

N° 28

Dec 2009

# European Geologist

Revue de la Fédération Européenne des Géologues  
Journal of the European Federation of Geologists  
Revista de la Federación Europea de Geólogos

*Thematic issue: Mining in Europe*



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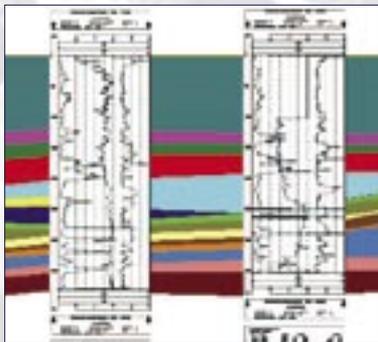
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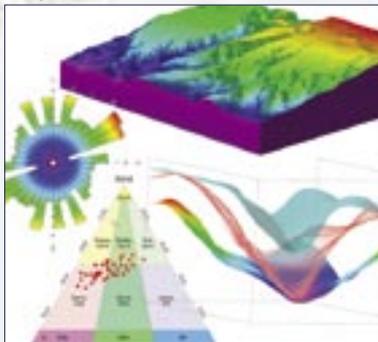
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*Cover photo: Aggeria mine, Milos Island, Greece. Owner company S&B, Greece. One of the largest bentonite mines in the world, it has been operating since 1985 with an average yearly production of one million tons. Created by iron oxides, the varying colours correspond to different qualities of the mineral. (Photo: Veronika Sandova, Euromines)*

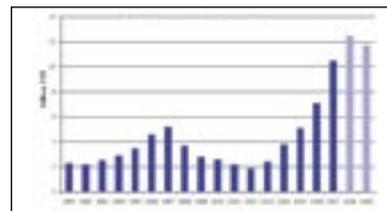
*Photos this page:*  
 Top, A Wirtgen cold milling machine, Estonia; Below, Global mining exploration expenditure; Bottom left to right, Rhyolitic domes, Hungary; Lignite mine, Kosovo; Emperor dragonfly at the Altkirch site, Switzerland

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## EUROPEAN GEOLOGIST

is published by the  
European Federation of Geologists  
C/O Service Geologique de Belgique  
Rue Jenner 13  
B-1000 Bruxelles, Belgium  
Tel: +32 2 6270412  
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## Foreword

# A new term

by *EurGeol. Ruth Allington, President*

As I write, I have now completed just over 3 months as President of EFG. It is a great honour to have been elected in May and to have this opportunity to contribute to the EFG and its important work in promoting and supporting geology and geologists in Europe, providing a forum and network for its member associations and supporting and regulating those who hold the European Geologist title.

Marino Trimboli (EU Delegate) and I join continuing members of the Board (Dirk DeCoster - Vice President, Seppo Gehör - Secretary General, and Piers Gardiner - Treasurer) at a time when the Federation is busier than ever. We are involved in two EU funded projects: as co-ordinator of "Geotrainet" and as a partner in Euro-Ages - more information about both of these projects may be found on the EFG website. A further phase of the Terra Firma project is expected to commence in 2010 and EFG will be much involved here too.

During the Council meeting the Council approved new Statutes for the Federation and is aiming to produce a new set of Regulations for discussion and approval at the December Council meeting in Brussels. The reason for the review is to update, clarify and rationalize these documents to better serve the smooth operation of the Federation for the benefit of its member



associations and the holders of the European Geologist title. The new Statutes and the working draft Regulations may be found on the EFG website. Bob Chaplow has been the driving force behind the revision of these important documents and I thank him most sincerely on behalf of the Federation for all his hard work.

I should like to record the thanks of the Federation to the retiring members of the Board: Manuel Regueiro and Herald Ligtenberg. Manuel carried off his second term as President of the Federation with characteristic energy and enthusiasm and Herald was a hard working and extremely effective EU delegate. I should also like to thank the continuing members of the Board, Isabel Fernandez and past presidents of the EFG for their warm welcome and generous support to me as I find my feet in my new role.

### A word from the Editor

My thanks to all of you for making the thematic issue on Mining in Europe possible. The contributions come from a range of sources: from the European Commission, working hard on the Raw Materials Initiative, from industry and from National Associations, as well as from individual EurGeols. I particularly welcome input from our members and from EurGeols and hope that you will also send any comments to me that you would like to share with the readership. This is your magazine, after all. The Editorial Board will discuss, at the informal Council Meeting in Brussels in December, a possible theme for issue 29, in June 2010. Please contact us if there is a particular issue you would like to see developed in the magazine. I would like to extend our



thanks to the advertisers and wish all of you a Happy Christmas and best wishes for 2010.

Maureen Mc Corry

# Shale of the century?

by Ted Nield<sup>1</sup>

Are oil shales a dead duck, or about to take off? For one European country where oil shale provides 93% of its electricity, an answer is keenly awaited. Ted Nield investigates...

**B**elieve it or not there is a modern European country, with an annual GDP growth rate of 12%, which today relies almost completely on oil shale for its electricity. Oil shale is that country's chief mineral resource (both for power generation and chemical industry feedstock) and it digs up about 13 million tonnes of the stuff every year. Even more surprising, these undeformed organic sediments date from the Ordovician, and they're a two hour Easyjet hop away from London's Stansted Airport.

#### Estonia at a glance

Area: 45,227 km<sup>2</sup>  
 Population: 1.4 million  
 GDP: €6.2bn  
 GDP (purchasing power standards per person, % of EU Average): 40%  
 Wages/hour (2000): €3.03  
 Unemployment: 12.4%  
 Agricultural workers: 7.1%

The country in question is Estonia (see box). But environmental campaigners there are finding themselves at loggerheads with the industry, which is set to grow markedly in coming years after a period of decline. They claim it is environmentally unfriendly, while the industry counters that campaigners are living in the past. Thanks to improvements in mining and combustion technology, the industry's environmental record is now clean, they say.

In fact, the future for oil shales worldwide may be brighter than even its Estonian enthusiasts are saying. New in situ combustion techniques being trialled in the USA may make oil shale one of the greenest fuel sources around, with all waste remaining locked firmly in the ground.

#### What is Oil Shale?

In the history of misnomers, "oil shale" must rate as one of the greatest, since it isn't shale and contains no oil. So forget about

<sup>1</sup>Editor, Geoscientist

Les schistes bitumineux représentent-ils une chimère ou leur exploitation va-t-elle se développer? Pour un pays européen dont 93% de son électricité est fournie par les schistes bitumineux, la réponse est vivement attendue. Ted Nield étudie le sujet...

those foul-smelling bituminous Jurassic shales of Kimmeridge Bay, or parts of the Carboniferous. These oil shales are fine-grained, toffee-coloured sediments of low density, containing high proportions of kerogen that give off liquid or gaseous hydrocarbons when heated. The proper mineralogical term for this rock is "kukersite", derived from the type locality near Kukruse, in Estonia.

Kukersite is really a source rock that has not passed through the "oil window". So the organic matter, having not been changed into an oil-like substance, has to be heated in a retort, in the absence of air, to between 350 and 650 °C (depending on feedstock). The kerogen undergoes the chemical process known as pyrolysis, and the hydrocarbons are driven off. The industrial process is called "retorting". Generally, only those shales yielding over 40 litres of oil per tonne are considered economic. The Estonian oil shales are particularly rich, yielding over three times that much. While some of Estonia's oil shale is used in this way, more is simply burned in power stations - usually after it has been further concentrated ("beneficated") to minimize the amount of low-calorific value gangue mixed with it.

The kerogen in oil shale owes its origin to the same organic processes as the hydrocarbons in conventional reservoirs - and

¿Están las pizarras bituminosas condenadas al fracaso o están a punto de despegar? Hay un país europeo en el que las pizarras bituminosas proporcionan el 93% de su electricidad, que espera una respuesta con ansiedad. Ted Nield investiga....

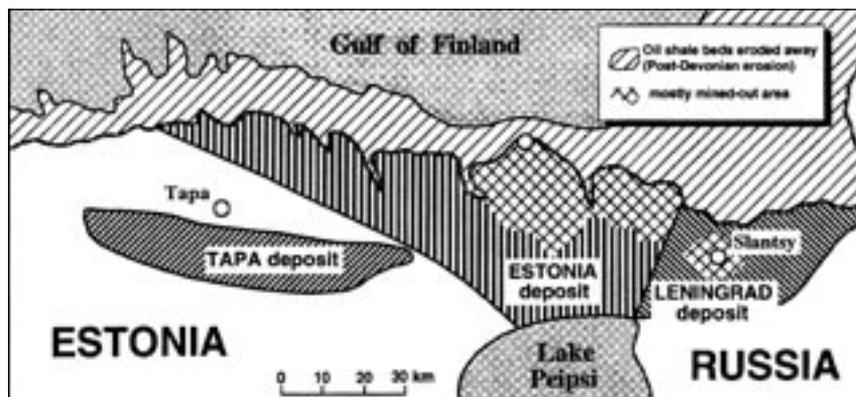
like them is composed of carbon, hydrogen, oxygen, with a dash of nitrogen and sulphur. However its complex macromolecular structure is insoluble in the usual organic solvents.

Oil shale was first researched scientifically in Estonia at the end of 18<sup>th</sup> Century. In 1838 first experiments were made to obtain oil by distillation from a small batch of kukersite mined near the town of Rakvere. Although the rock could be used as solid fuel and, after processing, as liquid or gaseous fuel, kukersite was not exploited until shortages created by World War I bit for the first time. In fact the history of the exploitation of oil shale globally has been marked by cycles of renewed interest based on shortages, or threats of shortages that have inflated the price of oil. Thus, under Jimmy Carter, America threw large amounts of money at "Synfuels Corp." during the 70s oil shock. It closed in 1985. The current high oil prices, concerns over "Hubbert's Peak" and security of future supply, have re-awakened interest in this vast and largely untapped global resource.

#### The rock that burns

The first genuine historical record of the unusual properties of the mineral that would be named kukersite was made about 1725 - a report about local shepherds

Figure 1. Location of shale deposits in the Baltic Oil Shale Basin (Heikki Bauert)



using the shale to build the nighttime fires by which to watch their flocks. Another reference appeared in 1777, in a report by August Hupel, (1737-1819), Lutheran minister, savant and man of letters in the city of Pöltsamaa.

Kukersite occurs in two main units in Estonia (Fig.1). In the North East part of the republic is the “Estonian” deposit, which comes from the base of the Viivikonna Formation (Kukruse Stage) of Upper Ordovician age (actually the precise stratigraphic position of the oil shale is still uncertain. Conodonts indicate Upper Ordovician (in the recent global timescale), while graptolites, which are very rare in limestones, support a topmost Middle Ordovician age.) The Estonia Deposit forms the western part of the Baltic Oil Shale Basin, covering an area about 5000 km<sup>2</sup>. Easternward extension of the Baltic Oil Shale Basin into Russian territory is called the Leningrad deposit. The Tapa



Figure 2. The brachiopod *Estlandia* from the Oil Shale (Kukruse Formation, Ordovician Caradoc) of Estonia. Both genus and family are endemic to this terrane, indicating how isolated Baltica was in the Ordovician. (Photo: Phil Crabb. © Natural History Museum)

deposit in central Estonia which is slightly younger in age, lies at a depth of 60 to 170 metres. It is not well explored.

Kukersite is a light brown rock flecked with abundant fossil remains (Fig. 2). Unlike in monotonous black shales as well as in microlaminated Green River oil shales, specific cell structures can be observed in kukersite microscope studies, particularly well distinguished under SEM. The kukersite organic matter derives from a colonial microorganism called *Gloecapsomorpha prisca* - thought either to be

an alga or cyanobacterium. *G. prisca* also shows many morphological similarities to the modern cyanobacterium *Entophysalis major*, which forms intertidal and subtidal mats in places like Shark Bay, Australia. The calorific value of the kukersite deteriorates to the south, falling from 10 Mega-joules per kilogram in the north to about half that in the south and southwest. The thickness of the commercial horizon also decreases in that direction.

Because of the chemical and isotopic characteristics of the organic fraction, the accumulations are thought to have originated in shallow subtidal marine lagoons of the Baltic epicontinental sea. More than 300 different species of fossil have been recorded from them, and they tend to have a rather low pyrite content - all indicative of good oxygenation. Palaeomagnetic data suggest a palaeolatitude of 30 to 50 degrees south, suggesting a temperate environment.

Since 1916-18, when commercial oil shale mining began in Estonia, it has had an enormous influence on the country's economy, particularly when it was part of the Soviet Union, and subsequently in the modern Estonian Republic. By 1955 annual output had reached seven million tonnes and was mainly used as power station/chemical plant feed, and in the production of cement (using the ash). The opening of the 1400 MW Baltic Thermal Power Station (1965), followed in 1973 by the 1600 MW Estonian Thermal Power Station, again boosted production, and annual output peaked in 1980 at 31 million tonnes.

The decline in oil shale production started in 1981, when the fourth reactor was launched at the Leningrad Nuclear Power Plant located in Sosnovy Bor and it became clear that no additional thermal power plant will be built in Estonia. By 1999 annual oil shale production had fallen to 10 million tonnes. Most was used for electricity and heat generation, and 1.3 million tonnes were distilled to produce 151,000 tonnes of shale oil. Estonian oil shale resources are currently put at 5 billion tonnes, including 1.5 billion tonnes of active (mineable) reserves. Since the turn of the century, each subsequent year has seen small recoveries in production, reflecting the rising power demand in Estonia as its economic recovery has gathered pace.

#### Future trends

As the consumption of oil globally begins to outstrip the discovery of new fields, oil-

poor countries like Estonia can be forgiven for looking upon their oil shale as a blessing. But the shale has, as well as its actual overburden, an invisible one - namely, opposition from environmentalists.

It is not hard to see why environmentalists instinctively oppose the industry. First, like most industries dating mainly from the Soviet era, it has had a dubious environmental past. The shale (mostly) needs to be strip-mined; typically, Estonian opencast oil shale mines have to take out 20-30 m of overburden to excavate a mere 3-4 m of kukersite (Fig. 3). Although new Wirtgen milling machines have improved the efficiency of this mining process (Fig. 4), relieving the need for further enrichment of the product before burning, all overburden must be replaced and the landscape restored and re-vegetated.

It is also widely asserted by environmental campaigners that the sludgy material left behind by retorting and burning, because of a so-called “popcorn effect” unique to oil shale, occupies 30% more volume than the original unburned material. The hole it came out of being too small to receive all this waste, the result has been large mountains of ash that are a familiar feature of the NE Estonian landscape. Moreover, environmentalists say, this residue contains phenol-rich organic molecules that then leach into groundwater.

However, Heikki Bauert, an expert on Estonian oil shales, but who no longer works in the industry says: “the popcorn effect...exists only in fantasy. The actual mass balance for kukersite oil shale and retorted waste are similar. Kukersite...is really a lightweight rock... and during retorting at least 10% of mass is removed as raw oil.”

The main reason for not dumping the sludge back into mines was not because it wouldn't fit, but to avoid contaminating groundwater. And as for those toxic phenols, the environmentalists' argument is also misleading and deceptive, according to Bauert. “During the Soviet time, all kinds of oil processing industry waste was dumped together into the same hills. Today, retorting waste may even be free of phenol compounds” he says.

But the biggest single charge levelled by environmental campaigners against oil shale is that because burning it also decomposes carbonates as well as hydrocarbons, it creates more than four times as much greenhouse gas as conventional hydrocarbon fuel. This assertion again, industry supporters say, is highly misleading because

the central assertion (that burning oil shale decomposes carbonates) is outdated. The German cold milling engines are highly selective and have much improved the quality of the power-plants' feedstock. Also those plants now employ much more advanced combusting technology.

Bauert says: "We are not "burning carbonates" in power plants any more". The companies who have developed the circulating bed combustors now employed in Estonian power plants say that while during conventional burning, as during the Soviet era, 30% extra CO<sub>2</sub> emissions could result from decomposing the carbonate gangue, in modern circulating bed combustors roughly 25% of the included carbonate stays intact." Also, the nitrogen content in kukersite is very low, Bauert says. These improvements have made it possible to consider expanding oil shale mining within emissions guidelines imposed by the EU.

Since 2001 the Estonian government has phased in liberalizing measures in its electricity sector. However, the government was chary of wholesale adoption of EU energy policy for the simple domestic reason that opening Estonia's energy market to competition from abroad would likely put mines, quarries and two huge power stations out of business - precipitating an economic and social crisis in the NE of the country. Estonia therefore pushed for the EU to recognise that most of its power would continue to come from oil shales until 2015 at least. In this they were largely successful.

Although a recent Estonian Economic Development Plan stated that oil shale's share in the country's national primary energy balance must fall to 52-54% by 2005 and to 47-50% by 2010, thanks to technological improvements in mining and combustion, the country's most recent governmental projection is able to project a marked increase in mining in the near future, with output rising to 31 million tonnes by 2015. Mining

*Figure 4. A Wirtgen cold milling machine in action. Since April 2006 this machine has increased the output of kukersite oil shale to 0.7-1 tonne/m<sup>2</sup>. The cutting drum has an accuracy margin of 2 cm, which means that changes in the height of the reference plane are rapidly compensated, minimizing overshoot. The slewing front-end discharge conveyor makes the mined material easy to load and the precision of the machine means that no further enrichment of the shale by flotation or hand picking ("beneficiation") is needed*



*Figure 3. Aidu (Vanakülu) Oil Shale opencast pit*

permits for this amount have already been issued.

Interestingly, regulatory hurdles have not only afflicted the power generation side of the oil shale industry. In May 2006, the European Parliament approved the Registration, Evaluation and Authorization of Chemicals Directive (REACH). By June, the Estonian chemical industry was already complaining that it was now put at a competitive disadvantage because its unconventional feedstock meant that it had to re-test all its products to ensure compliance - even if the molecule in question was already on the EU approved list.

But while the country's major chemical producer Viru Keemia Grupp (VKG) has struggled with gaining certification for its chemical products, Estonia as a whole is finding that improved technology has saved it from a very uncomfortable situation, despite the continuing opposition of green lobbies. Where once it seemed that Estonia's main mineral product and energy source had either to be reformed beyond the efficiency of any proven technology, or

abandoned in favour of imports, the industry is now looking at a renaissance.

### Shale renaissance

Estonia's response to its very singular energy problems is being watched intently by others with strategic concerns of their own. Outside Estonia, oil shales are exploited only sporadically - notably the Permian Irati Formation (Brazil), and Tertiary lake sediments at Fushun, Liaoning Province, China. However the energy potential of oil shale globally is truly vast. According to the BP Statistical Review of World Energy, the world's remaining oil and gas reserves total 2.1 trillion barrels. The total estimated global resources of oil shale are thought to be well over 2.6 trillion barrels. The total energy resource represented by the Tertiary Green River Formation is said to exceed the total oil and gas reserves of Saudi Arabia.

The amazing fact is that oil shales in Australia, Brazil, Canada, China, Estonia, France, Russia, Scotland, South Africa, Spain, Sweden and the USA have



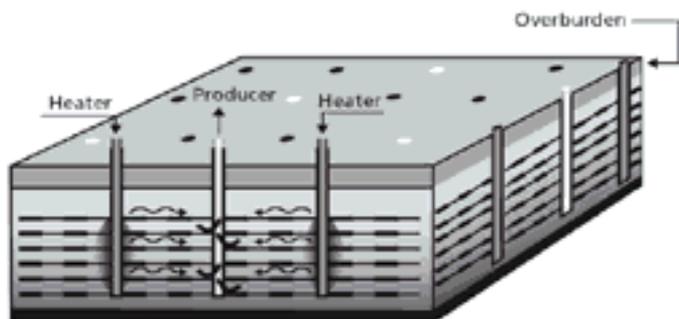


Figure 5. How they do it: Shell's ICP process. (Adapted from material provided by Shell Exploration and Production Company by RAND)

an energy potential exceeding all known conventional oil reserves. So how can all the valuable organic material contained in them be converted into energy at a market price, and without environmental damage?

Last year Royal Dutch Shell completed a demonstration project that produced 1400 barrels of oil plus associated gas from oil shale in the ground - without any of that shale ever seeing light of day, and without (as far as they can tell) any damage to groundwater. The process they used is called the In-situ Conversion Process, or ICP.

The tale began in 1981 when researchers at Shell's division of "unconventional resources" spent some time and money thinking about how to make oil shale productive. In 1996 Shell successfully performed a small field test on its Mahogany property in Rio Branco County, Colorado, about 320 km west of Denver. Four related tests have since been carried out, the most recent, the Mahogany Ridge Project, being the largest to date. The basic idea is simple in principle but difficult in practice. As oil shale is an immature source rock, what it needs is a good dose of pressure-cooking.

Shell's process puts an array of down-hole electrical heaters into the formation, which heat the surrounding shale to temperatures as high as 400 °C (Fig. 5). Over three to four years, dense oil and gas is expelled from the kerogen; lighter components are sheared off the denser compounds and the available hydrogen becomes concentrated in lighter fractions that then change to gas. This moves to surface through fractures - induced or natural - via producing wells.

Shell believes the process produces

up to 70% of the original carbon in the shale - 10 times more product per unit of shale than conventional mining-based methods. Also, when these wells dry up, they do so suddenly - unlike conventional oil wells, with their long and costly tail of poor productivity. The last stage involves injecting water, which flashes to steam and carries the final organics to surface for stripping. Then all the operator has to do is turn everything off and move along to the next plot.

The most cunning aspect of ICP is how groundwater is protected from contamination during the process. Shell drills a line of wells a few metres apart around the perimeter of the site and uses these to pass refrigerant. The groundwater then freezes, and the frozen columns coalesce to form a coffer dam of ice c.10 m thick. This technology is essentially the same as sometimes used for example by tunnellers to prevent groundwater ingress in saturated terrain.

The whole process is clearly energy intensive; but Shell estimate that - on the basis of the complete life-cycle of a field - 3.5 units of energy would be produced for every unit used in production. That is a very favourable ratio, compared to heavy crude fields using steam injection enhanced oil recovery, and certainly much more efficient than strip mining. The oil produced is light, and the lightest fractions come off first - which means a faster return on investment.

There is no evidence yet that this can work at greater depths on a commercial scale, but the results are promising. In Green River, Shell believe they could harvest a million barrels per acre - which is a billion barrels per square mile in a field

covering a thousand square miles, with (they hope) none of the environmental deficits of conventional oil shale mining. Shell also believe that the whole process - if it scales up - could be economic at a crude price of only \$30 per barrel, and before them lies the prospect of being able to recover between 500 billion and 1.1 trillion barrels - just from Green River Formation rocks in Colorado, Utah and Wyoming. The mid-point on that range, 800 billion barrels, is three times Saudi Arabia's oil reserves.

Shell are now conducting a \$50 million two- to four-year study of the ice-wall technology in Rio Branco County, and hope to decide by 2010 whether the ICP process is commercial. Meanwhile the US Department of Energy has signed an agreement with the Estonian Ministry of Economic Affairs and Communications for scientific and technology cooperation on oil shale research and utilization.

The era of home-brew oil may just be dawning. And that might just be the good news that Estonia needs.

#### Acknowledgements

I am deeply indebted to Heikki Bauert, Olle Hints and Rein Raudsep for help with this article, and for many of the pictures that accompany it. The piece also benefited by reference to online articles by Dan Denning, Vermund Jensen, Ingo Valgma, Randall Parker, Katharine Sanderson, Linda Seebach.

*This article is reprinted from Geoscientist, February 2007.*

#### Suggested further reading

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# Securing raw materials for European competitiveness

*'We are currently in the phase of implementing the Raw Materials Initiative, so it is really work in progress. By the end of 2010 the Commission has committed to report back to the Council on the achievements'. Paul Anciaux, European Commission*

A wide range of raw materials are essential inputs to European industry, yet in many cases enterprises are wholly dependent on foreign countries to obtain their supplies. The European Commission has launched its Raw Materials Initiative (RMI) to ensure European industry does not suffer from a competitive disadvantage over companies based in resource-rich countries.

**M**odern cars, flat-screen televisions, mobile phones, and countless other tools based on technological developments of the past couple of decades rely on a basket of metals and other raw materials. In many cases, the quantity required for each product is tiny, but with a mobile phone made up of around 40 high-tech metals, such as lithium, tantalum, cobalt and antimony, it is a major challenge and cost for any manufacturer to ensure they have supplies of all of them.

Television sets, computers and other information and communications technology products all rely on a similar mix of such metals. The same group of high-tech metals are also fundamental in new environmentally friendly products, with electric cars requiring lithium, hydrogen cars platinum, and new fuel-efficient aircraft reliant on rhenium alloys.

Beyond the high-tech sectors, European industry relies on a wide range of other raw materials, including 'traditional' metals such as copper, aluminium and iron, minerals such as potash, silica and salt, and aggregates - sand, gravel, cement - used in construction. Recent data show that almost 14% of jobs (30 million) in the EU are in businesses which depend on mineral raw materials, and a similar proportion of EU gross domestic product is generated by these same businesses.

The importance of such enterprises to the EU's economy is such that the Euro-

pean Commission has elaborated an integrated strategy to ensure that industries have fair access to the raw materials they need. The Communication on the RMI adopted by the Commission in November 2008, encompasses measures in three areas to secure sustainable supplies of the materials needed for the EU economy: ensuring fairer access to supplies from outside Europe, improving conditions for mining minerals within Europe, and increases in recycling of such materials.

Unlarge éventail de matières premières représente des dépenses essentielles pour l'industrie européenne ; cependant, très souvent, les entreprises sont totalement dépendantes de pays étrangers pour leur approvisionnement. La Commission européenne a lancé un Programme Matières Premières pour s'assurer que l'Industrie européenne ne souffre pas d'un désavantage commercial vis-à-vis des compagnies résidant dans les pays riches en matières premières.

## Supplier scarcity

The EU is self-sufficient in terms of (relatively low cost) construction minerals, and is also a leading supplier of certain industrial minerals such as feldspar, perlite or kaolin. However, the geology of the European continent is such that many other raw materials, particularly (higher cost) metals, are not found in large quantities within EU borders, or are only found in situations where extraction is difficult and expensive. Moreover, deposits inside the EU which can be mined are often not fully exploited due to a highly regulated environment or competing uses for land, such as agriculture, which push up the costs of extraction to the point where it is not economically viable.

For high-tech metals in particular, on the other hand, European enterprises are dependent on sourcing supplies outside the EU. In some cases, a few countries dominate supply, such as with niobium

Hay una amplia variedad de materias primas que son esenciales para la industria europea y sin embargo, en muchos casos, las empresas dependen completamente de países de fuera de la Unión para obtener sus suministros. La Comisión Europea ha lanzado su Iniciativa sobre Materias Primas para garantizar que la industria no sufra desventajas competitivas frente a empresas ubicadas en países ricos en recursos.

(90% from Brazil), rare earths (95% from China) and antimony (87% from China). Even when European firms have no difficulty in obtaining the supplies they need, they also have to compete with companies from those states which can secure their own supplies at lower costs.

Just as political concerns are rising about European energy producers' reliance on a small number of foreign countries for the fossil fuels which still dominate our energy consumption, so too manufacturers' dependence on a few raw-material supplying countries is ringing alarm bells. Demand for such materials is growing, with the current economic downturn expected only to bring a temporary reduction, and so there is an urgent need to look at supplier relationships for the longer term.

## Open markets

Resource-rich countries are more and more directing supplies towards domestic manufacturers. Whereas such manufacturers can often export their finished products to the EU at low duties or even tariff-free, EU manufacturers face a wide range of export restrictions and duties on raw materials, face investment restrictions in supplier countries, or are quite simply charged higher prices than local buyers. In these circumstances, EU manufacturers are placed at considerable competitive disadvantage, and the Commission has identified more than 450 export restrictions on raw materials, underlining the scale of the problem.



# Access to resources - a change in Europe's policy

by Corina Hebestreit<sup>1</sup>

The EU's Raw Materials Initiative is the first EU attempt (since the original Coal and Steel Treaty) to look at the raw materials supply for downstream industry in a coordinated way. Several strands of activities were identified for each of the stakeholders, EU Commission, national governments and industry in the EU economy in order to secure sustainable supply for future economic growth. Geological knowledge and research and technical development (RTD) play an important role in making Europe more competitive in the access to mineral resources. The Geological surveys and industry are well on the way to improve the situation.

In 2008, the European Commission added a focus in its European policy on raw materials by its Communication from the EC (Brussels, 4.11.2008, COM (2008) 699 final). But the struggle for natural resources has triggered not only the EU's Communication on the access to raw materials, but has led to a whole raft of initiatives and discussions at all levels, EU Member States, EU, OECD and UN.

The EU Raw Materials Initiative (RMI) underlines that "*securing reliable and undistorted access to raw materials is increasingly becoming an important factor for the EU's competitiveness and, hence, crucial to the success of the Lisbon Partnership for growth and jobs*".

Another citation from the Communication (COM(2008) 699 final) states very clearly: "*The critical dependence of the EU on certain raw materials underlines that a shift towards a more resource efficient economy and sustainable development is becoming even more pressing*".

This Communication is a first step towards this, building on an in-depth analysis by the Commission and the results of a public consultation in 2008. It provides the basis for the EU to form a common

La Directive européenne "Matières Premières" est la première initiative européenne (depuis le premier Traité Charbon et Acier) pour veiller, de façon coordonnée, à l'approvisionnement en matières premières de l'Industrie de transformation. Plusieurs domaines d'activités ont été identifiés pour chacun des dépositaires et acteurs, la Commission européenne, les gouvernements nationaux et l'industrie, au niveau de l'économie européenne, pour garantir un approvisionnement pérenne destiné au développement économique futur. La connaissance en Géologie et le Développement en matière de recherche et technique (DRT) jouent un rôle important en rendant l'Europe plus compétitive dans l'accès aux ressources minières. Les études géologiques et l'industrie sont bien sur la voie d'une amélioration de la situation.

approach in the international discussion on raw materials which has been addressed by the UN and by the G8 Summit in June 2007.

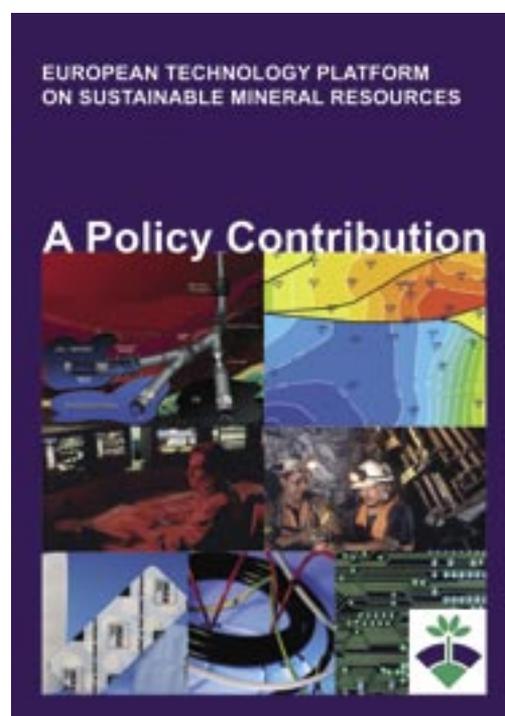
A catalogue of actions was established allocating responsibilities to the various stakeholders (Table 1).

As a result, at EU level, two working groups were established: one on "Criticality" with the aim to determine which resources are critical for the EU economy and one on "Best practices in land planning". For the Criticality working group, the Fraunhofer Institute has been appointed as a consultant to assist DG Enterprise in developing the methodology for defining the criticality and to screen a whole number of metals/minerals. Obviously the argument of criticality of European indigenous resources is accepted by DG Enterprise, but the criteria by which these should be selected or from what they should be protected, or how they should be fostered is not clear. This will be an opportunity to provide a mechanism.

Both working groups are supposed to deliver their results by about April 2010 with the aim of

La Iniciativa sobre Materias Primas de la UE, es el primer intento (desde el Tratado del carbón y el acero original) de tener en cuenta el suministro de materias primas a la industria de un modo coordinado. Se identificaron varias ramas de actividades para cada una de las partes interesadas de la economía de la UE, la Comisión Europea, los gobiernos nacionales y la industria, para garantizar el suministro sostenible de minerales para el crecimiento económico futuro. El conocimiento geológico y la investigación y el desarrollo tecnológico (I+D) juegan un importante papel para hacer una Europa más competitiva en el acceso a los recursos minerales. Los servicios geológicos y la industria están ahora en camino para mejorar la situación.

more formal Council of Ministers conclusions in June/July 2010. But just defining the degree of criticality of any raw material at any point in time or over the period of the next 10 years will not be sufficient.



<sup>1</sup> Director Euromines

	Level of response		
	EC	Member States	Industry
1. Define critical raw materials	X	X	X
2. Launch of EU strategic raw materials diplomacy with major industrialized and resource rich countries	X	X	
3. Include provisions on access to and sustainable management of raw materials in all bilateral and multilateral trade agreements and regulatory dialogues as appropriate	X X	X	
4. Identify and challenge trade distortion measures taken by third countries using all available mechanisms and instruments, including WTO negotiations, dispute settlement and the Market Access Partnerships, prioritizing those which most undermine open international markets to the disadvantage of the EU. Monitor progress by issuing yearly progress reports on the implementation of the trade aspects, drawing, as appropriate, on inputs from stakeholders	X	X	X
5. Promote the sustainable access to raw materials in the field of development policy through the use of budget support, cooperation strategies and other instruments	X	X	
6. Improve the regulatory framework related to access to land by: promoting the exchange of best practices in the area of land use planning and administrative conditions for exploration and extraction and developing guidelines that provide clarity on how to reconcile extraction activities in or near Natura 2000 areas with environmental protection	X	X	
7. Encourage better networking between national geological surveys with the aim of increasing the EU's knowledge base		X	
8. Promote skills and focused research on innovative exploration and extraction technologies, recycling, materials substitution and resource efficiency	X	X	X
9. Increase resource efficiency and foster substitution of raw materials	X	X	X
10. Promote recycling and facilitate the use of secondary raw materials in the EU	X	X	X

Table 1. EU Communication: action points and responsibilities  
(Orange colour: where industry is involved)

The Euromines recommendations for an action package for ensuring the secure supply of sustainable resources for Europe include a series of proposed key actions:

- Simplifying and streamlining the sustainable access to domestic raw materials, in particular by reducing permitting times and increasing the legislative reliability of investments in the extractive sector
- Facilitating exploration activities in Europe by re-establishing or increasing national expenditure for exploration with new technologies including the

use of GMES\* services and reinforcing the mineral intelligence at national and EU level

- Enhancing RTD and innovation in the area of extraction, processing and recycling of raw materials by supporting the ETP SMR and national research programmes that will provide access to new resources, provide improvements on resources and energy efficiency as well as improve their sustainability
- Strengthening the compatibility of extraction and environment, health and safety protection by supporting research and

best practices in environmental management, including biodiversity

- Ensuring a sustainable supply from 3<sup>rd</sup> world countries through the creation of a level playing field by ensuring that competing imported resources are subject to the same environmental, health and safety standards as well as transparency, good governance and anti-corruption rules
- Investing at national level in universities and educational programmes for the sector to increase the longer-term perspective of new resources and new applications which would improve the sustainability of the use of resources for the future.

Given the situation with regard to the European resource base and the expenditure in exploration declining again (Fig. 1), a number of actions have already been taken to support these demands through industry-driven activities: in particular, research, and thus also exploration, has been given particular attention in the policy.

For the second pillar the RMI states “To tackle the technological challenges related to sustainable mineral production, the Commission will promote research projects that focus on the extraction and processing of raw materials in its 7th Framework Programme (FP7). The European Technology Platform on Sustainable Mineral Resources focuses on innovative exploration technologies to identify deeply located onshore and offshore resources (including deep sea mining), and new extraction technologies to maximize economic and environmental benefits. The Waterborne Technology platform will undertake research for technologies that allow for a future sustainable exploitation of the seabed” and “the growing problem of skills shortage will have an impact on the future of the European mining industry<sup>19</sup>. In addition, there is still limited public awareness of the importance of domestic raw materials for the European economy. More effective partnerships between universities, geological surveys and industry should be encouraged to address these challenges. The Commission will encourage initiatives such as the European Minerals Day 2009 and will also foster the generation of new high skills on geology, earth observation and environmental issues, notably through the Erasmus Mundus Minerals and Environmental Programme (2009-2013) joint master and doctoral study programmes, to help counter this shortage”.

For the third pillar the RMI states: “The Commission is promoting research

projects that focus on resource-efficient products and production under FP7. In addition, the Eco-Design Directive 22 includes provisions for the design of resource-efficient products. Research will also play a major role in developing substitutes, in the interests of flexibility in the production process and reduced vulnerability to import dependence. Recently, the OECD23 recommended that its members promote resource productivity by strengthening their capacity for analysing materials flows. In the EU, the Data Centres on natural resources, products and waste will coordinate Member State input”.

### ETP SMR (European Technology Platform on Sustainable Mineral Resources)

This has been active for several years now and reissued its Strategic Research agenda in light of the Resource Strategy. Over the past years, the industry, geological surveys and academia have developed a number of project proposals for research and have submitted these to the European Commission and some national governments for funding.

Projects such as ONE GEOLOGY are examples for the projects that have already been awarded funding by the European Commission.

The OneGeology-Europe (1G-EU) project was launched in September 2008 after successfully securing funds in the recent EC eContentplus funding round. OneGeology-Europe is a high profile €3.25 million European project with 29 partners working to make the rich geological data assets held by national Geological Surveys discoverable and accessible. For those outside the Survey, or nation, they are not easy to obtain, to understand, or use. Geological data is essential to the prediction and mitigation of landslides, subsidence, earthquakes, flooding and pollution. Geology is a key dataset in INSPIRE. It is needed for the Groundwater and Soils Directives, GMES and GEOSS\*. OneGeology-Europe will make geological spatial data held by the Geological Surveys of Europe discoverable and accessible and see Europe play a leading role in the global OneGeology initiative.

The project will accelerate the development and deployment of a nascent international interchange standard for geological data, GeoSciML, enabling the sharing of data within and beyond the geological community. It will facilitate re-use of geological data by a wide spectrum of public and private sector users. It will address the licens-

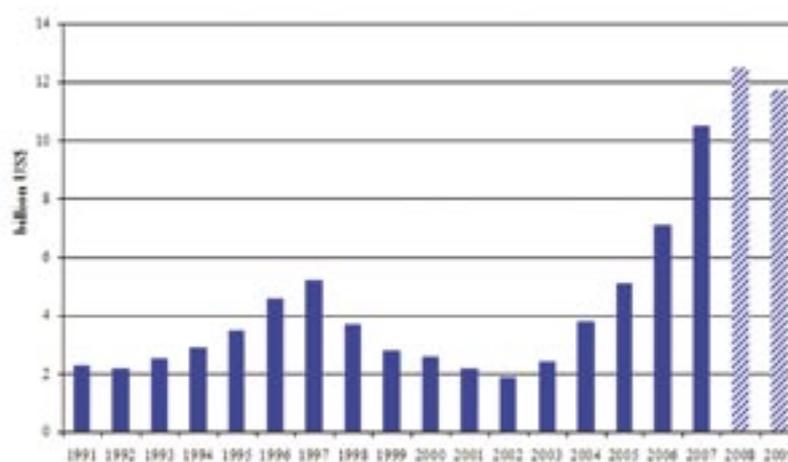


Figure 1. Global mining exploration expenditure (with 2008/2009 estimates)

Source: Raw Materials Data, Stockholm 2008

ing and multilingual aspects of access and move geological knowledge closer to the end-user where it will have greater societal impact. The project will provide examples of best practice in the delivery of high resolution digital geological spatial data to users, e.g. in the insurance, property, engineering, mineral resource and environmental sectors.

The results of the project will be: an interoperable geological spatial dataset at 1:1 million scale for all EU countries; a scientific and informatics specification for the harmonization of geological data and significant progress towards a harmonized dataset; a view service providing access to best practice high resolution geological spatial data services for 6 Member States; 2-4 case studies on cross-border delivery of harmonized high resolution data access; multilingual discovery metadata for all data provider participants' geological and applied map data; a robust data model, schema and mark-up language for the geosciences, which is OGC compliant; a web portal providing easy multilingual access to the above data and examples of user-focused web services; best practice examples of the delivery of geological data to a range of users; guidance and proposed code of practice on licensing and clearing arrangements facilitating re-use of geological spatial data; exchange of science, technology, informatics and communication skills and experience across the EU and globally.

These project achievements will allow substantial progress towards INSPIRE goals and not only benefit the geology theme but also provide a template for other environmental data themes. OneGeology-Europe will deliver data for the EU Geoportal and position Europe as the world leader in developing a geoscience SDI.

The ETP SMR has proposed a set of new projects which include projects on geological data collection and harmonization as well as the development of new exploration techniques in order to foster the discovery of new deposits and increase the European resource base for the EU's RTD calls for 2011-2013.

In addition, a number of events were and will be organized to raise political awareness for the needs of this industry and European society.

Following the Euromines event in Prague, addressing the question of demand and supply of minerals for the European Union, the Swedish Presidency continued in October 2009 with a conference on 'European higher education and research on metallic and mineral raw materials, a response to the Raw Materials Initiative', 12-14 October, 2009, in Luleå, Sweden addressing the question of research and mineral supply. The event was a joint event of the Luleå University of Technology, the County Administrative Board of Norrbotten, the Swedish Mining Research - MITU/ Bergforsk. and the ETP SMR.

This has been followed by the Swedish EU Presidency High-level Conference on 'Eco-efficient Economy - Towards Innovative and Sustainable Competitiveness', 2-3 November, 2009, in Linköping, Sweden. Events under the Spanish Presidency are still to be confirmed.

\***GMES**: Global Monitoring for Environment and Security is the European Initiative for the establishment of a European capacity for Earth Observation

\***GEOSS**: Global Earth Observation System of Systems



## Rosia Montana - More than a mine



The Rosia Montana Project introduces modern mining to Romania. The Project employs state-of-the-art technology in observing EU standards. It is also sensitive to its local impact, offering specific strategies for the preservation of local history and traditions, restoring historical monuments in the area and creating a safe and clean environment for the community – all in the service of sustainable development. This is a project for the future of Rosia Montana.



**GOLD**  
CORPORATION  
*Rosia Montana*

# Gold and wine: geological aspects of the treasures of the Tokaj Mountains, Hungary

by Éva Hartai<sup>1</sup> and Péter Scharek<sup>2</sup>

The Tokaj Mountains were built up by Late Miocene intermediate-acidic volcanic rocks. This geological background facilitated both precious ore mineralization and high-level viticulture. Low-sulphidation type Au-Ag mineralization is located near Telkibánya, in the northern part of the mountains. It was formed in a K-metasomatized subvolcanic andesite. The gold and silver mining lasted from the 13<sup>th</sup>-19<sup>th</sup> centuries. Viticulture developed in the southern part of the mountains, mostly on loess and volcanic subsoils formed on rhyolitic tuff. The high trace element and zeolite contents of the rocks have contributed to the special taste of the Tokaji wine.

Les montagnes du TOKAI datent de la fin du Miocène et sont constituées par des roches volcaniques intermédiaires, acides. Ce contexte géologique a facilité la genèse à la fois de minéralisations précieuses et d'un vignoble réputé. La minéralisation pauvre en sulfures de type or et argent est localisée près de Telkibánya, dans la partie nord de la chaîne montagneuse. Elle a été formée à partir d'un processus de K métagénèse de l'andésite. L'exploitation de l'or et de l'argent s'est effectuée entre les 13<sup>ème</sup> et 19<sup>ème</sup> siècles. La viticulture s'est développée dans la partie sud de la chaîne, principalement sur du loess et sous-sols volcaniques formés à partir de tufs rhyolitiques. Le taux élevé d'éléments en trace et de zéolites au sein de la roche a contribué à donner ce goût spécial au vin de Tokaj.

Las montañas Tokaj fueron generadas por rocas volcánicas ácidas e intermedias del Mioceno Superior. Este entorno geológico facilitó tanto la formación de ricas mineralizaciones metálicas como la viticultura de alto nivel. La mineralización de baja sulfidación del tipo Au-Ag se localiza cerca de Telkibánya, al norte de las montañas. Se formó en una andesita subvolcánica con metasomatización potásica. La minería del oro y de la plata duró desde el siglo 13 al 19. El cultivo de la vid se desarrolló en la parte sur de las montañas, principalmente sobre loess y sustratos volcánicos formados sobre una toba riolítica. Los elevados elementos traza y el contenido en zeolita han contribuido a darle un sabor especial al vino de Tokaji.

The word "Tokaj" (in Hungarian Tokaj) is well-known in many countries, mainly in the circle of wine-fanciers. Its reputation became even greater in 2002 when the famous historical Tokaj wine district was recognized as a part of World Heritage. However, the Tokaj Mountains have given other treasures to historical Hungary: there was a significant gold and silver production for centuries in the area. Both the wine culture and the mineralization go back to the same roots: the geology of the mountains.

## Geology of the Tokaj Mountains

The Tokaj Mountains are situated in the northeastern part of Hungary. They are built up mostly by Sarmatian volcanic rocks. Older (Early Palaeozoic and Late Permian) rocks can be found only in the northern part of the mountains, in minor outcrops (Fig. 1). Mesozoic formations (marine sedimentary rocks) were identified

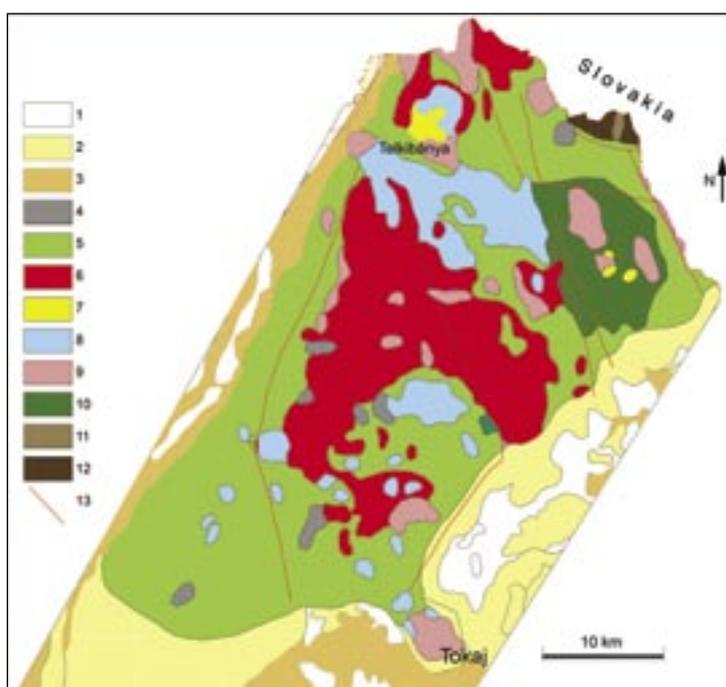


Figure 1. Simplified geological map of the Tokaj Mountains. 1: Holocene alluvium, 2: Pleistocene loess, 3: Sarmatian-Pannonian clay, 4: Sarmatian limnic silica, 5: Sarmatian rhyolitic tuff, 6: Sarmatian andesite, 7: Sarmatian K-metasomatite, 8: Sarmatian rhyolite, 9: Sarmatian dacite, 10: Badenian rhyolitic tuff, 11: Lower Permian sandstone, 12: Lower Paleozoic schist, 13: fault (after Gyarmati, 1972 and Fülöp, 1984)

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only in two boreholes. Right on the Mesozoic rocks we find the first volcanic units intercalated with marine sediments. Volcanic activity started in the Early Badenian with a submarine rhyodacite-ignimbrite flow. These volcanics and the overlying sediments were found only in boreholes, similarly to the succeeding Late Badenian andesitic-dacitic lavaflores and subvolcanic bodies. Late Badenian rhyolitic tuffs outcrop in the northeastern part of the mountains (Gyarmati, 1977), while in the Sarmatian, shallow marine sedimentation continued and large masses of rhyolitic pyroclasts accumulated on land. These rocks occur both in the southern and northern part of the mountain. In the pyroclastic sequence beside the subareal tuffs, ignimbrites and tuffites appear, and rhyolitic lavadomes were also formed. In the central part of the mountain, andesitic lavaflores and subvolcanic bodies are dominant. Their chemical character varies from basic pyroxene andesite to dacite. In the subvolcanic andesites, columnar jointing is frequent, and can be seen in several quarries (Gyarmati, 1977).

There was intense post-volcanic activity in the Late Sarmatian, which produced quartz veins and silica bodies. The latter were formed at the base of the steam-heated alteration zone, along the palaeo-groundwater table. In the hot-spring basins, industrial minerals like kaolinite, bentonite, illite, diatomite and limnic silica were formed (Molnár, 1994).

Following the volcanic activity, tectonic movements fractured the mountains and the peripheral parts gradually moved downward. Along the fractures, valleys and basins were formed.

#### Ore mineralization

The ore mineralization is of typically epithermal low-sulphidation type. It is concentrated in the northern part of the Tokaj Mountains at Telkibánya village where the dominant outcropping rock is Sarmatian rhyolitic tuff overlain or intercalated with shallow marine and fluvioclastic sedimentary rocks, stratovolcanic andesite-dacite-rhyolite, and late rhyolite domes and andesitic lava flows and dykes (Molnár *et al.*, 2009).

To the NNE of Telkibánya, two N-S oriented andesite caldera-like structures can be identified. The majority of mineralization is limited to the southern caldera, which contains an approximately 700 m thick sequence of hydrothermally altered andesite. Within the calderas, rhyolite and rhyodacite domes and lava flows were



Figure 2. Rhyolitic domes near Telkibánya showing the former eruption centres

formed, which also underwent intense hydrothermal alteration (Fig. 2). Following the rhyolite domes, a subvolcanic andesitic body emplaced in the caldera, and now it is exposed at surface. The latest stage of the Sarmatian volcanism in the region is represented by younger pyroxene andesite, which is unaltered and forms dykes in the strongly mineralized subvolcanic body (Gyarmati, 1977).

In the Telkibánya area, there was a two-phase mineralization. The older phase is not significant and was recognized as a polymetallic assemblage only in one borehole. The younger phase of mineralization occurred near the surface. The host rock is Sarmatian subvolcanic andesite, which underwent a strong K-metasomatic and propylitic alteration. The alteration was concentrated along the veins. In the near-surface zones, the  $K_2O$  content reaches 8–14 wt%. The main K-bearing minerals are potassium-feldspar and adularia. Due to the intense alteration, the original rock features can hardly be recognized (Fig. 3). In the peripheral part and the deeper zones of the mineralization, propylitic alteration is characteristic (Székely-Fux, 1970, Molnár, 1994).

The number of ore veins exceeds 20. Their strike varies between NNW–SSE, NW–SE and NNE–SSW. The major veins are 0.5–1 km long; their width varies between 0.1–1 m and they are known down to the depth limit of the mining activity (200 m). On the hanging wall side of the veins, up to 3–5 m thick hydrothermal breccia zones are present (Fig. 4.). With increasing depth, quartz, chalcedony, opal, then kaolinite and smectite, finally calcite fill the veins.

During exploration in past decades, the highest Au concentrations (7 ppm) were found in chimney-like structures with dense pyrite disseminations along the strike of veins. The Ag content in these structures is up to 320 ppm. Most of the gold is probably linked to the pyrite, but some base-metal rich infillings have also gold concentrations up to 20 ppm. Native gold occurs as 5–10  $\mu\text{m}$  grains in the cavities of sulphides and quartz. Higher gold content (up to 14 ppm) is typical in montmorillonite-bearing vein infillings.

Ag is enriched in the hydrothermal breccia bodies, as well as in association with

Figure 3. Strongly altered, K-metasomatized subvolcanic andesite (K-metasomatite), the host rock of the Telkibánya low-sulphidation Au-Ag mineralization



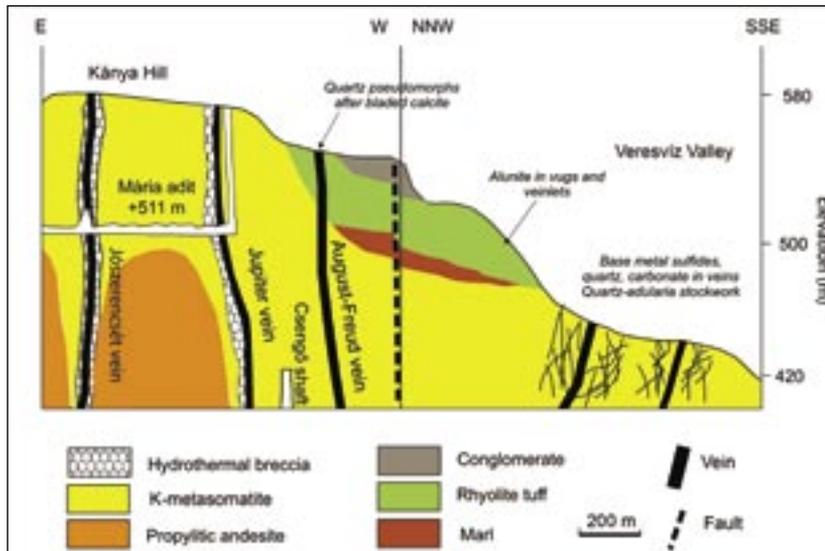


Figure 4. Section across the eastern part of the Telkibánya precious ore deposit (after Molnár, 2009)

the smaller amounts of polymetallic ores in which the concentration is up to 750 ppm. The silver content of gold grains is highly variable up to 45 wt%. The most frequent Ag mineral is achantite but sulphosalts also occur (Molnár *et al.*, 2009).

#### Mining history - gold and silver

The gold and silver mining in Telkibánya goes back to the 14<sup>th</sup> century. At the beginning, mining took place on surface, in open pits. The pits were deepened along the veins, which were harder than the surrounding rocks and formed outstanding crests. Several thousands of pits in the mining area reflect the intensity of the open-pit mining.

Telkibánya was given a rank of “Mining Town” by King Károly Róbert at the beginning of the 14<sup>th</sup> century. At that time, it was in fifth place in the order of mining towns in the Western Carpathians.

Figure 5. The Late Miocene *Vitis tokayensis* (Stur, 1867)



Underground mining started about 200 years later, as the near-surface parts were exhausted. These days we know about 80 adits in the area. Ventilation in the adits was through vertical shafts.

The excavated ore was processed in ore mills, the remnants of which also can be found in the mining district. The flourishing mining was interrupted by a catastrophe: probably due to an earthquake, the largest shaft collapsed causing a large number of fatalities.

After the catastrophe, mining was suspended, then started to prosper again in the 18<sup>th</sup> century, during the reign of Queen Maria Teresa. At that time, the adits were made using explosives. The prosperity ended soon after the discovery of huge silver deposits in Mexico when the price of silver dropped considerably. Finally, mining ceased in the 1850s. The amount of precious metals exploited from the Telkibánya ore deposit is not known due to the lack of mining documentation from the Mediaeval Age (Benke, 2001).

After the 2<sup>nd</sup> world war and even at the beginning of the 2000s, ore exploration started again in order to open the gold and silver mines. However, the ore reserves haven't proved to be economic.

#### Geological aspects of the viticulture

Although in the Middle Ages the prosperity of the area was due to precious ore mining, the real fame came from wine production.

The name “Tokaji” (in Hungarian: of Tokaj) is of Protected Designation of Origin and is used for labelling wines from this district. The viticulture developed in the southern part of the mountains, in Tokaj-

Hegyalja (“Hegyalja” means foothill in Hungarian).

The connection between the Tokaji wine and the rocks which build up the mountains were already explored by the famous Hungarian geologist József Szabó in the 1870s. He made a statement which is still generally accepted that the soils formed on volcanic rocks are rich in trace elements that have a positive influence on the quality of grape and wine.

The soil types of the viticulture area are loess soil and volcanic subsoil. These soils have been formed on andesitic and rhyolitic tuffs. The rhyolitic tuffs usually have high zeolite content. Besides the high trace element content coming from the rocks, the adsorptive character of the zeolites must have made a contribution to the special taste of the Tokaji wine.

Vine is a native plant species in the Tokaj Mountains. The fossil of *Vitis tokayensis* (Fig. 5), which is considered as the common ancestor of the recent types of vine species, was found in the southern part of the Tokaj Mountains, near Erdőbénye village in Sarmatian sediments. The *Vitis sylvestris*, which is an ancient vine type is a still existing self-sown plant in the area (Stur, 1867; Kecskeméti, 1993).

The geomorphological character and microclimatic factors also favour the grape and wine quality. Viticulture has been developed on gentle, southerly slopes. The area bordered by the rivers Tisza and Bodrog, is characterized by a special microclimate, which provides a favourable environment for the formation of noble rot, which is the benevolent form of a grey fungus, *Botrytis cinetia*, affecting wine grapes. Grapes when picked at a certain point during infestation can produce particularly fine and concentrated sweet wine. This process is the base of the production of the famous Tokaji aszú, the world's oldest botritized wine.

As a further additional contribution, the chestnut oak (*Quercus petraea*), which can be found in the higher areas of the mountain, serves as an excellent raw material for the casks. Among the wine-producers it is known as “Zemplén Oak” and it has a positive effect on the colour and taste of the wine (www.tokaj.hu).

Most of the wine cellars were excavated into rhyolitic tuff, mainly in the 15<sup>th</sup>-17<sup>th</sup> centuries. In these cellars the high humidity (95%) and the constant temperature (about 12 °C) are ideal for the aging process of wine.

Although the geology determines the

quality of the Tokaji wine, there are other factors which contributed to its special character. Several fortunate circumstances, like microclimate, fungi and vegetation have also played a role in the fame of the wine district.

<http://www.tokaj.hu>

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# Rosia Montana: more than just a mine

by Cecilia Szentesy<sup>1</sup>

In the current worldwide economic context, gold is a strong contributor to reinvigorating economies. Romania has the potential to become the European gold production leader if gold deposits from Transylvania get approval for exploitation. The Rosia Montana mining project, located in the Golden Quadrilateral of Transylvania, is a trademark of gold mining in Romania, as it is the largest industrial project. Rosia Montana Gold Corporation, owner of the project, is committed to the highest international standards for operating the mine; it is also committed to remediate the inherited historical environment and to preserve the cultural heritage. On top of that, the relationship with the local community bears witness to the fact that sustainable development relies on modern mining methods.

For more than 100 years, central banks and official international institutions have been the major holders of gold - about 20% of above-ground stocks - and, in future, are expected to retain large stocks. The process of rebalancing reserve portfolios to changing conditions has led recently to a reduction in the amount of gold held by some central banks and this process may continue for some years to come. But gold will remain an important reserve asset for the foreseeable future with an important role in reserve management.

In terms of the supply-demand mechanism, during 2008, the supply was 38% below demand; the total gold production was around 2,350 tonnes versus the demand reaching 3,800 tonnes. The forecast for 2009 is: 4,000 tonnes of gold demand versus 3,500 tonnes of supply, 2,000 tonnes of which comes from gold mine operations with the balance coming from gold sales of the banks and recycled scrap gold from previous uses.

## Global developments

According to the GFMS consultancy, a

<sup>1</sup>Technical Design Director

Dans le contexte économique mondial actuel, l'or contribue fortement à réanimer les économies. La Roumanie possède la capacité de devenir le leader européen en production d'or si l'on autorise l'exploitation des gisements aurifères de Transylvanie. Le projet minier de Rosia Montana, situé dans le Carré d'or de Transylvanie constitue la référence commerciale de l'exploitation de l'or en Roumanie, car il représente le projet le plus important. La Rosia Montana Gold Corporation, propriétaire du Projet, s'est engagée à respecter les standards les plus élevés pour exploiter la mine; elle s'est aussi fait une obligation de réhabiliter le patrimoine historique environnemental et de préserver l'héritage culturel. De plus, les relations existant avec les communautés locales témoignent du fait que développement durable dépend de la mise en oeuvre de méthodes modernes d'exploitation.

London-based research group that provides evaluations for gold mining companies and the World Gold Council, annual gold-mining output topped at 2,573 metric tonnes in 2000, falling to 2,518 metric tonnes in 2005, then 2,469 metric tonnes in 2006 and finally 2,444 metric tonnes in 2007. The world leader in gold mining output is China (Fig.1), which upped its production in 2007 by 12% over 2006, producing 9.7 million ounces or 276 metric tonnes. South Africa produced just 296 tonnes of gold last year, down from 1,000 tonnes in 1970.

The leader in European gold production is Finland, followed closely by Spain and Sweden. Romania has the potential to be a top European leader in gold production, if the local Government will agree to the exploitation of some of the gold deposits located in the Golden Quadrilateral of Transylvania, out of which only the Rosia Montana gold deposit would produce around 14 tonnes of gold per year.

## Romania background

Between 1990 and 2002, the Romanian state expenditure to sustain the mining sector was US\$ 5,249.5 million, as follows:

En el actual contexto económico mundial, el oro representa una importante contribución a la recuperación de las economías. Rumanía tiene el potencial para convertirse en el líder de la producción de oro en Europa si los yacimientos de oro de Transilvania consiguen los permisos de explotación. El proyecto minero Rosia Montana, situado en el Cuadrilátero Dorado de Transilvania, es una marca de calidad de la explotación de oro en Rumanía ya que es el mayor proyecto industrial. La Corporación Rosia Montana Gold, propietaria del proyecto, está totalmente comprometida con el empleo de las normas internacionales más exigentes en la operación minera. También se ha comprometido en la restauración del medio ambiente histórico heredado del pasado minero y para proteger el patrimonio histórico. Además de eso, las relaciones con la comunidad local son un testigo de excepción del hecho de que el desarrollo sostenible se basa en métodos mineros modernos.

subsidies: US\$ 2,769.6 million

capital allocations: US\$ 1,428.7 million

budgetary allocations: US\$ 75.0 million

The current situation of the Mines Restructuring Programme in Romania shows that:

- 550 mines closed since 1998, of which only 168 were rehabilitated
- 47 mines closed with rehabilitation activities in progress
- 335 mines closed, without rehabilitation funds
- More than 80,000 miners lost their jobs plus another 150,000 persons from collateral industries.

The governmental strategy for the mining industry for 1994 - 2020 provides the following steps:

- Best use of mining products according to the rules of the free market
- Reconsideration of mining perimeters, for developing primarily the most productive areas
- Mining output at competitive costs
- Resizing of staff and remuneration based on efficiency and market-oriented management

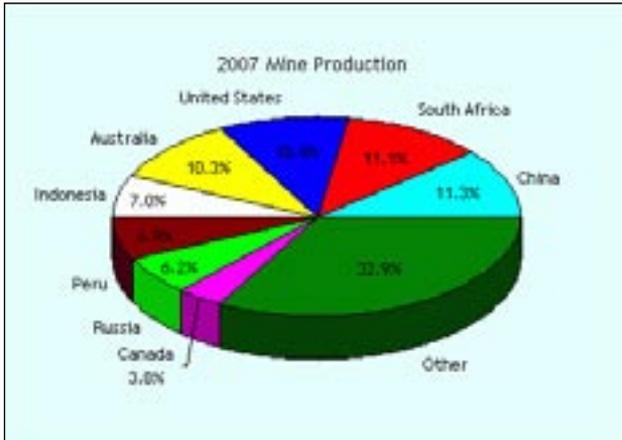


Figure 1. The global distribution of gold production, 2007

and two tailings dams), two open pits (where the operations started in 1970) of the former state mining company RoşiaMin, closed since 2006 because of the lack of proper funding to meet EU safety and environmental standards.

- Modernization and rehabilitation of viable mines or with revival potential by transfer of mining licenses to private operators
- Development of state-private partnerships
- Evaluation of the environmental impact of mining activities and setting the appropriate standards to be followed by the state mining companies and the private license holders
- Preparation of the environment protection handbook for the industry, according to European standards
- Following the elimination by 2006 of the state budget financing geological exploration, the exploration risk is taken over by the exploration license holders
- Re-launch of the viable mines activity and fluidization of economic activities in the mining regions.

**Economic Environment**

Rosia Montana is lacking investments, except those induced by the Rosia Montana Gold Corporation S.A.'s (RMGC) mining activities.

From the point of view of the environment, the area is affected on a large scale by previous mining activities; environmental management systems (waste, wastewater, water) are still extremely weak, if non-existent.

The population - very likely to decrease in the future - is aged, poor, mainly female, and with a higher incidence of chronic and acute diseases, according to the Health Baseline Report prepared as part of the Environmental Impact Assessment for the Rosia Montana Project. Given the monoindustrial profile of the locality, many of the young inhabitants left the area and the process is still ongoing.

The region has abandoned, non-rehabilitated mining sites (18 waste rock stockpiles

**RMGC Background**

In 1995, Gabriel Resources Ltd, a Canadian-based resource company, undertook an extensive survey in order to expand its international resource portfolio, looking for a safe business-friendly stable environment, with mineral resource potential. It was willing to make significant investments in the exploration, re-engineering, construction and operation of new mines. Europe's most rich gold production district for over 2000 years - the Golden Quadrilateral of Western Romania - was recommended as an area with a high potential, where more than 400 state-owned mines were operating at that time, all heavily subsidized by the state because they did not meet the standards of competitive market-oriented economies.

The long-term strategies prepared for the mining industry associated with other policies showed the will of the Romanian Government to attract investments in this area. In these conditions, many foreign investors and mining companies started negotiations with the Government and its representative in the area, the National Company for Gold, Copper and Iron Minvest S.A. Deva, to instigate joint-venture agreements and to re-develop outdated operations. RMGC was created in 1997, as a joint-venture between Gabriel Resources (80%) and Minvest S.A.(19,7%), owned by the Government of Romania and three other minor shareholders. The owners have committed to building a state-of-the-art mining facility that will reinvigorate the local economy, preserve the region's unique cultural heritage, remediate inherited environmental problems and set world-class standards for environmental and social responsibility. The Project, in RMGC's design, represents Romania's largest foreign direct investment in the mining and industrial sectors to date, and meets the highest international standards

for operation and safety, serving as a model for other private similar operations. It will create jobs, taxation revenues and opportunities for local suppliers and will provide infusion of modern mining technology and create complementary training skills.

Investments to date since 1997 are US\$ 386 million.

**Re-engineering, re-designing and building the new Rosia Montana Mine**

RMGC is the titleholder of a Mining Concession License in the Rosia Montana area being the coordinator of the geological exploration and re-engineering works for the new project.

The Project aims to develop a large mining operation for 14 years, followed by an additional two years for the processing of the low grade ore and a further period of eight years for the completion of decommissioning, environmental restoration and rehabilitation activities, long-term environmental monitoring. It is designed to process an average annual quantity of ore of 13 million tonnes for approximately 16 years and a total estimated life of over 25 years.

Given that the environment is strongly affected by previous mining operations, the Project foresees a number of works to eliminate pollution, as well as strict environmental protection and rehabilitation measures, according to international environmental and social accountability standards.

The deposit identified - with the sites for viable open pit mining in Cetate, Carnic, Jig şi Orlea - is of large dimensions, with disseminated mineralization and low gold and silver grade. To ensure efficiency, the mining project caters for open pit mining and conventional transport of the ore, namely: crushing, extraction by cyanide leaching, precious metals processing recovery by electrowinning and pouring of the doré bullion in ingots, waste rock stockpiling, detoxification of process tailings and wet deposition of tailings into the TMF.

Stages of the project:

- construction, approx. two years; preparation of the industrial facility sites, construction of infrastructure and processing plant, installation of equipment and machinery, construction of TMF (raised in increments during operations)
- operations, approx. 16 years; ore mining and processing with all the associated activities as well as starting of the closure and environmental restoration activities by backfilling Carnic, Jig and

Orlea pits with waste rock

- closure/environmental restoration and post-closure decommissioning of the processing plant and various facilities, completion of the waste rock backfill of Carnic, Jig and Orlea pits, flooding Cetate pit, covering the industrial facility sites with top soil and reforestation, long term monitoring of the environment.

To ensure processing of about 13 Mt of ore per annum, the hourly plant throughput will average 2500 t/hr. The operation will generate tailings at a rate of approximately 13 Mt/annum for approximately 16 years, producing a total of approximately 215 Mt of treated tailings. Deposition of tailings requires construction and operation of a TMF. The waste rock generated will be stockpiled in two waste rock dumps.

### Regulatory background

- The mine will be the first permitted under the EU's stricter environmental laws, creating a new European model
- The Romanian Government is unable to secure on its own the required resources for environment protection
- The company is a signatory to the International Cyanide Management Code (ICMC) and it will comply with the EU Mine Waste Directive
- Also, it has adopted the more stringent requirements of World Bank guidelines, industry best practice and Best Available Techniques (BAT)
- The company is a co-founder of the Rosia Montana Environmental Partnership, a joint action partnership among area stakeholders raising awareness of environmental issues, a model of collaboration between the community and private investors
- The cultural heritage protection strategy follows the Romanian legislation and international regulations of ICOMOS and Equator Principles
- The Property Purchase Programme is designed to World Bank standards and the decision of individuals to sell is based on individual choice.

### The Dilemma

As a non-renewable resource business how can a mining project generate sustainable development in the area where it operates? What is left behind after the resource will be depleted? Will the area be left with no alternative? What is the best moment to initiate the sustainable development successful action plans? Could it solve



Figure 2. Location of Romania showing the position of the Rosia Montana mine

the current social, economic and environmental issues? When a mineral resource becomes exhausted and a mine is about to close, the challenge is to use the stimulation of the economic inputs, the know-how, the derivative demand for goods and services and the required infrastructure and facilities - along with the natural endowments and comparative advantages of the area. In this way you can build long-term capacities and activities. True sustainable development requires that steps ensuring the sustainability of the community and its people have been integrated into the mining activities throughout the life of the mine, with closure and rehabilitation plans before the mine starts, plus a strategy aimed to contribute to the development of the local community strategy.

Even before the start up of operations, for building trust within the local community, RMGC has designed a Sustainable Development Action Plan (SDAP) to provide an implementation strategy for company commitments towards the community.

Currently, mining is the only development opportunity for the area, as tourism is lacking the proper infrastructure, and the opportunities for agriculture are extremely limited. It is anticipated that if the Project is not implemented, this situation will follow a negative trend because of the loss of:

- both the current employment with RMGC as well as the jobs anticipated for a minimum of 25 years
- the opportunities for the development and diversification of the economic, social, commercial and services activities as well as of the local know-how

- the opportunities to increase local budget revenues from taxes and fees.

### Jobs provided by a RMGC fully operational Project

During the construction of the RMGC Project: 6504 jobs

Direct: 2337

Indirect: 4167

During the operation of the RMGC Project: 3083

Direct: 881

Indirect: 2202

During the closure of the RMGC Project: 1811

Direct: 270

Indirect: 1541

Construction project support includes: transportation, local warehousing, accommodation and food services, repair, travel, IT, retail services, customs operation and temporary employment. The mine will also use chemicals, mining consumables, fuels, as well as maintenance materials.

Currently, RMGC pays wages that are 4.7 times the national average and has developed an extensive programme of job training and skills enhancement for more than 2,500 people preparing for the future mine operation, but also in IT, tourism, construction etc.

If the Project is not implemented, deterioration of the health status of the population is expected, the new modern village will not be built and the improvement of the environmental infrastructure (water supply, sewage, waste management) is uncertain. If the Project does start, an investment of \$77 million in local infrastructure is anticipated, from the local roads, to power and water supply.

In the future operational industrial zone, significant sources of surface and ground-water contamination were discovered, with Acid Rock Drainage (ARD) generated by former mining operations. The result is high levels of acidity and heavy metals and sulphates pollution of the streams and groundwater in the area. RMGC aims to collect and treat all ARD waters, for the elimination of current major sources of water contamination: otherwise, the environment will continue to be affected.

Large areas of the Project area (Cetate and Carnic open pit, waste rock dumps) also lack vegetation cover and are exposed to wind erosion and other weather conditions. Fast erosion of the surface or in depth was encountered in the area, in the Corna and Rosia Valley, frequently associated with bank collapse. The current insufficient funding will not stop this trend. From the biodiversity standpoint it is anticipated that should the project not be implemented and no other activities be carried out in the area, the restoration of the biodiversity will be evident in 50—60 years. Where the Project is implemented the restoration of the flora will start within 20 years.

The economic decline left obvious

traces in the area of the protection of cultural heritage. Under Law No. 422/2001, the owner is fully responsible for the fate of historical monuments. Some of the heritage structures are abandoned and in most of the situations the owners do not have the financial resources required to restore them. RMGC purchased ten historical buildings currently under restoration and also assumed responsibility for maintenance of at least the current state of preservation for the others and plans to set up an NGO that will enable the rehabilitation of all the historical structures. Following six years of archaeological research and cultural heritage studies, undertaken under RMGC funding, a unique opportunity has been created for a better understanding and documentation of the evolution of the mining community in the last 2000 years. If the Project goes ahead, a budget of US\$ 92 million is allocated for programmes on community, environment and patrimony.

**Conclusions**

There was a time when gold was money. In the present uncertain world, the yellow metal is back on track. The arguments for further gains in the gold price are com-

elling. It looks cheap, despite climbing from a low of about US\$ 250 a troy ounce in 1999, when central banks were selling reserves. Gold is also benefiting from diversification away from equities. Commodities have emerged as a distinct asset class, with billions of dollars poured into exchange traded funds.

The world's major economies have recently experienced rapid money supply growth of 10%+ per annum. If gold is a finite currency, its value against not just the dollar, but sterling and the euro too, should rise.

Could a mining project bring benefits to the local community and national economy and generate sustainable development in its operational area? What is the best moment to initiate successful sustainable development action plans? The answer to the first question is definitely “yes” and the current period is the best possible. The RMGC's management has decided to initiate and implement sustainable action plans even before the start up of the mine operations in order to win the trust of the local community with detailed and complex initiatives.

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# Mining challenges in Kosovo

by Barney Paul Popkin<sup>1</sup>

Mining is perhaps one of the worst but vital and wealth-producing point-source activities with severe large-scale adverse environmental impacts. Mentioning mining at cocktail parties usually congers up visions of trapped underground coal miners, black-lung disease, acid surface runoff, polluted groundwater with heavy metals, underground coal fires, destroyed and flooded habitats, threatening mining spoils and overflowing and failing dams, mountains turned to ruins, and one-income company towns that come and go on the whim of world-wide markets. Moreover, mineral resources have historically been treasured for strategic reasons and have been listed, along with prime agricultural land and water resources, as an objective if not a cause of warfare. Mining challenges in Kosovo may reflect these opportunities and risks better than in most places.

Vukovic and Weinstein (2002) present a short history of the Kosovo mining-metallurgy industry over the last 800 years. They say Kosovo contains the region's highest concentration of mineral wealth as silver, lead, zinc, tin, coal, and explain the social and political impacts of metal production in mediaeval Serbia, the Ottoman Empire, and Yugoslavia. They note recent clashes between Serbs and Albanians are viewed in the light of the "geopolitics of minerals."

Spalevic (2007) notes "All attempts at providing an economic 'grading' for Kosovo are based mainly on ore deposits in the Southern Serbian area". He notes the

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Bien que source de vie et de richesse, l'exploitation minière est peut-être l'une des activités les plus dommageables en matière d'impact environnemental en raison de la sévérité et de l'échelle des dommages. Parler d'activité minière lors de réceptions cocktail suggère d'habitude la vision de mineurs de charbon coincés dans des galeries ou affectés par la maladie dite du poumon noir. D'autres images font référence aux fuites acides en surface, à l'eau souterraine polluée par les métaux lourds, au coup de grisou et feux souterrains, à l'habitat détruit ou inondé, à la menace de terrils miniers et celle venant d'un trop plein ou d'une rupture de barrages, aux montagnes transformées en ruines et au revenu des compagnies et agglomérations minières dont le futur est à la merci des caprices du marché mondial. Cependant, les ressources minières ont été valorisées historiquement pour des raisons stratégiques et listées à côté des riches terres agricoles et des ressources en eau comme un objectif sinon une cause de guerre. Les enjeux miniers au Kosovo peuvent illustrer ces opportunités et risques bien mieux qu'ailleurs.

importance of the lignite reserves and Kosovo ore mines for rare minerals - indium, cadmium, germanium, thallium, gallium - as well as commercial deposits of silver, lead, zinc, iron, aluminum, copper, bismuth, cadmium, nickel, cobalt, bauxite, magnesium, kaolin, and bentonite.

Recently, the actor Richard Gere posed an open question: "I'm very suspicious as to why the great powers are so resolute in their intention to grant Kosovo independence."... "There must be something in that Kosovo, when they fight for it so hard," (the actor was quoted). Sure there is "something", Mr. Gere. This one's for you.

A well known US company of "Westinghouse" led by Mr. George Soros did numerous researches on Kosovo resources in the late 80s. Their analyses confirmed what Serbian experts had to say:

La minería es quizás y al mismo tiempo una actividad esencial y generadora de riqueza y una de las actividades que producen los peores y más graves impactos ambientales adversos y a gran escala. Si se menciona la minería en una fiesta suele concitar una visión de mineros atrapados en minas de carbón, pulmones ennegrecidos, aguas ácidas de mina, aguas subterráneas contaminadas con metales pesados, fuegos subterráneos de carbón, hábitats destruidos o inundados, escombreras amenazadoras y presas mineras desbordadas o que se rompen, montañas destruidas pueblos mineros mono dependientes que vienen y van al pario de los mercados mundiales. Además los recursos minerales han sido históricamente atesorados por razones estratégicas y se han incluido junto con los recursos agrícolas y el agua, como objetivos si no como causas de las guerras. Los desafíos mineros de Kosovo podrían reflejar mejor que en otros sitios esas oportunidades y riesgos.



Figure 1. Location map of Kosovo

- The reserves of Kosovo coal are enough for the needs of all Serbia for the next 200 years (17 billions of tons)
- The soil samples from Kosovo indicate

enormous reserves of oil - though very deep in the ground (but not unreachable). Also, Manas Petroleum Corp. confirmed this, researching oil reserves in North Albania

- The reserves of galena ore and zinc ores are practically inexhaustible. These ores are concentrated in the mine of Trepca (read: Trepcha), the second biggest lead and zinc producer in Europe
- Big reserves of rare minerals such as the ores of boron (used in nuclear technology), nickel and cobalt
- The agricultural potential is said to be bigger than the one in Vojvodina (Serbian North)
- Fresh water - no comment.

### Background

Kosovo is a land-locked country one-fifth the size of France at 10,887 km<sup>2</sup>, in south-east Europe, surrounded by Serbia, Macedonia, Albania, and Montenegro (Fig.1). The country is a flat fluvial basin with an elevation of 400 to 700 m above sea level surrounded by several high mountain ranges with elevations of 2,000 to 2,500 m. Its natural resources include nickel, lead, zinc, magnesium, lignite, kaolin, chrome, and bauxite.

A very young country with a very long history preceding the Ottoman Empire and more recently the Socialist Federal Republic of Yugoslavia followed by a region of Serbia, Kosovo declared its independence from Serbia on February 17, 2008, and approved its constitution to be in effect on June 15, 2008. Its nearly 1.8 million people produce an estimated gross domestic product per capita per purchasing power parity of \$2,300, distributed as 20% Agriculture, 30% industry and 60% services (CIA, 2009). Its industries are mineral mining, construction materials, base metals, leather, machinery, and appliances and its export commodities are mining and processed metal products, scrap metals, leather products, machinery, and appliances (worth \$527 million in 2007 per CIA (2009)). Its import commodities are foodstuffs, wood, petroleum, chemicals, machinery and electrical equipment (worth \$2,600 million in 2007 per CIA (2009)). The CIA (2009) estimated that there were 21,000 internally displaced persons in 2007.

According to the CIA (2009):

*Over the past few years Kosovo's economy has shown significant progress in transitioning to a market-based system and maintaining macroeconomic stability, but it is still highly dependent on the inter-*

*national community and the diaspora for financial and technical assistance.*

*Remittances from the diaspora - located mainly in Germany and Switzerland - are estimated to account for about 15% of GDP, and donor-financed activities and aid for another 15%. Kosovo's citizens are the poorest in Europe with an average annual per capita income of only \$2,300. Unemployment, around 40% of the population, is a significant problem that encourages outward migration and black market activity. Most of Kosovo's population lives in rural towns outside of the capital, Pristina. Inefficient, near-subsistence farming is common - the result of small plots, limited mechanization, and lack of technical expertise. With international assistance, Kosovo has been able to privatize 50% of its state-owned enterprises (SOEs) by number, and over 90% of SOEs by value. Minerals and metals - including lignite, lead, zinc, nickel, chrome, aluminum, magnesium, and a wide variety of construction materials - once formed the backbone of industry, but output has declined because of ageing equipment and insufficient investment. A limited and unreliable electricity supply due to technical and financial problems is a major impediment to economic development. Kosovo's Ministry of Energy and Mining has solicited expressions of interest from private investors to develop a new power plant in order to address Kosovo and the region's unmet and growing demands for power. The official currency of Kosovo is the euro, but the Serbian dinar is also used in Serb enclaves. Kosovo's tie to the euro has helped keep core inflation low. Kosovo has one of the most open economies in the region, and continues to work with the international community on measures to improve the business environment and attract foreign investment.*

The 2003 Kosovo- Biodiversity Assessment (ARD-BIOFOR IQC) notes:



Figure 2. KEK Lignite mine

*Kosovo is home to a rich ecosystem and biodiversity.*

*Aquatic ecosystems in rivers are highly threatened as a result of water pollution from domestic and industrial sources as well as uncontrolled sand and gravel mining in riverbeds.*

*Many stretches of rivers have been severely disrupted by sand and gravel mining and attempts to control river flooding with artificial levees.*

*The diversity and numbers of fish in rivers is believed to be drastically reduced in most rivers as the result of sand and gravel mining and pollution from domestic waste, mine tailings, and industrial pollution.*

Figure 3. The Stan Terg/Stari Trg mine waste processing plant in Trepca, Kosovo - lead, zinc, silver, and gold ores since Roman times  
Source: UNDP (2009)



**Metals**

**Bauxite and Alumina.** Bauxite deposits and mines are near Gllareva in the eastern part of Kosovo. Total known resources of bauxite amounted to about 6 Mt, of which the content of aluminum oxide ( $\text{Al}_2\text{O}_3$ ) ranged from 45% to 51%; iron oxide ( $\text{Fe}_2\text{O}_3$ ), 30% to 38%; and silicon dioxide ( $\text{SiO}_2$ ), 2% to 4%.

**Iron Ore.** Kosovo's resources of nickeliferous iron ore and ferronickel producer Ferronikel Kosovo are near Komorane, which is located in the central part of the Province; the nickel- and cobalt-bearing laterite iron ore exceeds 10 Mt and contains about 1.3% nickel and 0.07% cobalt. The ferroalloy plant, which had an installed capacity to produce about 12,000 t/yr of nickel in ferronickel, had been idle since 1999. In 2004, the Kosovo Trust Agency, which was established by UNMIK in 2002

in part to oversee the operations and privatization of energy and mining enterprises, announced plans to prepare laterite iron mines and the ferronickel plant for privatization.

**Lead and Zinc.** Lead and zinc resources amounted to about 22 Mt; ore grades ranged from 5.1% to 11.7% lead, 3.5% to 16.9% zinc, and 112 grams per metric ton (g/t) to 166 g/t silver. The major lead and zinc deposits were at Stari Trg, Belo Brdo, Novo Brdo, and Ajvalija. The rehabilitation of the Trepca lead and zinc mining, beneficiation, smelting, and refining complex remained a key element for restoring the lead and zinc industry in Kosovo and in Serbia and Montenegro in general. Operations at Trepca in 2004 involved preparations to transition from care and maintenance to a resumption of concentrate production.

**Industrial Minerals**

Kosovo's mineral industry also include such industrial minerals as aggregates, dimension stone and magnesite. Magnesite deposits and mines are located at Golesh in the central part of Kosovo and at Strezovce in the east. Total resources amount to about 5 Mt; magnesium oxide (MgO) ranging from 38% to 46%.

**Mineral Fuels**

The Bardh and the Mirash Mines, located in central Kosovo, were rated with combined resources of more than 18 billion tons of lignite. These mines and the Kosovo A and B thermal electric powerplants were under the operational control of Kosovo Electric Power Corporation (KEK). The KEK-operated mines (Fig. 2) produced about 6 Mt of lignite, of which almost all was used to fuel the power stations.

Table 1. Metals, industrial minerals, and mineral fuels in Kosovo. Source: Steblez (2004)

*Steps must also be taken to protect ecosystems and species outside current protected areas by protecting rare plant habitats and protecting the rivers from pollution and sand mining to conserve biodiversity.*

*Improved environmental management will also enhance biodiversity conservation - especially efforts to reduce river pollution and sand and gravel mining in rivers, eliminate toxic pesticides from the market, and prepare spatial plans that reflect biodiversity values and environmental concerns.*

*Badly degraded river aquatic ecosystems can and should be restored over time through significant reductions in water*

*pollution and halting of sand and gravel mining in rivers.*

The economy is still affected by the socialist past. Prior to 1990, Kosovo's economy was based primarily on mining and agriculture, with some manufacturing. Many of the factories and mines closed under pressure from international economic sanctions during the 1990s and few have reopened. Most factories and significant amounts of farmland are in the hands of the Kosovo Trust Agency (KTA) and are largely idle or working at a fraction of their capacity. Lead and zinc smelters that formerly operated in Mitrovicë/Mitrovica had an enormous environmental impact on both air and water quality. Environmental

management was largely ignored during the socialist period.

To paraphrase Kongoli *et al.* (2008)

All historical periods (Ilirik, Roman, Medieval, Turkish, ex-Yugoslavian) of Kosovo are linked with intensive development of mining and metallurgy. This activity influenced and still is influencing the overall position of Kosovo as a country. The potential of lignite resources (geological reserves) are about 1.5 billion tons. Rational use of these resources could create about 35,000 jobs. These reserves have a world 5th place listing. Other important industrial minerals in Kosovo are lead, zinc, gold, silver and rare metals indium, cadmium, thallium, gallium, bismuth etc (about 41,200,000 tons) (Figs 3 and 4). Rare metals found in these minerals are of particular importance in developing advanced industrial technologies. According to the world stock-market, metals of these minerals are evaluated at about 12 billion Euros. Resources of nickel and cobalt (about 14,500,120 t oxide minerals) are considered to be important as rare and qualitative resources in Europe and in the world. In the location Gremnik of Klina about 2 million tons of bauxite reserves have been identified. Kosovo also has resources of copper, uranium, iron, etc. as well as non-metals such as magnesite, quartz grit, bentonite, clay, talc, asbestos, etc. There is still no complete database



Figure 4. Tailings from the Artana mine in Novo Brdo/Novoberde, Kosovo - iron, lead, gold, and silver ores since 1326  
Source: UNDP (2009)

for these non-metal reserves, and further studies are needed.

#### The future

Over 30 international companies attended the International Conference on Mining, held in Prishtina in 2007. The participants share the belief that Kosovo's mineral capacities present good possibilities for potential investors and for developing the country. The positive aspects of Kosovo such as low labour cost, laws and investment climate were also presented. Hence, the belief that Kosovo is attractive for investments. "Kosovo's natural resources, especially minerals are important national property and should influence the economic development of Kosovo. However, we have to use the resources with the most advanced technology" said Kosovo President Fatmir Sejdiu. "The Mining and the mineral sector is the traditional strength of Kosovo because Kosovo has the advantage over competitors in international markets" said SRSJ Joachim Ruecker. "Although during the last years, we have been focusing on the status of Kosovo as an essential issue, we did not leave economy aside. Once the status is resolved, the economy will become our priority," said Prime Minister Agim Ceku. The Minister of Energy and Mining (MEM) Ethem Ceku spoke of the laws and regulations of the mining sector. "Kosovo is quite rich with mineral resources, lignite, lead, zinc, nickel, chrome, gold and silver as well as many other rare minerals," said Minister Ceku, adding that the status of Kosovo is the basis for investments. "We are confident that Kosovo's status will soon be resolved and we will have development platforms ready."

Various aspects of the mining sector were presented at the conference. KTA

officials spoke of the ways Kosovo enterprises have been privatized, especially the mines. "The KTA, the Ministry of Energy and Mining and others are looking into ways of privatizing the greatest mine, Trepca. There are also mines of Ferromikeli, Golesh and those of Strezovc," said KTA Deputy Managing Director, Ahmet Shala.

#### Discussion

Major air, water, and soil pollution from mining includes: sulphuric acid and sulphur dioxide, dust, fugitive emissions, and heavy metals (especially lead) from the 1967 Lead (Pb) Sinterplant at Trepac; six-stack and fugitive emissions from the Old Refinery at Svecan; lead dust from the Battery Recycling Plant at Sevcan; ash, coal dust, sulphur and petroleum emissions from the very old Energy Plant at Sevcan; sulphuric acid, sulphur dioxide and zinc dust from the 1967 Kosovska Mitrovica Facility; air and water pollution from dust, heavy metals (lead, zinc, iron, arsenic), non-metals (sulphur), xanthates (salts and esters of a xanthic acid), and cyanide from tailings at Trepca (Fig. 3); and, prior to 1985 stack scrubbers and filters, enormous pollution to commercial and urban areas from suspended solids and particulates and sulphuric acid at Malo Rudare, Blair, Zvecan, and Mitrovica environs.

These common practices lead to degradation of air, soil, and water: mining and burning lignite and its resultant acid rain, dust, particulate and fugitive emissions; disposal of fly ash and coal-gasification plant wastes; cement making and its dust pollution; and marble and other rock and aggregate quarrying and processing.

There are, of course, other significant non-mining environmental challenges in Kosovo. These, and the long-time lack

of public awareness, and lax regulations, enforcement, and appropriate facilities, no doubt have an adverse impact on human health and habitats.

Both the United National Development Programme (UNDP) and the European Agency for Reconstruction (EAR) have run environmental programmes in Kosovo since 2000, as have several other donors and non-governmental organizations. These need to address the urgent need of modernizing outdated polluting industries as in all socialist countries in transition. This includes the construction industry and proper settlement planning where currently most people build their own homes. Kosovo needs to develop its own model though. Raising environmental awareness is a must if Kosovo is to meet its European Community directives and agreements.

#### Acknowledgements

The author acknowledges the generosity, patience, and insights provided by: Ari Rusila, Development Project Manager, Jyväskylä, Finland; Dr. Beatriz Cuartas, Professor of Government, El Paso, Texas; Betim A. Osmani, Senior Business Operations Coordinator - Middle East and Central Asia, Houston; Claus Lillemark, Senior Project Manager, Waste Plant Development, Ploiesti, Romania; Gail Warrander, Author, London; Dr. Florian Kongoli, Chief Executive Officer, Montreal; Ole Jermiin Nielsen, Head of Projects and Technical Manager, Esbjerg, Denmark; Peter Lingwood of CE Consultants, UK; Richard P.T. Ots, Development Consultant, Bosnia-Herzegovina; Ruy Frank, Water Management Expert, Vienna; and Tom Wolters, Sustainable Development & Disaster Management Adviser, Beijing.

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# Biodiversity conservation at mineral extraction sites

by Rashila Tong<sup>1</sup>

The cement and aggregates industry is a resource intensive business and its production depends on quarrying. Future permitting and public acceptance of mining projects in Europe depend on present ability to develop and implement good practices for quarry operations and rehabilitation. Two examples of the Holcim Group showcase where biodiversity in a quarry is enhanced through progressive rehabilitation and a former extraction site now promotes conservation.

Protecting biodiversity ensures that healthy ecosystems provide the services we depend on. Biodiversity is the variety of all life on Earth. This includes variety of genes, species, and ecosystems and these elements interacting together make up the planet's biodiversity.

An ecosystem is a community of plants and animals living together with its surrounding non-living elements as a functional unit. Ecosystems are everywhere, and humans and their cultural diversity are part of them.

Ecosystem Services are the goods and services provided by nature and the benefits people get from ecosystems. Examples include regulating services such as flood control or climate moderation, provisioning services such as food, wood or pollination, and cultural services such as recreation. By conserving biodiversity, we ensure that healthy ecosystems are maintained and can continue to provide a healthy life support system and the services that we depend on.

## Business and nature can co-exist

Conserving biodiversity is a crucial part of sustainable development, and the business community is becoming an important

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L'industrie du ciment et des agrégats nécessite un approvisionnement en matières premières; l'extraction des ressources minérales est une étape indispensable à la production de ces matériaux. L'obtention de futurs permis d'extraction en Europe dépend de notre capacité à développer et implémenter les meilleurs pratiques existantes durant les phases d'extraction et de réhabilitation. Deux exemples de carrières gérées par Holcim montrent comment la biodiversité des sites a été mise en valeur, à travers une réhabilitation progressive dans le cas d'une carrière en exploitation, et de mise en valeur de la biodiversité locale dans une ancienne carrière.

player in efforts to address it. The cement and aggregates industry is a resource intensive business and its production depends on long-term access to raw materials acquired through quarrying. Holcim is one of the world's leading suppliers of cement and aggregates (crushed stone, sand and gravel) as well as further activities such as ready-mix concrete and asphalt, including services. It employs some 82,000 people and operates in around 70 countries on all continents. Sustainable development is a

La industria del cemento y de los áridos es un negocio que usa los recursos de modo intensivo y su producción depende de la explotación de las canteras. El futuro de las autorizaciones y de la aceptación social de nuevos proyectos mineros en Europa, depende de la habilidad actual para desarrollar e implementar buenas prácticas en las actividades de explotación y de rehabilitación mineras. Se presentan dos ejemplos del portafolio del Grupo Holcim en los que la biodiversidad en una cantera se mejora por medio de la rehabilitación progresiva y lo que fue una antigua zona de explotación ahora promueve la conservación.

key element of Holcim's business strategy. The priorities in Sustainable development are: climate and energy; community involvement; stakeholder engagement and partnerships; sustainable construction; resource conservation; and sustainable product and service solutions.

## Progressive rehabilitation supports enhanced biodiversity

At the Holcim Altkirch cement plant in France, the company operates an 83 hec-

Figure 1. The rehabilitated area of the Altkirch site, with present quarry wall in the background



quarry (Fig.1) which supplies the needed clay, limestone, and shale. The quarry operation is planned with progressive rehabilitation with specific goals to conserve natural habitats and increase the available fauna and flora. Incorporating continuous rehabilitation into the mine planning ensures that the time needed to establish a thriving biodiversity in an economical, efficient way is achieved while operating.

The mine plan aims to minimize the impact on biodiversity by conserving the natural habitats with an increase of fauna and flora. Holcim has defined the end-use of the site and works to achieve this final goal with annual rehabilitation activities. Native species are finding a favourable environment and are naturally colonizing the site.

Holcim works with the French ONF (Office National des Forêts (National Forest Office)) in the rehabilitation planning. The ONF helps with onsite assessment and monitoring efforts, as well as designing an environment that ensures the rehabilitation is successful. Working with expert partners provides the needed support to evaluate, monitor and manage the development of biodiversity in our quarries.

Many species are thriving in the quarry. Almost half of the exploited area has been completely rehabilitated and has resulted in significant biodiversity enrichment. The ONF has identified over 100 different species on site, including several that are registered on the Alsace Red List and the France Red List of Threatened Species. These species include reptiles and batrachians (tail-less stout-bodied amphibians with long hind limbs for leaping) such as Yellow-Bellied Toad, aquatic birds, mammals, such as wild boar and roe deer, and insects, especially dragonflies (Fig.2). Some examples of Vulnerable species found on the site include: Praying Mantis and Smooth Snake (according to the Alsace Red List) and Peregrine Falcon (according to the France Red List). With mining activities still ongoing, these species live in perfect harmony with their surrounding environment. This site demonstrates that properly planned quarrying activities can be conducted whilst also enriching biodiversity.

#### **A former quarry provides a platform for raising awareness of biodiversity**

Two education centres have been installed at Holcim's rehabilitated chalk quarry in Mons, Belgium, near its active Obourg



*Figure 2. An emperor dragonfly, one of the species today found at the Altkirch site*

cement plant. The “Jardin Géologique” (geological garden) was opened in 2002 and the “Maison de la Biodiversité” (house of biodiversity), in spring 2008. These venues are used to inform the public about the local geology and importance of biodiversity and are also used in dialogue with local stakeholders.

The Geological Garden showcases the geological history of the area over time and in space with permanent and temporary exhibits (e.g. Fig. 3). Nearly 3000 people per year visit the facilities. The aim is to educate in the life sciences including flora and fauna, and the former quarry visibly demonstrates the natural resources of the area. The facility provides education programmes on fossils and minerals found in the area and organizes activities with local schools.

The recent opening of the House of Biodiversity complements the Geological Garden, with a focus on nature, showcas-

*Figure 3. A dinosaur exhibit at the Geological Garden in Obourg*



ing some of the flora and fauna at the quarries in Obourg.

The centre aims to educate and inform the public on what biodiversity is, and why it is important to conserve (because society values it for economic, dietary, medical, ecological, ethical and aesthetic reasons). The exhibits also explore threats to biodiversity, the causes of loss of biodiversity, and some actions being taken in response to this.

The facility also hosts educational events (such as courses in life sciences and photography) and discovery activities of fauna and flora in the quarries with guided visits.

Placing the centers in a former quarry highlights the geological and biological richness along with some of the efforts undertaken to conserve biodiversity at the surrounding extraction sites.

#### **Collaboration for conservation**

Holcim and the International Union for Conservation of Nature (IUCN) signed a cooperation agreement in early 2007 to work jointly on ecosystem conservation and biodiversity issues relevant to the building materials sector. The relationship has three strategic objectives:

- Review of Holcim Group's biodiversity conservation management and develop a more comprehensive corporate biodiversity policy and strategy
- Support sustainable livelihoods and biodiversity conservation joint initiatives of mutual interests
- Promote good practice by sharing our knowledge with wider industry and communities.

An Independent Expert Panel is entrusted to provide independent recommendations to Holcim on how to integrate biodiversity conservation in its quarry operations, from site development to closure, thus playing a key role in the implementation of the agreement. Holcim has in place some tools to assist the operations such as raw material management, environmental and social impact assessment and quarry rehabilitation planning. The Holcim-IUCN relationship aims to further improve these tools and introduce others.

The global relationship has also triggered local agreements in Sri Lanka, Vietnam, Costa Rica, Nicaragua and Spain. In these countries, Holcim and IUCN are working together on local projects to conserve biodiversity during quarry rehabilitation, raise awareness, and support sustainable livelihoods.

# Geohistorical stone landmarks in the Pannonian Basin, Hungary

by Dr. Irma Dobos<sup>1</sup>

Mining and construction have opened more and more windows in the geological environment of Hungary, threatening some exceptional geological formations not only for us but for future generations as well. Therefore, following the example set by the USA in the 19<sup>th</sup> century, the registration and protection of geological landmarks was introduced to Hungary. These landmarks are mainly included in bigger landscape protection areas or nature reserves. At present, 50 geological landmarks are registered in the ten national parks of the country but only the most remarkable ones are mentioned in this paper.

**W**hen we talk about conservation and preservation of nature we usually mean saving the biosphere, though we should also consider the value of geology, hydrology, cartography and the history of civilization. The latter - some hydrological aspects as well - are non renewable and therefore their preservation deserves distinctive attention.

Preserving nature is not a new idea. Due to the first decisive conservation measures, the well known Yellowstone Park was established in the United States in 1872 which served as an example and stimulation all over the world. In Hungary, as in many other countries, conservation developed in the organization of forestry. Though the first Hungarian Forest Act (1879) referred to the necessity of conservation it did not make it obligatory. Protecting natural values started only 60 years later with the protected area Nagyerdő (Great Forest) in Debrecen and several trees and forests were put under protection in the following years. Unfortunately, significant portions of these areas were partly or totally destroyed in the 2nd World War.

## Sand-hills and hot springs

Extensive preservation work began in the

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Les activités minières et de construction ont ouvert de plus en plus de fenêtres au sein de l'environnement géologique hongrois, menaçant la pérennité de quelques formations géologiques exceptionnelles, non seulement pour nous mais aussi pour les générations futures. C'est pourquoi, à la suite de l'exemple donné par les USA au 19<sup>ème</sup> siècle, l'enregistrement et la protection des sites géologiques furent adoptés en Hongrie. Ces sites de référence sont, pour la plupart, inclus dans des aires de protection plus larges ou dans des réserves naturelles. Aujourd'hui, 50 sites géologiques sont enregistrés au sein des 10 parcs nationaux du pays mais seuls les plus exceptionnels sont mentionnés dans cet article.

early 1950s in which Prof. Elemér Vadász, professor of geology and president of the Conservation Council, had significant input. It is due to him that, among others, the protection of geological sites also started. It was he who, in 1951, prescribed developing outer protecting areas around the valuable hot and warm springs and wells of the capital.

However, the Hévíz thermal lake, which is of major importance even on a European scale, was put under protection rather late (Kiss and Benkhard, 2006).

In the southern part of the capital, bitter water plants were set up in the 19<sup>th</sup> century of which the Hunyadi János plant was declared protected at the beginning of 1980s.

The necessity of protection was urgent because of increased raw material production and industrialization, accompanied by extensive construction that threatened to damage or destroy irreplaceable environments. Fortunately some sites remained intact due to the existence of national parks and protection areas.

Obviously, geological areas of value under protection so far are mostly found in mountainous or hilly areas because most of the raw materials for the construction industry, as well as caves and exceptional geological formations were exposed here by researchers, miners and road- and rail-

La minería y la construcción han abierto más y más ventanas en el medio ambiente geológico de Hungría amenazando algunas formaciones geológicas excepcionales no sólo para nosotros sino también para futuras generaciones. Por lo tanto, siguiendo el ejemplo establecido por los EEUU, en el siglo 19 se introdujo en Hungría el registro y protección de los sitios geológicos. Estos lugares están fundamentalmente incluidos en zonas más amplias de protección o en reservas naturales. Actualmente hay 50 lugares de interés geológico registrados en diez parques nacionales del país, pero sólo los más importantes se mencionan en este artículo.

way builders. The many million year old marine, terrestrial and volcanic formations, which show geohistorical events and former flora and fauna, remained in their original place in these areas.

In spite of the fact that there are much less noteworthy geological formations needing protection in the low-lying areas, the first national parks were established here. The Hortobágy and Kiskunság national parks fulfil international requirements. Their outstanding natural characteristics include loess formations of differing evolution, and in some places, sandhills originating from the Danube, which are unique in Europe. These sandhills alter their form continuously but their substance remains untouched.

## Preserved basalt organ pipes

An increased awareness of geological phenomena was accompanied by their more

Figure 1. Rocking stones in the Velence mountains

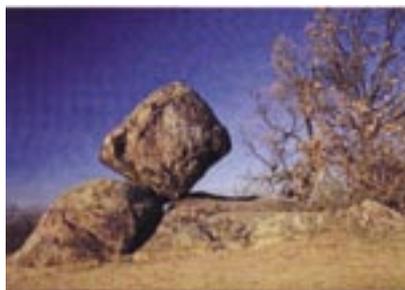


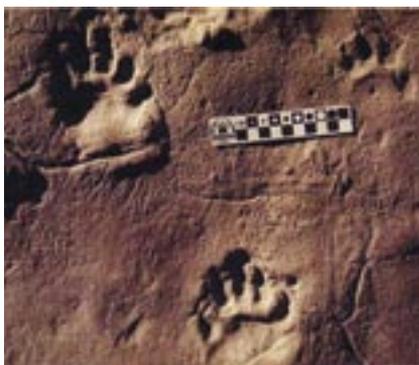


Figure 2. Stone run, Balaton highlands

and more detailed and accurate mapping in the entire country. Increasing international relations made it possible for our national geological features to become recognized outside of Hungary. Most of the preserved formations of the country are unique and spectacular not only from a geological but also from an aesthetic and touristic point of view. Among the most important are the karstification on the surface of the Triassic limestone, some 200 million old, and on which sediments containing manganese were deposited in the Jurassic. Due to manganese production, the primary karst of Úrkút and Iharkút, resembling the Grand Canyon, was revealed and was protected by the Conservation Council in 1951. In the same year, the 300 million year-old granites, the peculiar sheet rocks called «wool sacks» and the rocking stones in the Velence mountains on the Meleg hill near Sukoró and Pákozd were also protected (Fig. 1). In these, we see proof of the inner energies of the earth and of the effects of erosion. A year later, the special structured castle hill of Csesznek was put under protection (Bohn 1985).

The stone fields of Kővágóörs in the

Figure 3. Prehistoric footprints, Ipolytarnóc



Balaton highlands and of Boldogkőújfalu in the Tokaj mountains (Fig. 2) were formed by natural processes as was the beautiful castle hill of Sümeg.

Beehive stones (eroded Miocene rhyolitic tuff cones with rectangular “windows” carved into them which were used for beekeeping in the Middle Ages) of Szomolya in the Bükkalja region are of both geological and cultural importance.

The relatively young - just 4 million year-old - basalt hills of the Balaton highlands are not only geological but also landscape wonders. In some of the hills, the extruded and quickly-consolidated lava has an organ pipe-like form; hence, basalt organs. To protect these extraordinarily beautiful formations some of the mines, in use for more than 100 years, had to be abandoned so that the remaining features could be preserved. There are more than 50 protected formations in the region, some of which are genuine geological museums. The molluscs of the one-time Pannonian inland sea at Tihany called «goat nails» (*Congerina unguiculaprae*) have belletristic relations. Several geysers were active on the Tihany peninsula for a long time after the volcanic lava and tuff eruptions, emitting postvolcanic hot steam and gas. Traces of the above are preserved in more than 100 attractive geyserites. Mesozoic formations aged 110-180 million years and their various superposing forms are found on the Calvary hill in the town of Tata. Extraordinary geological features, 18 million year-old siliceous prehistoric pine trees and footprints of rhinoceros-like prehistoric animals preserved by volcanic ash were found at the 150-year old quarry of Ipolytarnóc (Fig. 3).

### Fairy-tale world of caves

Other treasures lie hidden in the deeper levels of our mountains. Dripstone-, crystal- and lake caves came into being due to the slow but persistent work of water in many million year-old limestone layers. Preserving them is not an easy task because they are extremely sensitive to the effects of environmental changes. However, there are several examples showing that establishing protecting zones in settlement development or introducing new technologies in mining makes it possible to coordinate the interest of production and the protection of caves and karst water. Some of the highly protected caves are not only famous tourist sites but are also suitable for curing respiratory diseases.

Informing the public about our protected natural treasures is an important educational tool. For example, there is an education centre at Sümeg where students of geology and geophysics can study every important event of the period between 200 and 70 million years on the surface in the quarry of Mogyorós hill.

The Geological Institute of Hungary has expanded the protective work onto the evaluation of every new or abandoned mine, road cut, trench, etc. in order to collect most important raw data for the national key section programme. The researchers of the institute have already compiled some 300 key sections which are continuously supplemented by new ones. In all probability the Csód hill in Dunabogdány, still being worked, will soon be protected as it is one of the country's laccoliths. It is a typical example of the geological formation where andesite lava did not break through the surface sedimentary rock but lifted it and consolidated underneath. Solving protection tasks like this can help in salvaging ancestral pieces of our environment (Dobos, 1988).

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# A question of competence: Spanish geologists and the Mining Law

by Rubén Esteban Pérez<sup>1</sup>

Spain had in 2006, according to the most recent official statistics, 4,292 mining operations (dimensional stone, quarry products, energy minerals, industrial and metallic minerals). Mining is a strategic sector in the national economy with a turnover in the millions.

The total direct mining workforce in 2006 was around 37,000 with another 7,000 outsourced. Of these, 3,706 were graduates and 463 outsourced, making a total of 4,169 graduates employed in Spanish mining companies. A very small percentage of them are geologists.

According to a recent interview (January 2009) with the Dean of the Faculty of Geology of the University of Oviedo, published in the newspaper "La Nueva España", only 20% of geologists work in the mining, environment and hydrogeology sector in Spain. The remaining 80% work exclusively in engineering geology, with a minority employed in diverse public administration. Looking at these figures one wonders why the distribution of work among geologists is dominated by only one main activity.

In the mining industry, for example, in spite of the fact that geologists are well prepared to manage mining operations at the same professional level or even in many respects at a higher level than mining engineers and certainly much better than mining technicians (3 years training), the current Mining Law prevents them from doing so. The Law disregards the academic and professional competences of geologists and establishes a restriction to practise, granting mining engineers and technicians exclusive authority in mining projects.

Geologists are not permitted to manage mining facilities, and although they may carry out exploration and research works as well as manage safety and health in mining sites, many enterprises and unfortunately also many Public Administrations, restrain or even veto the possibility of geologists fulfilling these tasks. It becomes a nightmare to prove to them that we geologists,

according to the Statutes of the Official Spanish Association of Professional Geologists (ICOG), may legally perform those tasks.

The Mining Law (passed in 1973, when Spain was still ruled by a Dictator) and its Regulations, have been scarcely modified since then, except in matters such as the territorial distribution of competences -due to the constitutional establishment of the State of Autonomies- and the free movement of goods and people, due to the entrance of Spain into the European Union. But they have not been modified at all, in what concerns the responsibilities of the various professionals working in the mining industry. The different Governments of Spain from the beginning of the democratic period have subtly tried to modify this Law, although, to date, no major reform has been approved.

On June 12 2009, the Spanish Cabinet approved a draft bill (Omnibus Law) modifying several laws, in order to adjust the Spanish national legislation to the European Directive on free access to activities and services. The text will have to be passed by the Spanish Parliament.

Article 17 of the bill modifies four articles of the Mining Law leaving them meaningless. These changes together with the previous suppression of other articles back in 1986, should render Section 8 of the Mining Law regarding the "Conditions to own mining rights" ineffective. The report justifying the changes of article 17 in the bill says: "The proposed modifications of the Mining Law try to ban restrictions to the free circulation of professionals in the European Union that were still in force".

The Omnibus Law is interesting in that it modifies 47 laws and eliminates 111 legal requirements, of which only 11 are replaced by less restrictive requirements. Twenty-two of these changes enable certain professionals to perform an activity that up to this moment, for one reason or another, they were not authorized to perform.

With regard to the restrictions removed from the Mining Law, the Ministry of Economy and Finance itself describes

them as "discriminatory requisites" for a significant number of European citizens including Spanish, who could not use their rights in relation "to be owner of mining properties".

The new Law also removes many incompatibilities currently suffered by many other professional groups (lawyers, attorneys, business agents and social graduates).

In spite of all this, it seems that geologists will still suffer incompatibility with the so-called "mining professionals" because those restrictions to professional practice are established in the Law itself. When a Law establishes a restriction to practise, the bill specifies that only another specific law can change that. Biologists have won some law cases related to attribution of professional competences against other professional groups, but geologists might not be able to seek the same legal protection under the same assumptions, since the attributions of the "mining professional" are included in the Law.

Just recently, the Spanish Supreme Court in a decision of 15/2002, derogated several paragraphs of article 21 of the bylaws of ICOG, specifically all those concerning the mining operations referred to in the Mining Law. The Law provides "exclusive attributions" to the graduates of mines and, in spite of the right approach of the ICOG's defence council in his reply against the claim of the High Council of Mining Engineers, the Court specifically explained that the exclusive right of practice that the Law gives to mining engineers, overcomes the fact that geologists might be qualified to carry out works in the exploitation of quarries and mines and in other mining production facilities.

In a Mining Law passed by the parliament of the Autonomous Community of Galicia (North western Spain) in 2008, which states that mining legislation in an Autonomous Community supercedes the Spanish national Law, and, in spite of the fact that it does not really modify professional competences, it does refer in its explanatory preamble to the need of a major change in the legislation:

<sup>1</sup>EurGeol.

*“The long time that has elapsed since the approval of the Mining Law 22/1973, of July 21, and the fact that it was passed in Spanish pre-constitutional circumstances, together with the important technological changes and the higher environmental and land-use concerns of the civil society, are all elements that imply the need for a Galician legislation in response to those changes”.*

When reading such a preamble to the bill we (but especially the Spanish mining authorities) should think, that among all these changes experienced by Spain in the

last 36 years since the Mining Law was passed, one particular one is the existence of professional geologists as a group of highly qualified professionals, with a high level of academic education.

Many of these geologists have been working for a long time in posts related to the exploitation of geological resources and the management of mining facilities. And during all these years they have been subjugated by a Law approved in another time when mining was a strategic industry for a Dictatorship, and that such a law granted to certain professionals preroga-

tives to the detriment of other professionals with similar qualification and that nowadays are completely obsolete.

Therefore, the ban of those professional legal prerogatives in the Spanish Mining Law is a must, to improve the competitiveness and boost free provision of services in Europe in this sector. It will also be necessary to adapt the academic curricula to the current mining industry, which has shifted from the traditional underground mining to opencast mining which involves higher environmental and safety and health concerns.

*Translated and revised by Manuel Regueiro*

## EFG News and Events 2009

### **EFG Council Meeting, Dublin, Ireland 16-17 May 2009**

At 9am on Saturday morning, Manuel Regueiro rose to speak in the same building where Queen Victoria of Great Britain had stood some 150 years earlier. Although both were opening proceedings of rather different kinds, the setting was that of Dublin Castle, an 800 year old monument to centuries of British dominance over Ireland that was itself built in 1220 over the traces of the earlier Viking settlement on the site of the old Viking Thing (Parliament).

The Council Meeting was hosted by the Institute of Geologists of Ireland (IGI), who were also celebrating their tenth anniversary with associated events. Indeed, the opening of the Meeting was uncharacteristically subdued due to the long-lasting hospitality of the IGI the previous evening, which had followed on from the excellent ‘Natural Resources Reporting Workshop’ jointly organized by the IGI, EFG, and CRIRSCO, and supported by the Irish Mining & Quarrying Society, Irish Association for Economic Geology, The Geological Surveys of Ireland and Northern Ireland. Investec kindly sponsored the event, which was opened by Mr Conor Lenihan TD in his role as Minister of State for Natural Resources.

Included in the welcome appearance of some 60 delegates and observers was a gathering of Past Presidents of the EFG, namely Richard Fox, Gunnar Hultquist, Manuel Regueiro, Gareth Ll. Jones, and Christer Åkerman. The meeting was also enhanced by the presence of strong delegations from North America. The AIPG were represented by John Bogna (President), Kevin Buchanan, Robert Font (Past

*Delegates taking the ‘air’ at Dublin Castle during a break at the Council meeting*



*Gareth Jones with his medal and the person who said she deserved it, his wife Sheila, with then President Manuel Ruggiero*





From left to right. Garth Earls, Director Geological Survey of N. Ireland, John Clifford, CRIRSCO, Manuel Regueiro, then President EFG, Conor Lenihan, Minister of State, Kevin Cullen, President Institute of Geologists of Ireland, Eibhlin Doyle, Past President IGI, Peadar McArdle, Director Geological Survey of Ireland

Presidents) and Bill Siok (Executive Secretary), while Bruce Broster (President) and Ollie Bonham (Executive Secretary) represented the CCPG.

Key events of the Council sessions included the election of the first female President of the EFG, Ruth Allington, and Marino Trimboli as the new EU delegate. Substantial consideration was also given to proposed revisions to the Statutes and Regulations, based on the excellent draft consolidated document produced over a number of months of painstaking effort by Bob Chaplow, Chair of the Registration Authority. As a result, the Council approved a new set of Statutes, although time constraints meant that assessment of the draft revised Regulations was postponed. Amongst the other items dealt with,

*EFG Treasurer Piers Gardiner and then Irish delegate Fionnuala Collins at the celebration in Dublin Castle after the Workshop*



the European Geologist magazine gained many plaudits for the Editor Maureen McCorry.

The traditional wine tasting took place with 24 competitive wines that the Council addressed with gusto on the evening of the first day. After suitable deliberation the winners were declared to be Slovenia (white wine) and Spain (red wine). This then led on to dinner, held in the Clarence Hotel beside the river Liffey. Owned by the U2 band members, one of whom was spotted by a delegate, the hotel provided an attractive setting that was attended by a large crowd of delegates, spouses and guests. The source of Guinness flowing past inspired the speeches which also flowed past. The keynote of the dinner was the well-deserved award of the EFG Medal of Merit to Gareth LI. Jones. It was a pleasure to see Gareth's support team present in the person of his wife Sheila.

The field trip to the 19th century lead mines of west County Wicklow was led by Matthew Parkes. This started in typically wet Irish weather, but finished on the shores of the Upper Lake in Glendalough in evening sunshine. Delegates were encouraged during the worst moments with traditional Czech "medicine". Finally, delegates arrived at the highest pub in Ireland, Johnny Fox's, to be regaled, not only by traditional Irish dancers and singers, but also by a dazzling performance by Pierre Christie who showed off his Alpine talents with energetic abandon.

*Piers Gardiner, Fionnuala Collins, Gareth LI. Jones*

#### GEOTRAINET update Intelligent Energy Europe Project IEE/07/581/S12.499061

GEOTRAINET is a European initiative supported by the European Commission's "Intelligent Energy". As presented in European Geologist 26, the aim of the project "Geo-education for a sustainable geothermal heating and cooling market" is to develop the training of professionals involved in Ground Source Heat Pump installations. From the different groups of professionals involved in a GSHP, the GEOTRAINET project is focused on two target groups: designers and drillers.

Visible results of the project will be the curricula, learning tools, manuals, an e-learning platform for the designers and the trainers, and several courses to be launched during the project duration.

The European Federation of Geologists is the Coordinator for a large group of partners who have worked successfully during the 1st year of the GEOTRAINET project, resulting in the management of the two first courses:

- First course Training the Trainers: Uppsala, Sweden, 10-12 June 2009
- Second course Training for Drillers: Dublin, Ireland, 28-29 September 2009.

The programmes of the courses are based on the curriculum developed by the GEOTRAINET European Experts Platform. The Experts Platform is developing an education programme including the necessary content and skills for designers and drillers from shallow geothermal systems.

The Training the Trainers course was attended by professionals with experience in the design and installation of shallow geothermal systems and in the delivery of training and dissemination of these subjects to practitioners: trainers of designers, and trainers of drillers.

The course received a very good evaluation from the participants. It was attended by 43 participants from 11 EU countries, and lasted 25 hours. It was taught by 10 European Experts from the Geotrainet Experts Platform.

The material, content and participant evaluations will be the base reference for the Curricula on Designers and Drillers, developed by the project.

The objective of the Training for Drillers course was to train drillers for the installation of shallow geothermal systems. This course aims at responding to the demand

*Photos from top: Lecture in progress in Uppsala; Participants at the Uppsala course; Adrian Brody demonstrates the remote drilling operation, Dublin*

from the market on GSHP. The drillers normally have a background in mechanics and work for drilling companies in water, foundation engineering etc.; only a few are SME's, fully dedicated to geothermal energy.

Following the Uppsala course, the Dublin course was evaluated and modified. After the Overview of Shallow Geothermal Systems by Burkhard Sanner, firstly a local national introduction was made, involving Irish Geology and Geothermal Resources by Gareth Ll. Jones, Irish Hydrogeology by David Ball and Irish Geothermal Drilling Status and Limiting Factors by Ric Pasquali. Drilling in practice was given by Kjell Carlsson, who showed a pictorial study of a complete geothermal well closed loop installation, and Dirk de Coster, who looked at the detailed practicalities. The programme then broadly followed the outline of the Uppsala course with Olof Andersson looking at Open systems and Jörg Ujde dealing with Key components of closed Geothermal Installation. A Working Group session then reported back at the end of the theoretical course, followed by an Open Discussion Forum. On the second day, site visits included a visit to the new Vistacare Health Clinic's 340kW Heating and Cooling Open Loop system in Naas, Co.Kildare, and an on-site discussion at an adjacent well drilling location.

The course was designed for 40 trainees, but it was heavily over-subscribed and some 70 delegates attended on the day. These were mostly from Ireland, but there were also drillers from nine European countries present. Initial feedback was encouraging, but the course will require further development. In particular it was found to be too short and crowded, especially with the introduction of new sections, so the next Drillers' course in France should be suitably enlarged and longer.

The long-term aims of the project include the raising of standards in this growing industry, with a view to protecting the environment and providing quality for the consumers. More information about future courses and project activities can be found on the Geotrained website: [www.geotrained.eu](http://www.geotrained.eu)

*Gareth Ll. Jones and Isabel Fernandez Fuentes*





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### News from Geologos del Mundo

#### Supply of freshwater to four communities of the municipality of Conchagua (El Salvador)

In September, World Geologists completed a freshwater supply project to the communities of La Brea, San Ramón, el Caribal and Los Monos (El Salvador). This project will reduce gastrointestinal and all water-transmitted diseases, minimizing the costs of public health and the works needed to transport freshwater to the dwellings (generally done by women), thus increasing the available resources for families.

These communities, generally rural and with low income, received their water supply from springs and shallow private wells, generally bacteriologically polluted. In summer many wells dried, and the flow of springs was reduced, so that part of the population was left without access to fresh water.

The geological substrate of the area of the project is mainly volcanic, belonging to the Balsamo formation (Mid Miocene to Upper Pliocene), although there are also Quaternary alluvial and/or colluvium deposits. Main fractures are N-S.

The project was carried out in two phases, the first financed by the Nando-Peretti Foundation, and the second by the Community of Madrid.

#### Exploration Phase

The objective of the first phase was to carry out a hydrogeological study before drilling the borehole. The study included an inventory of wells and springs in order to gauge the underground water resources. Later, a geological and photogeological survey of the area was carried out, and finally a geophysical survey including Electric Vertical Logging and electric sections.

Based on the results of the geophysical logging, a 6" test borehole was drilled, using a rotoperussion drill with a bottom hole hammer. During the drilling, it was estimated that the flow from the well was about 13 l/s at 55 m depth. The water level measured in the well was located at 15 m.

The lithological section drilled was, from surface down to 18 m: red clays; from 18 to 24 m: red tuff (with water flow) and from 24 m to the end of the borehole: basalts, probably fissured. It seems that there are two aquifers, one upper open aquifer (18-24 m) and a lower fissured one. Both aquifers are probably transected by a fault, in turn probably linked to a large one, all of which generate a high water flow.

Casing was carried out taking into account the lithological section and the increased flow with depth. It was then decided to install 160PSI 8" perforated PVC tubes from 18 to 27 m and from 33 to 51 m.

Finally, the well was cleaned and developed using compressed air. After that, a pump test was carried out to determine the hydrogeological characteristics and the maximum exploitation flow, which was close to 30 l/s. during the pump tests, water samples were taken for analysis, which indicated that the water was drinkable.

Finally, a 75 m<sup>3</sup> semi-buried brickwork structure was built. This was located in La Brea, because of its greater elevation.

The objectives of the second phase, which started in September 2008, were twofold; construction of the water mains from the deposit to the dwellings and the construction of a black sewage as well as strengthening of the organizational and managerial capacity of the freshwater system.

#### Construction of the mains phase

The project was designed for a projected population of 3,600 inhabitants in 20 years time, (current population 2,100), and an estimated resources need of 1,101 inhab/day.

From the topographic survey, a branched type mains distribution was designed, using 160 psi and 4" (mains) to 1" (house connections) PVC tubes. The network had regulating distribution valves allowing closure of sections in case of a breakdown. House connections have manholes which include control valves and a water meter. The tubing was laid in a 70 cm deep trench with 3 stretches of galvanized steel tubing.

All works were carried out by the beneficiaries with the supervision of WG.



Inside the well, a 10CV single-phase submersible pump was installed. To automatically control the start and stop of the pump depending on the water level, an electric installation for the valve of the floater inside the deposit was also made. At the tank exit, a chlorination system was installed.

**Community work**

Several meetings were organized with representatives of each community to form daily working shifts and to elect the managers of the Water Board. A Board with six men and five women was subsequently elected representing proportionally all three communities.

In order to strengthen the community's organizational and management capacities for the freshwater system, several training courses for the Water Board were organized in matters such as pumping electric and chlorination systems, as well as in accounting, administrative and juridical matters so that the system is sustainable.

Awareness campaigns in the communities on the control of water consumption, management of solid residues and sewage, the importance of the environment and the resources that they have available, were carried out throughout the whole project by organizing meetings with the communities and in the schools.

Printed material has also been produced, in the local language which includes the training courses and the technical and accounting material.

Four General Assemblies were also organized with all the beneficiaries of the system, in order to approve the statutes and bylaws of the Water Board.

*Jesús Garrido Manrique and Javier Reina Ortega. NGO World Geologists*

*Translation: M. Regueiro y González-Barros*



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**News from Spain**

**The Geological School of Granada (Spain) turns 50**

The 50<sup>th</sup> anniversary celebrations on 15 and 16 May 2009, of the introduction of geology studies at the University of Granada, managed to gather more than 800 former students from one of the foremost Spanish geology schools.

Among the official events, all of which were led by prestigious geologists educated at this university, those that stood out were the book presentation (see picture below) "50 years of geology at the University of Granada" by Professor Juan Antonio Vera (President of the Organizing Committee), the presentation entitled *Are the earth's metal resources depleting? Geological responses with examples of findings in the Andes*, by Professor Lluís Fontboté (Head of the Mineralogy Department at the University of Geneva), the presentation *Social perception of Geology: some ideas for improvement*

*Professor Vera, President of the Organizing Commission, presenting the book '50 años de Geología en la Universidad de Granada'*



by Dr. Cecilio Quesada (Chief of the Technical Cabinet of the Spanish Geological and Mining Institute, and Secretary of the National Commission of Geology) and the Round Table on *Present and Future of Geology in Spain*.

Among the many leisure, and similar social activities that stood out at the event were the inauguration of a commemorative monolith in a town square carrying Professor Fontboté's name (founder of the school during the 50s), a musical concert with outstanding performance by the *Emseble La Danserye* (www.ladanserye.com), consisting principally of geologists from Granada, a pleasant match of football, *Globigerínidos versus Esquistosos*, a long tradition between geology teachers and students, as well as a poster exhibition with photographs and texts from each of the university's yearly graduate classes. (<http://www.ugr.es/local/agcasco/geougr>).

**The School's influence on scientific research and industry**

The University of Granada has produced more than 2500 licenciates and over 260 doctors of geology during its 50-year history. They have come to play an important role in Spain and in the rest of the world, in the academic field as well as the professional.

This history is characterized by two phases with very different characteristics. *Phase one (1958 - 1983)*

The first part of the School's history was very distinguished, on the academic side, with the submission of the first set of PhD theses, destined to create an indispensable, basic infrastructure for regional, geological knowledge that would lead to highly focused research. Worth promoting is the important collaboration with French and Dutch schools at the beginning.

From this stage in the field of professional geology, one can distinguish the prestige that this university's prominent



Photo above: Congress sessions at the Faculty of Sciences of the University of Granada



Photo left: Anniversary gathering in the Principle's Office of the University of Granada

tion, geotechnics, hydrogeology, geophysics, territorial planning and exploitation of ornamental and industrial rocks.

**Present day situation**

According to the *Institute for Scientific Information (ISI)*, the last decade's numerous international publications and the citations they have received have placed the geological school of Granada between first and third position along with the University of Barcelona and the Complutense University of Madrid. Our graduates have made distinguished advances in the fields of stratigraphy, geophysics, structural geology, marine geology, geochemistry, geochronology, geotechnics, hydrogeology, mineralogy, palaeontology, petrology, sedimentology and mineral findings.

Geologists, educated at the University of Granada, find themselves occupying important positions in public research organizations and as teachers at 41 of the world's universities. Private and public corporations, dedicated to the diverse aspects of applied geology, especially mining and hydrocarbon prospecting, geotechnics, hydrogeology and environmental protection, employ our excellent professionals who apply their proficiencies, acquired at this university, throughout the entire world, but especially in European and Latin-American countries.

The anniversary has definitely been an emotional journey and a grand event, celebrating one of Europe's great geology schools. Congratulations.

*Dr. César Viseras (Professor in Stratigraphy. University of Granada.) and Dr. Isabel Fernández (EFG, Office Director)*

iversity of Granada, played a fundamental role. Proof of this is the important intervention, by Grenadian geologists, in the creation of the *Official Spanish College of Geologists* in 1978, whose first President and General Secretary originated from this university. *Phase two (since 1984)*

The second part of the School's history, commencing in 1984, has seen the publication of the well-known *Law of Science*, the creation of the *Counselling Commission of Scientific and Technical Investigation (CAICYT)* and Spain's entrance into the European Union. These events have made the development of

research projects in the different fields of Earth Science possible for the University of Granada's researchers - projects of great economical importance - as well as the frequent exchange of geology teachers between many foreign universities.

In the professional field, the socio-economic evolution and associated legislative modifications have enabled the geologists, educated in Granada, to play an important role in the fields of environmental preserva-

geologists took in the private sector, researching in the mining and oil prospecting fields. An important impulse that also affected the Grenadian geologists was the rise in competency brought on by the publication of the *Mining Law* (1973). This, together with the great national plans for geological mapping (plan MAGNA) and for groundwater resources (collaborations IGME-FAO), made way for the creation of many corporations where cartographers and hydrogeologists, educated at the Uni-

**News from GsF**



**The filter "Bioarena": a simple and economic way to bring drinkable water to poor rural communities**

"Geologists without Borders" (Geologi Senza Frontiere GsF) have started the production and distribution in developing countries of the "Filter Bioarena", a very simple way to produce the necessary daily quantity of drinkable water for a family, in those areas, where drinkable water is difficult to find and where a proper "water

*Pictures, from top*  
 The "Biosand Filter" scheme  
 One of the concrete "Biosand Filters" tested in the Danli (Honduras) workshop, Republic of TOGO (Africa)  
 The "Bioarena Filter", being illustrated in a school system" has not yet been installed (see illustration, top).

GsF have started the production and distribution of such Filters in Honduras, in close cooperation with local Rotary Clubs, following the example of USA Rotary Clubs who are very active in this kind of project mainly in Mexico and Guatemala.

Production takes place in the town of Danli (South East Honduras), where, in a small workshop, concrete Filters are manufactured. Distribution is largely to poor rural communities of the area, where the quality of water for family use is of very miserable quality (surface polluted sources). Up to now, more than 2,500 filters have already been distributed.

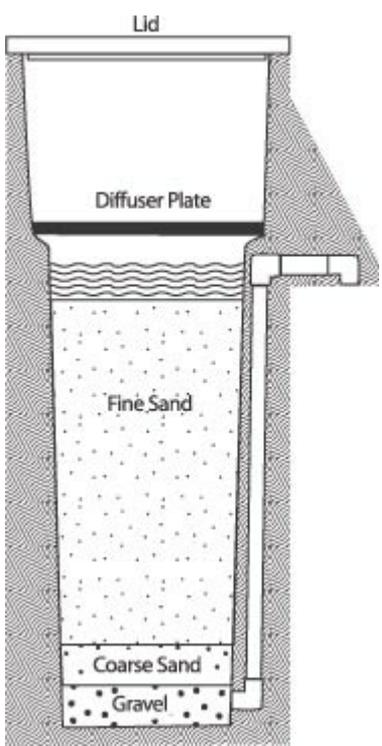
Due to the encouraging results obtained in Honduras, GsF have also decided to start the production of those filters in some Africa countries.

Some have already been built in the Democratic Republic of Congo and in April 2009 some "Biosand Filters", manufactured locally, have been produced and distributed to schools in Togo. Production and distribution is also envisaged in Mali.

The basic production cost of each filter is Euro 60. The GsF Project "Adopt a Filter", needs the help of everybody.

Below you can find the bank details for donations:

*GsF Adopt a Filter*  
 c/o Banca Popolare Bergamo, Milano, Italy  
 IBAN IT 11 0054 2801 6020 0000 0024497  
 Carlo Enrico Bravi



**Obituary**



Jean-Michel Quenardel, former UFG President (1991-1998) and French delegate to the EFG (1993-2001), died in Besançon, France from leukaemia, at age 63, on Sunday the first of November 2009.

Committed to Geology, Jean-Michel was first a *Maître Assistant* then *Maître de Conférence*, teaching at Orsay University (Ile de France) and finally moved in 1999 to the Franche-Comté University, Besançon where he held the position of Professor in charge of the DESS of Applied Geology and Geotechnique.

Very active in the defence of Geology, he was eager to train his students both at theory and practice to high levels of quality, giving them the sense of data analysis and self questioning. He also created a Geodiffusion Service allowing the circulation of theses between all the French Universities.

Jean-Michel was among the first French geologists to support the EFG and became a EurGeol. in 1995, very much concerned with the need for Geology to be more central in people's lives and concerned by the free movement of geologists through the whole of Europe (he was also a Member of the Geological Society of London). He was an enthusiastic delegate for France and we remember particularly the notorious French feast of the Seven Deadly Sins (all cheese courses) that he laid on for the EFG Council Meeting in 1997.

Beyond his academic responsibilities, his openness to the professional geologists in Industry - he was the treasurer of the Association for Quality in Applied Geophysics (AGAP) - made him a prominent actor for pushing the geologist forward and easing communication between the different French Geosciences Associations. The future *Société des Géologues de France*, now under creation, is partly his work.

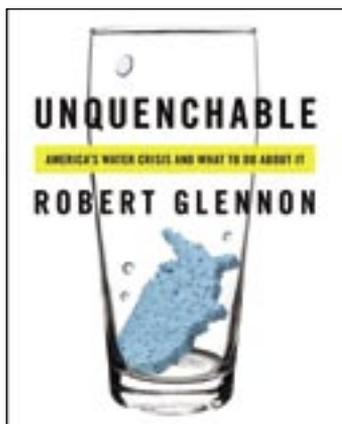
Optimistic fellow, bon vivant, Jean-Michel will be missed by the whole French Community.

*Antoine Bouvier, Gareth Ll Jones*

**Unquenchable***Book review by Barney Popkin<sup>1</sup>*

Unquenchable: America's Water Crisis and What to Do About It  
by Robert Glennon

*Published by: Island Press/Shearwater Books, Washington \* Covelo \* London  
ISBN: 9781597264365  
Date: 2009, 416 pages  
Price: 16.99 stg.*



Robert Glennon, the Morris K. Udall Professor of Law and Public Policy in the Rogers College of Law at my alma mata (the University of Arizona) has again amused, informed, and educated me in America's water challenges. As he so articulately achieved in his earlier groundbreaking *Water Follies: Groundwater Pumping and the Fate of America's Fresh Water*, Professor Glennon, with the support of grants from the National Science Foundation and (another of my alums) the Arizona Water Resources Research Center, travels around the country observing, interviewing, and documenting the water crisis, and real and surreal solutions, then offers a new approach. In reading *Unquenchable*, you will be reading professor-turned-journalist.

We live under the paradox of depending upon water of high quality always being available in the quantity when we want it. Yet, we rarely think about it except when there is a flood or a drought.

Increasingly so, here is the paradox: more and more of the U.S. fresh-water demand is for power plants as steam and cooling water, while more and more of the U.S. energy demand is for fresh-water pumping and treatment systems. For several years now, the water-demand for power plants has surpassed the water-demand for agriculture in the U.S., though in several states, agriculture continues to comprise

70 - 80% of water demand.

Nonetheless, slight increases in irrigation efficiencies and food processing to reduce agricultural water losses are the likeliest and easiest ways to make more fresh water available for the "unquenchable" demand. Professor Glennon writes, "Let's be clear about one thing: the water for new demands, whether refining ethanol or processing semiconductor chips, will mostly come from agriculture... In many states, a high percentage of agricultural water is used to grow crops that return a relatively low value," which of course is quite true in many countries, especially developing countries in Asia, the Central Asian Republics, and the Middle East.

Of course, significant across-the-board improvements have already been made in most industrial and commercial sectors which more likely pay closer to the true cost of fresh water. Also, when energy production and distribution efficiencies are improved, the energy sector may likely demand less fresh water for steam and cooling. Hmm.

But clearly, does the water demand from irrigation, food processing, industrial and commercial activities, and energy production really require fresh water? Not so. Water conservation is a fork with several prongs from reduced use to reuse of other water sources to reduce fresh-water demand. Among these other sources are, of course, treated wastewater, street-runoff, roof-top water, household and commercial grey water, and storm or flood waters.

Professor Glennon promotes the sweet-16 water reforms, from encouraging creative water conservation to securing water for the environment.

Water-demand management figures in a major way in the Professor's reforms. It is likely a long way off before we will enjoy the technological advances of say seawater aquaculture, low-cost wastewater treatment for reuse and saline-water desalination, and breakthroughs in water-less energy production. We will need to depend more on proper metering and pricing policies which in themselves will produce incentives to water conservation and removal of water-efficient institutional and cultural barriers.

But we should be cautious. If piped urban water is priced too high, there will be increases in unauthorized connections (water piracy), sale of trucked agricultural water for urban water by street vendors, and drilling of shallow water wells in urban areas where groundwater is likely to be contaminated, as we see in from Amman,

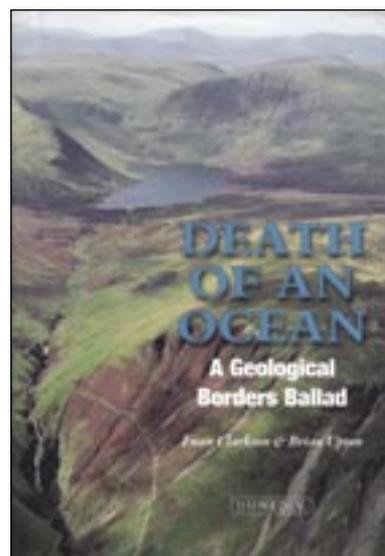
Jordan to San Francisco, California. In fact, severe water-pricing policies in Amman has led to such a high degree of water conservation and grey water capture and reuse that wastewater from that municipality is extremely saline, as well as tremendously high in oxygen demand, organic matter, and micro-organisms. This leads to great potential for methane production, but requires some aliquot desalination then mixing to make treated wastewater suitable for irrigation of most crops.

<sup>1</sup>*EurGeol. Environmental, water and waste management consultant*

**Murder deep in the Southern Uplands: a geological whodunnit***Book review by David Harper<sup>1</sup>*

Death of an Ocean. A Geological Borders Ballad  
by Euan Clarkson and Brian Upton

*Published by: Dunedin Academic Press Ltd [www.dunedinacademicpress.co.uk]  
ISBN 978-1-906716-02-8  
Date: 2009, 224 pages  
Price: £25 (stg), hardback*



The scene of the crime is the beautiful, rolling hills and remote lochs of the Southern Uplands of Scotland, the setting of Sir Walter Scott's greatest novels, but still a largely undiscovered corner of Europe. Euan Clarkson and Brian Upton have collaborated once again, following the success of 'Edinburgh Rock', to carefully assemble the evidence for the death and destruction of an ancient seaway, the Iapetus Ocean. But how could the likes of Sherlock Holmes or Inspector Morse solve such a crime, interrogating some very

silent witnesses indeed, rocks and fossils from deep time. The authors, in an elegant and lucid narrative, take us back nearly 500 million years to an ocean that separated the continents of North America and Europe, a sea teeming with extinct organisms such as the graptolites and trilobites, while explaining with lavish illustrations the concepts of deep time and plate tectonic processes. We meet many colourful and iconic geologists on the way. Without the cutting edge studies of Charles Lapworth, Ben Peach and John Horne, Gertrude Elles and Ethel Shakespeare together with Rachel McRobert, contemporary geologists could never have stood on the shoulders of these giants and understood the processes of microcontinent-continent collision and subduction-related processes. The Southern Uplands are composed of slabs of the floor of this ancient ocean, locally rich in key fossils that can help us date the rocks, confirm their deposition in deep ocean environments and reconstruct the palaeogeography of these distant continents and oceans. Painstaking description of the rock types and their structures, fossils and their life styles together with their final resting place in the Caledonian mountain belt are the hallmarks of any good detective work. But what about the culprit? It was our restless Earth itself. During the Early Palaeozoic, the large continent of Laurentia (essentially North America and Greenland) and the smaller continent of Avalonia (essentially England, Wales and some adjacent terranes) converged and collided some 420 million years ago. The resulting Caledonian mountains stretched from the north of Norway to the southern part of the Appalachians. The life of this ocean was over, but the geological history of the Southern Uplands continued. Patches of rock provide us with glimpses of Devonian deserts and volcanoes, Carboniferous lakes and rivers and shallow incursions of the sea, populated by remarkable arthropods and fishes, punctuated by a range of volcanic outbursts. Finally, the evidence for glaciation and recent climate change in the Southern Uplands is tracked through the characteristic landforms and sediments of the Pleistocene and faunas and floras of the Holocene.

This is a splendidly produced book, beautifully illustrated and eloquently written. The plot and the main characters are meticulously developed through the clear and didactic narrative. It focuses the most modern of concepts and investigative techniques on the buried history of one of the bonniest parts of Europe.

### See Naples and die! The life and times of Vesuvius

Book review by David Harper<sup>1</sup>

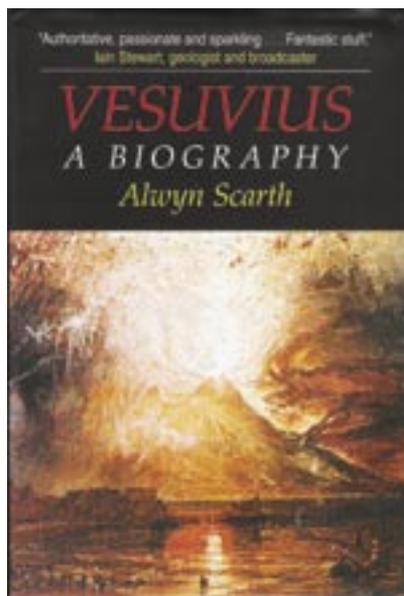
Vesuvius. A biography  
by Alwyn Scarth

Published by: Terra Publishing [[www.terrapublishing.net](http://www.terrapublishing.net)]

ISBN: 978-1-903544-25-9

Date: 2009, 342 pages

Price: £24.95 (stg), hardback



James Hutton, the founder of modern geology, succinctly summarized his views on volcanoes in his *Theory of the Earth* (1788) 'A volcano is not made on purpose to frighten superstitious people into fits of piety and devotion, nor to overwhelm devoted cities with destruction; a volcano should be considered as a spiracle to the subterranean furnace, in order to prevent the unnecessary elevation of land, and fatal effects of earthquakes.....'. Alwyn Scarth has extravagantly amplified and developed these themes in a monumental biography of the only mainland European volcano to erupt in last 100 years, the magnificent, simmering Vesuvius. Scarth, in a precise and racy narrative, vividly exposes the history of this iconic landform. Yes, Vesuvius is a product of subduction processes within the complex of mosaic microplates in the Mediterranean, caught in the collision zone between Africa and Asia, but it is much more. It has influenced the culture and destiny of the inhabitants of Campania and indirectly impinged on the local strategies of empires and governments. It has inspired works of fine art and great literature, together with of

course intensive scientific investigation. The story begins with the development of the Somma-Vesuvius system and its first casualties during the Bronze Age before moving swiftly to the day of wrath in AD 79. The doomed and terrified denizens of Herculaneum and Pompei cry out in agony from the pages as they succumb to the pyroclastic surges. The accurate documentation of Pliny the elder and the younger did much to establish the science of volcanology and in the aftermath, Emperor Titus organized massive relief aid for the region. Our story continues through the putative eruptions of Mediaeval times to the eruption of Monte Nuova; but, in contrast to earlier explanations, the Renaissance had already developed a more scientific approach to the volcano, its origin and its products. Such ideologies were relatively short-lived, soon to be replaced by the fire and brimstone of the reformation. By the late 1700s and early 1800s the volcano was very much part of the Grand Tour with distinguished visitors such as Hans Christian Andersen, Hector Berlioz, Charles Dickens, Wolfgang Amadeus Mozart and William Turner viewing the edifice but often not without problems. Nelson too turns up at the foot of Vesuvius to foster the infamous ménage à trois, joining Sir William (himself an accomplished volcanologist) and Lady Hamilton in a notorious relationship that titillated both the British fleet and high society. The persistent activity from the early 1820s to the mid 1940s paved the way for an era of careful, scientific investigation and the book concludes with a menu of lessons for the future.

Alwyn Scarth has produced a meticulously researched yet eminently readable obituary of one of the world's best known geological features and its cultural and social consequences. The simple sketches of the evolving volcanic complexes and the effects of earthquakes and eruptions work well. The photographs are carefully selected if occasionally a little pale. And although not cited in the text, the illustrations closely match the text while the boxed didactic material, together with the useful glossary, provides clear explanations. If one must see Naples and die, Scarth's book is an essential companion.

<sup>1</sup>David Harper is Professor of Palaeontology and Head of Geology in the Natural History Museum of Denmark, University of Copenhagen

## Submission of articles to European Geologist Magazine

The EFG calls for quality articles for future issues of European Geologist. Submissions should be in English, 1000 words for short articles and 3000 words for feature articles. 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-mccorrey@net.telenor.dk](mailto:Harper-mccorrey@net.telenor.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 CYMK colour. Further details may be found on the EFG website: [www.eurogeologists.eu](http://www.eurogeologists.eu)

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Data for European Geologist Magazine

Number of issues printed:

6500

Periodicity:

2 times a year

Print mode:

Offset

Size:

A4 (210 mm x 297 mm)

Deadline:

30 March, 30 September.

Published:

30 May, 30 November

Advertisement delivered as computer file:

EPS, TIFF

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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

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## 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.

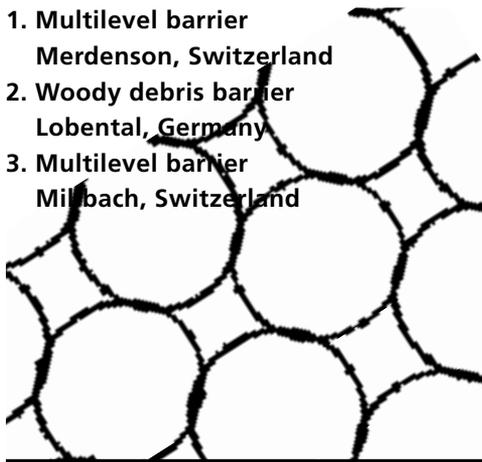
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6. To promote the establishment of best practice for training of geologists.
7. To safeguard and promote the present and future interests of the geological profession in Europe, including:
  - to guarantee the free movement of geologists in Europe, 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.
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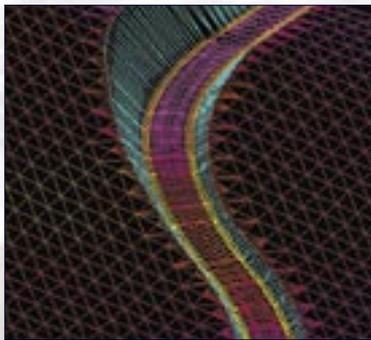
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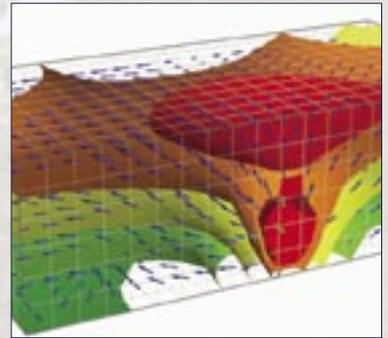
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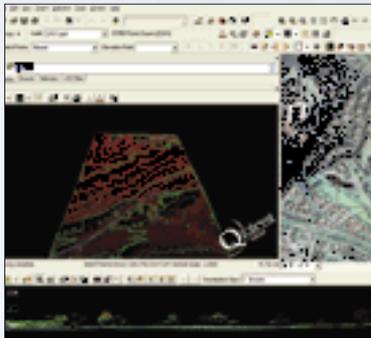


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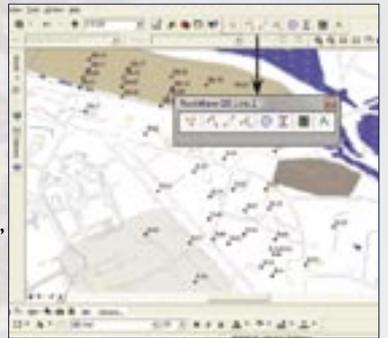
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