Nº 32

Dec 2011

European Geologist

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

Natural Hazards
Risk Management
Strategy

Contents *European Geologist 32*

Cover photo:
Main photo: In January 2010 torrential rain and snow meltwater combined to reek havoc in the Glendalough area, Ireland. There were a number of mud slides. This is one which started very high up the side of the valley and ran down the gulley. When it reached the Miners Track it partly washed it away and blocked what was left. Smaller photos, from top: living in the shadow of Mt. Merapi; ash plume from Eyjafjallajokull, Iceland; rockslide of Murialdo, Liguria.
Photos this page:
From left: students on Summer field training at the Rudabanya open pit; effects of the earthquake in Lorca, Spain; rockfall accident along the Via Aurelia, Italy; Mt. Merapi, Central Java, Indonesia.

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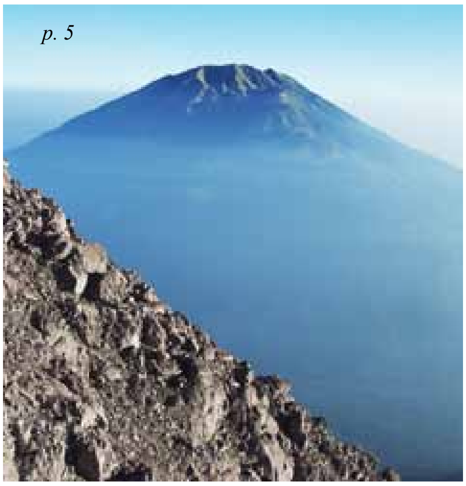
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Foreword

Strategic plan

by EurGeol. Ruth Allington, President

Over the past year, the Council has worked on re-focusing the Federation's mission, vision and values with a view to producing a new strategic plan for the next 5 years. The Board will be presenting a draft plan for discussion to the Council meeting in Brussels at the end of November. Further work on action plans will be completed before the summer Council meeting in 2012 and it is hoped that a finished plan will be agreed then. The vision established by the founders of the Federation has not changed very much since its formation over 30 years ago (essentially to be the voice of professional geology in Europe), and neither have the core values and objectives. The activities of professional geoscientists in both applied and academic arenas, and therefore the work of the Federation, is as important now as it was when it was conceived, although the context and challenges have changed somewhat. It is especially important to articulate clearly what our values and objectives are both internally and externally.

These draft high level statements that have come out of our work so far will be put to Council in November for discussion, amendment and agreement.

The EUROPEAN FEDERATION OF GEOLOGISTS believes that public safety; sustainable development; responsible use of natural resources; and effective prediction, prevention and mitigation of natural hazards is best served by well-educated and appropriately trained professional geoscientists working transparently with other professionals and communicating effectively with the public.

EFG is a professional organization which aims to contribute to safer and more sustainable use of the natural environment, protection of the public and responsible exploitation of natural resources by promoting excellence in the application of geoscience and creating public awareness of the importance of geoscience to society.

This edition of the European Geologist magazine, with its emphasis on prediction, prevention and mitigation of natural hazards amply demonstrates the essential contribution that geologists make (or should be asked to make) to keep the public safe and to the development of public policy. The magazine also includes an article on iron ore exploration in Hungary – another extremely important area of professional practice for geologists.

This edition of the magazine is the last to be edited by Maureen McCorry. Maureen has been the editor of our magazine since 2001. To say she has transformed the magazine in that time would be an understatement and the EFG owes her an immense debt of gratitude. It is because of her efforts (as editor, proof reader, commissioner, graphic designer, publisher, advertizing executive, and dispatcher) that we have had a magazine twice a year for the past 10 years. She has recently steered us through the change from print to electronic copy and has made the task of handing over the administration to the EFG office and the editorial duties to others that much easier. Thank you Maureen, for all you have done – we all wish you well for the future!

The creatures will protect us

by Kate Donovan[1] and Aris Suharyanto[2]

Kate Donovan and Aris Suharyanto have been living on Mt. Merapi, Indonesia, attempting to understand the people who live, farm - and die there.

Kate Donovan et Aris Suharyanto ont vécu sur le mont. Merapi, en Indonésie, en essayant de comprendre les gens qui vivent, ferme - et y mourir.

Kate Donovan y Suharyanto Aris ha estado viviendo en el monte. Merapi, Indonesia, tratando de entender a las personas que viven, la granja - y morir allí.

Climbing towards the growing summit dome of Mt. Merapi one cannot help but think 'I am going to die' - and then 'I am so stupid'. Anyone who has studied past eruptions of Merapi (Central Java, Indonesia) should surely know better. Every two or three years the dome collapses - sending pyroclastic flows down its slopes. Less frequently, larger explosive eruptions threaten over one million people living on the fertile but deadly flanks of this volcano.

Despite the danger, in late 2007, just one year after a dome collapse eruption, cultural expert Aris Suharyanto, local villager Riyanto and I - a social volcanologist - climbed to the summit. In the dark, among house-sized boulders of andesitic rock and against the backdrop of growling rock falls, I realised that the villagers with whom we were living were correct. This volcano is alive. No one believed this more strongly than Mbah Maridjan, Merapi's "spiritual caretaker", who, when asked about the dangers, said: "The creatures will protect us".

Tragically, in October 2010, burning pyroclastic flows expelled during the largest eruption in living memory killed Mbah Maridjan - along with over 250 others. Despite efforts to evacuate this elderly and humble man, he refused to leave until he had performed sholat maghrib (Islamic sunset prayers) because he felt it was his duty to stay and appease the unseen creatures of the mountain and fulfil his Islamic duties. He did so. His body was found still in a position of prayer.

Many residents living on Merapi have a spiritual relationship with the volcano that appears to have influenced their reactions during its frequent episodes of unrest. The local blend of Javanese and animistic beliefs have been shaped by years of eruption experiences, producing a distinctive culture of hazard – or, as others describe it, a "disaster subculture". This is not unique to Mt. Merapi. Examples can be found all over the globe.

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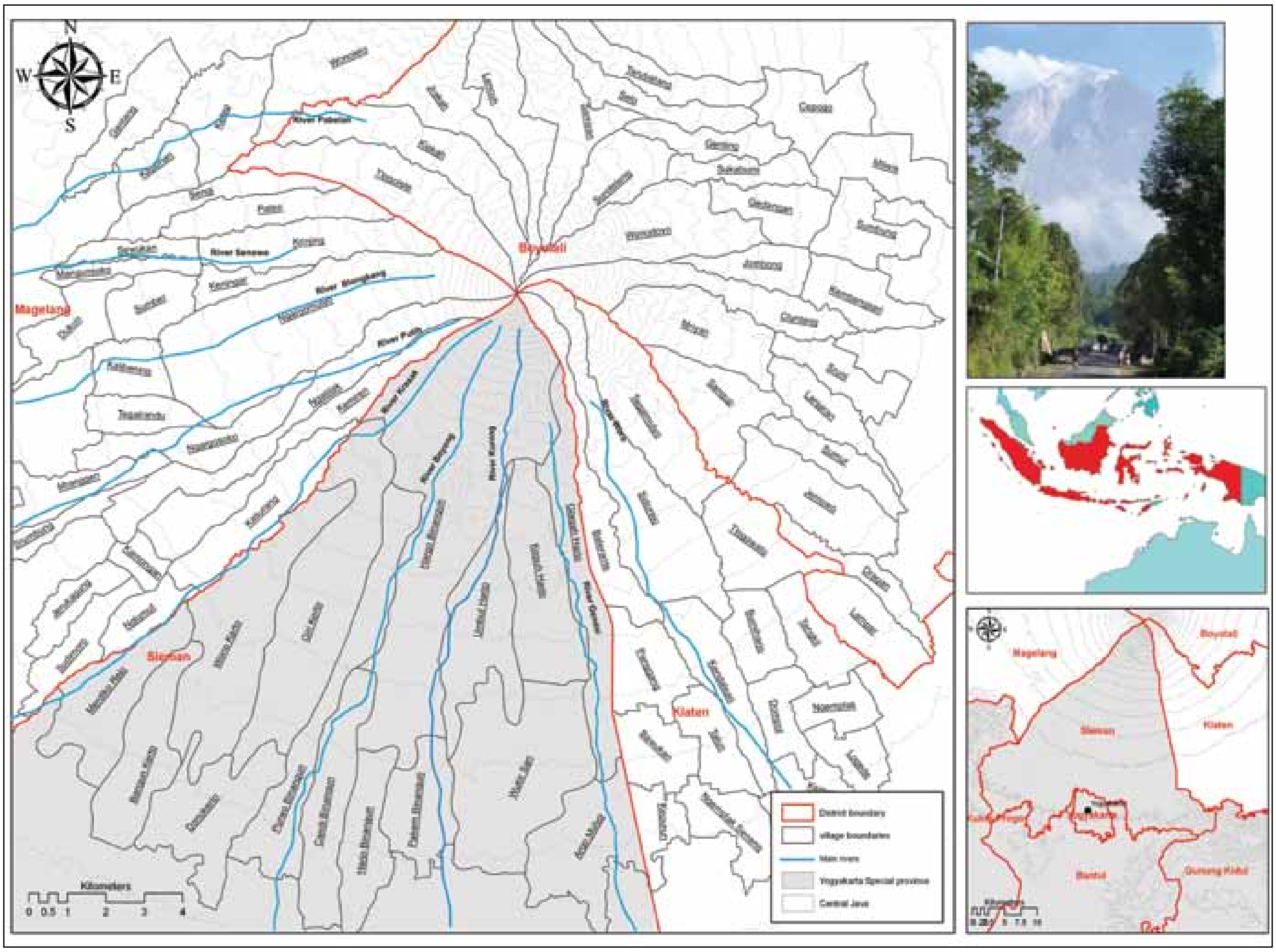
Alive

At Vesuvius and Etna (Italy), Christian religious ceremonies incorporating saintly relics have been held in an attempt to stop flows of lava (Chester et al., 2008). Such folk traditions need not always be dangerous. During the 2004 Indian Ocean Tsunami, 78,000 residents of Simeulue Island (150 km off the west coast of Sumatra, Indonesia) self-evacuated (McAdoo et al., 2006)), saved by a traditional lullaby whose lyric recalled the warning signs and advised running to high ground. Around Mt. Pinatubo (Philippines) despite no official record of pre-1991 eruptions, historical eruptions had been memorialized within the legends of the Aytas people, warning of the potential for large events (Rodolfo and Umbal, 2008). These examples suggest that while a local subculture can place communities at increased risk, as people attempt to "prevent" the hazard, it can, conversely, form the basis of local resilience.

"Those who ran down from the village to a place of safety told of the suicide procession. There was hardly a survivor who didn't have a relative or friend walking out to welcome death and honour the god. They had seen them go, accompanied by their music." (Mt Agung, 1963, described by Anna Mathews in *The Night of Purnama*).

In 1963, hundreds of people were killed as they processed towards Mt. Agung (Bali, Indonesia) as it erupted. Many bodies were later found still clutching traditional gamelan instruments. Mt. Agung had not erupted for 500 years; locals interpreted the eruption as representing gods coming down from the mountain and decided to welcome them at their many temples. In 2006, media reports suggested that residents living on Mt. Merapi were refusing to evacuate. Perhaps the tragedy of Agung was about to repeat itself on Merapi.

The man at the heart of these news stories was Mbah Maridjan. He had been appointed by the Sultan of Yogyakarta (a large city just 30 km south of the volcano) to hold ceremonies for the creatures that apparently lived at the summit. He was refusing to leave his home, and by doing



so was apparently inspiring others to do likewise. This may not have been the entire story, however. Were these people really willing to face a horrible death for the sake of their traditional beliefs alone?

To try to answer this question volcanologists and geologists need to immerse themselves in the everyday lives of communities at risk, and employ the techniques of social science. This hybrid subject could be referred to as social volcanology (Donovan, 2010) using methods of social research to explore the local perception of volcanic hazards.

Diversity

Mbah Maridjan's reaction to official evacuation policy and his trust in his traditional beliefs demonstrated the Indonesian's cultural belief in the connection between nature and human life. Ancient beliefs remain strong in Indonesia. Natural disasters are often interpreted as punishment for political corruption, or perceived lack of respect towards traditional customs in the wake of modern ideas. Mt. Merapi's eruptions have not only created a subculture specific to its immediate slopes. They play an important role in Javanese culture as a whole.

Indonesia is one of the most geologically active and culturally diverse countries in the world. At the heart of this archipelago of more than 17,500 islands lies Java, the country's cultural and political hub and home to over 40 active volcanoes and 130 million people. Mt. Merapi, a stratovolcano considered by some to be in a continuous state of eruption due to its constant dome growth activity, sits at its heart. Its cone looms over two large cities - Yogyakarta city (pop. 400,000) and Surakarta (Solo) city to the east (pop. 600,000 – see map). In the last 200 years this volcano has shown two styles of eruptive activity. In the 19th Century it produced relatively large explosive eruptions, while in the 20th, viscous lava domes have cyclically grown and collapsed. The most recent eruption (October, November 2010) saw an increase in explosive behaviour and confirmed that Merapi's activity is now primarily directed towards its southern flanks.

Disaster subculture

From 26 October through to mid-November 2010, Mt. Merapi expelled large pyroclastic flows, destroying villages on these southern flanks. One of the many settlements destroyed was Pelemsari, home of Mbah Maridjan, located just two kilometres from the summit between two main drainage systems: the Rivers Gendol and Kuning.

Among dense undergrowth, this scattering of traditional Javanese households eked a living, selling milk and livestock. The people owned only small plots of land that provided some food to feed their families, while grass for cattle had to be laboriously collected from elsewhere on the volcano's slopes.

Despite this humble, quiet day-to-day existence, once a year Pelemsari played host to the Labuhan ceremony, the largest and most important traditional event in the region. Its purpose was to appease the creatures that, according to local belief, lived at the summit. Lasting over two days, it brought participants from across Indonesia to the tiny settlement, eager to receive a blessing.

In the early morning, Mbah Maridjan would lead a silent procession consisting of staff from the Kraton (the palace of the Sultan of Yogyakarta), villagers and pilgrims to a sacred place of worship one kilometre above the highest house on the volcano's southern side, set not within dense forest, but surrounded by the grey scree that caps the summit. Through the swirling mist, one could hear the gemlugur (rockfalls); and as the chanting began, Pak Pujo (Mbah Maridjan's aide) lifted cloth and rice above his head as an offering to the Makhluk halus alus, or unseen creatures as a sense of anticipation grew within the kneeling crowd. Once the offering was made, the crowd surged forward, each person trying to get their own piece of the blessed food. Later, back in the village, the story of the Labuhan would be told through a traditional and elaborate dance.

This begins with Sultan Panembahan Senopati, being presented with Endog Jagad, or "Egg of the World", by a mysterious stranger. The Sultan is asked to eat the egg; but in order to make sure it was not poisoned, he orders both his loyal assistant and his gardener to try first. Immediately they turn into Buto - giants or creatures. Being fearful of these, the Sultan orders them to live at Mt. Merapi, promising to provide them with food and clothing every year in the form of Labuhan. With the completion of the ceremony, the creatures are appeased and will protect the village from eruption. However, frequent eruptions remind the villagers of what might happen if the creatures are "unhappy".

Modern myth

In 1994 a dome collapse sent pyroclastic flows towards a settlement called Turgo. Tragically, at this time Turgo was hosting a wedding ceremony and 64 people were killed. Mt. Merapi residents believe that the wedding party died because they had disobeyed instructions given to them by the creature of Turgo. Pak Karyo, a resident of Pelemsari, explains:

"In 1994 the farmers in the village of Turgo were given permission to live in Tugro by the creature, with one request: if you plan a ceremony or wedding do not use the days Jumat Kilwon and Selasa Kilwon [specific days in the Javanese calendar]. The victims of the 1994 eruption were attending a wedding on Selasa Kilwon."

The area in Turgo that was destroyed was abandoned. The house holding the wedding is now a ruin. Remnants of the nuptials were never removed, and the area is now avoided as if cursed. Turgo is now a reclusive settlement - reflecting the stigma of losing so many of its community, and by the conviction that they brought it on themselves.

This and other modern myths, well known among local people, suggest three things. First, by being able to place blame elsewhere, the local community is able to better cope psychologically with the dangers it faces. Second, the stories also suggest that unaffected populations perceive themselves as less vulnerable and more skilful. This complacency renders them less likely to prepare for a future eruption, ironically making themselves more vulnerable. Third, if these stories are entirely believed then the only preparation deemed necessary might be to hold ceremonies to appease the creatures.

As more people fall victim to Mt. Merapi, more myths are created. For example, during the 2006 eruption two local people were killed in a bunker near Pelemsari. Yadi, from Batur (five kilometres south of Pelemsari) explained:

"The people who died...were wrong to be in the bunker because they knew it was dangerous. The creature wanted them"

"Our village is safe"

With so many killed last year, including Mbah Maridjan, will similar myths arise, as residents return to their stricken settlements? The answer may relate to the widespread perception that 'our village is safe'

This idea comes not only from a belief in the supernatural creatures' ability to protect certain dutiful settlements but also from previous eruption experience. On the northern saddle between Mt. Merapi and Mt. Merbabu (a volcano immediately north of Merapi) communities clinging to the unstable slopes have not been directly affected by an eruption in living memory. Farmers here find it unimaginable that Mt Merapi could erupt in their direction - and therefore have no plans to evacuate. Harno, a resident of Bulu Kidul on the north east of the volcano, says:

"It is impossible for Merapi to spit here, this is the back bone. We have never evacuated from here. It is impossible..."

As Harno implies, the volcano is thought in this region to be a giant sitting with its back to the northern villages. The erupting volcano is thought to be vomiting; and because vomit comes only from the mouth, the belief is that Mt. Merapi too will only spew southwards. As Ismail, from Selo (the largest settlement on Mt. Merapi's southern flank) says:

"If you climb Merapi from the south the Sultan says that it is dangerous and impolite because you are climbing up the face of Merapi"

With such a strong conviction that their villages are safe, many locals on Mt. Merapi do not believe that evacuation is necessary, especially when this means abandoning their livestock and potentially losing all they have. For these extremely poor communities their livestock are their livelihoods, savings and future. As Narti from Pelemsari explains:

"If I stayed in the evacuation place I get food but my cow does not"

These people have to balance the risk

between definitely losing their income if their livestock starve or possibly losing everything in an eruption. In 2006, many villagers were unwilling to accept the loss of their livestock and continued to care for them throughout the crisis. This meant that communities at risk only evacuated part time, returning home during daylight hours. Similarly, in the initial stages of the 2010 eruption, the local population tried to return to their homes. Sadly this risk became too great. Pelemsari was one of the first settlements to be destroyed as pyroclastic flows thundered down the once-lush slopes.

Future

Living within the community on Mt. Merapi, one soon begins to appreciate the people's daily struggle to survive, which outweighs the less frequent risks emanating from the volcano. As the 2010 eruption demonstrated, these people are extremely vulnerable, and their vulnerability is influenced by many variables as traditional beliefs become intertwined with social, economic and political influences, creating complex scenarios at times of elevated risk.

To understand the elements of their vulnerability, including cultural vulnerability, and so improve volcanic risk reduction, a new breed of interdisciplinary science is required. The integration of social science methods into volcanology produces a new area of study, called "social volcanology". By exploring both the people and the hazard together, we gain an holistic picture. Using an innovative and unrestricted spectrum of methods allows hazard experts to work with communities, and develop risk reduction strategies that are acceptable to them. The future of social volcanology relies on identifying and monitoring high-hazard regions, and will only be effective if used in collaboration with physical volcanology to produce an holistic view of risk. Collaboration and mutual respect are vital to the practical application of such research.

As for those who must live alongside Mt. Merapi on a daily basis, thousands are currently doing so in temporary shelters. As they recover, they will continue to balance the benefits of living in this fertile region against the dangers of an eruption. In the south, recent experience has changed people's attitudes towards the volcano and many are trying to find other places to live. The head of Pelemsari hamlet says he is too heartbroken to return and is looking for another place to live. But those who do return may continue to use their beliefs as coping mechanisms.

As the memory of this recent eruption fades into mythology, only one thing remains certain. Mt. Merapi will erupt again.

Acknowledgements

This research was funded through an ESRC/NERC Interdisciplinary Studentship and was successful due to the support and guidance from colleagues within the School of Geography, Earth and Environmental Sciences at the University of Plymouth, in particular Professor Iain Stewart and Professor James Sidaway. Photographs by the authors.

Reprinted from Geoscientist 21.1 February 2011

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The red mud catastrophe in Kolontár, Hungary: applying geology

by Gyozo Jordan[1], Ubul Fügedi, András Bartha, József Vatai, György Tóth, Judit Murati, Ildikó Szentpéteri, Péter Konya, Imre Gaburi, Daniella Tolmács and Tamás Müller

Red mud spilled through the failed dam of the Ajka alumina plant depository on October 4, 2010, resulting in loss of lives and contamination of agricultural land. Immediate scientific efforts at the site included geological and geochemical surveys by the Geological Institute of Hungary (MAFI). The early phase included geochemical sampling. Laboratory leaching tests were accomplished to identify the mobility of toxic elements in the waste material. In the closing phase, geologists are active in long-term human health and ecosystem risk assessment. Geologists have been playing a documented role in various national and international expert boards providing a scientific basis for decision making.

Les boues rouges qui se sont répandues, le 04 octobre 2010, après rupture du barrage retenant les déchets d'alumine de l'usine d'Ajka ont provoqué des décès et la contamination de terres agricoles. Les moyens scientifiques mis en œuvre immédiatement sur le site incluaient des études géologiques et géochimiques menées par l'Institut Géologique de Hongrie (MAFI). En premier, a eu lieu un échantillonnage géochimique. Des tests de lessivage en laboratoire furent ensuite effectués pour identifier la mobilité des éléments toxiques au sein des déchets boueux. En dernier ressort, les géologues ont joué un rôle actif dans l'évaluation des risques touchant la santé humaine à long terme et les écosystèmes. Les géologues ont donné un avis documenté lors de réunions d'experts nationaux ou internationaux, fournissant une base scientifique à la prise de décisions.

El vertido de lodos rojos por la rotura de la presa de la balsa de lodos de la planta de alúmina de Ajka el 4 de octubre de 2010, produjo la pérdida de vidas humanas y la contaminación de terrenos agrícolas. Los trabajos científicos realizados en la zona inmediatamente, incluyeron investigaciones geológicas y geoquímicas realizadas por el Servicio Geológico de Hungría (MAFI). La primera fase consistió en un muestreo geoquímico. Se realizaron ensayos de laboratorio de lixiviado para identificar la movilidad de los elementos tóxicos en el residuo. En la fase de cierre los geólogos siguen involucrados en la evaluación de los riesgos para las personas y el medioambiente a largo plazo. Los geólogos han jugado un papel relevante en diferentes comités de expertos nacionales e internacionales que han aportado los fundamentos científicos para la toma de decisiones.

On October 4, 2010, red mud residue from Bauxite processing spilled through a ca. 40 m wide failure of the dam wall (60 m wide at the basis and 25 m in height) in the active Basin No. 10 of the tailings pond of the alumina plant depository at Ajka, Veszprém County. The plant lies 120 km south-west of Budapest, Hungary. An estimated 0.9–1 million cubic meters of alkaline (pH >13) caustic red mud and NaOH suspension was released in a catastrophic flood that ran along the nearby Torna Creek hitting the villages of Kolontár, Devecser and Somlóvásárhely (Figs 1 and 2). The flood reached the downstream River Marcal within a few hours posing the possible contamination of the River Danube. The flood resulted in the loss of ten lives and almost 150 injuries and damage to properties, destruction of railways, bridges and other structures. Fish kills were observed by the Hungarian authorities in the Torna Creek, and high pH and sediment loadings propagated downstream through surface water courses. About 800 ha of agricultural land were covered by 2-25 cm of red mud material. Earlier geological mapping by MAFI confirmed that loose and variable floodplain sediments of the Torna Creek (clay, silt and sand layers, organic-rich lenses) characterize the area at the tailings dam.

First response remediation included the addition of gypsum ($CaSO_4.2H_2O$) and acetic acid (CH3COOH) to stream water, in an attempt to neutralize the alkaline surge. Long-term response activities included the development of an emergency dam system around the failed pond and protective dams upstream of the village of Kolontár, a switch from wet to dry waste deposition technology and the construction of a temporary depository for collected spill material.

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Bauxite and red mud reviewed

Bauxite is the prime aluminium ore consisting of aluminium, iron and titanium oxides and hydroxides (>50%), in addition to quartz, clays and some carbonates. There are two main types of bauxite. Karst bauxite forms on carbonate rocks by lateritic weathering and accumulation or by the autochton weathering of intercalated clay particles. Lateritic bauxites are found mostly in the tropics in the form of residue of the lateritization of various silicate rocks. Besides differences in the lithological settings, the major difference is in the mineralogical composition of these bauxites. Lateritic bauxite is predominantly composed of gibbsite, whereas karst bauxite has gibbsite, boehmite and diaspore as Al-minerals. Karst bauxites often contain carbonate minerals as well (Bárdossy, 1977) (Thiry & Simon Coincon, 1999). The world annual bauxite production was $211,000*10^3$ metric dry tons in 2010 (source: USGS Mineral Commodity Summaries - 2011) (Fig. 3 and Table 1).

Red mud is the waste of alumina production, a by-product of the Bayer process used for refining bauxite to alumina. It is characterized by very high alkalinity

Figure 1. The extent of red mud flooded area at the Ajka bauxite processing plant, Hungary (Image source: ALI/EO-1/NASA)

Figure 2. Impact of the red mud spill (Upper left: the breached dam as the contamination source. Upper right: the Torna Creek and its floodplain as the contamination pathway. Lower left: flooded village downstream as the human receptor. Lower right: flooded agricultural land as ecosystem receptor)

Component	Bauxite	Red mud	Red mud IAI values*
Al_2O_3	47,6%	16,9%	10-20%
SiO_2	9,7%	10,1%	3-50%
Fe_2O_3	21,8%	39,7%	30-60%
TiO_2	2,7%	8,5%	traces-10 (25)%
Na_2O	0,2%	4,8%	2-10%
CaO	0,7%	8,9%	2-8%

*Table 1. Average chemical composition of bauxite (n=651) and red mud (n=125) based on a worldwide review. Last column shows global red mud composition as minimum and maximum values according to the International Aluminium Institute (marked with *)*

(pH>13) and its main constituents are oxides of iron, aluminium, titanium, silicon, calcium and sodium. Red mud is also used as a secondary raw material for important elements such as Ti, Zr, Ga, V and REE (Sayan & Bayramoglu, 2000). The chemical composition of red mud depends on the geochemistry of the source bauxite and the applied Bayer process technology. In the Bayer process, after crushing and milling, the bauxite ore is digested by a hot solution of NaOH at 145-250 °C at a pressure up to about 35 atmospheres so that the majority of aluminium-containing species dissolve in the hydroxide solution and form sodium aluminate ($NaAl(OH)_4$). Other components such as various metal oxides are separated from the solution by filtration. The mixture of the solid impurities filtered out is the thixotropic red mud. Aluminium-hydroxide is then precipitated from the thus cleaned solution by cooling and seeding with gibbsite. The washed precipitate is calcined at up to 1,200 °C to produce anhydrous aluminium (Al_2O_3). The by-products of these procedures are also disposed together with the red mud. Alumina is an important marketed industrial product itself, but it can be smelted in the Hall-Heroult process in order to produce aluminium metal (Hind *et al*., 1999). Although the basic technological steps of various Bayer plants are the same, small alterations (e.g. different temperatures and pressures applied) may affect the chemical composition of the red mud (Power *et al*., 2011). The annual red mud production was 120 Mt in 2007 (source: Bauxite Residue Issues: I. Current management, disposal and storage practices).

Significant ecological and environmental effects are caused by toxic trace elements (As, Cd, Pb, etc.), radioactivity and the alkalinity (NaOH) of red mud. Due to the environmental hazard of the waste, the storage of red mud requires special care. Prior to the 1970s there were two main disposal methods in use, marine discharge (residue slurry disposed directly to the sea) and lagooning (residue slurry pumped into land-based ponds). Dry stacking and dry cake disposal methods are also in use, and a great number of refineries have changed from wet to dry disposal in recent decades (Power *et al*., 2011).

Geological survey response to the catastrophe: a concerted action

The activities of the Geological Institute of Hungary (MAFI), a government institute acting as the leading geological research competence centre in the country, can be divided into three phases:

Fast Response Phase (first few days): The objective in this phase was to provide reliable and independent scientifically-based results for the understanding of the situation and for the orientation of fast response catastrophe mitigation actions. Geologist activities: immediate site visit, expert site report development, early red mud sampling and laboratory analyses; geochemical investigation to support airborne hyperspectral survey; consultation in national expert boards, reports to government

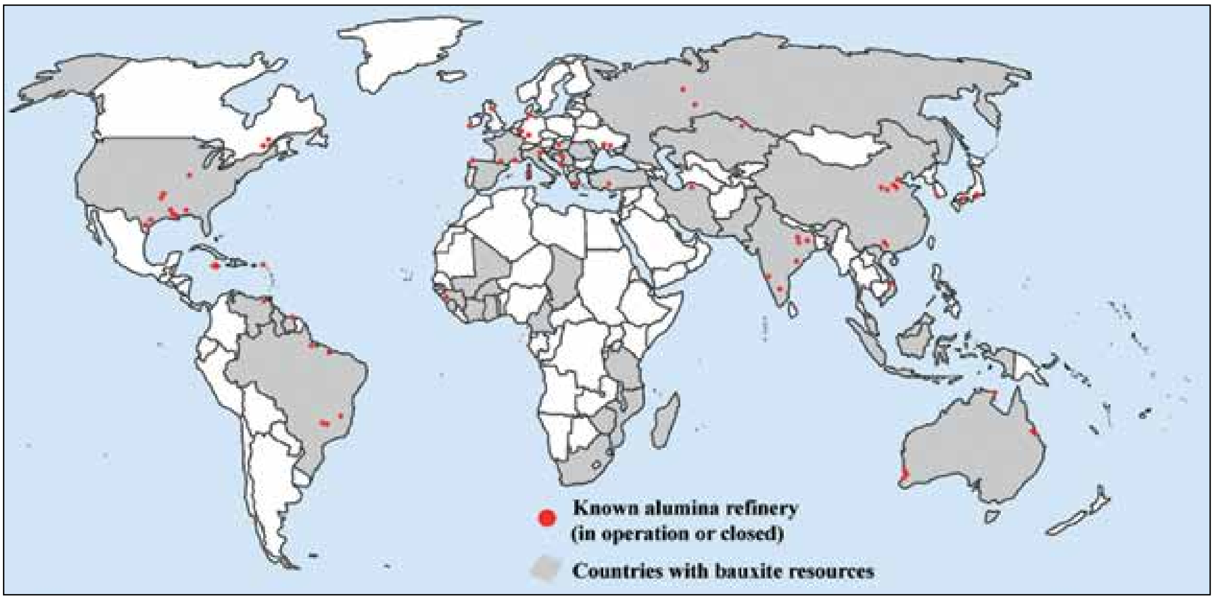

Figure 3. Worldwide bauxite and red mud production. Countries with bauxite resources and the distribution of alumina refineries (Source: BRaDD - Bauxite, Residue and Disposal Database: https://extranet-wf.minerals.csiro.au/BRaDD/)

authorities, and knowledge exchange with national and international experts.

Catastrophe Mitigation Phase (first few months): The objective in this phase was to carry out a detailed survey of the near and far site in order to provide information for the causes of the catastrophe and to estimate the impacts on human and ecosystem receptors for planning remediation actions. Geologist activities: detailed geochemical survey of the impacted Torna Creek catchment based on stream sediment and soil samples including radiometric measurements; hyperspectral field and laboratory measurements on geochemical survey site samples; various laboratory leaching tests for red mud toxic element mobility assessment, together with detailed particle phase studies; geochemical analysis of dam material; detailed geological mapping of near-site area for the development of the temporary depository of red mud collected from the spilled areas.

Long-Term Remediation and Planning Phase (from the first year onwards): The objective in this phase is to develop models and improve scientific knowledge to support remediation actions and planning to prevent further catastrophic events at the site and elsewhere. Geologist activities: scientific research with national and international partners on human health impact tests, long-term geochemical record in floodplain sediments, airborne dust survey, urban geochemical survey and bauxite and red mud composition world-wide review; improvement of catastrophe response capacities.

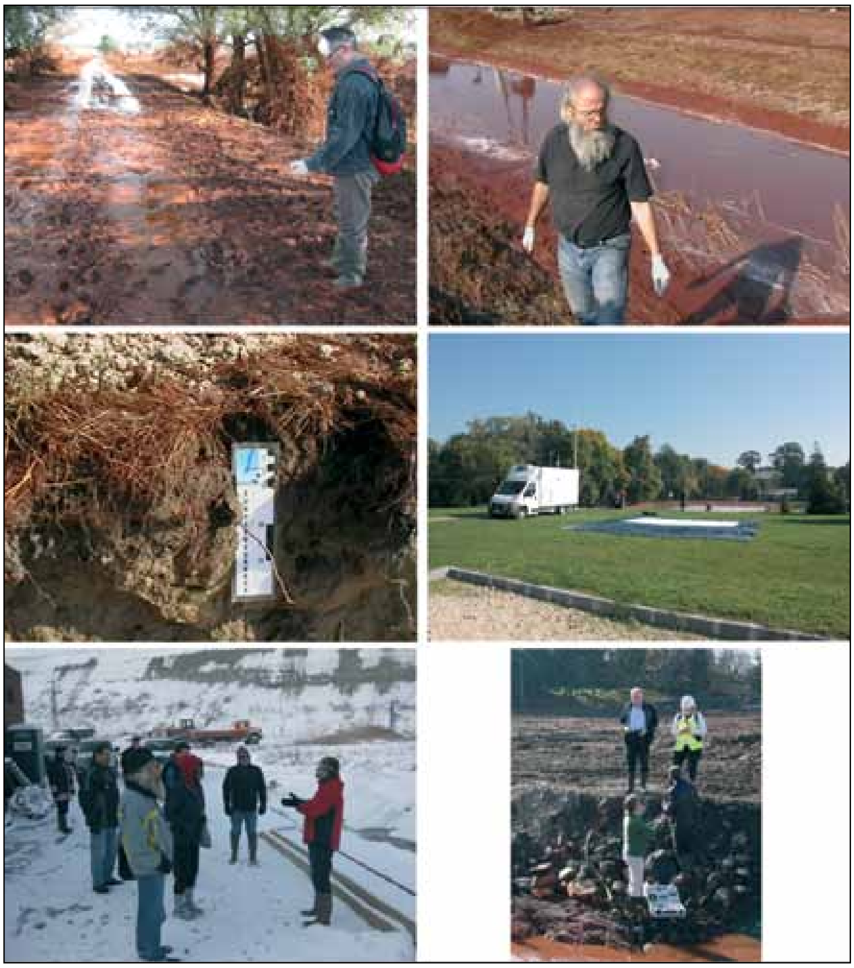

Figure 4. Geologists in early response action (Upper left: MAFI personnel among the first in the site. Upper right: geochemist carrying out stream sediment sampling according to international EuroGeoSurveys sampling protocol. Lower left: airborne hyperspectral measurement ground truthing with homogenic reflectance surface. Geochemical sampling ongoing in the background. Lower right and left: joint field work with American (USGS) and British (BGS and Newcastle University) scientists)

MAFI geological personnel were among the first in the field for a reported site visit and for the collection of red mud spill samples on October 7, 2010. The samples were analysed in the accredited MAFI Laboratory and published within a few days. These results still serve as one of the first and most reliable datasets from the site. On 10 October, a national research consortium consisting of the Károly Robert College, the University of West Hungary, the Agricultural Technology Research Institute (MGI), and the Geological Institute of Hungary (MAFI) was in the field and carried out a detailed airborne hyperspectral and LIDAR survey. MAFI geochemists were called to lead and carry out a ground survey and sampling of red mud and soils, and to provide fast and reliable geochemical laboratory analyses of the samples. All geochemical sampling followed the EuroGeoSurveys Geochemistry Expert Group Sampling Protocol developed for the European Geochemical Atlas (Fig. 4). The consortium was extended later with the Chemical Research Center (MTA KK AKI) and the Research Institute for Soil Science and Agricultural Chemistry (MTA TAKI) of the Hungarian Academy of Sciences.

In the second phase, a detailed geochemical survey of the impacted Torna Creek catchment was carried out and 14 stream sediment, 24 soil and 19 red mud samples were collected according to the EuroGeoSurveys Geochemistry Expert Group Sampling Protocol. Samples were analysed for major and trace element composition with ICP-OES and ICP-MS, grain size distribution and mineralogical composition with XRD at MAFI. Scanning electron microscopy (SEM) and microprobe (MA) analyses were carried out at the Miskolc University. All samples were analysed for mineral composition by hyperspectral tehcnology (ASD FieldSpec3) by MGI and USGS. Field and lab radiometric measurements were taken with the Lithosphere Fluid Research Lab (LRG) colleagues of Eötvös University. The objective was to carry out an impact assessment especially to identify pre-mining geochemical background levels and to define the geochemical baseline for follow-up monitoring. Geochemical analysis of dam material was also performed.

An important activity was to carry out various laboratory leaching tests for red mud toxic element mobility assessment using national and international standard methods such as leaching with deionized water, with acetic acid and ammonium acetate. Finally, detailed geological mapping of the near-site area was carried out for the temporary depository of red mud collected from the flooded areas.

In this period, partner European and overseas geological surveys provided collaborative assistance in red mud geological and geochemical surveys. Based on previous MAFI co-operation, United States Geological Surveys (USGS) colleagues paid a short visit and carried out joint field and laboratory work in December in order to apply high-tech portable XRD and Hyperspectral instruments in the Kolontár region. A joint MAFI-USGS field exercise was performed to adopt USGS Catastrophe Response procedures in Hungary. British Geological Survey (BGS) experts, together with Newcastle University researchers, joined MAFI geochemists under high-level government cooperation and a field visit and bilateral expert meetings were accomplished and reported (Reeves et al., 2010).

In the current long-term phase, various detailed research work is carried out such as human health impact tests with USGS, project development with BGS and other international partners. Chemical and mineralogical analyses of the collected 27 airborne dust samples and the 46 urban geochemical samples are under implementation. An important result is the database developed for bauxite and red mud composition based on the worldwide review of more than 600 data sources (see Table 1). Improvement of catastrophe response capacities is a priority now and a mobile GIS facility has been acquired, together with the planned portable lab. technology acquisition. MAFI geochemists are active members of the newly formed National Catastrophe Mitigation Working Groups motivated by the EU Council Conclusion (Draft Council Conclusions on Further Developing Risk Assessment for Disaster Management within the European Union). This long-term scientific research work should contribute to a better understanding of natural and technological processes in order to support efficient site remediation and prevention of further catastrophic events.

Scientific research for informed decision making

An example for ongoing scientific research at MAFI is provided by the assessment of toxic element mobility by various standard leaching tests. Total element content was defined by a mixed acid microwave unit digestion while deionized water leaching (pH=12) and acetic acid digestion (pH=3, 5, 8 and 10) was performed to indicate mobility of toxic elements in relative percent of total concentration. Among the studied elements only As, Co and Ni seems to have concentrations exceeding disposal on soil standards, according to Hungarian legislation on sewage sludge deposition on soils (50/2001[IV. 3.]Government regulation about the soil limits and sewage sludge utilization and treatment). According to Table 2, leaching by deionized water releases less than 1% of total concentration, apart from Mo (53.7%), As (2.48%) and Cu (1.78%). Current investigations study the speciation of the elements by sequential

Total content (mixed acids in microwave unit)	Min	Average	Max	Tolerated limit in soil	Tolerated limit in sewage sludge in case of agricultural utilization	Leaching Test with deionized water
unit	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	Rel. %
As	79.4	93.5	133	15	75	2.48
Cd	0.57	0.88	1.08	1	10	0.627
Co	40.9	60.5	77.3	30	50	0.036
Cr	357	499	626	75	1000	0.024
Cu	37.2	49.4	58.4	75	1000	1.78
Hg	0.74	1.96	3.59	0.5	10	–
Mo	5.16	10.3	18.7	7	20	53.7
Ni	134	218	248	40	200	0.026
Pb	85.0	119	149	100	750	0.025
Se	0.1	0.1	0.1	1	100	–
Zn	84.2	107	122	200	2500	0.008
			exceeding soil limit			
			exceeding soil and sludge limits			

Table 2. The average total composition of the Ajka red mud spill (n=10) for toxic elements (Concentrations are compared to the Hungarian 50/2001. (IV. 3.) Government Regulation on the Soil Limits and Sewage Sludge Utilization and Treatment. Standard deionized water leaching test results are shown in the last column to indicate mobility of toxic elements (in relative percent of total concentration))

extraction procedures, in addition to detailed XRD and SEM, and Microprobe analyses.

As in the red mud analyses, dam material was also sampled and analysed for chemical and mineralogical composition, with IPC-OES and XRD, respectively, in order to study possible mineralogical transitions. Chemical analysis shows that there is an excessive Ca content in the dam material due to the fact that the coal burnt in the nearby power plant producing the fly ash used for dam construction is deposited in a carbonate host rock (Tables 3&4).

Sample	Material	SiO_2	TiO_2	Al_2O_3	Fe_2O_3	FeO	MnO	CaO	MgO	Na_2O	K_2O	^-H_2O	^+H_2O	CO_2	SO_3
1	flyash	17.3	0.40	8.49	2.55	0.80	0.025	29.8	2.23	0.14	0.26	9.57	11.2	11.0	5.94
2	dam, sandy	73.2	0.62	9.61	1.94	1.52	0.08	1.1	0.89	1.25	1.24	1.96	6.2	0.26	0.15
20	dam, slag-flyash	10.8	0.30	6.59	2.83	0.48	0.027	34.0	2.73	0.38	0.44	13.5	10.8	9.43	7.64
2	eroded dam material	15.3	0.39	9.67	3.02	0.96	0.028	33.8	2.3	0.59	0.48	3.35	7.2	21.4	1.35

Table 3. The average composition of the Ajka dam material composed of fly ash and slag

According to the results, the main component of dam minerals is ettringite: $Ca_6Al_2[(OH)_{12}(SO_4)_3] * 26\ H_2O$, where Al is mostly replaced by Fe3+. Ettringite, for example, can react with atmospheric CO_2 and hydro-grossular and calcite forms: $Ca_6Al_2[(OH)_{12}(SO_4)_3] + 3\ CO_2 = Ca_3Al_2(OH)_{12} + 3CaSO_4 + 3\ SO_3$, an example for chemical erosion.

Material	illite+ chlorite ++ montmorillonite+	quartz	alkali-feldspar	plagioclase	wollastonite + carnite	ettringite	calcite	vaterite	portlandite Ca (OH)2	ackermanite (Mg+)	hidrocalcite (Mg+)	gehlenite (Al+)	hydro-grossular (Al+)	maghemite	gypsum	amorphous	number of samples
fly ash		12				26	20	6	3			9		3	3	12	1
dam, sandy	25	56	4	4			1					0		0		8	2
dam, slag-fly ash		6			4	40	17	8	10	2	2	5	0	1	3	11	18
eroded dam material		12					46	3			6	9	8	6		10	2

Table 4. The average mineralogical composition (%) of the Ajka dam material made of fly ash and slag

Lessons learnt

Firstly, it has been shown that geological knowledge played an important role in the contamination risk assessment of spilled red mud. Geology was instrumental in the hazard assessment of the contamination source (dam and red mud material), in the analysis of contamination pathways (stream sediment, airborne dust) and in the impact assessment at the receptors (stream sediment and floodplain soils) investigation. Second, it is obvious from the one-year catastrophe-related experience that it would have been much more efficient to invite more geological knowledge in the planning phase of waste storage facility development and planning for accident prevention and control. It is also obvious that geochemisty had the fundamental role in risk assessment and served as the core knowledge-base for Earth Science investigations. Geologists have been playing a recognized and documented role in various national and international expert boards providing a scientific basis for decision making.

How could MAFI geologists be so responsive and integrated in their reaction under extreme conditions? Firstly, in several large contracted projects the survey personnel have been trained to act under pressure with precision and reliability. Secondly, the Geochemistry Programme has long been carrying out scientific research for decision support, including risk assessment in mining areas (Jordan & D'Alessandro 2004; Jordan, 2009). Thus, an overall concept and daily practice had been available prior to the accident and the emerging demand did not pose an unexpected challenge. Finally, the Geochemistry Programme had been involved in international research cooperation such as the EuroGeoSurveys Geochemical Atlas of Europe Programme that provides the standards and skills for handling an industrial contamination accident of international significance.

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Natural hazards in the Spanish Security Strategy

by José Luis González García[1]

The Spanish government has adopted a strategy that analyzes the interests, risks and threats to Spain from a global perspective. Natural hazards and environmental challenges are some of the issues addressed in that strategy.

Le gouvernement espagnol a adopté une stratégie basée sur l'analyse des intérêts, des risques et des menaces touchant l'Espagne, dans une perspective globale. Les risques naturels et les défis environnementaux représentent quelques unes des questions posées dans le cadre de cette stratégie.

El gobierno español ha adoptado una estrategia que analiza los intereses, riesgos y amenazas a España desde una perspectiva global. Los riesgos naturales y los retos ambientales son algunos de los temas que se abordan en dicha estrategia.

The Spanish government has adopted a National Security Strategy (NSS), subtitled "Everyone's responsibility". While other European countries such as the United Kingdom, Netherlands or France have already produced similar documents, the NSS is the first security strategy for Spain. Javier Solana, former EU High Representative for the Common Foreign and Security Policy, was in charge of the development of the document, assisted by a working group of experts in different aspects of security.

The objective of the NSS is to guarantee the security of the State and its citizens, based on Spain's national interests, the study of the threats and risks that affect Spain and by highlighting a number of priority areas of response. The NSS is developed within a national, European and global dimension. Under the concept of a comprehensive approach, new threats in the fields of environment, economy, energy or cyberspace are included in the strategy. Natural hazards and environmental challenges are some of the issues addressed in the strategy.

Risk multipliers

Drawbacks of globalization, demographic imbalances, poverty and challenges of climate change are all transnational drivers that can multiply the effects of natural hazards.

Globalization has improved the quality of our lives and has put the world within our reach. But the high mobility and the many interconnections in the globalized world, have the result that events in any part of the world might have an impact anywhere on the planet.

Another risk multiplier is population growth. For the first time in history most people live in cities: more than half of the current world population, compared to only ten per cent a century ago. In certain areas of the world megacities are emerging. These cities have many opportunities but can also be places where risks can be exacerbated, especially those associated with natural hazards.

Climate change is also one of the most important multipliers of risks covered by the NSS. The variability of global climate in recent years is the result of a very real process; its impact is already being felt, and it requires immediate responses. It also poses medium and long-term challenges of particular significance to global society. Conflicts will arise over scarce resources, the number of climate migrants will skyrocket and poverty will be intensified in many societies, increasing the weakness of some States as well as the threats to global security.

Climate change affects all of us, though its effects vary. Spain faces risks inherent to the Mediterranean habitat, such as floods, droughts, forest fires or desertification. Our proximity to Africa, one of the regions most exposed to these phenomena, may exacerbate the incidence of health problems coming from that continent.

Climate change is a worldwide phenomenon that ought to be addressed by coordination actions of the different actors involved. Solidarity is needed and we must all assume our part of the responsibility. In recent years, Spain has made efforts to mitigate the effects, decrease the danger and limit the impact of climate change. Legal and planning instruments have been developed and have actively participated in multilateral forums, particularly within the European Union and United Nations.

The new dimension of natural hazards

In today's world, classic threats such as natural hazards coexist with new ones and others still unknown. The complex nature of today's challenges ads to the difficulty of guaranteeing the degree of security demanded by 21st century societies. In a future that will probably resemble the past less than we can imagine, unexpected events will continue to define our security context.

Now, the security of critical infrastructure and services as well as the economic system can be seriously affected by natural hazards. But the main concern is not so much specific hazards as undetermined consequences. Therefore, today, natural disasters are leading to multidimensional crises such as the recent tsunami and nuclear accident in Japan or Iceland`s volcanic eruption in the last year.

The Icelandic volcanic eruption in April 2010 disrupted the airspace of virtually the entire European continent. Volcanic ash several kilometers high (Fig. 1) forced some major airports to close. Up to 20,000 flights a day were cancelled and the airspace chaos spread to other continents. This example illustrates how the growing complexity of critical infrastructure and services introduces new greater vulnerability factors in our lifestyles. Therefore, public systems with greater resilience are needed to address these challenges.

Spain is no stranger to natural hazards. The most widespread and almost endemic ones are floods and forest fires. Earthquakes and volcanic eruptions are also possible and could cause important

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Figure 1. Ash plume from Eyjafjallajökull volcano over the North Atlantic (NASA / MODIS Rapid Response team)

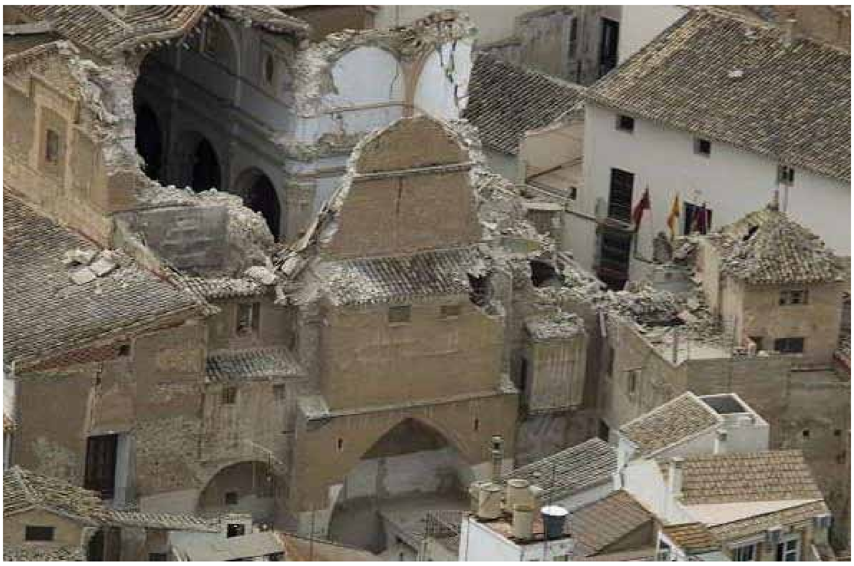

Figure 2. Effects of the 5.1 magnitude Richter earthquake in Lorca (Spain)

human and material losses, as in the recent 5.1 earthquake on the Richter scale in the city of Lorca (Fig. 2).

In the environmental security field the strategy considers that water scarcity can generate or aggravate tensions of conflicts in many areas of the world. Ensuring quantity and quality of water supply to the growing world populations is one of the greatest challenges of the 21st century, one with serious implications for security. Due to its geographical location and climate, Spain is a country historically affected by water problems, with cyclical droughts and flash floods.

To meet this challenge, Spain already has a large storage and water flow control capacity through dams. New national and European regulations have been proposed to consolidate a model of integrated water management based on natural hydrographical basins. Water management has been improved through various plans and actions for risk areas, such as dam and reservoir security, flooding, droughts, water quality and especially prevention of contamination.

Security of water supply involves greater efforts for efficient and sustainable use, measures for management of demand, water-saving technologies (especially in agricultural irrigation) and water treatment and re-use.

The responsibility of Spain in civilian emergencies also has a European dimension. The "solidarity clause" in the Treaty of Lisbon requires the European Union Member States to provide mutual assistance if any member is the victim of a natural or human-caused disaster or terrorist attack.

Civil protection is the area where cooperation between national, regional and local authorities and governmental institutions is most intense. The Spanish Civil Protection articulates the means to respond to natural disasters in the framework of an integrale management system.

Strategic lines of action

Spain has equipped itself with substantive preventative, natural and technological risk management instruments. The new land law makes natural hazards assessment compulsory in urban planning, in order to limit certain types of land use in potentially dangerous areas. The government has also scientific and technical bodies such as the Geological Survey of Spain (IGME), the National Geographical Institute (IGN) and the Meteorological Agency (AEMET) for support and advice on hazards prevention and mitigation. Implementation of early warning networks on natural hazards is also considered.

The NSS aims to promote a culture of prevention among citizens, establish cooperation programmes between State and regional authorities for mapping hazards and risks, and improve instruments for cooperation and coordination among the various public administration bodies dealing with environmental disasters.

In order to implement the strategy, a Spanish Security Council will be established, which will be supported by a number of inter-ministerial committees that will develop the different security dimensions (environmental, health, defence, diplomatic or economic). Cooperation with the regional government will be enhanced. A social forum of experts will also be promoted as a consultative body. The necessary legislative instruments will be updated, especially in the area of crisis management, civil protection and planning for effective response to emergencies and disasters.

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Rockfall hazard and landslide risk management:

local road network of Liguria, Italy

by Marino Trimboli[1], Sergio Restagno[1], Gaya Briano[1], Luana Isella[1] and Renato Falco[2]

In this article some case histories of the risk management of the local road network of the Liguria region are presented. The Liguria region, located in the north-western part of Italy, is characterized, throughout the territory, by mountains and high cliffs along the coast. Railways, highways and roads paths run along or under steep unstable slopes. The landslide hazard is often high and the protection of slopes is very expensive or uneconomic. The control of safe traffic conditions at the different hazardous points is frequently based on geotechnical monitoring systems with alert signals.

L'article fait état de quelques cas historiques touchant la gestion des risques concernant le réseau routier local de la région Ligure. La Ligurie, située dans la partie nord-ouest de l'Italie est caractérisée, sur l'ensemble de la région, par un relief de montagnes et aussi de hautes falaises le long de la côte. Les tracés de voies ferrées, d'autoroutes et de routes sont localisés en bordure ou en contrebas de pentes instables. Le risque d'éboulement est souvent élevé et le confortement des pentes à titre de protection est très coûteux voire économiquement pas viable. Le contrôle des conditions de sécurité du trafic sur différents secteurs critiques est fréquemment basé sur des dispositifs de contrôle géotechnique avec signaux d'alerte.

En este artículo se presentan diversos casos de gestión de riesgos en la red local de carreteras de la región de Liguria. La región de Liguria localizada en la parte noroestes de Italia se caracteriza en todo el territorio por montañas y altas colinas situadas a los largo de la costa. Los ferrocarriles, las autopistas y las carreteras discurren a lo largo o en la base de escarpadas pendientes inestables. El rieso de deslizamiento es muy a menudo muy alto y la protección de las pendientes es o muy cara o simplemente antieconómica. El control de unas condiciones seguras del tráfico en los diferentes puntos de riesgo se suele basar en sistemas de control geotécnico con sistemas de alerta.

The road and railway network of the Liguria region is characterized by a high number of geo-hazardous points with instability conditions. This report describes some examples of the management of low stability slopes; the rockfall at Cape Noli and the deep slide of the La Francesca gulf. The landslide sites described, and many others, are currently monitored by automatic geotechnical control systems.

The geomorphology of the Liguria region is typical of a mountainous territory close to the sea with high faulted cliffs and small beaches. Since the second half of the 19th century the development of the road and railway network has faced problems related to slope stability and shore protection. The significant traffic increase during the 20th century prompted the construction of new highways and the doubling of the coastal railway from Rome to Genoa and the French border with many new tunnels.

From the point of view of slope stability, widespread geological hazardous conditions affect the old road network (i.e. the historical Roman long shore road "Via Aurelia", and all the local roads from the coast to the mountains). Consequently, it is necessary to carry out maintenance work and consolidation of the slopes; nethertheless, the need to contain operating costs, forces intervention in the most dangerous situations involving the closure of the road, in an attempt to significantly

Figure 1. Location of Liguria, Italy (yellow)

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Figure 2. Rockfall accident along the Via Aurelia

Figure 3. Installation phase of Jointmeters on the slope

Figure 4. (Below, left) Alarm signal

reduce the risk conditions. In the period 2006-2011, the Road Department of the Province of Savona, for instance, has had to invest more than €5m. in extraordinary consolidation work. Given the length of the damaged roads, this cost rate is extimated at c. 500,000 €/km/year

Since 2002, the Province of Savona has carried out a study on geological hazards along different parts of the road network; the study identified several areas with slope stability problems, establishing different hazard levels and estimating priorities and intervention costs. The sum of the cost of the consolidation work and the damage related to the traffic interruption was estimated at 200,000 €/km/ year.

The typical geological hazards along the road and railway network are generally related to rockfalls, slides of cover soil and rock or Deep-seated Gravitational Slope Deformations.

The Cape Noli rockfall

The stretch of the Via Aurelia which runs through Capo Noli promontory (length 1.5 km) is characterized by mesozoic dolomitic and limestone cliffs over 100 m high. The rock fracture density and the verticality of the cliffs causes the frequent release of blocks; to avoid this danger, a wire grid coating of the slope was put in place many years ago. However, the presence of deep fractures with karst erosion causes the fall of large rocky volumes which tear the wire mesh and their short rockbolts anchorages. The recurrence period of these deep rockfalls, related to heavy rainfalls, is estimated at c. 20-30 years.

During the development of the project it was immediately clear that the cost of the consolidation of the slope would be very high, in order to emplace deep rockbolts and a new coating of the slope with high resistence wire grid. Therefore it was decided to make a detailed geological survey of the slopes localizing the most dangerous points and assessing different hazard levels.

The results of the hazard analysis are shown in Figure 5, were the intensity of colours represents an increasing probability of large and deep rockfalls.

On the basis of these results it was decided to intervene in order to retain fallen rocks under 3 m^3 along the slope; additionally, an automatic control system of fractures that can isolate greater volumes has been installed.

The system is characterized by 20 jointmeters connected to a datalogger with a GSM modem. Each jointmeter is equipped with an alarm sensor that allows the datalogger to send a warning or alert SMS to the control staff. On exceeding a limit value established for each sensor the system activates a red light that stops the traffic along the hazardous road section. The system acquires data six times a day and measures are transferred and plotted using spreadsheets.

In the late 1950s the Genoa-Rome railway track was shifted upstream and doubled. The old single track railway, built along the coast, was abandoned and no longer maintained by the Italian State Railway. Recently, the regional government has promoted a touristic re-use of the old railway route with the construction of cycle

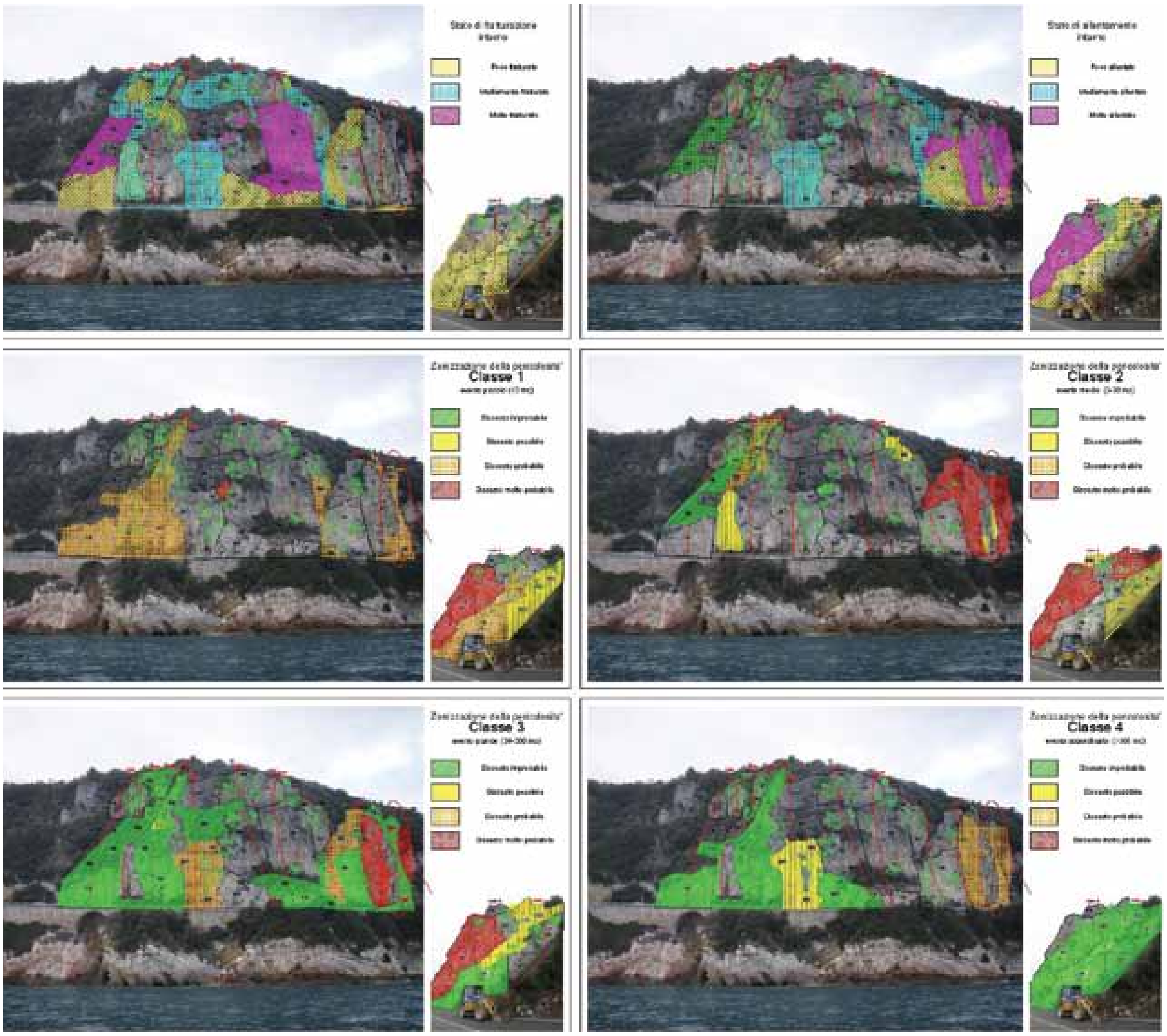

Figure 5. Hazardmap Capo Noli (Top two pictures ((yellow: slightly fractured; blue: moderately fractured; purple: very fractured). Bottom four pictures (Green: unlikely to collapse; yellow: collapse possible; dark yellow hatch: collapse probable; red: collapse very probable))

routes and walkways. In the bay of La Francesca, between Levanto and Bonassola, the old railway was built through the foot of a great slow landslide known as the Deep-seated Gravitational Slope Deformation of La Francesca.

This large ancient landslide is characterized by movements of a few centimeters per year with acceleration peaks after the heaviest rainfalls.

The rise of the groundwater level over a certain threshold causes a resumption of movements. The railway crosses the landslide in a large tunnel (Maxinara Tunnel); the massive rock blocks structure of the portal of the tunnel was built to create a contrast to the landslide. After abandoning the railway the part of the tunnel through the landslide was macroscopically deformed, but not destroyed; the gradient of deformation of the tunnel was estimated at 0.78 cm/year.

The first problem to be considered in the design phase of the cycle route was the safe reuse of the old railway tunnel. In 2003, the Regional Basin Authority installed a landslide monitoring system with five inclinometers and five piezometers along the slope up to 60 m depth. The strain control showed 1 cm/yr displacements near the portal of the tunnel. The displacements occurred when groundwaters reached a critical level. A geological and geotechnical model of the slope was commissioned.

Thus, a new internal liner of the tunnel was designed, with deformable steel profiles, weldmesh and shotcrete coupled to a drainage system of the water table with large drilled drain pipes. In accordance with the safety requirements of the Basin Authority the geotechnical control system of the landslide was installed with new electrical devices inside the tunnel and in the lower part of the landslide. The control system is characterized by four authomatic bore-hole rod extensometers, four vibrating-wire strain gauges, 10 jointmeters and one electrical piezometer; all these sensors are connected to a datalogger installed near the portal of the tunnel. The acquisition of stresses on the new internal liner and soil deformations around the tunnel allows the analysis of the behavior of the structure and its safety.

General considerations

Many high-risk situations characterize the regional road network; in 2010, some large landslides affected the road network in the Provinces of La Spezia and Savona. The large rockslide of Murialdo blocked more than 100 m of road requiring the construction of a 1 km bypass along the river Bormida using a prefabricated metal bridge. Even in this case a flood alert system along

Figure 6. The rockslide of Murialdo

the bypass has been installed.as well as a slide control with inclinometers along the slope.

Since the end of the 1990s, geological hazard studies of the whole territory have been carried out in the Liguria region. The widespread landslide hazard conditions of many villages and infrastructure require a management policy based on risk analysis. Nevertheless, the need to contain public budgets prevents the realization of costly structures wherever there is a danger. Under these conditions the use of early warning and control systems can guarantee a better safety degree along the infrastructure network.

Geoscientists Canada, together with co-conveners, the Australian Institute of Geoscientists, the European Federation of Geologists and the American Institute of Professional Geologists, invite you to the 4th International Professional Geology Conference ("4IPGC"), January 22-24 in Vancouver.

By special arrangement with the Association for Mineral Exploration British Columbia (AME BC) 4IPGC will coincide with Mineral Exploration Roundup 2012 and those who register for 4IPGC will be able to then register and attend Roundup at no extra cost. Once part of Roundup, there are many excellent short-courses, fieldtrips and additional social events on offer at attractive Roundup prices.

PHOTO CREDIT: TOURISM VANCOUVER

Vancouver, Canada's gateway to the Pacific and host of the spectacular 2010 Winter Olympic Games is an ethnically-diverse, outdoors focused city, surrounded by water and mountains.

Occurring in January, 4IPGC will coincide with ski season. Local ski resorts overlook and are within minutes of the city. Whistler-Blackcomb is only a two hour drive away. This conference offers a unique opportunity to combine business with winter sports, take in an NHL ice hockey game, visit historic Gastown, or to relax and enjoy Vancouver's mild winter scenery.

Mineral Exploration Roundup

- is western Canada's annual mineral exploration conference. Now in its 28th year, the "Roundup" has become a major international technical gathering of mineral exploration geoscientists from around the world.

Roundup 2011 saw an attendance of over 7000 delegates from far and wide for a 4 day technical program, together with fieldtrips and short-courses. 2012 marks the centennial of AME BC and the upcoming Roundup promises an event with even more impressive offerings.

www.amebc.ca/roundup

4IPGC Plenary and Technical Sessions - extending over two and a half days the program will cover a wide range of broad topics relevant to professional geoscientists across all disciplines:

- Governing a globally mobile profession
- Securities and Other Public Reporting – A Global Perspective
- Geohazards – Keeping the Public Safe
- Geoscience Practice – Environmental Responsibility
- Practice Skills, Competencies and Capacity for Sustaining a Global Profession
- Geoscience in an Interdisciplinary World
- Serving Society – Effective Public Engagement

4IPGC Program at a Glance

	Sunday	Monday	Tuesday
AM		Keynote Address and Technical Sessions	Technical Sessions
Lunch		Global Practice Luncheon	(to be decided)
PM	Plenary	Technical Sessions	Technical Sessions
Evening	Welcome Reception	4IPGC Museum Banquet	(to be decided)

Keynote Address

Deborah McCombe, P.Geo.

4IPGC will open with a Keynote Address covering the overall theme of the conference "Earth Science – Global Practice" by Deborah McCombe, P.Geo., Executive Vice President and Principal Geologist at Roscoe Postle Associates Inc. (RPA) of Toronto.

Former president of the Association of Professional Geoscientists of Ontario and current Chair of CRIRSCO (Committee for Mineral Reserves International Reporting Standards), Ms McCombe has over 30 years experience in exploration project management, reserve estimation, feasibility studies, due diligence and valuation studies on base metals, precious metals, and industrial mineral projects. She has worked in diverse geological settings in North and South America, Asia and Africa.

Prior to joining RPA, Ms. McCombe was Chief Mining Consultant for the Ontario Securities Commission. She is the author of numerous articles and presentations focused on providing corporations and professionals alike with a better understanding of disclosure rules for mineral projects.

The keynote address at 4IPGC will allow Ms McCombe to reflect on the work of professional geoscientists in all disciplines and bring the theme of the conference "Earth Science - Global Practice" into focus for delegates.

Global Practice Luncheon with Guest Speaker:

Jim Franklin, P.Geo.

4IPGC Registration includes a complimentary ticket to the Global Practice Luncheon on Monday January 23. As part of this luncheon delegates will hear a presentation by Dr James M. (Jim) Franklin PhD FRSC P. Geo, of Franklin Geoscience. Jim Franklin is an exploration geologist focusing on the discovery of base metal, uranium and gold deposits. After teaching at Lakehead University he joined the Geological Survey of Canada (GSC) in 1975, where his research focused on metallogeny and modern and ancient VMS deposits. Later as Chief Geoscientist of the GSC he coordinated its scientific program. Dr Franklin is currently a director of three companies and sits on numerous boards for professional and scientific groups. He is a Past President of both the Geological Association of Canada and the Society of Economic Geologists. He is a Fellow of the Royal Society of Canada, and an Adjunct Professor at Queen's, Laurentian and Ottawa universities.

The title of Dr Franklin's luncheon presentation will be announced at a later date. It is understood that his remarks will focus on the role that geoscience can play in underpinning a country's economic competiveness, by using Canada as an example.

4IPGC's Museum Banquet.

Plan to join fellow 4IPGC delegates for a special cultural and social get-together with geoscience professionals from around the globe at Canada's world famous **Museum of Anthropology at the University of British Columbia.**

Dine and explore the museum's renowned collection of totem poles and other dramatic aboriginal art of the coastal First Nations peoples. This **ticketed evening event** will include a cocktail reception, banquet, guided tours of the galleries and return coach transport to the conference hotel.

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	Early Bird/Full Fee+	Quantity
Professional Delegate	C$400/C$500	
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Monday, January 23, 2012 • Global Practice Luncheon (ticket required)	No Charge	
Monday, January 23, 2012 • 4IPGC Museum Banquet (ticket required)	C$120	

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Monday, January 23, 2012 • 4IPGC Museum Banquet (ticket required)	C$120	

*(*Delegate registration includes access to all 4IPGC technical sessions, and conference facilities, ticket to Global Practice Luncheon, and rights to register and attend the Exploration Roundup 2012 conference at no extra cost and become a member of AME BC for one year. Those registered for Roundup can then avail of the many short-courses, fieldtrips and additional social events that are offered as part of Roundup, at regular Roundup prices) (+Early Bird fees apply until December 2, 2011; full fee after)*

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Emergency response of Italian geologists to recent natural disasters

by Gian Vito Graziano[1], Domenico Calcaterra[1], Corrado Cencetti[1] and Giorgio Di Bartolomeo

Some experiences of Italian geologists are briefly reported, in relation to some of the main natural disasters that have occurred in Italy in the last 15 years: landslides in Campania region (1998), earthquakes in Umbria-Marche (1997-1998) and Abruzzo regions (2009). On these occasions, the involvement of professional geologists, along with researchers and geologists from public agencies, has been extraordinary, both during the emergency and reconstruction phases, but also in the studies on the causes of disasters. These experiences show that these professionals are of paramount importance in all the activities of prediction and prevention of geological risks.

Des géologues italiens témoignent ici brièvement de leurs expériences concernant les désastres naturels majeurs qui ont affecté l'Italie, ces quinze dernières années : glissements de terrain en Campanie (1998), tremblements de terre en Marche Ombrie (1997-1998) et dans les Abruzzes (2009). Lors de ces événements, l'implication de géologues professionnels associée aux géologues et chercheurs du domaine public s'est révélée extraordinaire non seulement lors de la période critique de secours immédiat et la phase de reconstruction mais aussi pour les études effectuées sur les causes des désastres. Les travaux mentionnés montrent que ces professionnels jouent un rôle incontournable pour toutes les actions de prédiction et de prévention des risques naturels d'ordre géologique.

Se comentan algunas experiencias de geólogos italianos en relación con algunos de los principales riesgos naturales que han sucedido en Italia en los últimos 15 años: los deslizamientos en la región de Campania (1998), los terremotos en Umbria-Marche (1997-1998) y la región de Abruzzo (2009). En todos estos casos, la implicación de los geólogos profesionales de las agencias públicas ha sido extraordinaria, tanto durante las fases de las emergencias y reconstrucción, como durante el estudio de las causas de los desastres. Estas experiencias demuestran que estos profesionales son de importancia fundamental en todas las actividades de predicción y prevención de los riesgos geológicos.

For many years the Italian National Council and the Regional Councils of Geologists have resolutely placed much importance on soil conservation and defence themes, being well aware that, among the various kinds of natural risks that affect Italy, seismic and hydrogeological[‡] (the adjective "hydrogeologic" is a comprehensive term used in Italy to describe the effects caused by mass movements, erosion and flooding) risks represent those causing the highest social and economic impact.

The following basic data on landslide risk highlights the problem:

- approximately 485,000 landslides recorded in the entire country, which certainly seems to be an underestimated figure
- 5,581 municipalities, corresponding to 68.9% of the total number, exposed to high hydrogeological risk
- 11,000 landslides and 5,400 floods occurred in the last 80 years.

[1]Consiglio Nazionale Geologi, Rome, Italy

A topic often underrated even by geologists is the last report by Legambiente, a non-political non-profit Italian association for the safeguard of the environment, underlines that in Italy every year approximately 500 km^2 of land are consumed, which is equivalent to say that every four months a town the size of Milan is established on Italian territory.

Equally alarming are the figures related to the seismic risk: since the 1968 event which hit the Belice valley in Sicily, there have been 4,600 fatalities and approximately 500,000 made homeless due to earthquakes. In a nation where it is estimated that about 20m. Italians are potentially exposed to earthquakes, an immense number of strategic buildings (schools, hospitals, public buildings, etc.), among which more than 40% of the Italian schools, rest on areas highly vulnerable to seisms.

Even though Italian agencies and institutions have not succeeded in working as a unit in land management and governance, among the few positive experiences related to natural disasters can be counted the activity of the Italian geologists engaged in the Field Survey Teams (FSTs); FSTs, introduced for the first time after the 1998 Campania landslides, have the mission to control, before and after a critical event, a territory susceptible to landslide or a flood so as to allow suitable Civil Protection measures to be carried out.

In the following examples, some of the recent disasters that have occurred in Italy are briefly presented. These have been important occasions for Italian professional geologists to show how important their contribution can be in the various stages subsequent to critical events such as landslides or earthquakes.

The September 26, 1997 earthquake in Umbria-Marche

In 1997/1998 the Umbria and Marche regions (central Italy) were affected by a seismic crisis that reached its peak with two earthquakes on September 26, 1997 (M_L = 5.6 and 5.8). The main damage occurred in the Umbria-Marche Apennines: consequently, 11 people died, more than 100 were injured and about 20,000 were evacuated from 48 municipalities (http://www.ispro.it/site/content/1997-terremoto-umbria-e-marche), 28 of which were declared "disaster areas". The cultural heritage suffered severe damage, well

Figure 1. St. Francis Church in Assisi and the damage produced by the September 26, 1997 earthquake (www.raffer.it; www.archeomolise.it; www.hotelfratesole.com)

testified by the St. Francis Church in Assisi (Fig. 1): the collapse of the vault, as a consequence of the second shock, resulted in four fatalities and the destruction of 130 m² of Medieval wall paintings..

The Umbria-Marche earthquake represented, for professional geologists, a very important occasion for participation and solidarity (Regione Umbria, CNR-IRRS, 2000). During the emergency phases the Councils of Geologists of both regions showed their willingness to carry out inspections and consultancies, with the support of many chartered geologists. Since the damage was not homogeneously distributed from the epicenter and was unrelated to the building vulnerability, it was deemed necessary to investigate the cause of such variability which was due to seismic amplification induced by local geological characteristics.

After the emergency phases, on March 26, 1998 a "Protocol between the Regional Council of Umbria and the Umbria Council of Geologists for urgent investigations of seismic microzoning" was signed, which allowed Expeditious Seismic Microzoning (ESM) to start in April. ESM was carried out, above all, by professional geologists, on the most severely damaged built-up areas. Based upon geological-geomorphological evaluations and assessment of damage, 61 sample sites were selected (39 in Umbria) to be submitted to ESM investigations, representative of morphostratigraphic situations common to the whole territory.

Lithological-geomorphological maps were produced at a 1:5000 scale, correlated to "sample" situations, previously analyzed by models where a seismic impulse had been imposed, in turn derived from historical-statistical analysis of the seismic hazard. ESM, even if based upon predefined classes of seismic amplification, hence without giving an experimental answer to specific situations, quickly allowed the pinpointing, over a wide territory, of homogeneous areas in terms of local seismic response.

Furthermore, specialists of the Italian National Council of Research (Institute for Research on Seismic Risk) and of the Italian National Seismic Service carried out modelling of the local seismic response, in order to evaluate the expected effects in terms of impulse amplification. The results led to the drafting of a "Table of amplification coefficients of the reference seismic action due to site effects", used to extend the results of ESM from the sample sites to a further 465 sites investigated afterwards. The results were eventually controlled by means of field inspections and analysis of the produced maps, and especially of the "Map of the zones susceptible to local amplifications or dynamic instabilities". On July 13, 1998, about three months after the protocol's signing, the validation of the products was obtained.

Finally, the Umbria Regional Government created a database, organized on a municipal basis and for specific sites, which was transferred to all local authorities to be used as a tool for urban planning.

The May 5, 1998 landslides in Campania

On May 5, 1998, a huge number of rainfall-induced soil slides – debris flows occurred in the Campania region of Southern Italy (Del Prete et al., 1998; Calcaterra et al., 1999). The landslides, which involved loose volcaniclastic materials overlying a carbonate bedrock, invaded five foothill towns (Sarno, Quindici, Siano, Bracigliano and San Felice a Cancello), four of which were located around Mt. Pizzo d'Alvano (Fig. 2) resulting in 160 casualties and serious damage.

The May 1998 event represented only the last episode in a long history of instability in the disaster areas: archival records, in fact, document similar previous events, dating back to the 17th century (Calcaterra et al., 2003). Nevertheless, the May 1998 event was considered as unprecedented, in terms of the number of landslides, the volumes involved and the socio-economic effects. After that disaster, the Italian government was forced to have the national law on land management and soil

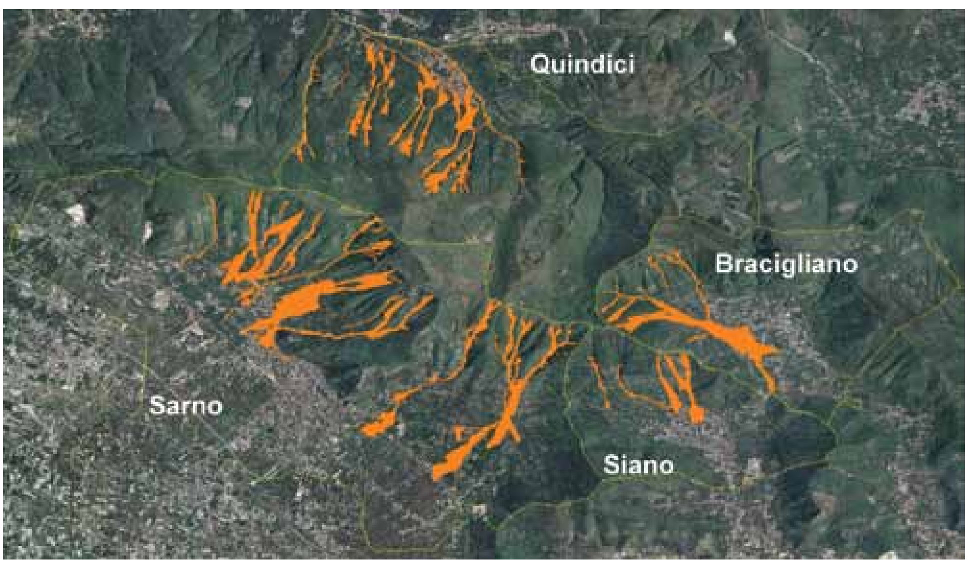

Figure 2. Main landslides, May 5, 1998, around Mt. Pizzo d'Alvano (after Versace et al., 2007, modified)

protection, promulgated 10 years before (law no. 183/1989), fully implemented. Accordingly, tight deadlines were given to the relevant public agencies (Basin Authorities) for the lay-out of the Hydrogeomorphological Setting Plans, which classify the Italian territory according to landslide and flood hazard and risk.

The May 1998 event also represented a turning point in the management of civil protection. In fact, a control scheme was carried out, framed within the so-called Emergency Plans, which put together real time monitoring systems, forecasting models, and above all, the FSTs, composed of geologists and engineers, who look after the territory during the emergency phases, when the models suggest the threshold values have been exceeded (Picarelli et al., 2007). FSTs, especially during "peace-time" but also in times of emergency , are entitled to immediately reach, possibly through safe paths, the areas exposed to risk and assess, based on their experience, the seriousness of the expected event; by doing so, they contribute to a much more precise definition of risk scenarios (Fig. 3).

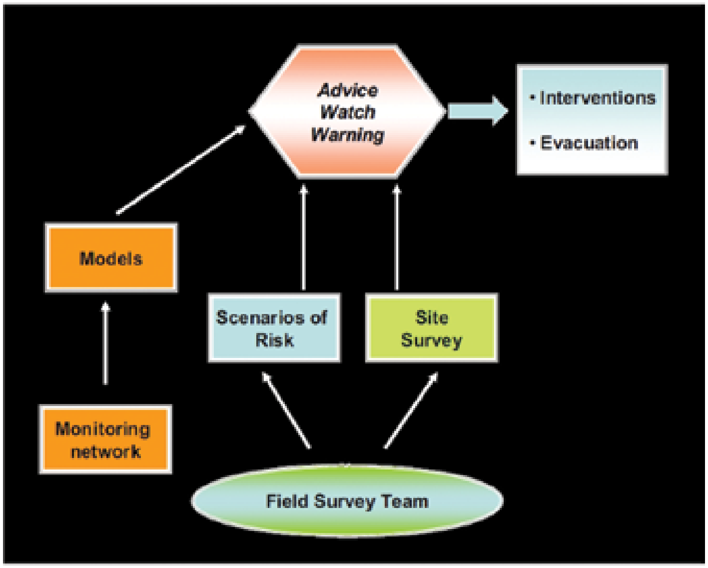

Figure 3. Main components of the Emergency Plans (after Picarelli et al.*, 2007)*

The April 6, 2009 earthquake in Abruzzo

On April 6, 2009 at 3:32, a severe earthquake (M_L = 5.8; M_W = 6.3; Io = IX MCS) affected central Italy and in particular the province of L'Aquila in the Abruzzo region, along the central Apennine chain (http://portale.ingv.it), resulting in 308 dead, about 1,600 injured and damage to many buildings and to the cultural heritage, estimated by the Italian government at around 12-15 bn. €. The epicentre was located in the villages of Onna and Castelnuovo (Fig. 4), near the city of L'Aquila, about 95 km north-east of Rome; in 57 municipalities a >VI MCS intensity was registered.

The main shock, as a result of normal faulting on a NW-SE oriented structure, was preceded by a long foreshock sequence beginning in December 2008 and followed for several months by aftershocks with Mw > 4.0.

Based on the experience gained during the seismic crisis of 1997 in Umbria and Marche, the Council of Geologists of the Abruzzo Region immediately made available its chartered members to participate in field surveys to estimate the damage to countless buildings.

The months immediately after the event were hectic for both professional geologists and for those working for public agencies (e.g. National Seismic Service, National Institute of Geophysics and Volcanology, Civil Protection, Universities) assembling information essential to undertake the preliminary seismic microzonation in the city of L'Aquila and neighbouring municipalities in order to lay the basis for reconstruction.

In January 2010 a protocol was signed by the Department of Civil Protection, the National Council of Geologists and the Council of Geologists of Abruzzo Region for the reconstruction and restoration of damaged public and private dwellings, maximizing the available public resources and ensuring the quality of the professional

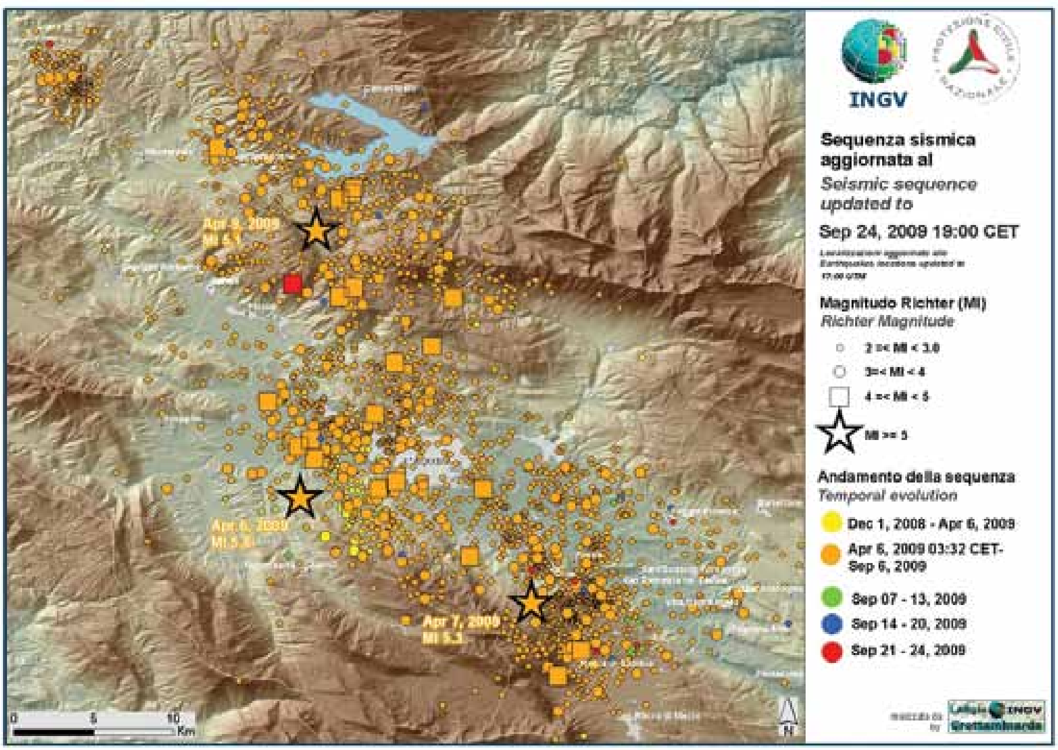

Figure 4. Seismic sequence of the 2009 Abruzzo earthquake (map available at www.ingv.it)

work of the geologists involved.

The Abruzzo earthquake induced the Italian government to adopt, for the whole country, new technical standards on buildings stating the need for local seismic response studies, which, in turn, led to the development of suitable geophysical methods and technologies to be applied by professional geologists. The 2009 earthquake also represented an occasion to apply and test the “General Addresses and Criteria for Seismic Microzonation”, prepared by the National Department of Civil Protection in 2008.

At present, the reconstruction intervention is still underway, while the regional government has recently established the criteria for entrusting the seismic microzonation activities, which should involve all the Abruzzo municipalities for the next five years.

Conclusions

In Italy, after decades of geological disasters of different types, an organic law of land management and governance still does not exist.

Law no. 183/1989, which introduced elements of great innovation with respect to previous legislation, (e.g.: the concept of “hydrographic river basin”, which for the first time overcame the limits of administrative borders; the institution of the “River Basin Authorities”), unfortunately was not applied until 1998. It was, in fact, only after the tragedy of Sarno with its 160 victims, that, with strong public pressure, the Italian government had to enact a decree (no. 180/1998), forcing the regions to prepare, within strict deadlines, the Hydrogeomorphological Setting Plans (HSPs).

HSPs represented a fundamental step from a cultural, technical and political standpoint, since they compelled public administrators to monitor the landslide and flooding risk; at the same time, HSPs partly constituted a kind of abdication, since they were socially felt as a further land constraint to urban planning, and not a suitable tool for effective land management and governance.

Nowadays in Italy there is a general political-institutional delay, consequence of a strong cultural delay, well evidenced by only responding to each disaster, instead of having a prediction and prevention phase; so, the next landslide or earthquake, for example, will be a new occasion to find the economic resources necessary to reconstruct the disaster zone, after the usual sorrowful count of victims and material damage.

Currently, soil defense and protection in Italy is relegated within a wider environmental code, decree no. 152/2006, which cannot be regarded as an effective tool for land management and governance, since it does not clearly delimit powers and responsibilities; therefore, it is quite difficult to understand who has to do what.

Furthermore, the whole situation is getting worse due to a systematic depletion of national and regional technical services (e.g: in the Abruzzo region, even after the huge 2009 earthquake, a regional Geological or Geophysical Service does not exist yet) and of monitoring and surveillance networks, due to both an enduring lack of resources, and, above all, to a persistent lack of attention to these issues.

Italian geologists, therefore, continue to ask governments for an organic law of land management and governance, to clearly define the network of competences, to prioritize actions of ordinary and extraordinary maintenance of catchment basins, to lay the foundations for a modern reform of urban planning, drawing lessons from those positive experiences that in some cases have seen geologists collaborating with governmental institutions.

In this respect a recent initiative of the National Council of Geologists gave a fruitful result. On September 15, 2011, a first protocol was signed between the Council and the National Department of Civil Protection, aimed at favouring and promoting a stable cooperation between the two bodies and the regional Councils of Geologists regarding a better management of seismic emergencies. In the following months a similar protocol will be signed with reference to the “hydrogeological” risk. In both cases, a central role is assigned to the FSTs, which will be composed of suitably trained geologists.

There is still a long way to go before getting a full acknowledgment for the role of Italian geologists, especially in this persistent period of political and institutional decadence in Italy and of worldwide economic crisis. However, it is hoped that governments of the entire world, and not only in Italy, could understand the importance of investing in non-structural preventive measures devoted to reduce natural hazards. Such an option, among other benefits, allows remarkable economic savings, if compared to the huge amounts of money usually needed in the post-emergency phases, and, above all, promotes responsible behaviour in the public.

The adjective “hydrogeological” is a comprehensive term used in Italy to describe the effects caused by mass movements, erosion and flooding.

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Geothermal energy resource exploitation in the EU: ThermoMap

A new EU project on area mapping of superficial geothermic resources from soil and groundwater data

by David Bertermann[1] and Gyozo Jordan[2]

This article takes a look at the area mapping of superficial geothermic energy resources in Europe based on the ThermoMap project. This project is partially funded under the ICT Policy Support Programme (ICT PSP) as part of the Competitiveness and Innovation Framework Programme of the European Community: (*http://ec.europa.eu/information_society/activities/ict_psp/index_en.htm)*
The conditions required for superficial geothermic resource exploitation are briefly reviewed, the necessary technology is introduced and key geological parameters for successful installation are presented. The application of soil and groundwater data for the spatial mapping of potential sites for heat pump installation within horizontal energy systems is presented. Finally, a few examples from the ThermoMap project are presented.

L'article, basé sur le contenu du Projet « Thermomap » nous invite à considérer la carte issue de la cartographie des ressources géothermiques énergétiques, superficielles de l'Europe. Ce projet est en partie financé par un Programme Politique de Soutien (ICT PSP) en tant que composante du cadre de travail de la Communauté européenne pour la compétitivité et l'innovation: *(http://ec.europa.eu/information_society/activities/ict_psp/index_en.htm)*
Les conditions nécessaires pour l'exploitation des ressources géothermiques superficielles sont examinées brièvement, le volet technologique indispensable, exposé, et les paramètres géologiques clés pour une installation fonctionnelle, mentionnés. L'utilisation de données concernant le sol et l'eau souterraine pour la cartographie spatiale des sites potentiels avec installation de pompes à chaleur au sein de systèmes énergétiques horizontaux est expliquée. Enfin, sont présentés quelques exemples tirés du projet Thermomap.

Este artículo da un repaso a la cartografía de los recursos geotérmicos superficiales de Europa basado en el proyecto ThermoMap. El proyecto ha sido parcialmente financiado por el Programa de Apoyo a las Tecnologías de Información, y Comunicaciones (ICT PSP) como parte del Programa Marco Europeo para la Competitividad y la Innovación de la Comunidad Europea: (http://ec.europa.eu/information_society/activities/ict_psp/index_en.htm). Se revisan someramente las condiciones necesarias para la explotación de los recursos geotérmicos superficiales, se hace una introducción a las tecnologías necesarias y se presentan los parámetros geológicos fundamentales para que la instalación tenga éxito. Se presenta la aplicación de los datos del terreno y de las aguas subterráneas para la cartografía espacial de los lugares potencialmente adecuados para la instalación de las bombas de calor en sistemas de energía horizontales. Finalmente se presentan también algunos ejemplos del proyecto ThermoMap.

The European Union recently confirmed its dedication to the promotion of sharing environmental information for the sustainable development of natural resources and it defined a clear impact of objective 6.2 "Geographic Information" under the CIP-ICT-PSP (Information and Communication Technologies Policy Support Programme). Implementing network services will allow users to identify, access, use and reuse in an interoperable and seamless way and for a variety of uses, aggregated geographical information covering a significant part of Europe and coming from a wide range of sources, from the local to the European level. The ThermoMap project contributes to this planned impact from the ICT PSP programme as it creates new delivery channels for digitalized geographical content on superficial geothermal energy resources. This opens up a unique opportunity to make the geographical information accessible online to the public.

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[2]Geological Institute of Hungary (MÁFI), Stefánia út 14, 1143 Budapest, Hungary

The project will contribute as a strategic objective to an increase of superficial geothermal energy use by providing efficient visualization conditions of the resources and is therefore in line with the targets set in the European Commission´s 'Renewable Energy Road Map'.

Horizontal shallow geothermal energy within the first 10 m below the Earth´s surface is predominantly influenced by solar energy input and thus belongs to renewable energy resources. Variations of air and soil temperature and heat flow at low depths are controlled by external variables like effective sun radiation, distribution of rainfall and infiltration processes based on site specific soil conditions. This energy resource can be best exploited in the saturated and unsaturated zone of the unconsolidated rock zone where easy access to the underground is possible with regard to logistical and economical aspects. Identification of areas suitable for shallow geothermal energy exploitation is a challenge and it requires the estimation of the two key parameters of soil

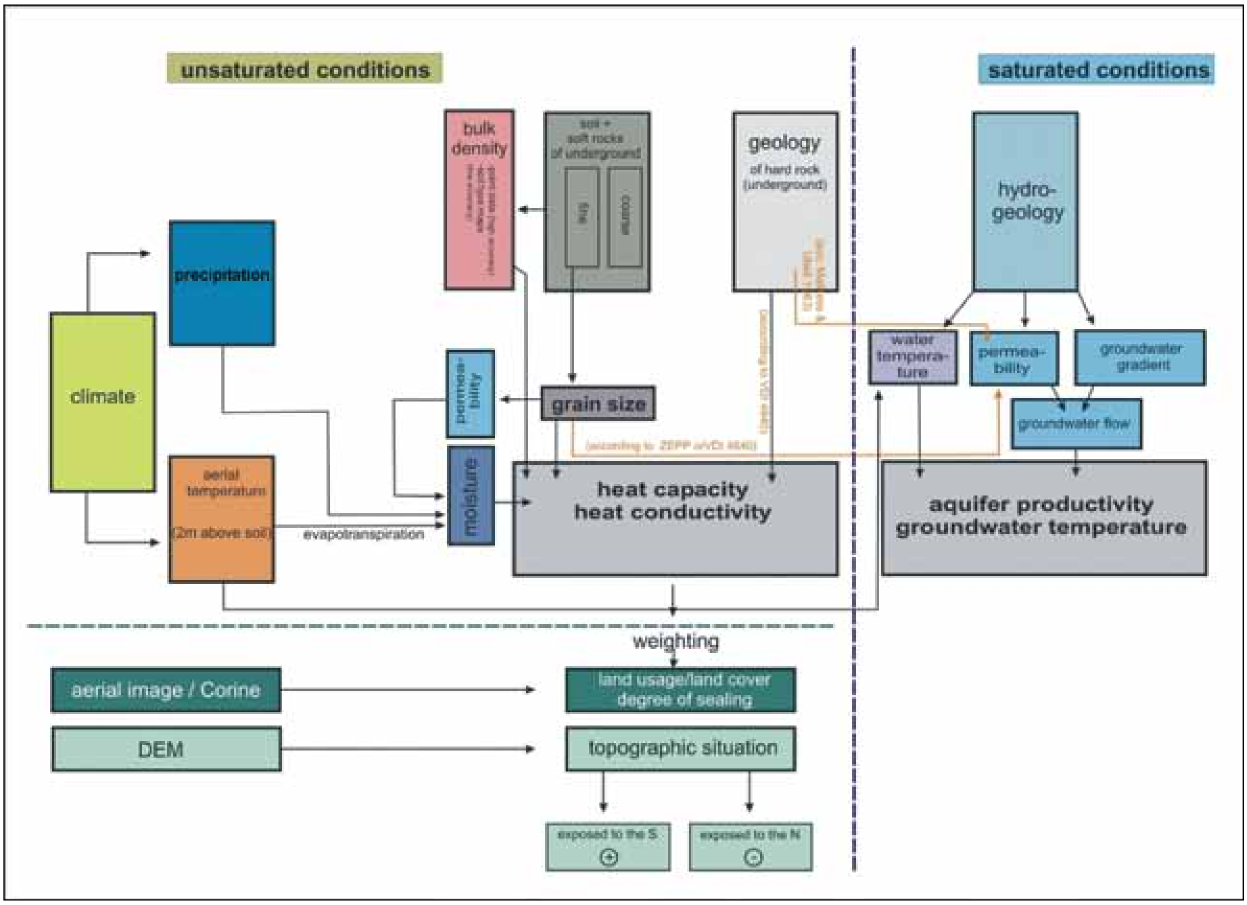

Figure 1. A schematic review of key parameters influencing shallow geothermal energy potential

thermal properties, heat capacity and heat conductivity (according to the model of the Kersten formulas) (Kersten, 1949). These parameters can be measured in laboratories or by field measurements using heat probes. Field measurements also have to consider the diurnal and seasonal heat fluctuations driven by climatic and groundwater conditions. An alternative to these costly and tedious measurements is provided by the proper mapping of climatic and soil parameters such as rainfall conditions or soil moisture. The important parameters for superficial geothermal resources are the following (Fig. 1):

meteorological and climatological parameters

- monthly and annual mean temperatures of the air close to the soil surface (as a rule 2 m above soil surface)
- average rainfall coverage
- relief conditioned slope as a controlling factor of surface drainage and microclimate
- temperature of soil infiltration seepage.

soil properties

- heat conductivity within the saturated and unsaturated zone of the soil
- thermal capacity within the saturated and unsaturated part of the soil specified by soil type, grain size distribution, organic content, mineral content, water content, bulk density, porosity.

hydrogeological parameters

- depth of water table below surface
- vertical sequence of layers (lithology).

The use of existing geoscience information and the connection with a GI-System helps the discovery of favourable areas for superficial geothermal exploitation within a very short time frame and without high costs. This information improves the possibilities for speedy planning of a sustainable, ecological energy supply by local authorities and energy suppliers. Furthermore, the planning of geothermal facilities is made easier and less expensive for engineering firms.

Within the vertical sequence of superficial earth material layers, different chemical and physical conditions exist. The heat conductivity and heat capacity that are documented in this project depend mainly on water storage and movement as well as porosity and air distribution within the soil and the subjacent soft rock zone (zone of unconsolidated rock). According to these crtiteria, particularly soft rocks have sufficiently favourable properties. If hard rocks exist within the vertical sequence of layers, the study site cannot be effectively used for shallow geothermal exploration. In that case the technical expenditure is too great compared with the results. On the other hand the information about the vertical sequence of layers is an important requirement to estimate the hydrogeological and thus geothermal parameters up to 10 m depth.

The ThermoMap project attempts to exploit the treasures of Earth Science databases, such as the above mentioned long-term climatic records or soil maps, existing in the European member states and it tries to develop methods to map areas with potential for shallow geothermal energy exploitation (See Fig. 2 for installation example).

Mapping shallow geothermal energy potential: a standardized approach

Many geographical data exist in the European member states that are not accessible to the public. ThermoMap develops a solution to combine the existing datasets for

Figure 2. An example of horizontal geothermal energy system installation

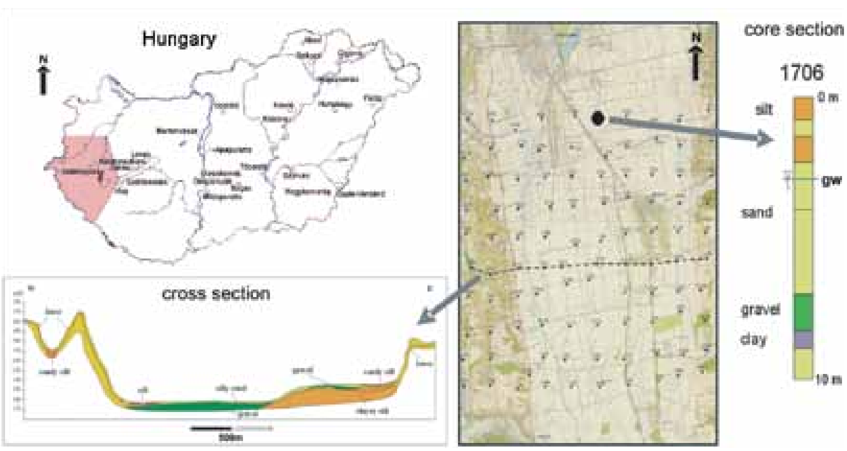

Figure 3. ThermoMap test site Zalakoppany , Hungary (Note the high-density shallow (10 m) borehole data along a 200 m x 200 m grid)

an area-wide visualization of geothermic resources by soil and groundwater data. The first step is to harmonize pedological, (hydro)geological, climatological and topographical basic information to a European standard, which will then be made visible digitally, based on a spatially adjusted open-source GI-System. ThermoMap intends to visualize geothermal resources in superficial zones of the Earth´s crust to 10 m depth by maps of medium to larger scales (1:10 000, 1:250 000).

The superficial geothermal resources are defined in the ThermoMap project as the resources in the part of the Earth´s crust down to about 10 m. This definition is based on the following:

- Climatological and meteorological influence of the solar heating of the soil or the influence of the temperature of seepage flow reaching a depth of about 20 m
- The zone down to 10 m below the surface can be easily exploited by open cuts or by shallow boreholes. Therefore this part of superficial geothermic usage is a relatively inexpensive variant
- Boreholes deeper than 100 m in many countries (e.g. in Germany) require special, often complicated licensing procedures. In the zone down to 10 m depth, soil properties (grain size, porosity, permeability, ground water level, water retention, etc.) important for heat storage and conduction, are available almost continuously and spacially. This is not the case at greater depth. Here only intermittent information is obtainable.

The ThermoMap project is implemented at two specific spatial scales. Site scale mapping is implemented for selected test areas in nine participating European countries (Austria, Belgium, France, Germany, Greece, Hungary, Iceland, Romania, UK) with proper high-resolution (1:10.000 scale or more detailed) data covering the above parameters. At a 1:250.000 regional scale an outline map for all partner countries is developed that uses simplified shallow geothermal energy suitability mapping criteria such as the exclusion of protected areas and sensitive groundwater bodies or WRB and ESDAC datasets.

The IT technology used in the standardized mapping approach is the core of the project. The system will be established as a WebGIS service which can be reached through an internet URL. This Web-based system consists of two components, a GIS server for the geodata storage and a visualization front-end running in a usual Web-browser. The user may be enabled to define the spatial extent of the view, zoom to a test area or an address, switch on and off several thematic maps, may pan and interactively acquire information of the geothermal potential for each clicked point in the map via data information windows with all relevant data.

Review of existing examples and development of new test sites

A Hungarian test sit is located at village Zalakoppány in western Hungary. It is one of the numerous agro-geological study areas of the Geological Institute of Hungary (MAFI) (Fig. 3). It has unique high-density shallow (10m) borehole data on soil, soft rock, groundwater and topography.

The German test site for the ThermoMap project is located west of Erlangen (Figure 4). It comprises a mostly flat rural area, traversed by small rivulets and pond strings in a W.- E. direction, of ca. 2,5 km^2 extent which is largely used for agricultural purposes. The climatic conditions can be roughly described as continental and therefore relatively warm and dry.

From the geological point of view the test area is situated at an altitude of 290-320 m asl within the Franco-Swabian escarpment region.

Regarding the main soil properties, the test area shows only a few characteristic soil types (in various subtypes) , Cambisols, Regosols, Pelosols, Gleysols and Planosols (see Figure 4). In terms of soil texture the USDA grain size classes, clay loam and loam, occur in at least two thirds of the studied area.

Who are the target users?

European Union citizens will be able to access geodata currently stored in public institutions in a user-friendly way. The citizens will be able to evaluate the superficial geothermal resources in selected regions in order to choose if superficial geothermal energy can be used for heating and/or cooling systems in housing, etc. *Governments* will get a new insight on the data as new forms of combination allow them to get a visualization of geodata on superficial geothermal energy. *Businesses* will have free access to harmonized data sets. Based on these data sets the business actors will have new business opportunities and can plan the exploitation of superficial geothermal energy across Europe more efficiently. The *European Commission* will be supported in conversing the INSPIRE directive for selected regions and data in the identified test areas. *Scientific researchers* will get access to data on common standard to work with the data in research.

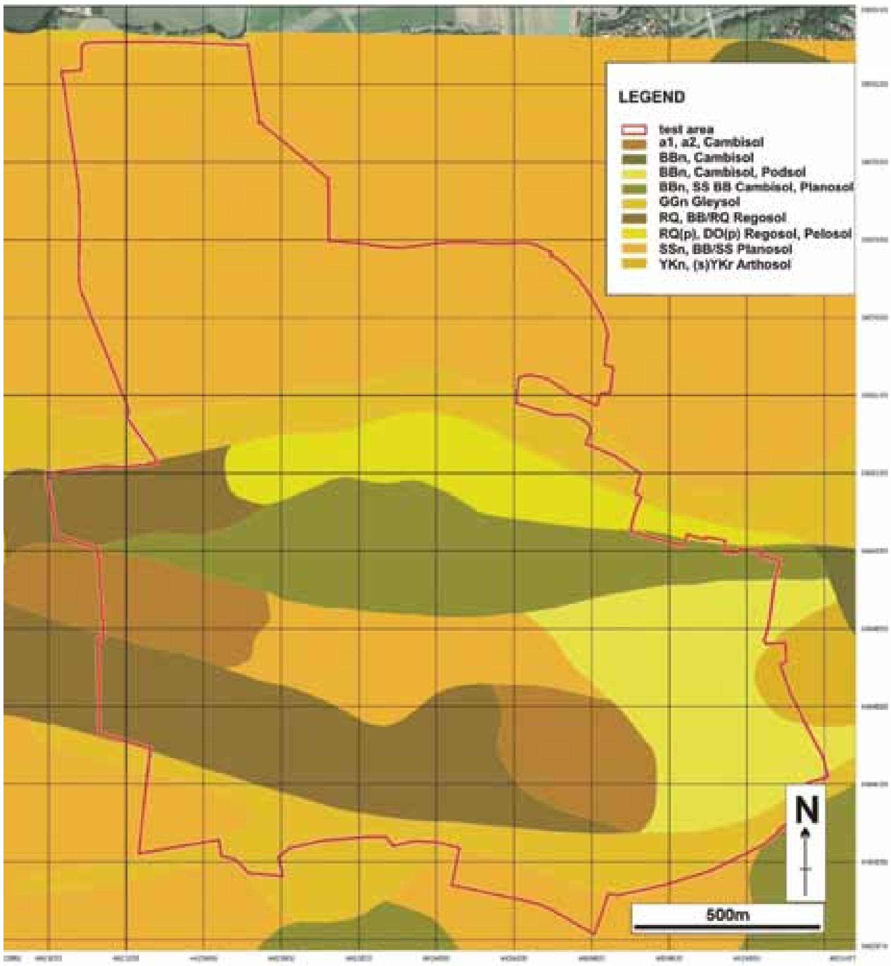

Figure 4. German test area. Map of soil types based on the WRB soil classification

Related sources and useful links

ThermoMap Project: http://www.thermomap-project.eu/

Kersten, M. 1949. Thermal Properties of Soil. *Univ. Minnesota, Bull. 28* L11/21, Minnesota.

EGEC (European Geothermal Energy Council): http://www.egec.org/

European Soil Portal: http://eusoils.jrc.ec.europa.eu/

European Soil Data Centre (ESDAC): http://esdac.jrc.ec.europa.eu/

MapViewer: http://eusoils.jrc.ec.europa.eu/wrb/

ICT-PSP: http://ec.europa.eu/information_society/activities/ict_psp/index_en.htm

European Commission – Department Energy: http://ec.europa.eu/energy/index_en.htm

WRB (IUSS Working Group WRB. 2007. World Reference Base for Soil Resources 2006, first update 2007. World Soil Resources Reports No. 103. FAO, Rome: http://www.fao.org/ag/agl/agll/wrb/doc/wrb2007_corr.pdf

USDA (United States Department of Agriculture) – Soil Texture Calculator: http://soils.usda.gov/technical/aids/investigations/texture/

ThermoMap participant organizations

Participant no.	Participant organisation name	Participant short name	Country
1 (Co-ordinator)	Friedrich-Alexander-University Erlangen-Nuremberg	FAU	Germany
2 (Participant)	Bureau de recherches géologiques et minières	BRGM	France
3 (Participant)	Iceland Geo Survey	ISOR	Iceland
4 (Participant)	Geological Institute of Hungary	MAFI	Hungary
5 (Participant)	Geological Institute of Romania - National Institute for Research-Development in the field of Geology, Geophysics, Geochemistry and Remote Sensing	IGR	Romania
6 (Participant)	Natural Environment Research Council	BGS (NERC)	UK
7 (Participant)	European Geothermal Energy Council	EGEC	Belgium
8 (Participant)	Royal Belgian Institute of Natural Sciences	RBINS-GSB	Belgium
9 (Participant)	REHAU AG+Co	Rehau	Germany
10 (Participant)	Gesellschaft beratender Ingenieure für Bau und EDV mbH & Co KG	GbI	Germany
11 (Participant)	Austrian Academy of Sciences - Research Unit for Geographic Information Science	PLUS	Austria
12 (Participant)	Instituto Geologikon Kai Metalleytikon Ereynon	IGME	Greece

Rudabanya, Hungary - new ore exploration in an old terrain

by Janos Foldessy

Hungary is a mature mining region. In its north-eastern part the geology and structure still has the potential to discover new mineralization. An exploration company and university laboratories joined to meet the challenge of finding base-metal ores in Rudabanya, once a prosperous mining town with iron ore mines. The applied tools varied from simple field mapping to advanced 3D computer modelling, from soil geochemistry to core-drilling. The initial data show that re-modelling of old mining regions may give rise to new, formerly unknown resource potential. The industry benefits from the modern laboratory tools and methods, the university uses the project as a training ground for its students. As a result, the town may face a renaissance through the discovery of new base-metal resources.

La Hongrie est un pays minier ancien. Dans sa région nord-est, la géologie et les études structurales peuvent encore découvrir de nouvelles minéralisations. Une compagnie d'exploration et des laboratoires universitaires se sont associés pour relever le défi de trouver du minerai métallique à Rudabanya, autrefois une ville minière prospère avec ses mines de fer. Les moyens mis en œuvre étaient divers, allant de la simple cartographie de terrain à de la modélisation 3D, et de la géochimie des sols au forage carotté. Les premiers résultats montrent qu'une nouvelle modélisation des anciennes zones minières peut être la source de nouvelles ressources potentielles, inconnues auparavant. L'industrie bénéficie des outils et méthodes de laboratoire tandis que l'université utilise le Projet comme un support de formation pour ses étudiants. En conséquence, la ville pourrait renaître grâce à la découverte de nouvelles ressources métalliques.

Hungría es una región minera señera. En su parte noreste la geología y la estructura todavía presentan potencial para el descubrimiento de nuevos yacimientos. Una empresa de exploración y unos laboratorios universitarios se han unido para asumir el reto de encontrar menas de metales base en Rudabanya, que en su tiempo fue una próspera ciudad minera con minas de hierro. Las herramientas aplicadas variaron desde la simple cartografía de campo a un avanzada modelización 3D computerizada, desde geoquímica de suelos a sondeos con recuperación de testigo. Los datos iniciales indican que la rehabilitación de antiguas regiones mineras puede dar lugar a un potencial de recursos nuevos antes desconocidos. La industria se beneficia de las modernas herramientas y métodos de laboratorio y la universidad utiliza el proyecto para la formación de sus estudiantes. Como resultado, la ciudad afronta un renacimiento por el descubrimiento de nuevos recursos de metales base.

When an economy follows a determined, albeit negative mineral policy for a long time, making a U-turn is a difficult business. For 20 years in Hungary the policy has been the gradual abandonment of extractive industries, both coal and ore as well as several industrial minerals. The reasons were numerous, but the result at the end was undoubtedly the suspension of mine production and the partial or complete reclamation of mine-sites. The echo of the recent global rally for mineral resources has slowly reached the country and the issue has been shifted more into the focus of public interest. Turning back to mining is now becoming an economic necessity. The country was considered as a mature mining region, nevertheless there remained several geological white spots where the re-modelling of the local alteration geology, structures might have offered substantial economic potential in discovering new mineral resources. This is especially the case in the north-eastern region of Hungary where it would also have definite social advantages, due to the reduction of the recent high unemployment rate of the region.

The well-known iron-ore deposit of Rudabanya lies in this region, the historic records of mining here go back 3,000 years (Fig. 1). It lies in a known mineralization rend from the southern Recsk to Slovakia. With its 3000 inhabitants it is one of the oldest mining towns, 50 km from Miskolc a regional centre, where the country's unique mining school is

Figure 1. Rudabanya's geographic position

located. The closeness has also promoted the idea of using the university think-tank to give technical and scientific support for the mineral exploration which was started in 2007 by the Rotaqua, a Hungarian private company.

After years of preparatory work, the town may now face a new renaissance after the discovery of substantial base-metal mineralization on the flanks of the old mine operations. The discovery is a practical result of the efforts of the exploration company and the parallel research works running in the Institute of Geology and Mineralogy of the University of Miskolc.

History

Figure 2. Silver seal of the Rudabanya mining town from 1529

Mining started using the surface native copper ores in prehistoric times. Mediaeval silver mining was historically recorded. From the 19th century the outcropping oxidation zone of primary siderite iron ore ore-bodies was extracted in open pits. Up to 1910 the annual output reached a maximum of 430,000 tons, 20% of the contemporaneous Hungarian domestic iron ore production. The iron ore production has been continued with the underground extraction of primary siderite ores, with a production rate of 200,000-700,000 tonnes per year approximately.

A roasting and magnetic separation processing plant was commissioned in 1960. The plant produced 200,000 tons of ore concentrate annually for the pelletization plant adjacent to the local iron smelter works.

From the 1970s the underground drifts intersected several small copper ore bodies and a number of lead ore bodies. However, only small scale test production of copper ore was carried out due to the lack of local beneficiation facilities. The mining was halted in 1986 due to the continuously depressed market prices of the iron ore.

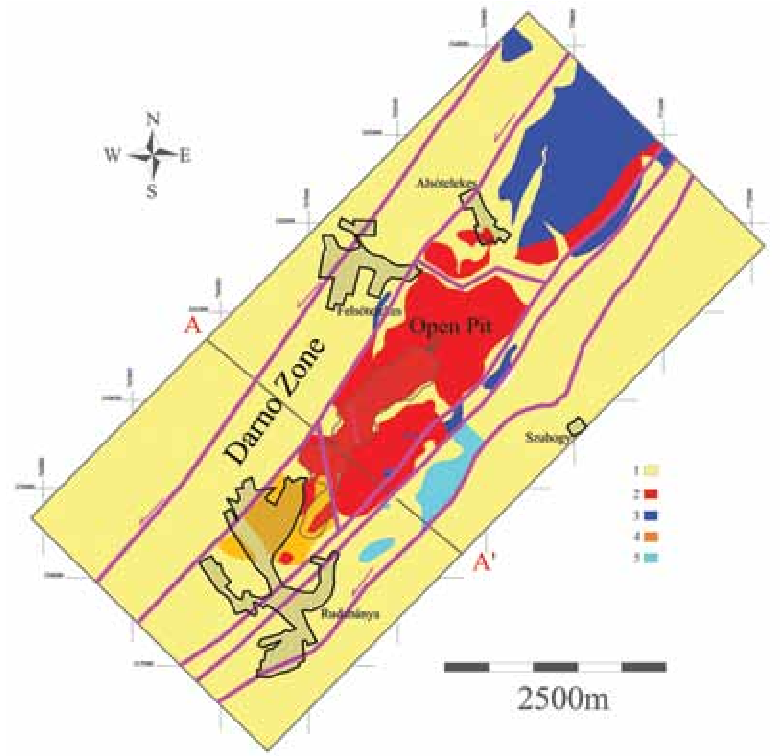

Figure 3. Simplified geological map of Rudabanya

Geological setting of Rudabanya

The Rudabánya Mountains, which includes the ore occurrence, lies in the Darnó Zone, a NNE-SSW striking, several km wide tectonic belt (Fig. 3). The zone traverses through NE Hungary, as a branch of the Mid-Hungarian Lineament. It is widely accepted as a regional scale strike-slip fault zone (Zelenka et al 1983). The movements along this zone were renewed several times during the Tertiary period with changing sense.

In the area three major structural subunits were identified (Less, 2000). The south-eastern side comprises epi-metamorphic Palaeozoic rocks - shales (originally flysch type sediments), fine-grained marble and crystalline, micaceous limestone. On the north-western flank Upper Permian to Middle Triassic series of evaporites, sandstone, marl, limestone, bituminous dolomite, platform limestone, also remnants of pelagic sediments (cherty limestone, radiolarite) occur in a series of thrust sheets (Silica-nappe).

In the central zone bordered by the strike slip master faults detached and intensely fractured brecciated segments of the Lower and Middle Triassic units of the Silica nappe (limestone, dolomite, shale, marl) host the iron ore bearing complex.

Apart from the central, NNE-SSW elongated range, the pre-Tertiary basement is covered by young Neogene sediments.

The northern continuation of the zone contains several metamorphosed-hydrothermal siderite, barite and sulphide mineralizations similar to Rudabánya (Grecula *et al.*,1995; Radvanec *et al*., 2004).

Previous geological model

The local geology for the iron ore mine was first described in detail by Pantó (1956). His views determined the strategy of mining geology until the closure of the mine. He stated that the original Lower Triassic succession was disintegrated by multi-phase folding and thrusting. The stratigraphically overlying carbonate rocks (dark grey dolomite and limestone) occur as 10-100 m sized disintegrated blocks, mega-clasts, which are surrounded by the strongly folded, grey shale and marl. The rocks in most places are fractured, brecciated. His model suggested a four-stage succession of ore formations: (1) *(Fe)* early metasomatic siderite-hematite mineralization in the Lower Triassic sandstones, (2) *(Fe)* metasomatic sideritization of the Middle Triassic Gutenstein Dolomite, (3) *(Cu and Pb-Ag)* disseminated copper, barite with Pb-Ag ores developed on the borders of the siderite bodies, and (4) *(Si-Ag)* young epithermal overprint of silica, pyrite, silver bearing sulfosalts. In this geological model the random and erratic distribution of the iron ore and sulfide ore bodies was emphasized, and the Pb-Zn-Ag-Cu mineralizations not separately characterized. This offered little perspective for finding economically significant base metal enrichment in either direction.

Re-modelling of archive data

During the 1990s a systematic regional geochemical-geological survey was carried out, and its authors underlined the potential of the area to discover sediment hosted gold mineralization (Korpas et al 1999) as well as to host MVT type base metal deposits (Hofstra *et al*., 1999).

The recent ore explorations started in 2007, with the initial aim of localizing the sources of the known silver anomalies. The task was to identify the base metal and precious metal forming stages and define the relevant geological environments.

The complexity of the previous geological model has meant great challenges to identify the possible base metal ore controls. The first step was initial data re-evaluation. As a result of more than a century of mining in the 19th and 20th centuries, over 2,400 drill-hole logs and their assays, a great number of surface and underground assay and drift maps were archived. These were re-worked, partially digitized and re-interpreted to provide a 3D insight into this complex ore deposit. The iron ore in this stage was taken as country rock of the base metal mineralization. It was found, that base metal enrichments (1) are dispersed throughout the iron ore zone and beyond on a large area, and (2) they are probably genetically independent from the iron ore mineralization and represent multiple stages of mineralization. The outcrop samples revealed the important role of the previously undetected zinc mineralization intimately related to the known lead ores.

In understanding the geology of the ore deposit, structural evolution has had a key role. The most important task was to separate the different overlapping structural events in comparison with the different recognized ore types. As a result three main periods of structural evolution have been distinguished. (1) Oldest recognizable structures are W or W-NW dipping master and E or E-SE dipping subsidiary thrust planes with associated folding. The metasomatism producing the siderite ores is earlier than this deformation period. The stratiform Pb-Zn ores pre-dated this structural development, while the Pb-Zn-Ag ore bodies post-date the siderite formation and were controlled by the low angle thrust faults. (2) The formation of the Darno shear zone, with SE and NW dipping thrust zones and associated zigzag folding characterize the next phase; the development of the disseminated copper ore mineralization is certainly controlled by these elements and (3) the youngest observed normal faults also affect the Neogene and Pliocene strata, formed during the uplift of the Rudabánya hills. The feeder zones of the epithermal overprint may be linked to this faulting.

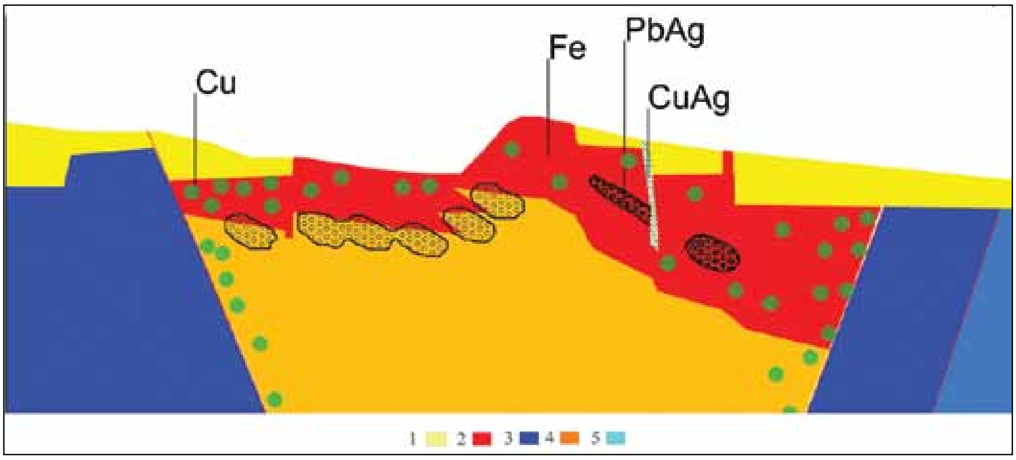

Figure 4. Historical genetic model of the Rudabánya ore occurrence (Szakáll et al.*, 2000) Legend: 1: Paleogene-Pliocene sedimentary cover, 2: Upper-Middle Triassic shale, limestone, dolomite 3: Middle Triassic dolomite with siderite iron ores, 4: Middle -Lower Triassic siltstone, sandstone, 5: Palaeozoic shale, limestone. The different mineralization stages are marked by their main ore-forming element (see in the respective paragraph)*

It was concluded, that the different structural elements along the Darno-zone were thus tectonically active from the Middle-Triassic until the Late Pliocene, and the ore mineralization events took place in different episodes, when widely differing tectonic situations prevailed.

Detection of sulphide and non-sulphide zinc mineralization and base metal palaeogossans

The follow-up mapping was designed to revise the accessible outcrops of the base-metal enrichments within the surface mining works. The well-recognizable lead ores were chosen first as prime target due to their high silver grades. On the pit walls stratabound Pb-mineralization was recognized in folded remnants of fine siliciclastic sediments. Important zinc enrichments were also verified by the assays, although their field recognition was difficult due to their low-iron character and pale colour, which made them similar to the adjacent dolomites and dolomite breccias. A barite-Pb-Zn mineralization was found related to crosscutting N-S faults, and post-dated the iron ore mineralization. The late tectonic movements along the Darno Zone are linked to the localization of disseminated to semi-massive copper mineralization along the main fault zone. The oxidation cap, formerly classified as oxidized iron ore, equally held highly anomalous Pb, Zn, Cu and silver values.

The surface channel and panel samplings verified the assumption of close links between galena ores and silver. It was also found in the surface outcrops that the oldest type of visible stratiform sulphide mineralization broadly follows the layering of the Lower Triassic siltstones, the younger Pb-Zn and Cu-sulphide bearing phases were vein-type and clearly penetrative to these strata. The wider zinc enrichment halo is characterized by fine grained sphalerite and secondary smithsonite. The gossan zone developed earlier than the Pliocene period as testified by the gossan outcrops overlain by Pliocene sedimentary strata.

Soil geochemistry

On the flanks, where mining has not disturbed the surface, soil geochemistry was used as a preliminary tool. The B soil horizon was sampled along NW-SE striking lines at 50 m spacing, and 200 m distance between the lines. The 450 samples were assayed for Au (AAS-FA) and another 35 elements (ICP-AES). The outcome was very conclusive and concordant with the channel and panel sampling. There were anomalous enrichments of Pb, Zn and Ag, occasionally with Cu as well as sole Zn enrichments on some areas far beyond NE

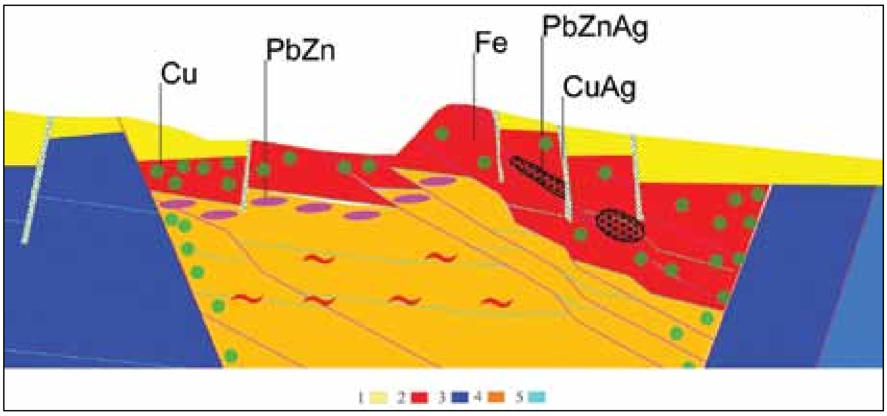

Figure 5. New geological model of the Rudabánya ore occurrence (Legend: 1: Palaeogene-Pliocene sedimentary cover, 2: Upper-Middle Triassic shale, limestone, dolomite 3: Middle Triassic dolomite with siderite iron ores, 4: Middle-Lower Triassic siltstone, sandstone, 5: Palaeozoic shale, limestone. The different mineralization stages are marked by their main ore-forming element (see in the respective paragraph))

from the open pits. The field check of the main multi-element anomalies has brought the localization of several (possibly mediaeval) old workings in gossan ores under these enrichments.

The new geological model

The results underlined that several mineralization events are superimposed in the area (Fig. 5) It was found that (1) *(Pb-Zn)* the earliest known event produced stratiform lead and zinc enrichments in the Lower Triassic calcareous siltstone horizon, (2) *(Fe)* metasomatic siderite mineralization is younger than the Middle Triassic dolomite host rock, with siderite filled feeders in the Lower Triassic sandstone, siltstone (3) *(Pb-Zn-Ag)* barite, galena, sphalerite ore lenses were emplaced along the interfaces of calcareous siltstone with siderite ore bodies, probably controlled by the thrust faults (4) *(Cu)* the siderite ore bodies and brecciated dolomites are overprinted by vein-type to massive pyrite, chalcopyrite, bornite mineralization along the shear zone master faults, and (5) *(Cu-Ag)* the silica-sulfosalt enrichments were parallel with the NE-SW faults with young (probably Tertiary) movements.

Initial drilling and trenching results

An 18-hole initial drilling programme was designed and started to verify the surface anomalies. The holes were planned to a shallow, 100-150 m depth to discover the vertical continuation of the surface exposures of the enrichments. It was found that (1) all the ore types known from surface exposures can be traced downwards hosted by the different Middle Triassic units (2) all the Lower Triassic siltstone intersections were free from zinc and copper enrichment, (3) copper and Pb-Zn have complementary localization, i.e. copper enriched intervals have low Pb, Zn grades and vice-versa.

The company plans to complete this programme later this year.

Another task was to search lateral connections between known surface mineralizations, using mechanized and manual trenching and channel sampling. The trenches revealed lithological control of Pb-Zn ores, and tectonic control of the superimposed copper mineralization. A schematic profile of the trench made in a short section of the centre-line of the open pit illustrates the position and grades of the intersected mineralization. Using 0,2 % Cu and 0,5 % Pb or Zn cut-off grades substantial areas can be outlined as potential ore-bodies (Fig. 6).

From industry to education: Rudabánya as a university training ground

The University of Miskolc has first proposed the exploration to its industrial partner and ever since it provides the professional and scientific background for the works. During the four years of cooperation 6 BSc, 4 MSc or Diploma, and 2 PhD theses were completed or being prepared in relation to different geological problems of the deposit. Being 50 km from the campus, the site is used as a field laboratory for

Figure 7. Students on Summer field training in the Rudabanya open pit

student work. On the other hand, the company receives the results and interpretations of our research. The mutual benefits are obvious and the cooperation continues involving ore processing and mine design oriented research. The research is partly financed from state R+D+I grants, giving a strong incentive for the industry to rely on the scientific assistance given by the University.

Conclusions

An old mine district is not necessarily a depleted reservoir for exploration

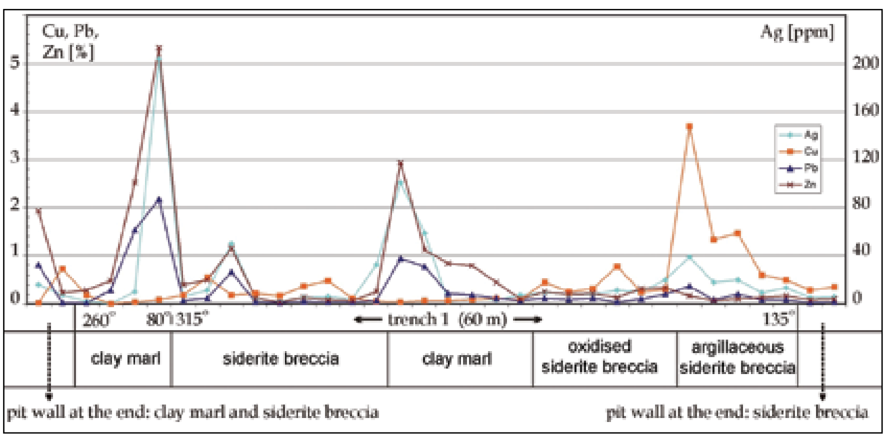

Figure 6. Schematic profile of a surface trench in the centre line of the open pit

possibilities. It may offer large economic potential by re-interpretation of historic geological, geophysical and mining data.

New geological models open new routes of exploration. Mineralized areas which have not been worked, explored for 20-30 years, certainly merit a thorough professional revision to evaluate their recent economic and technical feasibility.

Earth Science education and the mining industry can mutually benefit from joint involvement in projects, starting with scientific assistance provided by the university and ending with valuable professional training and research targets offered by the industry. The beneficial effect might be multiplied by properly designed co-financing schemes by the country or the EU in either the research or in the exploration.

Acnowledgements

The work was supported by the TÁMOP-4.2.1.B-10/2/KONV-2010-0001 project in the framework of the New Hungarian Development Plan. The realization of the academic project was co-financed by the European Social Fund. The publication of exploration results was permitted by the Rotaqua.

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News from World Geologists

Managing the balance between risk, environment and development: case study of Caldera Laguna de Apoyo Natural Reserve (Nicaragua)

Nicaragua's Laguna de Apoyo Natural Reserve, a seismically active volcanic caldera, is under increasing urban development and environmental degradation. For the last five years, World Geologists has supported the creation of an Association of seven municipalities, AMICTLAN, that together manage the Natural Reserve on the basis of studies and regulations created by the project. They also take the lead in institutional strengthening, improvment actions with local authorities and with municipality technicians, communal organizations and the public. Risk management, environmental management and sustainable economic development work have together led to a direction change in area management. Nowadays, the project is entirely managed by AMICTLAN, local organizations and municipalities.

La Réserve Naturelle Laguna de Apoyo au Nicaragua, caldera volcanique et active du point de vue sismique, est soumise à un développement urbain croissant et à une dégradation environnementale. Pendant les cinq dernières années, Géologos del Mundo a appuyé la création d'une Association de sept Municipalités, AMICTLAN, qui gère de façon conjointe cette Réserve Naturelle grâce aux études et réglementations mises en œuvre par le projet. Elles sont aussi à la pointe du renforcement institutionnel et de l'amélioration des activités menées avec les autorités locales, les techniciens municipaux, les organisations communales et la population. La gestion simultanée des risques, des conditions environnementales et la prise en compte du développement économique et durable a conduit à un changement d'attitude du point de vue gestion de l'espace territorial. Aujourd'hui, le projet est géré intégralement par AMICTLAN, les organisations locales et les Municipalités.

La Reserva Natural Laguna de Apoyo de Nicaragua, una caldera volcánica sísmicamente activa, está sometida a una presión urbanística y degradación ambiental acuciante. En los últimos 5 años Geólogos del Mundo ha apoyado la creación de una Asociación de 7 Municipios, AMICTLAN, que gestiona mancomunadamente esta Reserva en base a estudios y normativas creadas en el proyecto, acompañadas de fortalecimiento institucional y mejora de la capacidades y sensibilidades de autoridades locales, técnicos municipales, organizaciones comunales y población. Con esta base se ha incidido simultáneamente en Gestión de Riesgo, Gestión ambiental y Desarrollo Económico Sostenible consiguiendo un cambio de rumbo en la gestión de este espacio. Actualmente el proyecto está gestionado íntegramente por AMICTLAN, organizaciones locales y alcaldías.

Laguna de Apoyo caldera is located within Nicaragua´s volcanic cordillera, in an area of special seismic activity with more than 100 earthquakes per year. It was created after two great volcanic explosive eruptions of 6 VEI (Volcanic Explosivity Index) (Kutterolf *et al.*, 2007). Volcanic activity in the area is not very high at present but in 2010 a non-located massive sulfur gas emission caused a crisis.

The caldera has very high and unstable slopes liable to frequent rockfalls and landslides. Those events usually occur in the rainy season, in which hurricanes and flash flood are frequent.

Finally, its endorheic nature gives the lagoon a unique character due mainly to endemic fish species that are exclusive to this water body.

Laguna de Apoyo has been a protected area since 1991 (Decree 42-91), but until January 2010 it did not have a General Management Plan. This has now been elaborated and approved with the support of the project.

Programme's target group

Correct land management is not only the responsibility of institutions but also of the population and other actors. The programme designed its action plan with the following target groups in mind:

- the local population who depend on natural resources for their survival or whose identity is linked with the Lagoon
- local risk and environmental management committees, who take part in emergency situations
- local and national governmental institutions related to risk and environmental management
- municipality authorities responsible for their territories
- economic actors that profit from the Reserve´s natural resources, including small enterprises and the biggest investors (normally related to real estate)
- all users of the Reserve, who usually visit this area without being conscious that it is a protected area.

Carrying out the programme

To achieve an Integral Management of the protected volcanic area, World Geologists supported the constitution of the Association of the 7 Municipalities that Integrate the Basin and Territories of Laguna de Apoyo Reserve (AMICTLAN) (www.amictlan.com). For five years work has continued with this organization to build up bases.

In the first few years work was planned for medium and long term impact, building up bases for future actions:

- AMICTLAN has been consolidating as one of the national reference organizations for environment, risk management and governance and the main reference for the management of the Laguna de Apoyo Natural Reserve. The members of the association, town councillors and majors of the 7 municipalities (Photo 1), despite irregular participation, are increasingly more supportive and cooperative.
- Creation of a competent Technical Department capable of developing and managing programmes (building up web, radio show, bulletin, Facebook, YouTube, etc.).
- Carrying out base studies needed to manage the territories correctly (geological cartography, geomorphology, slope instability susceptibility, flood hazards, land use, hydrogeology, socio-economic, land carrying capacity, ecologic studies, cadastral data, solid and liquid waste management, land zoning). The involvement of municipality technicians and national institutions in these studies was a priority and has been the key to understanding the research process, results and applications and the final validation. Results of studies have also been popularized and presented to the communities in various ways (local media, training events, work with communal organizations and presentations in all the communities near the area).
- Strengthening institutions working in the area (Municipalities, Environment Ministry Delegations, and Risk Prevention Organizations) with training courses and follow-up of technical cases.
- Making the population aware of risk and environmental problems (through media -bulletin, radio-, campaigns and exhibitions, training with teachers (Photo 2)). A

successful training programme for teachers of the 14 schools of the area was carried out to ensure a better outcome in terms of the environment and geology in the longer term.

Integral management of the Reserve

Once the base studies, institutional strengthening and basic population awareness were established, parallel Risk and Environmental Management and economic development actions took place:

- Promotion and support of environmental and land management legislation based on the studies carried out. In view of the threat of uncontrolled urban development and residential tourism projects, basic land management legislation was promoted with the local authorities. Studies based on land zoning and environmental regulation were approved in many municipalities, converted in both ordinances, and included in the General Management Plan of the Reserve, approved finally in January 2010 by the Environment Ministry (MARENA, Resolution 01-2010). A programme of communication with the public was conducted with a roving exhibition and other media events. Meetings with judges to show the Reserve probles and explain the new legislation produced great results. Technicians from AMICTLAN and World Geologists were invited to prepare technical national laws (NTON 05 002-08, Protection and environmental conservation regulations of Crater Lagoons; Nicaragua Land Management Law).
- Creation and training of local risk and environmental organizations (Communal and Municipal). Risk Response Brigades Were established and furnished with risk equipment (Photo 3) and necessary mitigation works were made. The damage from dry season forest fires and local floods were considerably reduced.
- Survey actions with hired Reserve Rangers and municipality and AMICTLAN technicians were established, as well as cleaning campaigns, risk reduction campaigns, support for rural workers and cooperatives to make their activities more sustainable, and a follow-up of legal cases and infractions.

Toward sustainability and collaborative management.

With continuous management of the needs of the Reserve achieved, actions were focused on the sustainability of AMICTLAN and the Reserve by:

- Promotion of sustainable economic development (stimulating tourism - guides, cooperatives, organic farming, generation of prevention and environmental management for businesses).
- Designing, building and setting up the Natural Reserve Visitors Centre as a reference point in environmental education (Photo 4), risk management and touristic promotion. This multipurpose building works as the main office of AMICTLAN and the Reserve Rangers, museum, meeting point for guides and nature tracks, training room, communication and monitoring reception station and emergency refuge. It has become a centre for organizing the management of the protected area and promoting sustainable development. It also brings some income that, together with funds from the municipalities, can assure economic sustainability of the project.
- Collaborative management. The programme has been working for the promotion of an authority for management, constituted by all the interest groups of the area led by MARENA.

Conclusions

Laguna de Apoyo´s management panorama has been substantially changed by the actions of the programmes. It has changed from being a Protected Area with no study base, regulations, survey or planning to become a national reference point for environmental protection and risk management, where municipalities work together with a solid technical and legal base towards the sustainable development of the area. The work has been carried out in a gradual way, first establishing the base with studies, strengthening and awareness; afterwards introducing planning and regulations, supporting local organizations and collaborating actively for the correct management of the area; and finally channelling efforts towards the economic, technical and institutional sustainability of the Natural Reserve and of AMICTLAN.

There are still lots of challenges ahead, sustainability being the most important. The support of World Geologists has progressively been reduced, in agreement with the NGO, AMICTLAN and ACCD. Nowadays the project lies directly in the hands of AMICTLAN and its local partners. With this strategy, the Technical Department of AMICTLAN and the municipality technicians have assumed more and more duties, and the local authorities assume more responsibility to reach the equilibrium between development, risk management and environmental protection.

We thank all the institutions that have collaborated with these programmes, especially: Agencia Catalana de Cooperación al Desarrollo, Ayuntamiento de Barcelona and Fundación Biodiversidad.

Photos 1-4 from top (see text for captions)

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EFG registration authority

Modernizing the Professional Qualifications Directive: an update on initiatives from Brussels

EU citizens providing a wide range of professional services to consumers and business are essential stakeholders in the economy and gaining employment or providing services in another Member State is a concrete example of a benefit from the Single Market. It has long been recognized that restrictive regulation of professional qualifications has the same stifling effect on mobility as discrimination on the grounds of nationality. Recognition of qualifications obtained in another Member State has thus become a fundamental building block of the Single Market. As highlighted in the Europe 2020 Strategy and the Single Market Act, professional mobility is a key element of Europe's competitiveness. Burdensome and unclear procedures for the recognition of professional qualifications were identified in the EU Citizenship Report 2010 as one of the main obstacles that EU citizens still encounter in their daily lives when exercising their rights under EU law across national borders.

Mobility of professionals is still low in the EU. The number of complaints, SOLVIT cases and questions raised with Your Europe Advice and analysis of these cases provide clear evidence of a need to modernize the rules. In addition, intra-EU trade in services (including professional services) represents only about 25% of overall trade within the EU. This share is far too low when considered against the background of the overall importance of the services sector to the EU economy (70% of GDP). More can be achieved.

Increased mobility would also respond to the challenge of filling high-skill jobs, as the active population declines. According to the projections of the European Centre for the Development of Vocational Training (Cedefop), 16 million more people will be needed to fill high-skill jobs by 2020, which under current trends will lead to severe shortages of qualified professionals. Some of these skills shortages could be filled by people with professional qualifications obtained outside the EU, who currently face major problems in having their qualifications recognized.

Enabling citizens to realize their individual right to work anywhere in the EU must be seen in a wider context. To take full advantage of the freedom of movement, professionals must have their qualifications easily recognized in other Member States. It is therefore essential that the Professional Qualifications Directive sets out clear and simple rules for the recognition of professional qualifications. At the same time, the rules must ensure high quality of services without themselves becoming an obstacle to mobility.

The European Union has already achieved a lot in this area: some professional qualifications, notably in the areas of health, architecture, crafts, trade and industry are subject to automatic recognition; for all the other professions, the principle of mutual recognition on the basis of a "general system" has been introduced successfully. In 2005, these rules were complemented by a new lighter regime to facilitate temporary mobility. These rules benefit millions of professionals in Europe. It is estimated that the system of automatic recognition on the basis of harmonized minimum training requirements alone applies to 6.4 million citizens.

In January 2011, the DG Internal Market and Services published a Consultation document on the modernization of the Professional Qualifications Directive. EFG were amongst the 371 organizations that responded. The main conclusions stemming from the consultation are the following:

- The majority of respondents are in favour of improving citizens' access to information and further simplifying procedures.
- The principle of partial access to a profession – as developed by the Court of Justice – is not widely known and appears to be controversial.
- All citizens and educational bodies and many governments and professional organizations consider that it is necessary to support mobility of young graduates seeking to pursue a remunerated supervised practice in other Member States. Competent authorities seem more divided. It appears that the underlying jurisprudence of the Court of Justice is not well known.
- The development of a European professional card is supported by a large majority of stakeholders within all groups. Many respondents see in the card a means to increase transparency, enhance confidence and forge closer cooperation between Member States. Some respondents consider that the card could also reduce bureaucracy and help to speed up the recognition process. Most respondents consider that the card should be linked to the IMI and that the IMI should be strengthened. Others consider that it would be of benefit to link the card to a central database containing all relevant information. A small minority rejects the idea of the card altogether and suggests focussing only on improving the IMI.
- Opinions vary widely on the idea to replace the concept of common platforms by European curricula. Some respondents, notably certain competent authorities and professional organizations, foresee difficulties in moving away from common platforms towards a kind of 28th regime under a European curriculum. Many governments, but also educational bodies, are in favour of developing new mechanisms to extend automatic recognition to professions beyond those which currently enjoy it under the Directive.
- Views on the risk of an excessive number of regulated professions differ and suggest that this topic is quite controversial. Many respondents consider that no particular action is necessary, while some strongly argue that there is a serious issue.
- Stakeholders have mixed views on the idea of a lighter regime for professionals accompanying consumers from another Member State: citizens and professional organizations are mainly in favour whilst competent authorities largely oppose the idea.
- A large majority of respondents consider that there is no need to simplify the rules on temporary mobility, including on pro-forma registration, under the Directive. Clarification of what "temporary and occasional" provision of services means is often requested.
- There is also widespread satisfaction with the system of automatic recognition for craft, trade and industry activities, which is largely based on a minimum duration of professional experience. However, most respondents deem it necessary to simplify and update the list of activities in Annex IV of the Directive.
- The majority of respondents would like a future Directive to put more emphasis on continuous professional development (CPD). The main idea is that professionals who did not follow domestic requirements on CPD in their home Member State should not benefit from automatic recognition in the host Member State.

- Sufficient language knowledge by professionals is seen by almost all respondents as necessary for their integration into another country.

The results of the consultation fed into the Green paper on the modernization of the Professional Qualifications Directive which the Commission published on 22 June 2011. At the time of writing, EFG are responding to the Green Paper, and this will be placed on the EFG web site as soon as it is submitted.

A legislative proposal to modernize the Directive is planned for the end of 2011.

For those interested in reading more, the relevant documents are available on the EFG web site at the following links:

Consultation paper, February 2011:
http://www.eurogeologists.eu/images/content/News/consultation_paper_en%20Feb%202011.pdf

EFG response to consultation paper, March 2011:
http://www.eurogeologists.eu/images/content/News/EFG%20Consultation%20Paper%20-%20Questions%20%20FINAL%2014%20Mar%202011.pdf

Summary of responses to consultation paper, July 2011:
http://www.eurogeologists.eu/images/content/News/20110706-summary-replies--public-consultation-pdq_en.pdf

Green paper proposal, July 2011:
http://ec.europa.eu/internal_market/consultations/docs/2011/professional_qualifications_directive/COM267_en.pdf

David Norbury
Independent Consultant and Chair, EFG Registration Authority

Board activities May – November 2011

E-meetings, 13 May to date:
Ruth Allington (President), Nieves Sanchez (Vice President) and Isabel Fernandez (Brussels Office Director). Regular meetings of the 4IPGC Technical Committee. Managing call for papers, selection of abstracts and planning of conference sessions.

Vienna, 22-23 May:
Ruth Allington (President), represented EFG at the EAGE (European Association of Geoscientists and Engineers) annual President's dinner and congress.

Brussels, 2-3 July:
EFG Board meeting attended by all members of the Board, Isabel Fernandez (Brussels Office Director) and Anita Stein (Brussels Office Assistant).

Ljubljana, 27-28 July:
Eva Hartai (EU Delegate) took part in the PANGEO Project Meeting. It was the second progress meeting of the project. The partners discussed the on-going activities in the different work packages and formed a strategic plan for the future phases of implementation.

Bloomingdale Illinois, USA, 9-14 September:
Ruth Allington (President) represented EFG at AIPG's executive meetings (9-10 Sept) and at the annual meeting immediately following. She made a presentation at the AIPG executive meeting and contributed to discussions. She also made a presentation for EFG at the technical meeting (jointly authored by Isabel Fernandez) entitled "The roles and responsibilities of professional geoscientists in delivering and adding value to sustainable construction, mining, energy and natural hazard mitigation projects". During the meeting she attended informal planning sessions with representatives of AIPG and Geoscientists Canada for 4IPGC.

Belgrade, 14-16 September:
Eva Hartai (EU-Delegate) took part in the MAEGS 17 Conference "Geology in Digital Age in Belgrade. She made a presentation in the Session Geoinformation in Europe entitled "Qualification Framework for Higher Education - the EuroAges Project".

Ljubljana, 22-23 September:
Ruth Allington (President) represented the EFG at the final conference of the SARMa project (sustainable aggregate resources management in SE European countries) and made an invited contribution: "The quarry design process as an essential framework for sustainable planning and operation of aggregates quarries".

E-meeting, 30 September:
EFG Board meeting attended by all members of the Board and Isabel Fernandez via GoToMeeting.

Brussels, 14 October:
Ruth Allington (President) attended an open meeting on the future of GEOTRAINET. The President chaired a session at the meeting, which attracted around 35 participants from more than 10 European countries.

Wrocław, 20-21 October:
Ruth Allington (President) represented the EFG at the conference "Sustainable Production and consumption of mineral resources – integrating the EU's social agenda and resource efficiency" and presented a paper "The roles and responsibilities of professional geoscientists in ensuring sustainable mineral production". She also participated as a member of an expert panel in a discussion of the final communiqué and had discussions with Polish delegates about progress with re-joining the Federation and with Romanian geologists about the possibility of joining.

London, 31 October – 3 November:
Ruth Allington (President), represented EFG as keynote speaker at a workshop on 31 October organized by CRIRSCO (with support from ICMM and MinSouth): "Competency in International Minerals Reporting". Her presentation was entitled: "Competent person concepts in European countries and mobility of technical professionals between member states". She also attended the half day open session of the CRIRSCO annual general meeting on 1 November, and participated in two half-day workshops on Thursday 3 November: "International minerals reporting and globalization" and "Reporting standards implementation and regulation". She has been co-opted to be on a PERC working group to assist Turkey in developing a CRIRSCO compliant reporting code. During the week she had informal discussions with the Chairman of UNECE about the relationship between the high-level UN Framework Classification and project and company specific CRIRSCO reporting codes. Actions were agreed to clarify this relationship more clearly.

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 info.efg@eurogeologists.eu. Photographs or graphics are very welcome and should be sent to the Editor as tif or jpg files in CYMG colour. Further details may be found on the EFG website: www.eurogeologists.eu

Deadline for submission 30 April and 30 October.

Contact:

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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), Croatia (CGS), Cyprus (CAGME), Czech Republic (CAEG), Finland (YKL), France (UFG), Germany (BDG), Greece (AGG), Hungary (MFT), Ireland (IGI), Italy (CNG), Netherlands (KNGMG), Portugal (APG), Russia (NAEM), Serbia (SGS), 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 50,000 geologists across Europe.

Mission

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

Objectives

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

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