

# Yojoa Lake environment protection studies

*by C.E. Bravi[1], U. Puppini[2], M. Remonti[2], A. Rainero[2] and A. Uttini[3]*

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Since April 2006 the Association GSF Italia (Geologi Senza Frontiere / Geologists without Borders) has been carrying out ten water supply projects in a number of communities in Honduras C.A.

The typical water supply project consists of running a hydrogeological study of the area together with geophysical survey and, based on the interpretation of the results,, drilling a water well equipped with a submergible pump provided with an electrical connection, building a water storage tank and a water piping system to the users.

The completed projects, summarized in table 1, concerned some 9000 people.

During the execution of the above-mentioned projects, GSF was asked by the local Organizations ASIDE and AMUPROLAGO to run a study on the Yojoa Lake basin, the largest inland lake in Honduras, seriously damaged by rapidly escalating pollution.

With the ambitious slogan 'Let Yojoa Lake Environment Survive', a hydrogeological and environmental study of the whole Yojoa basin was planned and carried out in collaboration with ESI Italia, the main task being to draw, for the first time ever, a hydrogeological conceptual model.

The entire work has been financed by the Nando Peretti Foundation (Rome, Italy) with some local support.

The results of the Lake Yojoa study highlighted the main threats to the environment as:

- the human presence
- aqua farms
- mining activity
- the exploitation of the lake waters for hydroelectric purposes.

Human action produces a strong impact on the ecological system of Yojoa Lake, primarily by deforestation and production of organic waste. In addition, the dramatic demographic increase has resulted in a decrease in natural resources.

The area surrounding Las Vegas Village showed particularly high concentrations of organic and inorganic contamination, due to hotels, restaurants, mines and waste from farming activities, whose drains discharge almost untreated waste into the lake, causing water pollution and high fish population mortality.

Mining activity produces strong heavy metal contamination, due to lead, zinc and cadmium, originally located in exploited sedimentary rocks layers. Many different monitoring studies showed serious lead concentration in two different fish varieties living in the lake (the Black Bass and Tilapia), their lead concentration, respectively 0.586 ppm and 0.423 ppm, exceeding the standard values.

Moreover, intensive aqua-farming increases the faecal bacteria presence in the lake waters.

The exploitation of the lake waters for


*Environmental protection of Yahoa Lake, Honduras Republic, Central America*

| Name of the communities | Geographic area | Type of project | Users |
|---|---|---|---|
| LAS CRUCITAS - EL HABILLAL - LA CAMPO | Southern Honduras | Water supply and distribution system | 2300 people |
| 27 DE MAYO - COROZALITO - SANTA FÉ | Northern Honduras | Water supply and distribution system | 840 people |
| COLONIA EL BUEN SAMARITANO | Northern Honduras | Water supply and distribution system | 470 people |
| JUTICALPA | Northern Honduras Bay Island | Water supply and distribution system | 770 people |
| ESPERANZA 1 | Northern Honduras | Water supply and distribution system | 540 people |
| SAN ANTONIO DE LA UNION | Northern Honduras | Water supply and distribution system | 480 people |
| LA CAÑADA | Central Honduras | Water supply and distribution system | 690 people |
| DAKROATARA | North-East Honduras Moskitia area | Sanitary services and rehabilitation of damaged water wells | 800 people |
| KAUKIRA | North-East Honduras Moskitia area | New water wells in 8 kaukira's schools | 1900 children |

*Table 1. Communities who benefit from the project (13 communities with 8770 people)*

the hydroelectric plant affects the water level very strongly, particularly during dry periods; this is particularly true of the southern area.

For a better understanding of these effects, the main terms of the water mass balance were defined to give an updated picture of the basin water resources and address the development and mitigation policy, together with some relevant players in water management, **Amuprolago**, the consortium of nine Municipalities related to the Yojoa basin, and **Aside,** a national association for social development and environment protection, which have been GSF local partners in all of the projects carried out in the country.

The Yojoa Lake is located in the northern hydrographical basin whose waters discharge towards the Atlantic Ocean. The lake was grown within a tectonic structure, so called 'Horst and Graben', defined by a system of direct faults.

The current lake outlet on the northern side is through an artificial channel, completed by ENEE (the National Electric Company in Honduras), to feed an hydroelectric plant..

Two main hydrogeological units are present in the area, one made by fissured limestone rocks and the second made by fractured volcanic rocks. The boundary between the two units is likely to run underneath the lake, in a SSE – NNW direction as shown on the northern lake bank. Both units are hosting consistent groundwater circulation.

A comprehensive data analysis and survey was run to:

- collate previous scientific studies and environmental, geographical and social databases published by public or private bodies
- collate field data from April to July 2007
- perform chemical and physical on-site and desk tests from April to July 2007.

The first stage of the study has already been accomplished with the reconstruction of the hydrogeological conceptual model and the analysis of the major environmental impacts, which impend on the Yojoa Lake, run by applying a Leopold matrix to the case.

The second stage will consist of a detailed bathymetric and sub-bottom study of the lake itself. This phase will be carried out at the beginning of 2008.

A first positive result has already been achieved, as a recent Government Law declared the Lake area a 'National Inheritance' and has produced some rules of behaviour to protect the environment of the whole lake basin.

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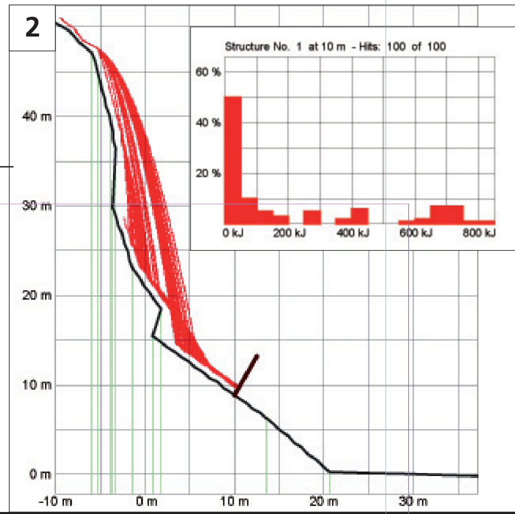


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