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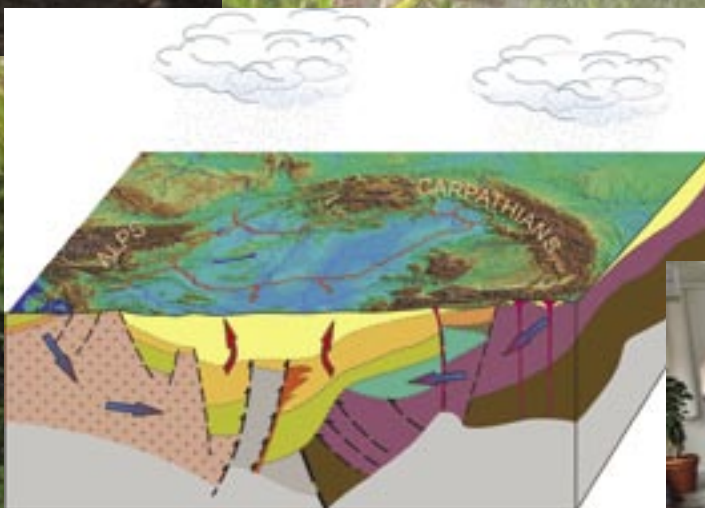
May 2011

European Geologist

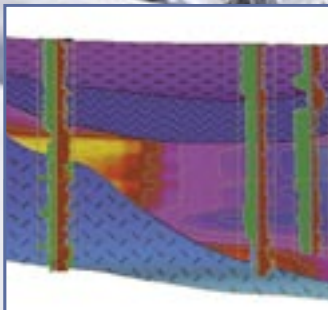
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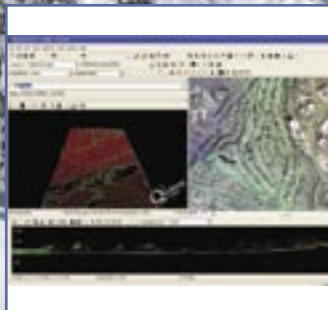
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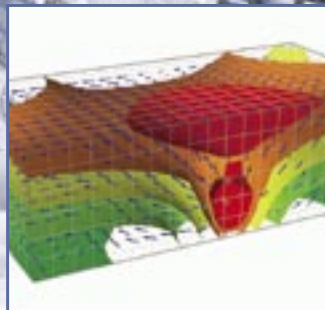
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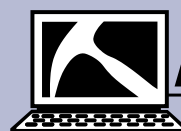
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Main photo: Dolomite quarry, Slovenia (Photo: A. Burger). Smaller photos, from top left: Geotrainer training course, practical visit; the Pannonian Basin in central Europe; Geotrainer training course, classroom.

Logos this page:
Clockwise from top right: SARMa; PanGeo; Terrafrima; Transenergy with European Regional Development Fund; Geotrainer with Intelligent Energy Europe.

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Foreword

EU projects

by EurGeol. Ruth Allington, President

The EFG believes that well educated and trained professional geoscientists working transparently with other professionals and communicating effectively with the public are essential to ensuring public safety, promoting responsible use of natural resources and contributing to a sustainable natural environment. It contributes to this through promoting excellence in the application of geology and creating public awareness of the importance of geology in society.

This edition of European Geologist is a thematic issue on EU projects with geological components that are in progress or have recently been completed, and which are directly relevant to the values and mission of the EFG as expressed above.

Of the projects covered in this issue, three (Geotrainet, Terrafirma, and PanGeo) have had direct EFG involvement as co-ordinator or partner. The Geotrainet project was co-ordinated by EFG and has developed and delivered training courses for designers and installers (drillers) of shallow ground source heat pumps. Terrafirma and PanGeo are both concerned with the commercial application of satellite monitoring of ground movements. PanGeo aims to enable free and open access to geohazard information in support of GMES (Global Monitoring for Environment and Security). EFG's role in both of these projects is as a project partner representing end users of remote sensing products.

Through the activities of the EU Delegate, President and expert groups, and by contributing to consultations and participating in dissemination events, EFG has kept in touch with the progress and emerging results of many other projects with which it is not directly involved as a partner, but which are relevant to the objectives and interests of EFG and the wider professional geology community. In this issue, we are delighted to have articles about:

One Geology Europe
Digital geological map of Europe

SARMa
Development of a framework for delivering sustainable aggregates resource management and supply.



Transenergy.

A project that considers how geothermal energy resources that straddle national boundaries can be developed and exploited in a sustainable way by reference to the example of transboundary geothermal resources in Slovenia, Austria, Hungary and Slovakia.

In the centre pages, you will find the abstracts for the contributions to our forthcoming workshop on "Geology at Different Educational Levels in Europe" (Budapest, 19 May). This workshop is being convened by Eva Hartai and her colleagues in Hungary who were also important project partners in the EuroAges project – it will present and build on the results of that project and take forward the discussion themes that emerged during the final conference for that project.

Finally in this Foreword, I'd like to draw your attention to EFG's contributions to two important consultations in the past few months: *EFG Response to the European Commission Public Consultation on the Recognition of Professional Qualifications Directive*

(<http://www.eurogeologists.eu/>)
and *EFG Comments on Discussion Paper "Raw Materials for a Modern Society"*, February 2011

([http://www.eurogeologists.eu/images/content/panels_of_experts/minerals_and_their_sustainable_use/EFG_comments_discussion_paper_Raw_materials_for_a_modern_society\[1\].pdf](http://www.eurogeologists.eu/images/content/panels_of_experts/minerals_and_their_sustainable_use/EFG_comments_discussion_paper_Raw_materials_for_a_modern_society[1].pdf)).

GEOTRAINET

Geo-Education for a sustainable geothermal heating and cooling market: European project results

by I.M. Fernandez Fuentes¹, B. Sanner², R. Allington¹, P. Dumas², O. Andersson³, G. Hellström³, D. Banks⁴, J. Urchueguía⁵, F. Jaudin⁶, H. Huber⁷, D. Cucueteanu⁸ and G. Ll. Jones⁹

The European Federation of Geologists has been the coordinator of a large group of partners who have successfully completed a European project for the training of professionals to install shallow geothermal systems. The project's objective was to develop education programmes as a first step towards certification of geothermal installers. As a result, education programmes have been developed, for designers and drillers of shallow geothermal facilities, with didactic materials, ten training courses in eight European countries, an e-learning platform, information and access to geological data required in these types of installations and, finally, it has developed a training structure at European level, which aims to continue training as a basis for the proposed GEOTRAINET certification structure.

La Fédération Européenne des Géologues a représenté un élément de coordination entre les nombreux partenaires qui ont achevé avec succès le projet européen destiné à la formation de professionnels pour l'installation de systèmes géothermiques à faible profondeur. L'objectif du projet consistait à développer des programmes éducatifs en tant que premier pas vers la certification des professionnels en géothermie. Ainsi, les programmes éducatifs ont été développés pour les installateurs et foreurs de systèmes géothermiques peu profonds, en utilisant des outils didactiques et une série de 10 modules de cours, dans 8 pays européens, une plate-forme d'enseignement à distance ainsi que l'information et l'accès aux données géologiques requises pour ce type d'installation. Finalement, il a été développé une structure de formation à l'échelle européenne dont le but est une formation continue à valeur de base pour la recommandation d'une structure de certification GEOTRAINET.

La Federación Europea de Geólogos ha sido la coordinadora de un amplio grupo de socios que han culminado con éxito un proyecto europeo para la formación de profesionales de la instalación de sistemas geotérmicos someros. El objetivo del proyecto era diseñar programas educativos, como primer paso para la certificación de instaladores geotérmicos. Como resultado del proyecto, se han desarrollado programas educativos para diseñadores y sondistas de instalaciones de geotermia somera, con material didáctico, diez cursos de formación en ocho países de Europa, una plataforma de formación on-line, información y acceso a los datos geológicos necesarios para este tipo de instalaciones y finalmente se ha desarrollado una estructura formativa a nivel europeo que pretende continuar la formación como base para la estructura de certificación GEOTRAINET propuesta.

Ground Source Heat Pumps (GSHPs) contribute greatly to energy saving and emission reduction. In Europe, a sustainable market has been established in only a few countries such as Sweden, Switzerland, Germany and Austria. One of the barriers to a sustainable and growing geothermal market is



the lack of appropriate skilled personnel, and quality of design and drilling is not always satisfactory. Furthermore, to maintain quality, a certification programme for GSHP workforce is required.

Therefore, the GEOTRAINET project, supported by the European Commission's IEE programme ("Altener" project no. IEE/07/581/SI2.499061), aims to develop a European-wide educational programme as an important step towards the certification of geothermal installations. From the different groups of professionals involved in a GSHP installation, the GEOTRAINET project focuses on two target groups: designers (those who carry out feasibility and design studies, including geology) and drillers (who make the boreholes and insert the tubes).

The project took place from September 2008 to February 2011. The long term vision of the project includes the development of education structure and certification to continue support in the growing

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www.geotrainet.eu



industry of geothermal energy with a view to protecting the environment and ensuring high quality standards for customers.

During this time, education programmes for designers and drillers of shallow geothermal facilities, didactic materials, training courses, an e-learning platform, information and access to geological data required in these types of installations, a training structure at European level, and a GEOTRAINET certification structure have been developed.

During the first period of the project, a platform of European GSHP experts researched the necessary data for GSHP design and installation. These experts cover the range of specialities involved and represent European countries from different geological and climatic zones. They evaluated the skills and knowledge required to design, drill and install GSHPs and created curricula for GSHP designers and drillers.

During the 10 training courses held by partners based in Belgium, France, Germany, Ireland, Romania, Spain, Sweden and the UK, the didactic materials have been evaluated and optimized. The courses cover all issues relevant to Shallow Geothermal Design from concept and feasibility studies, through design and integration to installation and regulation. The project also aims to improve access to geological data since adequate understanding of the geological setting of the installation site is a mandatory issue for the design of every GSHP.

The vision of the GEOTRAINET project is that the training and certification programme will be recognized all over Europe and provide benchmark standards for consistent voluntary further education in the shallow geothermal field in all participating countries. The training is essential for people interested in becoming shallow geothermal accredited designers and drillers. EFG supports this training as an activity for Continual Professional Development of Geologists in Europe.

The results of this project have been due to the high quality of the project consortium, the excellent collaboration between partners and enthusiasm given by each of the experts who participated in the project.

The geographical distribution of the GEOTRAINET partners in Europe is presented in Figure 1.

The GEOTRAINET project group comprises:

- European Geothermal Energy Council (EGEC)
- European Federation of Geologists (EFG)

research institutes:

- BRGM (the French Geological Survey)
- Arsenal Research of Austria

universities:

- Newcastle University, UK
- University of Lund, Sweden
- Polytechnic University of Valencia, Spain

private companies:

- GT Skills of Ireland
- The Romanian Geoexchange Society



Figure 1. Geographical distribution of GEOTRAINET partners in Europe

Curricula for shallow geothermal professionals

The curricula and the contents of didactic material have been delivered by two GEOTRAINET panels of experts: Designers and Drillers. The experts from both panels have also been involved in the training courses. Over the lifetime of the project, the experts received support on specific topics from other persons involved

in the GSHP industry. These additional inputs, as well as the feedback from the training courses, have led to improvements in the curriculum and the course programmes.

Curriculum for Designers of shallow geothermal systems

The curriculum contains information and data necessary for designers of GSHPs.

The content is divided into seven sections, with 19 subsections. and develops topics as fundamentals and constraints for GSHP facilities, design introduction, integration of the GSHP installation with the ground and with the building, different GSHP system alternatives, GSHP installations and, finally, the regulation aspect, including environmental issues.

The levels of skills and knowledge expected of the participants are:

- Professionals with level 8 in the EQF system (European Qualification Framework)
- Professionals: engineers, geologists, technicians with 5 years experience
- Students: post graduate, more than 3 years in geology, engineering, hydrogeology, etc.

GEOTRAINET learning outcomes are statements of what a learner is expected to know, understand and/or be able to demonstrate at the completion of a course. As a final goal, the level of skills and knowledge

achieved as a result of the proposed training courses will be that the designers demonstrate the following key competences:

- Underlying basis on ground-coupling technology alternatives, GSHP limiting conditions, geological and geothermal parameters of the underground, basic hydrogeological knowledge, Borehole Heat Exchanger design fundamentals, and familiarity with different drilling and digging technologies
- Analysis, design and implementation: perform the feasibility study; understand the complexity of geological problems and the feasibility of their solution; choice of the optimum drilling method; prepare borehole reports including lithology, groundwater, ensuring protection of the environment (in particular, groundwater) while drilling; understand GSHP design criteria; understand Heat pump technology, to perform pressure tests; awareness of issues concerning the GSHP system alternatives selection: heating/cooling,

available ground area; deal with the relevant documentation including identification and drawing of drilling locations.

- Technological, methodological and transferable skills: to construct ground-water wells, to install the relevant pipes, pumps and control systems; to install borehole heat exchangers, to grout, backfill or otherwise complete the ground source system; skills for welding of plastic pipes and other connection methods; perform quality control; practical computer aided design sessions
- Other professional skills: understanding European Legal Situation and Standards; understanding environmental issues.

Curriculum for Drillers of shallow geothermal systems

The curriculum is divided into four sections; each section has subsections with the relevant topics, a total of 16 subsections including: introduction overview and

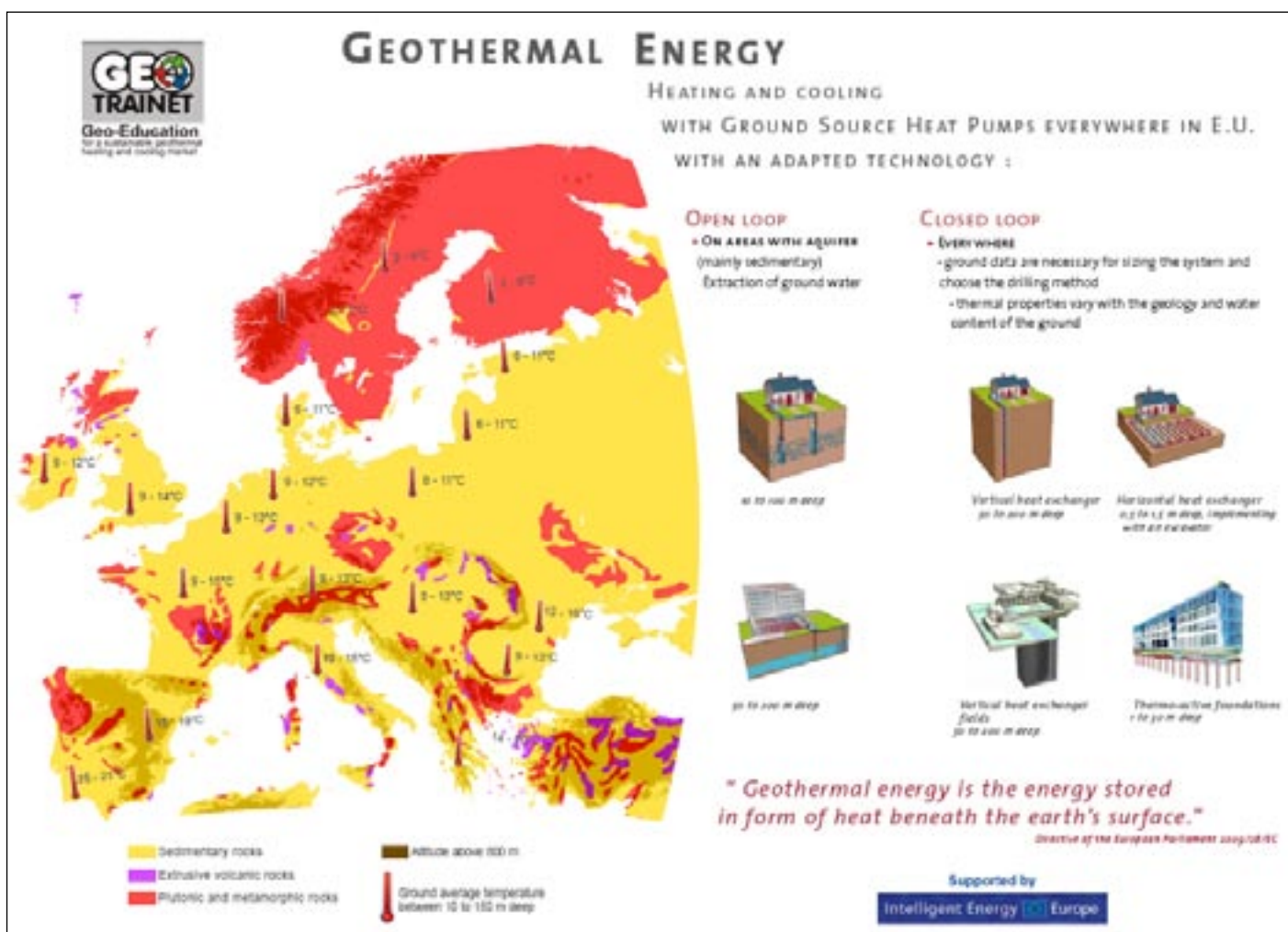


Figure 2. Relationship between geology, ground temperature and heating and adapted technology in GSHPs

limitations for GSHP facilities, shallow geothermal configurations and applications, boundary conditions, geology, drilling methods, test drilling and documentation, environmental concerns. There are also two specific sections on closed and open loop systems, and their relevance for drillers.

The levels of existing skills and knowledge expected of the participants are:

- Professionals with level 4 in the EQF system
- Professionals with 3 years of experience in drilling
- Students, background in mechanics

At the end and as a final goal, the level of skills achieved and certified as a result of the proposed training courses will be that the drillers/installers shall demonstrate the following key competences:

- understanding geological and geothermal parameters of the underground and knowing their determination, nomenclature and identification of soil and rock types, preparing borehole reports including lithology, groundwater, etc.; basic geological and hydrogeological knowledge
- familiarity with different drilling technologies, choice of the optimum drilling method, ensuring protection of the environment (in particular groundwater) while drilling
- ability to install borehole heat exchangers, to grout, backfill or otherwise complete the ground source system, and to perform pressure tests; skills for welding of plastic pipes and other connection methods
- ability to construct groundwater wells, to install the relevant pipes, pumps and control systems
- ability to perform the relevant documentation including identification and drawing of drilling locations.

Geological data for shallow geothermal systems

Adequate understanding of the geological setting of the installation site is a mandatory issue for the design of every GSHP. The geological parameters that must be investigated and defined at every site in order to provide essential design information include:

- identifying all the rock and soil materials beneath the installation site

- identifying the depth and geometry of the interface between soil and rock
- characterizing each soil or rock material present in terms of its disposition in the ground, and its geomechanical, thermal and hydrogeological properties and behaviour.

Because geology is one of the key determining factors for choosing the most suitable technology, its implementation and its design at any given site, the GEOTRAINET project compiled a database which identifies sources of geological data online in EU countries. For EU countries where no direct web-based access is available, the GEOTRAINET resource provides information on the available media and modes of access to geological data. The local geological data are necessary to make the geothermal energy choice, but in all cases a feasibility study conducted by engineering consulting firms specializing in geology is indispensable for any GSHP project.

A poster has also been produced, with general information about the main existing rocks in Europe, the average ground temperature between 10-150 m depth and the relationship with the most appropriate technology with ground source heat pumps for heating and cooling (Fig. 2).

To better understand the influence of ground conditions on geothermal installations, the project has also delivered guidelines to facilitate the acquisition of adequate geological data to evaluate and size GSHP projects. To choose the right system for a specific installation, the geological and hydrogeological setting of the site must be investigated and modelled to give the ground-related parameters needed for successful and sustainable design. The guidelines present the different ground

systems linked with heat pump, injection or extraction of heat into or from the ground, impact of geological data for choosing or sizing the ground part of the GSHP, the necessary geological data for each stage of the project and how to collect and evaluate the geological data.

GEOTRAINET training courses

During the project period, ten courses have been delivered with a total of 380 participants. In the context of DIRECTIVE 2009/28/EC on the promotion of the use of energy from renewable sources (RES) April 2009, there is a very high demand for training courses delivered in all EU countries. The first two GEOTRAINET courses were aimed at trainers in Europe; there were also four courses for Designers and four courses for Drillers delivered by the trainers and members of the expert platform.

The involvement of participants from different countries and with a range of experience and qualifications has provided a very rich forum for the GSHP sector. Figure 3 shows the training activity schedule.

The courses for training the trainers were presented as of interest to those with experience in the design and installation of shallow geothermal systems and in the delivery of training and dissemination of these subjects. Delegates were provided with presentation material to assist in the development of training courses in their own countries. This will be part of an ongoing process towards the creation of a European certification Framework for shallow geothermal installers, and raising and coordinating national and European standards in GSHP systems. Moreover, the training courses for designers were of

Figure 3. Geotrainet course during the project period



interest to those who have existing experience of the design of GSHP systems and to those who are intending to develop professional competence in this field. The course focused primarily on closed loop GSHP systems. Finally, the aim of the courses to train drillers responded the demand from the market on GSHP. The drillers normally have a background in mechanics and work for drilling companies in water, foundation engineering, etc.; only a few are SMEs fully involved in geothermal energy.

For each training course, participants were asked to fill out a questionnaire for evaluation of the course. The feedback has allowed refinement and improvement of the course programmes, and consequently also continuous improvement of the didactic material presented in the manual, which has been a living draft throughout the project.

During the project period, GEOTRAINET has trained almost 400 professionals, from 22 countries and with a range of qualifications. (Tables 1, 2 and 3)

Didactic materials

GEOTRAINET training manuals

The GEOTRAINET project has delivered two Training Manuals, one for Designers and one for Drillers of Shallow Geothermal Systems. This manual has been developed for European experts on GSHPs and it is intended to provide relevant and accessible support for their ongoing education. It is based on the curriculum developed by an international platform of experts from the GSHP sector over the period of the project.

The manuals are designed as the course text for a formal training programme in the design of GSHPs, including practical demonstrations and case studies based on experience. Successful completion of the GEOTRAINET training leads to the award of a European certificate, for which a system of European accreditation has been proposed as part of the project.

The Manual for Designers is a document of 190 pages, with seven sections divided into 19 chapters. The document was presented at the Brussels Training course for Designers, 24-26 January 2011, and in the GEOTRAINET Final Conference. The Manual for Drillers has four sections divided into 16 chapters, including specific items for closed and open loop systems. Both documents will be available on www.geotrainet.eu

Presentations

The experts have been involved in the

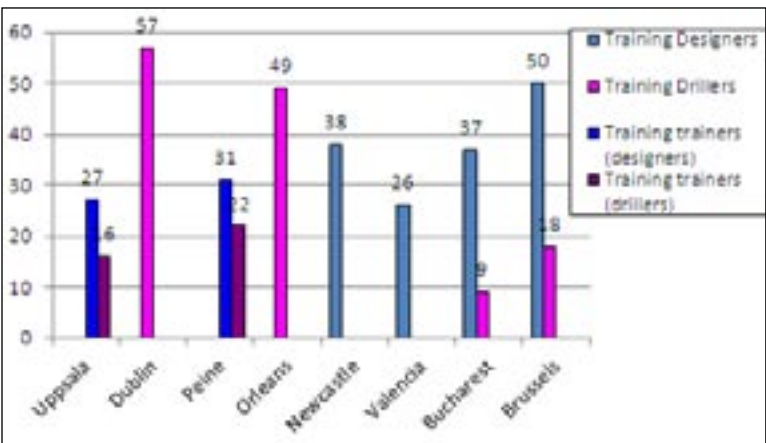


Table 1. Number of participants by training course

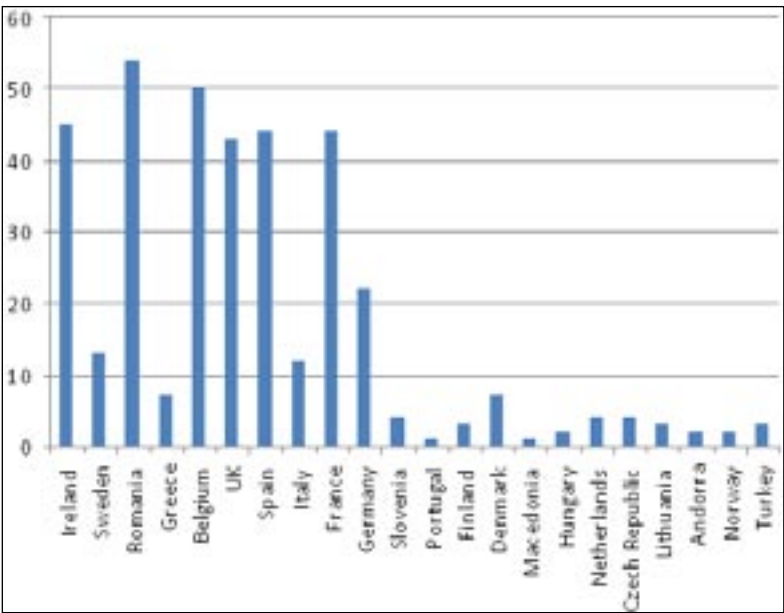


Table 2. Nationalities of the participants

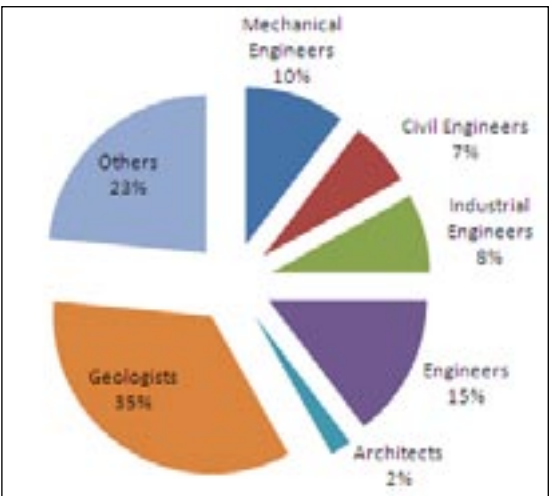


Table 3: Qualifications of the participants

training courses and their experience has been used to improve the course programme and presentations. All participants receive the presentations for each training course and all are available on the Geotrainet website.

E-learning platform

The training course for Designers is available as an e-learning course, on www.geotrainet.eu. The course is available to the public, after registration.

The Designers e-learning course is based on the curriculum developed by an international platform of experts from the GSHP sector over the period of the project, presented in the first point of this document. The course is split into the seven sections and 19 chapters. Each chapter contains a text and power point presentation, with an evaluation system based on 20 questions. The student can access the answers.

GEOTRAINET education and certification structures

As shallow geothermal systems continue to capture an increased market share, the need for competent designers and drillers also increases. The overall idea of the training programmes is to provide the market with trained experts in the field of shallow geothermal technology. An accredited training system is seen as the most effective way to prevent the market becoming saturated with low-quality, poorly-installed systems.

In the context of the DIRECTIVE 2009/28/EC on the promotion of the use of energy from renewable sources (RES) April 2009, GEOTRAINET supports the implementation of Article 14: Member, related to the certification schemes or equivalent qualification schemes for installers of shallow geothermal systems.

The GEOTRAINET project ended in February 2011. One of the outcomes is a concept for training and certification of drillers and designers, which was developed by the project partners representing their countries. To continue the work on a European level, the project partners formed an education committee, located at EGECE/EFG, European Education Committee, EEC.

The common understanding is that the EEC should keep the quality standards at an equal high level in all participating countries. The committee particularly coordinates education and certification activities in different countries and initiates new activities, e.g. through new research results or market demands. Figure 4 shows the coordination between the EEC



Figure 4. GEOTRAINET education and certification structures

and the Training and Certification Boards. The structure provides a common standard for European nations.

The European Training Board has, as its main objectives: maintenance of the training commitment including the mission statement, training targets, training standards, records; updating and refinement of established training standards; transfer and exchange of knowledge at European level; templates of documents for trans-national co-operations; continuing information exchange; monitoring of quality of national training schemes; promotion of the GEOTRAINET label.

The National Training Coordinator has, as its main objectives: implementation of the international training standard and definition of specific adaptations needed at a national scale; reporting to international education committees of required amendments and adaptations of training standards; notification of any changes in training systems to national training institutes; dissemination of training programmes at national level; and communication to national training institutes.

The European Certification Board is monitoring the quality of implementation and performance of the certification scheme and its compliance with the European certification standards and guarantee that the certification programme will be maintained at an international level. The board is also supporting the continuing exchange of information and experiences between members, updating and refinement of the standards at regular board

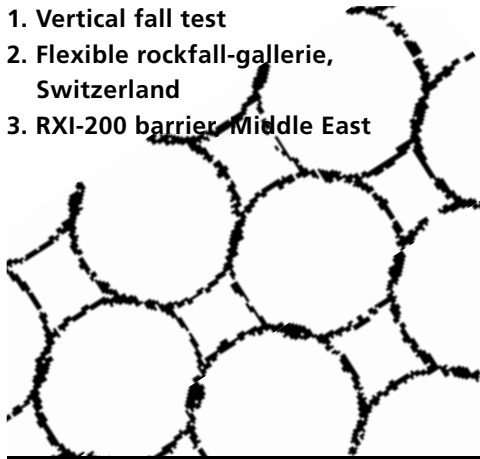
meetings.

The National Certification coordinator maintains the agreed certification standards at a national level. The main targets are: maintenance of close collaboration with the GEOTRAINET National Training Coordinator; ensuring the continuation of the European GEOTRAINET training programme and to enable a continuously updating of the program and the expansion of the system to new countries, with a stable financial basis; implementation of the European certification scheme into the national framework system and definition of specific adaptations needed at a national scale; reporting to the European certification board on required amendments and adaptations of the certification scheme; notification of any changes in the scheme to the operative certification body; dissemination of the certification scheme at national level (Fig. 4).

Conclusions

The vision of the GEOTRAINET project is that the training and certification programmes will be recognized all over Europe and provide benchmark standards for consistent voluntary further education in the shallow geothermal field in all participating countries. The training is essential for people interested in becoming shallow geothermal accredited designers and drillers. EFG supports this training as activities for Continual Professional Development of Geologists in Europe.

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Terrafirma Extension: an update on current EFG involvement

by David Norbury¹



I last wrote about EFG involvement in the Terrafirma project in European Geologist 26 (December 2008) and so it is time for an update. Since that time the initial stages of the project have been completed and the programme has now translated into the third stage, called Terrafirma Extension (TFX). We are currently coming up for 50% of the way through this three year stage which started at the end of 2009.

The main objective of the Terrafirma Extension (TF-X) project is to consolidate the services and products developed in Terrafirma 1 and 2 (TF1 and TF2) to provide an operational service portfolio.

Terrafirma, during phase 1 and phase 2, was able to bring Terrain Motion Maps to more than 51 users in 29 countries (Fig. 1). Based on the exemplary and focused results of TF1 and 2, the interest amongst the user community is well structured in moves towards achieving product sustainability.

The goal of TFX is to maintain and extend this group of users. During phase 2 of the Terrafirma project, the consortium carried out a validation activity to assess the PSI-element accuracy and the interchangeability of the different processing chains used within the operational structure. This provided concrete accuracy statements and demonstrated the interchangeability of the PSI output from the consortium.

All the products coming from the Terrafirma project will be based on SAR images with the operational data coming from the ERS (SAR), Envisat (ASAR) and Terrasar-X satellites. The consortium will make use of Sentinel-1 mission SAR data in the future since it will assure the continuity of data and consequently represent a key issue in the sustainability of Terrafirma services.

Terrafirma has identified four thematic products which are described below, and these are used in the organization of the project.

Hydrogeology theme services

The objective is to deliver European geo-information services for hydrogeological

hazards affecting urban areas, mountainous areas and infrastructures. For this purpose, a multi-hazard approach will be addressed concerning the ground motion directly or indirectly connected with the hydrogeological systems. In particular, the expected causes of ground motion should be mainly linked to groundwater over-pumping and recovery from pumping, mining, above ground and underground construction and slope instability.

The activity includes 13 test sites in Europe and the service baseline is structured into the following sub-themes:

- Groundwater management
- Abandoned / inactive Mines
- Mountainous areas

The users involved in the hydrogeology theme are the national geosciences institutes and/or surveys, in part already involved during Stages 1 and 2 of Terrafirma, distributed amongst the 26 countries where ground motion problems related to hydrogeology mechanisms have been identified.

Groundwater management

The development of existing products for those cases in which a link between the identified mechanisms and the underground hydrogeology systems has been supposed; this activity is aimed at fully exploiting the past actions of TF for a geohazard information service at the European level.

For the areas characterized by severe groundwater exploitation, the value adding activity will be related to GIS mapping, geological and hydrogeological interpretation and modelling of subsidence due to groundwater over-pumping.

For above ground and underground construction, the value adding activity will be related to GIS mapping and interpretation, strongly dependent on the availability of field data, of a variety of geological and anthropogenic factors such as natural

subsidence related to sediment compaction, urbanization impact and building loading, underground engineering works, underground natural and man-made cavities.

The users' involvement and their active participation will be obtained through educational activity, mainly based on users training (on-site sessions, joint workshops), strongly focused on the practical use of the product aimed at the autonomous geo-interpretation of updated data.

Abandoned/inactive mines

Abandoned mines represent a severe environmental threat, with important consequences such as sediment contamination, water and air pollution, ground instability (mine subsidence and sinkholes).

Mine subsidence can be defined as movement of the ground as a result of the collapse or failure of underground mine workings: surface subsidence features usually take the form of sinkholes or wide downward shifting areas.

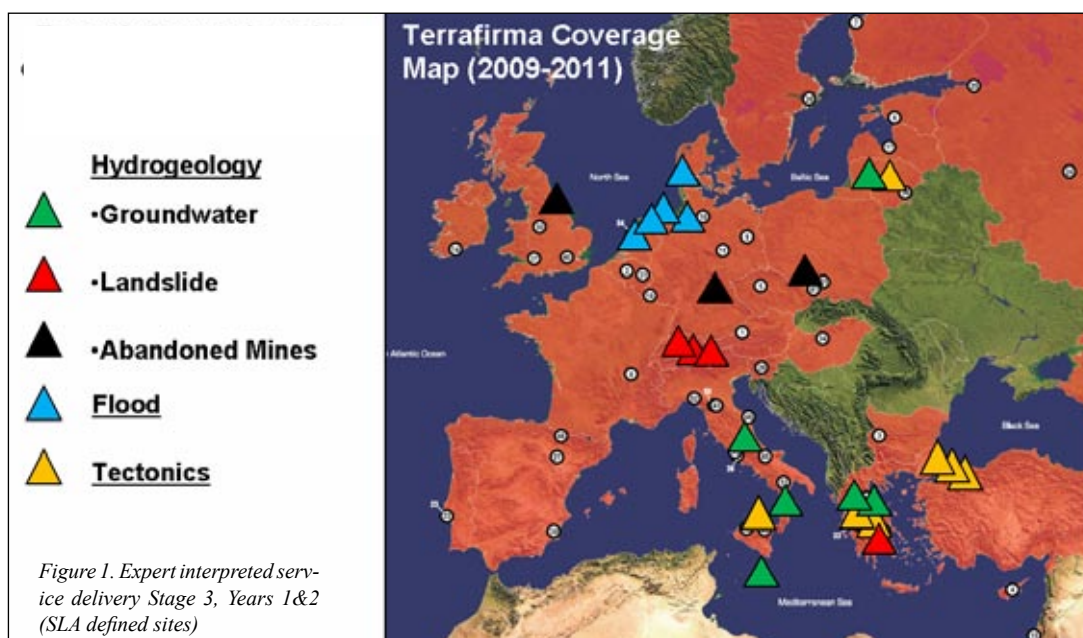
These phenomena are more important above shallow mines, resulting from the collapse of the roofs and pillars of underground rooms, with a consequent caving of the overlying strata and depression in the ground surface. Where the mining areas are widespread, the punctual sinkhole phenomena can develop in cluster systems, causing large subsidence, with extensive damages to structures and properties throughout the years.

The TF service on this topic will be devoted to the analysis of areas in Europe where mine subsidence is an important constraint on urban planning, evaluating the historical trend of the phenomena: the value adding activity will be related to GIS mapping, geological and structural interpretation of subsidence due to the mining activity, assessment of relationship between limited sinkhole events and development of wide subsidence areas.

Mountainous area

This service covers three test sites in Switzerland related to slope instability in mountainous areas. TFX will provide InSAR data processing.

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Tectonics theme services

The objective is to provide services that present information on seismic hazards oriented towards the needs of the end user. The transboundary nature of tectonics and the large areas affected answer to the requirements of the European level of the service and the multiple frame/track exploitation of PSI to account for wide area coverage. The following two macro services are envisaged.

Crustal block boundaries

The service is designed to exploit the analysis of surface movements recorded at a large scale. Moreover, in-situ data such as GPS measurements, optical levelling, geological mapping and seismological scenarios are combined with PSI data to perform a cross comparison, which can increase the effectiveness and reliability of the service. This approach is designed to provide a monitoring service along and across major faults to measure fault slip rates and estimate locking depths. Furthermore, the service is also designed to detect local active faults reactivated soon after major seismic events.

The service is oriented towards measurement of surface deformation through the overall earthquake cycle. Analysis of the earthquake cycle is a key issue for the definition of the hazard in seismic areas.

This service exploits the PSI analysis applied to measuring vertical surface movements in urban areas prone to seismic risk which aims to strengthen the scientific database to investigate the cause of subsidence and to identify the source (tectonic vs. non-tectonic/man made) of such effects.

The vertical PSI data can be compared with *in situ* levelling and GPS to cross-validate the results.

Vulnerability maps

The capability of PSI in obtaining very dense spatial data and detailed measurement of surface displacements provides input data to be added and integrated into *in-situ* measurements to compute vulnerability maps. The PSI maps and their integration with local data will lead to products that contribute to a deeper investigation of the effects of active tectonics, especially focused on the environment and human activities. The service can also contribute to the investigation of possible causes of surface movements, providing the discrimination between primary tectonic displacements and seismically induced movements.

Moreover, TFX can provide data towards understanding earthquake preparation and initiation processes:

- Sharing tools for analyzing and modelling multi-disciplinary data (borehole, ground and space-based monitoring data)
- Imaging fault zone structure and geometry
- Analysing and modelling seismogenic processes through time using multidisciplinary observations.

Flood Theme services

The TFX-Flood Theme is comprised of a portfolio of services to be delivered for Flood Risk assessment in coastal lowland areas and flood-prone river basins. The following issues are to be covered by these services

from a user point of view:

- Services need to cover the entire area to be exposed by a flood risk. From the user's point of view, this means that services need to consider multiple scenes and wide area coverage
- Flood protection generally involves linear flood defence structures over long distances. The quality of flood defence typically depends on the weakest link along such natural or man-made defence structures which means that services need to be able to detect local ground movement over long stretches.

This theme reflects TerraFirma's approach as it is envisaged to demonstrate and promote the value of PSI in coping with one of the potentially most damaging natural hazards that affect large areas in Europe. The Flood Theme directly relates to the EU-Flood Directive (Directive 2007/60/EC) on the assessment and management of flood risks. This Directive now requires Member States to assess whether any water courses and coastlines are at risk of flooding, to map the flood extent and assets and humans at risk in these areas and to take adequate and coordinated measures to reduce this flood risk. This Directive also reinforces the rights of the public to access this information and to have a say in the planning process. The Directive requires Member States to first carry out a preliminary assessment by 2011 to identify the river basins and associated coastal areas at risk of flooding. For such zones they would then need to draw up flood risk maps by 2013 and establish flood risk management plans focused on prevention,

protection and preparedness by 2015. The Directive applies to inland waters as well as to all coastal waters across the whole territory of the EU.

Three types of services are envisioned within the TFX-Flood theme:

PSI-wide area service

This service will deliver PSI-derived layer and database. Specifically for Flood Hazard mapping, wide areas will be processed by combining multiple scenes, in order to be of use to water management agencies responsible for large basin or floodplain areas. Digital Terrain Models can be derived as a by-product from the PSI processing and are of high value for flood risk analysis.

Advanced subsidence mapping service

This service envisions the integration of the Wide Area Service with ground truth data, notably levelling data and GPS, and geological data and information in order to develop a service which enables users to interpret PSI-derived subsidence maps within their geotectonic reference system of use and to assess mechanisms of subsidence risk.

Flood defence monitoring service

This is a focused application of PSI monitoring and evaluation of coastal defences and flood protection systems. This application demonstrates the applicability of PSI for pinpointing and monitoring localized phenomena along flood protection systems. Applications can be foreseen within the context of

coastal defence structures as well as along fluvial defence systems around Europe.

Wide Area theme services

The Wide Area mapping theme is a new entry level product. With a wide area product, users will have the opportunity to confirm that there is coverage of their area of interest and see whether there are signs of terrain motion in the area. From the feedback obtained during TF2 and looking forward to the new developments to come from new satellites the main requirements for a wide area service are as follows:

- To address the reported user perception of the complexity of the PSI product. The aim is to provide the non-technical user with a product that appears less complex, in order to avoid that the non-technical user be put off at the first level
- To reduce the need for specialist input in its interpretation. The wide area product will be visible and understandable to the non- or less technical users, although as with any technical information (such as a geological map), professional advice is advisable to gain full benefit of the information. The fact that a user can see what the map is showing him, even if not in all detail, encourages him to continue the review of what the map can do for his application
- To provide a solution to potential paying users put off from going ahead with a PSI contract by a) not being able to know at

the outset if the technique will deliver measurements on structures that are relevant to them or in areas relevant to them and b) not knowing whether the technique will be able to measure their type of motion.

- Be designed to be scalable to a stand alone Europe-wide service
- Be compatible as trans-boundary input to the flooding & tectonics services
- To address the needs as being for an entry level product, which is not unduly complex and which is clear and free to view.

This service offers an operational PSI processing for the Wide Area Mapping i.e. ground deformation with millimetre accuracy will be monitored at a scale of 1:250.000. In fact, this scale covers large areas, e.g. on a country level or even continent wide. This is in contrast to the usual PSI processing which is restricted to a single urban area or urban agglomeration. As a result, the Wide Area Mapping PSI product is a new type of data set. Research is ongoing and shortly a test case will be processed. An example for a new development is the mosaicing of the processed stacks into a regional deformation map with minimized error propagation and correction of residual trends. This can be the starting point for many new research and monitoring projects, providing or supporting the intended sustainability of the service. The processing will support and be compatible to the flooding and tectonics services of the TFX project.



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PanGeo: enabling access to geological information in support of GMES

by Ren Capes¹ and David Norbury²

EFG is a partner within the User Advisory Board in this new project which started on 1 February 2011. The PanGeo team comprises 13 'core' partners, as well as all 27 EU national geological surveys: Core Team partners are: Fugro NPA Ltd (UK - Project Coordinator), British Geological Survey (UK), Landmark Information Group (UK), TNO (NL), SIRS (FR), Institute of Geomatics (ES), BRGM (FR), EuroGeoSurveys (BE), AB Consulting Ltd (UK), European Federation of Geologists (BE), Tele-Rilevamento Europa (IT), Altamira Information (ES), Gamma Remote Sensing (CH). This article is to brief EFG members about this exciting new project activity.

La FEG a un rôle de partenaire actif au sein du Conseil Consultatif Professionnel, pour le nouveau Projet lancé le premier février 2011. L'équipe Pangea comprend 13 partenaires essentiels ainsi que l'ensemble des 27 Bureaux géologiques nationaux, européens. Les partenaires essentiels sont : Fugro NPA Ltd (UK- Coordinateur de Projet), le British Geological Survey (UK), le Landmark Information Group (UK), les groupes TNO (Nederland), SIRS (France), l'Institut de Géomatique (Espagne), le BRGM (France), le Bureau Géologique Européen (Belgique), l'AB Consulting Ltd (UK), la Fédération Européenne des Géologues (Belgique), le Tele-Rilevamento Europa (Italie), le Bureau d'Information Altamira (Espagne) et le Bureau de Télédétection Gamma (Suisse). Cet article a pour but d'informer les membres de la FEG sur la teneur de ce nouveau projet passionnant.

La FEG es uno de los socios, como miembro del Comité Asesor de los Usuarios, de este nuevo proyecto que comenzó en febrero de 2011. El equipo de PanGeo incluye a 13 socios principales así como a los 27 servicios geológicos nacionales de la UE. Los socios principales son: Fugro NPA (Coordinador del proyecto. Reino Unido), Servicio Geológico Británico (Reino Unido), Landmark Information Group (Reino Unido), TNO (Holanda), SIRS (Francia), Instituto de Geomáticas (España), BRGM (Francia), EuroGeo-surveys (Bélgica), AB Consulting Ltd (Reino Unido), Federación Europea de Geólogos (Bélgica), Tele-Rilevamento Europa (Italia), Altamira Informations (España), Gamma Remote Sensing (República Checa). Este artículo pretende resumir, para los miembros de la FEG, las actividades de este interesante proyecto.

PanGeo is a 3-year collaborative project with the objective of enabling free and open access to geohazard information in support of GMES. This will be achieved by providing an INSPIRE-compliant, free, online geohazard information service for the two largest towns in each EU country (Cyprus and Luxembourg only one), 52 towns in total (~13% of EU population). This is a project funded through the Seventh Framework Programme (FP7).

The geohazard information will be served in a standard format by the 27 EU national geological surveys via a modified version of the 'shared access' infrastructure as devised for the DG ISM project One-Geology Europe. The information to be served (a new geohazard data layer and accompanying interpretation) will be made by each survey, and be compiled from integrations of:

- Satellite Persistent Scatterer InSAR



- processing, providing measurements of terrain-motion
- Geological and geohazard information already held by national Geological Surveys
- The landcover and landuse data contained within the GMES Land Theme's Urban Atlas.

Upon user enquiry, a PanGeo web portal will automatically integrate the geohazard data with the Urban Atlas to highlight the landcover polygons influenced. Mousing over polygons will hyperlink to interpretative text. User input to design will be facilitated by the Surveys contracted into the project and initiation of a 'Local Authority Feedback Group'.

It is trusted that sustainability of PanGeo will be achieved by attracting a proportion of the remaining 253 Urban Atlas towns to procure the PanGeo service for their towns. The service that will already be provided

in their country will form the basis of the required promotional activity.

The key users of PanGeo are anticipated as:

- Local Authority planners and regulators who are concerned with managing development risk
- National geological surveys and geoscience institutes who collect and disseminate geohazard data for public benefit
- Policy-makers concerned with assessing and comparing European geological risk, much as the Urban Atlas data is used to compare the landcover/use status of European towns.

Contribution to policy implementation and development

The provision of an open-access, standardized information service on geohazards will enable policy-makers and regulators to:

- Systematically assess geohazards in each of the 52 towns involved
- Gain understanding of the geohazards themselves

¹Fugro NPA. Project Coordinator

²Independent Consultant, EFG Partner representative

- Know who to talk to for more information
- Statistically analyse and cross-compare geohazard phenomena across EU countries
- Gain a better understanding of the socio-economic costs involved
- Make more informed decisions
- Have confidence that the information provided is robust and reliable.

Also, EU citizens will be empowered with access to knowledge previously known only to a few.

Policy areas of relevance

Local policy

Following the EU subsidiarity principle, terrain-motion and associated geohazard policy is generally enacted at the local level. Some examples of local policies suggested by the Geological Surveys include: monitoring the impacts of dissolution and sinkholes in Hamburg city centre (Germany); monitoring of nuclear power plant stability (Lithuania); monitoring flood plain subsidence in urban areas (Luxembourg).

National policy

There are many national policies of EU member states that mandate the collection of geohazard data. Examples cited include: 'Map of active faults' project (Slovenia); Monitoring of hydroelectric power plants and the burial of nuclear and hazardous waste (Latvia); Mitigation of

Climate Change impacts (Estonia, Denmark national programmes).

European Union policies

PanGeo is relevant to several EU strategies and Directives:

- The EC Directive on Landfill (1999) requires that a landfill site must meet certain conditions relating to the risk of flooding, subsidence and landslides.

- The EC Flood Directive (2007) requires Member States to assess the flood risk of all water courses and coast lines; map assets and humans at risk; and to take adequate measures to reduce this flood risk.

- The European Programme for Critical Infrastructure Protection (ECPIP, 2006) was introduced for the identification and designation of European critical infrastructure and the assessment of the need to improve their protection. Related to this, Eurocode 8 (of the European Structural Design codes) is concerned with making buildings and civil engineering structures resistant to earthquakes.

- Future EC directives relevant to PanGeo are The Prevention of Natural and Man-Made Disasters, and The EU Strategy for Supporting Disaster Risk Reduction (DRR) in Developing Countries. Both these strategies require disaster mitigation by obtaining detailed information on areas most at risk from geohazards and their indirect impacts (see box)

International policies and strategy

There are several international programmes subscribed to by the EU and individual

Member States involving social, economic and environmental considerations under the sustainable development agenda into which PanGeo could provide valuable information:

- Policy for sustainable economic progress in parallel with environmental protections was highlighted in the Brundtland Report (1987), the Rio Declaration on Environment and Development (1992) and Agenda 21 (1992) programmes, and the Aarhus convention (1997).

- Climate change policy has become the increasing focus of international environmental concerns as evidenced by COP15 (2009). While geohazards are not a measure of climate change *per se*, terrain-motion, e.g. subsidence, can increase the risk of flooding (see FP7 SubCoast project), thus the capacity to understand geohazard risk and monitor the threat imposed is increasingly important as advocated in the Stern Review (2006).

- The Lisbon Strategy (2000) objective is to make Europe "the most competitive and the most dynamic knowledge-based economy in the world capable of sustainable economic growth ... and respect for the environment.". PanGeo will actively contribute to the environmental and economic pillars of the strategy. By making accessible state of the art, pan-European information on geohazard, PanGeo is enhancing public knowledge in a key area and creating an infrastructure that future project and users can continue to develop.

EU policies indirectly benefiting from PanGeo include: EU Habitats Directive, EU Soils Directive; Water Framework Directive (2000); Convention on Transboundary Effects of Industrial Accidents; Convention on Environmental Impact Assessment (EIA) in a Transboundary Context; The EC Directive on the Assessment of the Effects of Certain Public and Private Projects on the Environment; The 6th Environmental Action Programme (2002–2012).



Geology without frontiers: a seamless Europe

by Ian Jackson¹

Geologists know well that geology and rocks don't respect man-made political frontiers and nor do the environmental problems and natural resources that go with them. With our changing climate, there is an even more urgent need for Europe and its citizens to have coherent and comprehensive data about our environment to be available for those who need it.

A team of geologists and users of geological information from 21 nations has delivered the first ever multilingual internet geological map of Europe. OneGeology-Europe, a two year project supported by the European Commission, has built a system to serve live geological map data from the computers in each nation and make it available on the internet to anyone with a web browser. To do this the project team developed a state-of-the-art way to share digital geological map data (making it "interoperable") and also tackled the enormous challenge of harmonizing decades of scientific data from 21 different Member States. The team also overcame one of the biggest barriers to data access, the legal and copyright issues. All the participating nations have agreed a simple single one-click licence that makes the data available for free, for any use.

The project has taken cutting edge internet mapping technology and standards and applied it to the distributed geological data of a whole continent. It is the first example of a multi-national deployment of environmental data of this scale. Making available geological data like this opens up a host of possibilities, some of which are already in train, including geological Apps for mobile phones.

OneGeology-Europe was funded under the European Commission's eContentplus programme for 2008 - Best Practice Networks: Geographic information. The overarching objectives of this programme are to make digital content in Europe more accessible, usable and exploitable, facilitating the creation and diffusion of information, in areas of public interest, at Community

level. The programme is intended to have an enabling role.

OneGeology-Europe had 28 partners from 21 European nations, 20 of these partners are national geological surveys, 7 are users of geological information and one partner organization is expert in the legal aspects of digital data. One of the prime aims of OneGeology-Europe has been to test and advance the implementation of a new European Directive, INSPIRE, which was brought into force in May 2009. This EC Directive requires each Member State to make available and share Public Sector spatial environmental data to enable better delivery of policy and actions across Europe.

Making a global contribution

OneGeology-Europe is contributing to OneGeology, the overarching global initiative set up two years earlier in 2006 (see www.onegeology.org). OneGeology's deceptively simple mission is to improve the accessibility of geological map data, the interoperability of that data and the transfer and exchange of know-how and experience. Since its inception it has been extremely successful and 116 nations are now participating, with over 40 of those nations serving their data to a dynamic web map portal. OneGeology used the stimulus of the UN International Year of Planet Earth to begin the creation of this interoperable digital geological dataset of the planet. The intent was to design and initiate a multi-national project that mobilized geological surveys to act as the drivers and sustainable providers of a global geoscience dataset and distributed delivery system. OneGeology is synergistically using the vehicle of creating a tangible geological map to accelerate progress of a global geoscience data model and interchange standard (GeoSciML). Most importantly, the project is transferring know-how to those who wish to deliver spatial data on the Internet and especially developing countries, in the latter case reducing the length and expense of their learning curve and allowing them to serve geological maps and data that will attract interest and investment. OneGeology is coordinated by the British Geological

Survey (BGS) and the portal infrastructure is provided by the French Geological Survey (BRGM). But it is a voluntary collaboration absolutely dependent on data and support from across the world.

Lessons learned?

The OneGeology global and European experiences have provided some excellent lessons on how to bring together international participants to achieve a common goal. Many of these lessons were not technological but cultural and managerial. The first was that simplicity and clarity of purpose are essential in international collaborative projects where communication is a challenge due to the different first languages of participants. OneGeology global is a voluntary collaboration and maintaining steady growth in the number of participating nations is critical to its success. Participation is encouraged by providing a flexible environment where nations and individuals with a broad range of capabilities could contribute as they were able, and by minimizing process and bureaucracy. Once a certain "critical mass" of participation is achieved, reluctant potential participants are more likely to join. Regular and professionally-executed communication using a range of media to the public, the geoscience community and technical participants was a key contributor to success. Most scientists and technical experts find effective communication of their work to those outside their own domain, and society in general, challenging. By using communications professionals, OneGeology objectives and progress were communicated broadly and clearly, using ways which were quite novel to the wider geoscience community. Passionate and committed leadership was a key factor in the success of OneGeology and was instrumental in attracting participation and resources. But perhaps the most important lesson has been the benefit of raising awareness of the digital divide between and within the developed and developing world and how simple measures to raise competences through exchanging know-how can reduce that divide profoundly.

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Geology at different education levels in Europe



19 May 2011 Budapest

Abstracts



Secondary School Level

Education policy of the MOL Group: how to promote and improve education in Natural Sciences at secondary-school level

by Laszlo Szocs¹

The MOL Group has consciously built up succession management as a key HR activity. MOL's integrated approach is innovative because it offers programmes and competitions to young people from secondary school through to university level. MOL has been advancing in new, innovative directions in the succession management of highly-trained professionals. Recognizing the needs of the industry, universities are also putting growing pressure on secondary schools to improve the standards of instruction in the Natural Sciences and to give particular support to outstanding young talented people. With this in mind MOL has helped organize a number of competitions for secondary schools.

In 2010 it was the first time that an online Natural Science competition, "Junior Freshhh", was organized, in Hungary, as well as from countries outside the national borders. The scenario would be incomplete without recognizing the work of teachers. This year the company has created the Mester-M Award to acknowledge the efforts of secondary school teachers of Chemistry, Physics and Mathematics and the outstanding role they play in supporting talented youngsters. Teachers received nominations from their own former students, now working or studying in one of these technical areas. In 2011 MOL organized a Conference called "Dialog" for those teachers, professionals who develop the future generation in the field of Natural Sciences and there were workshops where the governmental and the business side collaborated with teachers on how we could help each other to achieve our goals.

From the sustainable growth point of view it is essential that engineers, skilled workers and technicians be available in the labour market in sufficient numbers.

All these actions that we have started will have measurable results within a few years according to our expectations.

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Geology in the 3rd basic school cycle and at secondary level in Portugal

by Margarida Silva¹

In the last four decades various reforms have been introduced in the education system in Portugal (in 1970, 1979/80, 1989/90 and 2001/02), affecting the Geology content of teaching programmes. In the 1979/80 – 1989/90 decade, science disciplines lacked geological content. In this context, the Portuguese Geological Association had an important role during the discussion of the 1989/90 and 2001/02 education reforms, contributing to a progressive enrichment of geological content in science disciplines. Presently, the implemented programme guide to "research teaching" approach, presents a situation-problem for each geological theme. Also, they provide some aims and procedures examples that reflect some didactic investigation guidelines.

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The teaching of geology in secondary schools in England

by S.D. Smallwood¹

Geology forms part of the National Curriculum (for children aged 11-14) in England - it forms less than 10% of the core Science component at Key Stage 3, and also forms part of the Geography programme of study too. This should mean that the vast majority of pupils in the first part of secondary education have some exposure to Earth Science education.

In the next stage of education (Key Stage 4), children aged 14-16 take GCSE (General Certificate of Secondary Education) Level Core Science, and can then go on to take either 'Additional' or 'Applied' Science. The most able take all three sciences (Biology, Chemistry & Physics) separately to GCSE; all of these include some aspects of Geology. Pupils can also choose to take Geology as a separate subject to GCSE, though this has a very small entry nationally.

At post-16 level, students can opt for AS (Advanced Subsidiary) and then (if they choose to continue)

A2 (Advanced Level) Geology 1-year courses. These are complementary to a range of other qualifications and provide good quality preparation for most Science-based university courses. In terms of the numbers of entries for examination, Geology is a small subject at secondary level in England, but it continues to be one that bridges successfully between the sciences and the humanities. The true extent of Earth Science Education in secondary schools is far greater than this, however, with aspects of Physical Geography, Palaeontology, Economics, Resource Development and Geopolitical and Historical Development occurring at all different Key Stages.

Issues for the future of Geology in England's secondary schools concern the training and recruitment of specialist teachers, the safeguarding of fieldwork in the secondary curriculum, the resourcing of geology as a minority subject and fitting Geology examinations to the requirements of university courses.

¹Head of Geology @ Bishop Wordsworth's School, Salisbury, UK

Dealing with outstanding secondary-school students: student conference on Earth Sciences

by Éva Hartai¹

Geology is not taught in public education in Hungary. Only a few hours are devoted to the most important topics – rocks, minerals, plate tectonics – within the framework of geography. Still, there are many young students who would like to know more about geology.

The Faculty of Earth Science and Engineering, University of Miskolc, together with the Hungarian Geological Society have organized annually, since 2007, a scientific conference for secondary-school students. The aim of the Student's conference on Earth Sciences is to assemble students who are working in a particular field of Earth Sciences and doing research, and provide an opportunity for them to share their knowledge with other students and interested teachers. Students between 14 and 18 years can participate in the conference.

There are several scientific and professional organizations in the fields of meteorology, geophysics, astronomy, pedology, and even the Earth Science Section of the Hungarian Academy of Sciences, which support the conference.

Students have to submit an abstract before the conference and an abstract volume is printed each year. The studies in the fields of mineralogy, petrography, geology, palaeontology, hydrogeology, environmental geology, astronomy, geophysics are presented in power point form, in 15 minute slots, in four or five sections. The conference lasts for two days. There are 70-100 participants each year.

The best presentations are awarded by sessions, and there are special awards by the Hungarian Academy of Sciences.

The best students can take part in the Hungarian Students' Research Conference and compete with university students.

The success of the conferences was summarized by a young participant as follows: "It is such a good opportunity that the future scientists and professionals can meet as early as that".

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Higher Education Level

The one-year masters degree: a British qualification in a Bologna context

by David Manning¹

For many years, British universities have offered M.Sc. degrees based on the outcome of 12 months of study. These have a strong reputation as the preferred route into major areas of employment within geology, especially hydrogeology and engineering geology, as well as more specialized areas. Part of the strength of M.Sc. provision is the intensity of work expected of a student; a well designed M.Sc. programme pedagogically acts as a bridge from academia to practice. Typically, a lecture/exam-based mode of learning, as encountered in undergraduate programmes, progresses to project-based work assessed through a dissertation that in some cases can take the form of a consultancy report.

In terms of ECTS credits, a British one-year M.Sc. accumulates 90 ECTS credits compared with 120 ECTS credits required for a typical two-year Bologna second cycle masters qualification. It is fully compliant with the requirements of Bologna, even though it is delivered within a 12 month period. It extends beyond the normal academic year, being a 3-semester programme that has no summer vacation period. Typically, students enroll in September, and complete at the end of the following August to enter the job market little more than 12 months after registration.

The School of Civil Engineering and Geosciences at Newcastle University offers 18 M.Sc. programmes with over 200 M.Sc. students, many part-time. The course structure favours life-long learning, with modules predominantly delivered as 1-week short courses that are open to occasional students as part of the School's CPD provision. The demographic profile of students includes a significant number of mature students who are using the opportunity to change career. In addition, there are students who left the Newcastle region to study elsewhere, return with a first degree and require a second degree to enter professional employment. Such students represent repatriation of skills to the region.

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Integrated higher education in palaeontology: bridging the academic gap between Denmark and Sweden

by David A.T. Harper¹, Per Ahlberg², Johan Lindgren², Maria Liljeroth¹ and Jan A. Rassmussen¹

The initial EU student mobility programmes, developed through the Erasmus and Socrates schemes, involved both formal inter-university networks and the more independent movement of students, by free-movers, for periods of up to one year at mainly bachelor levels. The 'Celtic fringe network', including the universities in Brest, Galway and Oviedo, was the first in the Earth Sciences, engaging students in 'pre-honours' field mapping projects abroad and participation in part of the final year of courses in the host department (Harper, D.A.T. 1996: *European Geologist* **3-4**, 57-59). The field mapping component was particularly popular, the courses less so when taught in the native language of the host institution. The Bologna Agreement and subsequent fine-tuning process (Ryan, P.D. 2010: *European Geologist* **30**, 9-13) have provided for a more unified structure in third level education across Europe (and indeed elsewhere), defining a three-cycle structure with specific learning goals and outcomes at each level in the hierarchy. Supported by funding from the INTERREG IIIA EU programme, staff members in the universities of Copenhagen and Lund are developing a joint Masters-level programme in palaeontology. Both Copenhagen and Lund have active and relevant teaching and research programmes, generally drawing on the population in southern Scandinavia with occasional overseas students from elsewhere in Europe and beyond. The programme not only provides for the mobility of staff and students within the system through a short commute over the Øresund Bridge, but also the 'mobility' of a menu of compact courses and field excursions. The programme forms the middle part of a 3-2-3 cycle, is taught in English and is split into one year of taught courses and one year of research, culminating in a thesis together with a short scientific paper. Fieldwork is an important part of the programme involving excursions to the Greek island of Rhodes and Swedish island of Gotland during the two-year programme. The programme promises to establish a wide variety of high-quality courses and project material relevant to both third-cycle research programmes or future careers in, for example, the exploration sector.

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The Euro-Ages project: qualification framework for higher education in geology

by Dr Isabel Fernandez Fuentes¹

The European Federation of Geologists has participated in the Euro-Ages project, a European pilot project in the context of the European Qualifications Framework (EQF), Lifelong Learning Programme. The project took place from January 2009 - January 2011. The project aims at developing Europe-wide applicable quality standards and criteria for the assessment of higher education programmes in geology in the context of the Bologna Process.

Combining the common interests and individual strengths of ASIIN (Germany), EFG (Belgium), ICOG (Spain), MFT (Hungary) and SACO (Sweden), Euro-Ages has provided important reference documents such as: mapping of the structure of geology study-programmes across Europe, and the existing qualification framework, including a set of learning outcomes which graduates of first and second cycle degree programmes are expected to achieve, and accreditation criteria and procedures.

The mapping of the existing qualifications for Geology supported the increase transparency of Earth Sciences qualifications across Europe and therefore to facilitate improved academic and professional mobility across Europe. The document consists of reports from 27 countries with information about: implementation of Bologna process, education in Geology programmes and structure, learning outcomes, professional pre-requisites and accreditation systems.

The Standards and Criteria are intended to provide a means for reviewing the quality of higher education geology qualifications in the European Higher Education Area (EHEA), in a way that encourages the dissemination of good practice and a culture of continuous improvement of geology programmes. They have been developed within the Euro-Ages Project, the principal aim of which is to develop a qualification framework for the assessment of geology degree programmes in the EHEA. Given the great diversity of geology education across Europe, the attempt to create framework standards comprising all areas of the geology discipline appears ambitious. The Euro-Ages Framework is thus intended as a broad common denominator, or overarching reference point, for the variety of geology programmes. In order to allow for possible inclusion of existing geology specializations within European Higher Education Institutions, the framework must be formulated in rather general terms. The Standards and Criteria contained in this document represent a quality threshold. All graduates of programmes assessed against the Euro-Ages Standards are expected to achieve the programme learning outcomes stated therein.

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Postgraduate Level

Challenging professional education: the EAGE way

by Davide Calcagni¹

Education for professional communities is one of the key elements in the mission of the European Association of Geoscientists & Engineers (EAGE).

Founded in 1951, with deep European roots, EAGE is nowadays probably one of the largest worldwide multidisciplinary professional associations in the field of the Geosciences. With nearly 16,000 members worldwide, EAGE is facing the "not easy to solve" challenge of serving its membership and supporting them in their professional activities by playing the role of the hinge point between formal educational entities (academy, post academy and private trainers) and the ever increasing demand of continuous and specific dedicated events for the professional development of our Members.

The challenge is boosted by the multidisciplinary/multiregional nature of the association in which the stakeholders and members cover the fields of Geophysics, Geology, Petroleum Exploration and Engineering as well as the vast community of professionals gathered under the name of Near Surface Geoscience, distributed world wide and with a variety of logistical conditions in their country of residence.

EAGE is coping with such requirements via a specific Educational Programme and a structure consisting of four offices (one main and three regional), two divisions (O&G and Near Surface) and a set of dedicated committees.

The EAGE commitment on professional education is reflected in a vast effort that extends from organizing Events (from large conferences and exhibitions to one day workshops), Publications (5 journals, and an extensive selection of books), Student Activities, support of the Industry in recruitment and delivering short courses and lectures regionally. One of the key elements in the Association's efforts is supporting and promoting the exchange of knowledge. EAGE, via an extensive and dense network, invites acknowledged experts (both industry professionals and academics) to lecture on the latest developments in the various geoscience disciplines. The worldwide EAGE education programmes include EAGE Education Tour short courses (EET / OTE) including the newly introduced NS EET (dedicated to specific themes in the field of Near Surface Geosciences), joint initiatives with other Professional Associations, Education Days Events, EAGE Short Courses (public and in-house) and Distinguished Lecturer Programme (DLP). The effort is so huge that at the Annual Conference in Vienna this Year it will be re-named: "Learning Geoscience".

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Postgraduate and professional training in geology-related fields at the Faculty of Earth Science & Engineering, Miskolc University

by Peter Szucs¹

The Faculty of Earth Science and Engineering was established in Selmezbánya in 1735. So that the University of Miskolc can be regarded as the oldest in the world in the field of technical and mining higher education. The mission of the faculty is to provide engineering solutions in education and scientific research for the sustainable utilization of natural resources from the Earth crust.

Although the Faculty introduced the current B.Sc. and M.Sc. programmes after 2006, there is a long tradition and history involved in the educational and research activity of the Faculty in geology-related fields. Currently the Faculty offers three different B.Sc. and seven M.Sc. programmes for more than 1000 students. The most talented students can achieve a Ph.D. degree at the Mikoviny Sámuel Doctoral School. In order to attract more international students in the future, some of the M.Sc. and Ph.D. programmes run in English.

There is an increasing demand from the industry for postgraduate studies as well as for professional training. Hungary is very rich in mineral, medicinal and thermal water resources. Although the experts should expect special geological and hydrogeological phenomena in the Carpathian Basin, Hungary is among the world leaders (Island, Japan, USA, France, Italy, China and New Zealand) where mineral, medicinal and thermal water resources are concerned. The government initiated the New Széchenyi Development Plan with seven main programmes to boost the economy of Hungary. Two main programmes (Medicinal Hungary, Renewable Hungary) aim to concentrate on the more intensive utilization of the mentioned groundwater resources. This means that special research educational programmes are required in order to train more experts. This is the reason why the Faculty of Earth Science and Engineering introduced postgraduate programmes in geothermal engineering and hydrogeology with great success some years ago. Short courses (groundwater modelling, environmental geotechniques, geological mapping, etc.) in geology-related fields are also becoming more and more attractive.

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Learning outcomes – C1 to C4: the relationship with the European Geologist title

by David Norbury¹

The learning outcomes identified in the EuroAges programme represent quality standards for competencies, skills and knowledge. Graduates of an accredited course at first or second cycle programme level would be expected to have achieved initial levels of ability from their academic training and studies as the basis for starting to practise geology professionally.

Further development of experience and skills is required following graduation through deployment in professional activities. The learning outcome level that would be expected when the student has gained sufficient professional post-graduate experience and is ready to submit their combined training and experience profile for validation by their peers, in other words to apply for the professional title of European Geologist (EurGeol.) or similar in their own country, will be outlined.

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AIPG's system of online instruction: a portal to global geoscience

by EurGeol Dr. Robert Font¹ CPG, PG, CG, REM

An online system with accredited geoscience courses is currently in place through the AIPG and the University of Offenburg in Germany. The system is the result of the interaction between the AIPG and EFG, specifically between Dr. Detlev Doherr (Dean and Professor at the University of Offenburg) and Dr. Robert Font (AIPG and GDM).

Currently, five AIPG-accredited and affordable geoscience offerings are available via the system. All course material has been reviewed by the AIPG's Educational Committee and approved for the awarding of continuing education units (CEUs). The following online seminars are presently available:

- "Introduction to Landslides and Mass Wasting"
- "Practical Petroleum Geoscience"
- "Introduction to Well Logs and Log Analysis for New Hires"
- "Geotechnical and Engineering Properties of Certain North-Central Texas Shales"
- "Virtual Field Trip Through the Lower Cretaceous Strata of North-Central Texas".

Courses are designed to reach multiple audiences. Critical concepts are covered in main chapters while more rigorous discussions and mathematical derivations are saved in strategically-placed appendices. For less technical

audiences, only the main chapters are covered, whereas both chapters and appendices can be made compulsory for more scientifically-trained groups.

AIPG actively encourages contributions to the system and authors of new coursework. Specifically, we seek participation from our colleagues from the EFG and CCPG. The opportunity exists for us to provide a portal to global geoscience via the vehicle which is now in place and through the synergy that we can achieve by combining our goals and efforts.

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Public Level

Earth system science education in the United States: challenges and opportunities

by Ann E. Benbow¹, P. Patrick Leahy² and G. Warfield Hobbs³

The American Geological Institute (AGI), an association of 49 member societies, represents over 120,000 geoscientists and geoscience educators. As such, part of its mission is to strengthen geoscience education, both in the U.S. and in the wider global community. To this end, AGI creates print and online instructional materials for all educational levels, provides professional development programmes for teachers; develops and implements outreach programmes for the general public and conducts educational research. AGI also brings together members of the geoscience education community to discuss issues of concern and develop procedures for addressing those issues. For example, in 2010, AGI hosted the first K-12 Earth System Science Education Summit. As a result of this meeting, working groups were formed to address such areas as the: *Perception of Earth Science Courses by School Districts and Colleges*; *Preparation of Earth Science Teachers*; *Challenges to Earth Science Education by the Creationist and Intelligent Design Movements*; and *Inclusion of the Earth Science Literacy Principles in New National Science Education Standards*. These working groups are currently in a data collection phase and will be reporting on their progress to the wider geoscience education community by Summer 2011.

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IGEO: achievements and future prospects

by Roberto Greco¹

The International Geoscience Education Organization (IGEO) (<http://www.geoscied.org/>) was founded in 2000 during the GeoSciEd III conference in Australia. The aims of IGEO are:

- to promote geoscience education internationally at all levels
- to work for the enhancement of the quality of geoscience education internationally
- to encourage developments raising public awareness of geoscience, particularly amongst younger people.

To reach these goals, the IGEO monitors international geoscience education worldwide and fosters communication between geoscience educators. The organization strives to create a network with international and national bodies concerned with geoscience education, with international professional geoscience bodies, such as the International Union of Geological Sciences (of which it is an affiliate) and with international bodies concerned with science education.

IGEO is led by a Council formed from one member from each interested country and a deputy member. Council meetings are held biannually as part of the programme for the International Geoscience Congress (IGC) and the GeoSciEd conferences. At the moment, 34 countries are represented with council members.

IGEO runs an International Conference approximately every four years, alternating with a representation at the International Geological Congress, which also takes place at four-year intervals. GeoSciEd VI took place in South Africa in 2010, with the next one being hosted in India in 2014.

The IGEO promotes the International Earth Science Olympiad – IESO (<http://www.ieso2011.unimore.it>) that took place for the first time in 2007 and is keen to support Earth Science education in developing countries.

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The role of the national geological services in public education and civil protection

by Nieves Sánchez¹

Our society is actually going through a new stage because globalization has produced many changes in different issues, especially communications. Social perception of catastrophic events is changing because now everyone can experience a disaster that occurs very far away, like something which we ourselves are suffering. Natural disasters produce much damage and the world is acting like a spectator, gathering information, and explanations about the role of the people in each case.

Civic education is a very important question in a possible emergency scenario. Geological services will have to adapt their goals to this new requirement and they should play an active role for all phases in the management of emergencies and inside the civil protection system.

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The role of geoparks in education: the Novohrad-Nógrád Geopark

by Imre Szarvas¹

There is a new phenomenon in the new millennium, the geopark initiative. A geopark is an established territory with rich geological heritage, where locals -- as geotourism stakeholders -- are actively involved in the preservation of the rare natural and cultural heritage of their own area. Since its birth in 2000 the European Geoparks Network (EGN) has taken a leading role in raising the public's awareness of geoheritage issues. The transborder Novohrad – Nógrád Geopark has been a member of the network since 2010. (The geopark comprises the administrative area of 63 settlements in Hungary and 28 habitations in Slovakia. The area is recognized as an important centre for the Palóc ethnic group's folk art and living traditions.)

The Bükk National Park Directorate is one of the main partners of the geopark management, an expert in interpreting geoheritage at Ipolytarnoc Fossils Nature Conservation Area (<http://osmaradvanyok.hu>), which is the main gateway to the geopark.

To ensure a common appearance in both countries, geosite educational materials follow the uniform geopark design. The emphasis is on the phrase: *less is more*. Usage of scientific jargon is minimal, explanatory figures dominate the on-site panels to accommodate non-professionals. The geopark management considers as a high priority, that knowledge of local geoheritage should find its way into local schools, as well as to the general public. Outreach to NGOs, teachers and students at different levels is essential in order to fulfill the geopark's mission goals.

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Posters

Geology at the kindergarten

by Dóra Bihari¹ and Ilona Bihariné Krekó²

Children in the kindergarten become acquainted with things in the surrounding world, which adults make possible for them. Because of this, teachers in the kindergarten have to carefully help them experience their environment.

Children below six have usually no abstract thinking, so they need to experience things directly by their sense organs. Thus, beside books, looking at pictures, it is important to walk with them in the natural or in the built environment.

Museums can play an important role in their thinking about geology, because after looking at pictures about volcanoes in books, they can observe the rocks, which were produced by the volcanoes, or they can see creatures from the geological past.

Buildings, statues and their mother's jewellery bring the rocks and minerals closer, and brings nature to life

They can experience the constructive work and the erosion of water in the garden of the nursery school. In the garden a path can also be built from pebbles and if children walk on them they will recognize the differences in the rock material and the shape of the pebbles. It also makes their feet stronger if they walk on the pebbles in bare feet.

We can encourage them to collect pebbles at the riverbank and group them by size or colour.

We can also show them lots of interesting shapes of drip-stones in the caves.

Parents can also help their children to know more about nature, including rocks and minerals by excursions and walking in the natural environment and childrens' knowledge will be deeper if they hear about these things not only in the kindergarten but at home as well.

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GeoExpo 2010

by Janos Haas¹ and Agnes Krivanne Horvath¹

Transmission of the new results of the Earth Sciences to the public is one of the prominent tasks of the Hungarian Geological Society. In the last couple of years a number of new results having definite social impacts were born in the domestic workshops of the Earth Sciences. The exhibition and multiple programme of GeoExpo 2010 wanted to serve this aim; it offered opportunity for a common and novel introduction of the academic Earth Science institutes, university departments, museums, companies, and national parks. The four-day programme was held in the great vaulted hall of the Hungarian Natural History Museum, Budapest, from 1 - 3 October 2010. Along with the presentation of recent interesting and spectacular results from geology and geophysics, the introduction of the most prominent, internationally appreciated sites of the geological heritage of our country was also among the highlights of the programme. The exhibitors occupied 16 booths. In addition to displaying posters, equipment and audio-visual presentations, the representatives of the companies and scientific institutions made personal contact with the visitors. There were about 2800 visitors; 25 non-conventional geographic lectures were held with 767 participants from various elementary and high schools.

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SAXA LUQUUNTUR Geology education programme (GEP) in NN GEOPARK

by Ádám Hajas¹ and Katalin Juhász¹

A geographical formation, consisting of epiclastics and volcanic sediments, lies within the area of Novohrad-Nógrád Geopark, between Nógrádszakál and Litke villages on the Hungarian-Slovak border marked by the Ipoly river. The formation was created in a river delta that existed about 15 million years ago during the Central-Paratethys period. The area is the continuation of the so-called Etes trench (*Etesi árok*) zone.

The bed of the seasonal Páris stream cuts through various layers of sand and pebble stone sediment. Multiple cross-layers of marl and tuff can be observed in the stream's canyon. The river sediment also contains huge andesite and granite blocks and cemented stone conglomerates separate themselves from above the steep canyon wall, the height of which can reach 20 - 25 m. The canyon wall is also marked by tiny caves created by remains of small pieces of wood originally trapped in the river sediment. The area is perfect to demonstrate and analyse geographical processes which require student involvement and cooperation in teaching. Besides explaining complex geographical information, developing cognitive skills (e.g. creative, memory, observing, thinking and problem

solving) is equally important. We summarize our GE Programme in the chart below.

| Project title | Geographical Area | Short description |
|------------------------------|---|---|
| Treasure hunt | Geographical history, palaeontology, geology, petrology | Finding and analysing stones and fossils |
| Anybody home? | General geology, petrology | Description and definition of caves created by wood remains and their formation. |
| What is in the water? | Structural geology, mineralogy, geochemistry | Analysis of waters containing CO ₂ and CH ₄ from fountains within and around the Etes trench. |
| Use your mobile | Geoinformatics, informatics | Device use, orientation, project presentation. |

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Vásárhelyi Pál technical high school and hostel, Békéscsaba: the only institution teaching geology at this level

by Méhi Gabriella¹ and Lisztes Tibor¹

"IF YOU COME WITH US, YOU WILL REACH YOUR GOAL!"

The Vásárhelyi Pál Technical High School and Hostel (VÍZMŰ) is situated in the city of Békéscsaba in south-eastern Hungary. The institution works on the improvement of architecture competencies. During the last six decades, education has been organized around the following professional groups: high building architecture, transportation architecture, water board, landsurvey-GIS and, in the last ten years, the geological technician. It is the only school in Hungary with medium level daily tuition for geological technicians. Based on the local geology (deep, not very old basins with settlements) we prepare our students to research into carbon dioxide and water as well as analyzing rocks, stressing the importance of rock samples from the drilling process. We also cover changes in the law which have influenced the field of geology. Students study the basic elements of the profession from grade 10-12. After the final exam, they learn those competencies which are necessary for starting their profession and for progressing to a higher level. The study groups of 10-20 students work together, under the supervision of three geology teachers. Tuition involves teaching theory and practice. During the practical work, the students work with modern and good quality equipment. The building with rock examining microscopes is worth mentioning (polarization and stereo microscopes), the three-part equipment for producing thin sections, the

twenty-four-channel seismic and geo-electric measuring systems plus many different types of apparatus. Another part of our tuition is field work. Among our programmes are mine visits [opencast and deep cast], collecting minerals and rocks, visits to museums, institutions and tourist's paths. This field work experience is used in the summer for work placements in companies whose work involves geological research. These companies such as the MOL Nyrt. (Hungarian Oil Company) is one of the financial supporters of our school. The aim of the school is firstly to be in contact with other institutions in different countries in Europe. Secondly, we would like to organize round table discussions and exchange of technical experiences.

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Foz do Douro geological walk: awareness of geoconservation and its role in education

by *Mónica Sousa¹, S. Aires, V. Ramos, C. Vasconcelos, M. Marques, L. Borges and F. Noronha*

The "Foz do Douro Metamorphic Complex" is an important place to better understand the geotectonical evolution of the NW Iberian Peninsula in pre-Variscan times. Its educational value is also unquestionable as it preserves a diversity of lithologies, structures and geomorphological features.

Aiming to increase public awareness of the geological heritage, the "Foz do Douro Geological Walk" was created in 2005, a scientific path that brought to public knowledge the natural wonders of the Porto shoreline outcrops.

Taking into consideration the different types of background and educational levels of the public and in order to improve their experiences in the realm of geology as well as to promote significant practices, an Interpretative Centre was opened in 2008 and some science education materials developed. The purpose was to complement the field guided visits, thus minimizing the novelty value.

The "Foz do Douro Geological Walk" was rewarded with a Mention of Honour in 2005 and with the Geoconservation Prize 2009 implemented by the European Association for the Conservation of Geological Heritage (ProGeo – Portugal) which distinguishes the best examples of Geological Heritage conservation promoted by municipalities.

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Support of geological and geophysical education through a Complex Scientific-Educational Centre at the University of Mining and Geology "St. Ivan Rilski", Sofia, Bulgaria

by *Str. Strashimirov¹, S. Pristavova¹, R. Radichev¹, S. Dimovski¹ and N. Tzankova¹*

Geological and geophysical studies are the basis for exploration and prospecting of mineral and energy resources, evaluation of geological hazards and other important activities, so the need for well-trained specialists is the main target of geological and geophysical education.

The University of Mining and Geology "St. Ivan Rilski" (UMG) is the only Bulgarian university center for engineering education in Earth and mining sciences. The National Sci-

entific Fund of Bulgaria has supported a project (2010 - 2012) developed by UMG to integrate disciplines that study natural geological objects in at least four different fields of the Earth Sciences – petrology, ore mineralogy, gemology and applied geophysics. The basis for the integrated studies is the necessity for student education in solving non traditional tasks related to complex studies of natural resources, prospecting of deep-seated mineral and energy resources, increased requirements in estimation of geological hazards, implementation of interdisciplinary studies in relatively new branches of sciences such as geoarchaeology, archaeogemology, ecomineralogy and others.

The main aim of the project is to create a new Center for complex geological and geophysical studies, which could be used, either in scientific research or in training students in UMG, Bulgaria.

The main educational task of the Center is to improve the training processes with fundamental and interdisciplinary characteristics, modernization of existing and new laboratory base for further development in optical and geophysical studies of minerals, rocks and ores, according to the world tendencies for training of highly qualified specialists with respective competencies and complexity in research work.

Part of the equipment in the University's laboratories for optical and geophysical studies is outdated and the project supports supplementation of new modern equipment. The project is realised by the academic staff from several leading departments at the Faculty of Prospecting Geology at UMG "St. Ivan Rilski".

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TRANSENERGY:

transboundary geothermal energy resources of Slovenia, Austria, Hungary and Slovakia

by Annamária Nádor¹, Andrej Lapanje², Gerhard Schubert³ Radovan Cernak⁴ -

The utilization of geothermal energy is mostly based on deep circulating thermal groundwaters from hydro-geothermal systems, which are strongly linked to favourable geological-hydrogeological settings, and are often shared by neighbouring countries. Thermal water extraction from the same transboundary geothermal reservoir at a national level without cross-border harmonized management strategies may cause negative impacts (depletion or overexploitation) leading to economic and political tensions between countries. The project TRANSENERGY – transboundary geothermal energy resources of Slovenia, Austria, Hungary and Slovakia addresses the problem of using geothermal energy resources in cross-border regions in a sustainable way at the western part of the Pannonian basin.

L'utilisation de l'énergie géothermique est basée principalement sur la circulation d'eaux souterraines, chaudes et profondes, à partir de systèmes géothermiques qui sont liés à un contexte géologique et hydrogéologique favorable et qui souvent sont exploités par des pays voisins. Le pompage d'eau chaude, à l'échelon national, à partir d'un réservoir géothermique transfrontalier commun, sans une stratégie commune de gestion harmonisée, peut avoir des conséquences négatives en matière de surexploitation et épuisement de la ressource, conduisant à des tensions économiques et politiques entre les pays voisins. Le projet TRANSENERGY – Ressources énergétiques géothermiques des pays frontaliers suivants : Slovénie, Hongrie, Slovaquie, répond au problème de l'utilisation des ressources fournies par l'énergie géothermique, de manière durable, dans les régions frontalières de la partie occidentale du bassin Pannonien.

El empleo de energía geotérmica se basa fundamentalmente en la circulación de aguas subterráneas termales profundas de sistemas hidrogeotermiales que están fuertemente ligados a entornos geológico-hidrogeológicos favorables y que suelen estar compartidos por países vecinos. La extracción de aguas termales del mismo acuífero geotérmico transfronterizo a nivel nacional sin una armonización transnacional de las estrategias de gestión, puede causar impactos negativos (agotamiento o sobreexplotación) lo que produce tensiones políticas y económicas entre los países. El proyecto TRANSENERGY – Recursos geotérmicos transfronterizos de Eslovenia, Austria, Hungría y Eslovaquia, investiga el problema del empleo sostenible de los recursos energéticos en las regiones fronterizas de la parte occidental de la cuenca de Pannonia.

Worldwide there is a growing need for the enhanced use of renewable energy due to the continuously increasing energy demand of the globe. This is underlined by the restricted reserves of fossil fuels and their uneven



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energy policy that aims to reduce energy consumption and greenhouse gas emission and increase the proportion of renewables. These ambitious goals were manifested in several policies, such as the Kyoto Protocol,

EU COM(2006) 848, COM(2010) 639 as well as the 2009/28/EC Directive on the promotion of the use of energy from renewable sources, which – among other types of renewables – defines geothermal energy as “the energy stored in the form of heat beneath the surface of the solid Earth”.

The immense heat of the Earth (whose main source is the decay of radioactive isotopes in the crust) is stored in the different rocks themselves, as well as in the fluids filling their pores and fractures. Apart from the universally deployable engineered geothermal systems (EGS) which

occurrences threatening the security of supply. Furthermore, anthropogenic emission of CO₂ resulting from the burning of oil, gas and coal affects the climate system of the Earth. Its consequences are a rise of average temperature and the boost of so called extreme events, such as droughts, floods, hurricanes which cause billions of euros of economic loss each year. These global issues urged politicians to elaborate an integrated approach to climate and

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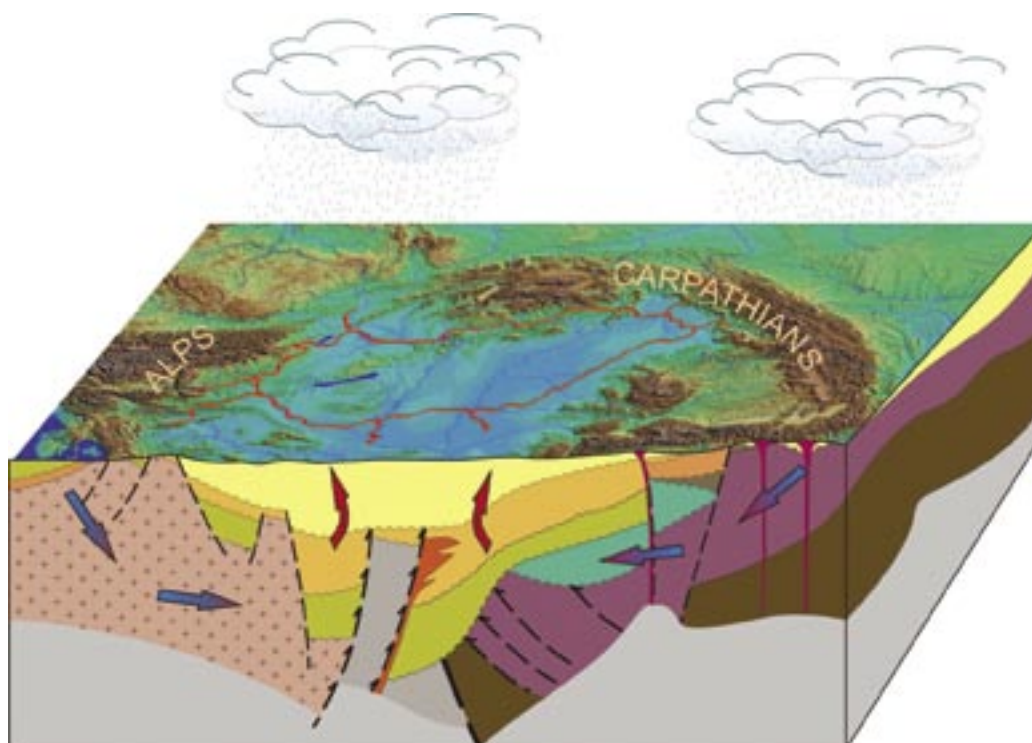


Figure 1. The Pannonian basin in Central Europe has many transboundary geothermal reservoirs, as the geological-hydrogeological units hosting deep groundwater flow systems are cut by state borders

are still in a testing phase (extraction of heat by circulating water via production and reinjection wells through artificially created fractures in massive hot rock volumes in the deep subsurface), and ground-source heat pumps that exploit the solar energy stored in the shallow subsurface, the “classical” utilization of geothermal energy is still based on deep circulating thermal groundwaters from hydrogeothermal systems. These hydrogeothermal systems are governed by convection. Heating from the Earth’s interior causes thermal expansion of the subsurface fluids causing lower density, and therefore their uprising along suitable pathways, like subsurface conduits and faults. Cold water from precipitation with higher density and higher hydraulic potential recharges the systems at their margins. To avoid overexploitation of geothermal systems and maintain reservoir temperature, pressure and discharge, i.e. to keep a sustainable production level (Rybach, 2003, Rybach and Mongillo, 2006) abstracted thermal water has to be replaced by re-injection (e.g. energetic and direct heat utilization schemes). In the case of balneological utilization where re-injection is not possible due to contamination, only that amount of water can be abstracted whose natural recharge and heat recovery is guaranteed. This issue makes a strong link with water management policies (e.g. Water Framework Directive 2000/60/EC)

and also highlights the long existing conflicts between the mining lobbies whose main interest is the maximum exploitation of resources, and the environmentalists whose aim is the maximum protection of resources, as shown by the controversial geothermal legislation in many European countries.

Transboundary management of resources

Like natural resources, large-scale hydrogeothermal systems are also strongly linked to favourable geological-hydrogeological settings, irrespective of state borders and are often shared by neighbouring countries. Thermal water extraction from the same transboundary geothermal reservoir at a national level without cross-border harmonized management strategies may cause negative impacts (depletion or overexploitation) leading to economic and political tensions between countries. Therefore only the establishment of a joint, multi-national management system can handle the assessment of geothermal potential and give guidelines for a balanced fluid/heat production.

This need was recognized by four Central European countries (Hungary, Slovenia, Austria and Slovakia) which share transboundary geothermal energy resources in the western part of the Pannonian basin, where cross-border utilization

conflicts already exist among the countries. The project TRANSENERGY – Transboundary Geothermal Energy Resources of Slovenia, Austria, Hungary and Slovakia therefore addresses the key problem of using geothermal energy resources in cross-border regions in a sustainable way. The project is implemented through the Central Europe Programme, Area of Intervention 3.1. (Developing a high quality environment by managing and protecting natural resources) and co-financed by ERDF and its duration is from April 1, 2010 to 31 March, 2013. The partners in the Transenergy project are four national geological surveys: MÁFI - Geological Institute of Hungary, Geo-ZS - Geological Survey of Slovenia, GBA – Geological Survey of Austria and SGUDS – State Geological Institute of Dionyz Stur (Slovakia), that have long experience in cross-border co-operation in Central Europe and as governmental institutions guarantee an independent assessment.

Geology and geothermics of the Pannonian basin

The Pannonian basin in Central Europe lies on a characteristic positive geothermal anomaly, with heat flow ranging from 50 to 130 mW/m² and geothermal gradient of about 45 °C/km. This increased heat flux is related to the Middle Miocene back-arc style extension (rifting) of the Pannonian



Figure 2. Supra regional and pilot model areas of the Transenergy project

basin, coeval with the thrusting of the Carpathian belt, when the lithosphere thinned and the hot asthenosphere got closer to the surface (Horváth and Royden, 1981). During the post-rift thermal subsidence of the basin in the Late Miocene, a single large depression developed which was occupied by the brackish to freshwater Lake Pannon and was filled up by sediments deriving from the surrounding Alpine-Carpathian mountain belt via large fluvio-deltaic systems prograding from the northwest and northeast (Bérczi and Phillips, 1985; Juhász, 1994). This resulted in the accumulation of an up to 4000-6000 m thick sedimentary succession.

This vast porous basin fill complex is the main reservoir of geothermal fluids (heated groundwater recharging from the surrounding Alpine and Carpathian mountain belts) (Fig. 1). Within this several thousand meters thick sedimentary

succession, the best reservoirs are large sand bodies which once deposited on the front of the prograding delta systems. These 50-300 m thick permeable sand/sandstone bodies with an aerial extent of 200-2000 km² have good connectivity with each other and are found at a depth of 700-1200 m where subsurface temperature is about 45-70 °C (Dövényi and Horváth, 1988). These reservoirs, referred to as “thermal-water bearing unit” in the Pannonian basin are widely utilized for balneological purposes as well as for direct heat (mostly greenhouses), therefore yield and temperature drop due to overexploitation is an already existing problem at many locations. Furthermore, the karstified zones of the Palaeozoic-Mesozoic carbonates, as well as fractured, weathered zones in the crystalline basement rocks are also very good thermal water reservoirs. At this depth (on average 2000 m or more), temperature can exceed

100 °C, reaching 120-140 °C in some areas (Dövényi and Horváth, 1988) and are therefore prosperous sites for generation of electricity with Organic Rankine Cycle (ORC) type of geothermal power plants with small capacity (< 5 MW_e).

Transenergy project aims and study areas

TRANENERGY's final goal is to provide a user-friendly, web-based decision supporting tool, which will function as a decision support tool for future geothermal exploration and exploitation. It will show all relevant information on the potential, vulnerability and sustainability of the geothermal systems in the investigated transboundary regions with different extraction scenarios of thermal water/heat. Targeted stakeholders are primarily authorities and investors, who will get a regional evaluation of geothermal

resources of the project area.

These assessments are based on geological, hydrogeological, and geothermal models comprising the whole area ('supra-regional models'), as well as detailed models for some representative regions along the borders (thermal karst of Komarno–Sturovo area (HU-SK), Central Depression of the Danube basin (A-SK-HU), Lutzmannsburg–Zsira area (A-HU), Vienna basin (SK-A) and Bad Radkensburg – Hodoš area (A-SLO-HU) (Fig. 2). These regions were selected because of their extreme sensitivity for any further intervention by different management policies in the neighbouring countries.

The Slovenian–Austrian–Hungarian cross border pilot area (Bad Radkensburg – Hodoš, Fig. 2) encompasses a very narrow and prolonged Mesozoic basement aquifer in the Radgona–Vas tectonic halfgraben along the Rába line. Although extensive research has been carried out during the last years in this region including the Styrian and Mura–Zala basins (e.g. Transthermal and T-JAM projects) and a fairly good understanding of the geothermal systems has been established, several questions remained unanswered; especially, the hydraulic connections of basement reservoirs to recharge areas are poorly known. Furthermore, cross-border utilization problems exist in this region: a few years ago a borehole in Slovenia drilled 500 m from the border hit the same reservoir supplying thermal water for the spa Bad Radkensburg in Austria, causing tensions between the two countries.

A similar cross-border utilization conflict exists in the Lutzmannsburg – Zsira pilot area (Fig. 2), which includes some famous spas in Hungary further to the southeast (Bük and Sárvár). A recently built large spa in Lutzmannsburg (Austria) abstracts thermal water from the Miocene–Pliocene aquifers and at the same time a continuously decreasing groundwater level has been registered in the nearby observation well which is screened for the same aquifer on the Hungarian side of state border.

The Vienna basin pilot area (Fig. 2) is divided into a northern and a southern part by the river Danube. The northern part is one of the most important hydrocarbon exploitation areas in Central Europe, therefore an ideal site to study links and conflicts between joint utilization of reservoirs for geothermal purposes. The southern part is known for its famous spas, like Baden, or Bad Vöslau. The Vienna basin is up to nearly 6000 m deep, and has a very com-

plex basement structure and development history, which also has an important control on the subsurface thermal groundwater flow systems: the central part is characterized by high temperature brines with high total dissolved content, while the margins encompass open thermoconvection systems with lower temperature and dissolved content. In the central depression of the Vienna basin no hydrogeothermal utilization has been established so far, despite the fact that permeable rocks exist down to a depth of 8000 m where reservoir temperatures can be as high as 200 °C.

The Danube basin, shared by Austria, Hungary and Slovakia (Fig. 2) is a bowl shaped structure filled by a nearly 7000 m thick clastic sedimentary succession. This is the only area in the project region where aggregated transboundary groundwater bodies have been delineated by ICPDR. Although geothermal potentials are not outstanding at this part of the Pannonian basin, a main thermal bearing aquifer which yields thermal water of 42–92 °C between 800–2500 m below the surface is utilized intensively both by Slovakia and Hungary. This unharmonized utilization has already caused a change of hydraulic potential which could be lowered by several meters in the region.

The Komarno–Sturovo pilot area (Fig. 2) is a typical karstic transboundary aquifer shared by Slovakia and Hungary. The main recharge area is composed of Mesozoic carbonate rocks that outcrop at the NEastern part of the Transdanubian Central Range in Hungary. Lukewarm karstic springs discharge at the foot of the mountains and thermal spas are found on both sides of the border, such as Esztergom and Sturovo, just a few km from each other. The Hungarian part of this area was seriously affected by karstwater withdrawal due to bauxite and coal mining in the 1980–90s when the depression of karst water level exceeded 100 m at many parts. This had a serious effect on the entire groundwater system, many lukewarm karstic springs dried up and yields dropped dramatically. After mines were closed and withdrawal finished, rehabilitation started in the region, so it provides an excellent natural laboratory to model thermal water utilization according to different withdrawal scenarios.

For such evaluations and establishment of models common data sets and joint database with harmonized data that are comparable between the countries are crucial. Abundant geological data is gathered/accumulated at all four Geologi-

cal Surveys, but data are diverse and of low uniformity (different formats, scales, projections, origins, classifications, etc.). Data relevant to the project include various types of geological maps and cross sections, geophysical profiles, as well as borehole data (lithostratigraphy, various types of geothermal data, production parameters from wells, hydrogeological and hydrogeochemical datasets, etc.). Such datasets from about 3000 boreholes in the four countries have been integrated into a joint multi-lingual database in a common format. Public access to this database will be available via a link to the web-based decision-supporting tool.

The web-based geothermal information system will also incorporate the utilization aspects of geothermal resources of the region. Data and structured opinion of different authorities dealing with the management and licensing of geothermal energy, as well as users and utilization parameters have been collected and organized into databases and visualized on joint transboundary utilization maps. These maps will provide an overview on the current exploitation rates and production parameters of the transboundary geothermal reservoirs which will offer background information to decision makers on enhancing spatial planning actions as well as for identification of problematic areas. Development agencies, potential investors and present thermal water users will be able to identify their advantages and disadvantages in comparison to other regions/users and gain more sensible information on possible future development on selected sites.

The project's main outputs may be summarized as follows:

- multilingual interactive geothermal web portal containing a database linked to thematic maps, cross sections and models
- geological, hydrogeological and geothermal models for the supra-regional and pilot areas
- scenario models showing estimates on the potential and vulnerability of the cross-border geothermal systems for different extractions of thermal water/heat
- database of current geothermal energy users and production parameters, visualized on transboundary utilization maps
- database of authorities dealing with management and licensing of transboundary geothermal aquifers

- summary of actual legal and funding framework at the participating countries with emphasis on cross-border geothermal facilities

- strategy paper evaluating existing exploitation, future possibilities and recommendations for a sustainable and efficient geothermal energy production at the project area

Results of the project can be followed on:
<http://transenergy-eu.geologie.ac.at>

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Sustainable Aggregates Resource Management and Supply:

South-east Europe project 2009 - 2011

by Slavko Šolar¹ and Deborah Shields²

Earth scientists, geologists and others are involved not only in fundamental research projects, but also in applied projects. Most applied projects are multidisciplinary and have as their goal the solution of different open and ongoing challenges that society faces. An important set of these projects deals with the provision of an adequate and secure supply of raw materials. This paper describes a Southeast Europe project, "Sustainable Aggregates Resource Management". The main objectives of the project are to develop a common approach to sustainable aggregate resource management (SARM) and sustainable supply mix (SSM) planning at three levels (local, regional/national, transnational) to ensure efficient and secure supply in south-east Europe.

Les géologues et professionnels des Sciences de la Terre participent non seulement aux projets de recherche fondamentale mais aussi à des projets d'application. La majorité des projets appliqués sont multidisciplinaires et ont comme objectif de résoudre les défis différents, actuels et naissants, que rencontre la société. Une partie importante de ces projets concerne un approvisionnement suffisant et garanti en matières premières. Cet article traite d'un projet en Europe du Sud-Est intitulé « Gestion d'une ressource durable en agrégats ». Les objectifs principaux du projet représentent le développement d'une approche commune pour la gestion des agrégats au niveau ressource durable (SARM) et un plan mixte d'approvisionnement durable (SSM) à trois niveaux : local, régional et international, pour assurer un approvisionnement efficace et continu en agrégats, pour l'Europe du Sud-Est.

Los geocientíficos, los geólogos y otros profesionales, no están sólo dedicados a proyectos de investigación fundamental, sino también a proyectos aplicados. La mayoría de los proyectos aplicados son multidisciplinarios y tienen como objetivo la solución de los diferentes retos que existen y continúan hoy vigentes a los que se enfrenta la sociedad. Un grupo importante de estos retos se refieren a la disponibilidad de fuentes apropiadas y fiables de materias primas. Este artículo describe un proyecto en el sureste europeo titulado "Gestión sostenible de áridos". Los principales objetivos del proyecto son desarrollar una aproximación común a la gestión de los recursos de áridos (SARM) y a una combinación sostenible de suministros (SSM) planificada a tres niveles (local, regional/nacional, transnacional) para asegurar un suministro eficiente y seguro para el sureste europeo.

Aggregates are used in construction of housing, commercial buildings, industrial development and a variety of public infrastructure projects. As a result of the global recession, construction activity has decreased significantly in many parts of the world. This in turn has decreased demand for, and as a result, production of aggregates. Given the economic situation, some authors have suggested that the major issue facing the aggregates sector is recovery from the recession. But longer term, more fundamental concerns are at stake that will need to be dealt with. For aggregates to be produced from new resources (or new areas associated with existing quarries), certain conditions will need to be met. These include the well-



recognized issues of deposit quantity and quality, location, permitting, and environmental protection, etc. In addition, firms must be able to demonstrate that they can be profitable considering all costs, including exploration, acquisition, permitting, operation, environmental controls, compliance with regulations, transport to market, and reclamation. They will also need a social license to operate.

There are differing interests with respect to, and competing goals for, land use. Moreover, while individuals familiar with quarrying, construction, and the material supply chain realize that provision of aggregates is essential to maintaining and enhancing economic development and quality of life, that connection is not necessarily obvious to people unfamiliar with the industry. As a consequence, communities

frequently do not consider the importance of setting aside areas for aggregates extraction during their land planning processes. This problem is compounded by the strong NIMBY factor associated with quarries, which is in turn exacerbated by poor environmental and social practices, a lack of reclamation by some operations, and the existence of illegal quarries.

Sustainable aggregates resource management (SARM) provides a framework for addressing these complex issues. SARM requires that: (a) sufficient aggregates be made available to meet the material needs of society, (b) eco-efficiency be practised so that resources are not wasted, (c) natural mineral capital be transformed into built physical, economic, environmental or social capital of equal or greater value, (d) environmental, economic, social and corporate values and responsibilities be recognized and addressed, (e) public debate before decision making be informed, so that decisions are based on adequate,

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sufficient, unbiased information that is understandable to all parties involved; and (f) tradeoffs regarding alternative land uses be acknowledged and dealt with.

Given the impacts of the global recession, current aggregates production levels are now dependent to some degree on economic stimulus expenditures and on public infrastructure projects. This circumstance provides an opportunity for governments to encourage producers to practice SARM and also to coordinate their mineral policies with other public policies so as to minimize conflicts and costs and optimize benefits. Recognition of the need for SARM that fulfills present demand and planning for supplies to meet future demand is present within modern society, although stringent SARM policies do not exist in most countries. Nonetheless, the multiple aspects and goals of SARM are not being achieved in many regions or countries, including the region of south-east Europe (SEE).

SEE countries are rich in aggregates, but neither management nor supply is coordinated within or across the area. At the site level, the issues are high environmental impacts, a need for stakeholder consultation and capacity, a lack of social license to operate, and limited recycling. At the regional/national level, the issues are policies and regulations affecting aggregates that: do not address resource and energy efficiency or EU guidelines, preclude the use of recycled materials and industrial by-products, and fail to address aggregate consumption in long-term sustainable development and spatial planning. The transnational issues are lack of capacity and lack of coordination on aggregates production and transport. Taken together these issues demonstrate the need to shift to sustainable aggregate resource management (SARM) and sustainable supply mix (SSM) policies. As noted above, efficient, low socio-environmental impact quarrying and waste management is SARM. A SSM comprises materials from multiple sources, including recycled wastes and industrial by-products (slag), that together maximize net benefits of aggregate supply across generations.

Project objectives and methodology

To meet the aforementioned challenges the project entitled “Sustainable Aggregates Resource Management” (SEE/A/151/2.4/X – SARMa) was approved by the EU Commission and co-funded by ERDF funds in 2009. The two main project objectives are: to develop a common approach to SARM across SEE, and ensure a SSM



Diabase Quarry - Revarsarea, Romania



Diabase Quarry - Revarsarea, Romania

in SEE based on fair distribution of costs and benefits of aggregate production, use, waste disposal and recycling, so as to enhance resource and energy efficiency and quality of life. Objectives comprise: coordination in managing aggregate resources; increasing the transfer of know-how, and supporting capacity building in firms, government and civil society; developing a unified information infrastructure and common understanding of aggregates based on EU guidelines and directives, including those in protected areas, potential secondary supply, and transnational transportation networks; and preparing for Regional Centre on SARM & SSM.

Scale specific objectives are to:

Local:

- Optimize the efficiency of primary aggregates production
- Prevent or minimize environmental impacts of quarrying and improve reclamation,
- Minimize illegal quarrying by improving knowledge
- Promote recycling (construction, demolition & quarry waste)
- Increase interested and affected groups' capacity.

Regional/national:

- Assess and quantify aggregate resources and relevant transportation links

- Develop strategies for sustainably managing aggregate resources, including in protected areas, considering aggregate resources in land management and use planning, and harmonizing policies across regions
- Develop guidelines and procedures for SSM planning.

Transnational:

- Develop recommendations for harmonizing SARM & SSM transregionally and transnationally
- Design a multi-purpose and multi-scale Aggregates Intelligence System (AIS) as a long-term tool for know-how transfer.

Follow-up:

- Prepare plan for a Regional Centre on SARM & SSM, to increase capacity of all interested and affected groups through workshops, training, and the creation of both educational materials and tools.

The project duration of two and half years is sufficient to perform proper sequences of interlinked activities. The project is structured in 5 Work Packages (WPs), 2 general and 3 thematic. WP3 (local) started first, followed in month 5 by WP4 (regional/national), which has built on preceding outputs and results. WP5 (transnational) began in the second part of the project, and builds on WP3 and in particular WP4.

Thematic WPs are comprised of a set of activities that are conducted sequentially, or in combination when there is a common purpose or location.

WP3 activities are:

- 3.1 Environmentally friendly extraction practices;
- 3.2 Illegal quarrying;
- 3.3 Recycling.

WP4 activities are:

- 4.1 Sustainable aggregate resource management;
- 4.2 Planning for sustainable supply mix.

WP5 activities are:

- 5.1 Harmonization of legislation and policies;
- 5.2 Sustainable supply across SEE.

Each WP activity starts with actions in selected locations in multiple project partner countries, including site visits, interviews, surveys, and data collection. The synthesis report for each activity will include evaluations of case studies and best practices, as well as “do’s and don’t’s”

and recommendations for successful implementation of SARM and SSM. WP manuals will condense the extensive information contained in the synthesis reports, add additional background information, and present recommendations and guidelines for capacity building for all interested and affected groups at all project scales. The audience for the WP 3 Manual is local, i.e., quarry operators (industry) as well as the local community, which is usually represented by local authorities, but also can also include other stakeholders. This is an important consideration since the focus would be different if it was compiled only for the public authority or for any other specific stakeholder. WP’s 4 and 5 results and recommendations will be reported in a Manual aimed primarily at regional and national public authorities, but again made available to any interested party. In addition, a Manual on Life Cycle Assessment for recycling and a report on the Aggregates Intelligence (decision support) System will be distributed. Manuals will be translated into all project partner country official languages.

The results will be disseminated in electronic and printed form, and at local/regional and transnational events, e.g. workshops or capacity building events. Within WP3, stand alone outreach events are planned; in WP4 and WP5 events will be combined. There are 13 local events planned across the SEE (IT, GR, SP, AL, HU) to be conducted mostly in local languages. Transnational events will mainly be linked with project meetings; kick-off meeting (Bologna, IT) was a partnership meeting only. The 2nd (Split, HR), 3rd (Bucharest, RO), and the 4th (Edessa, GR) project meetings coincided with national meetings and transnational events on outcomes of WP3. The 4th project meeting also included transnational events on WP4 and WP5 topics. The project will end with a 5th meeting that will coincide with the International Conference on Sustainable Aggregates Resource Management on September 20 – 22, 2011 in Ljubljana, Slovenia. Between the 4th and 5th project meetings there will be another transnational event in the northern SEE (St. Pölten, AT); it is included in order to share information with more beneficiaries.

Project team

Scientists and experts form a major part of the project team of South East Europe project SARMA. The partnership has all the expertise and responsibility for implementing the planned results and objectives.

Aspects of relevance include: (a) geographical coverage: 14 partners in 10 countries of SEE area (see box), (b) inclusion of partners from old member states, new member states, and candidate countries. This will assure knowledge transfer and best practices transmission to zones with less experience in SARM and SSM, which will enable better cohesion of SEE countries in aggregates management and supply. Other aspects of the partnership are: (c) competence and expertise of partners, not only in resources, but also with environmental issues, (d) vertical coverage in different countries of activities at different scales (i.e., different zones for field work, model development, and pilot implementation) will facilitate transnational activities, and knowledge transfer from experts to stakeholders at the policy and implementation levels in different countries, and (e) continuing partnership among project members and observers representing ministries in charge of mining, regional authorities, chamber of commerce and industry.

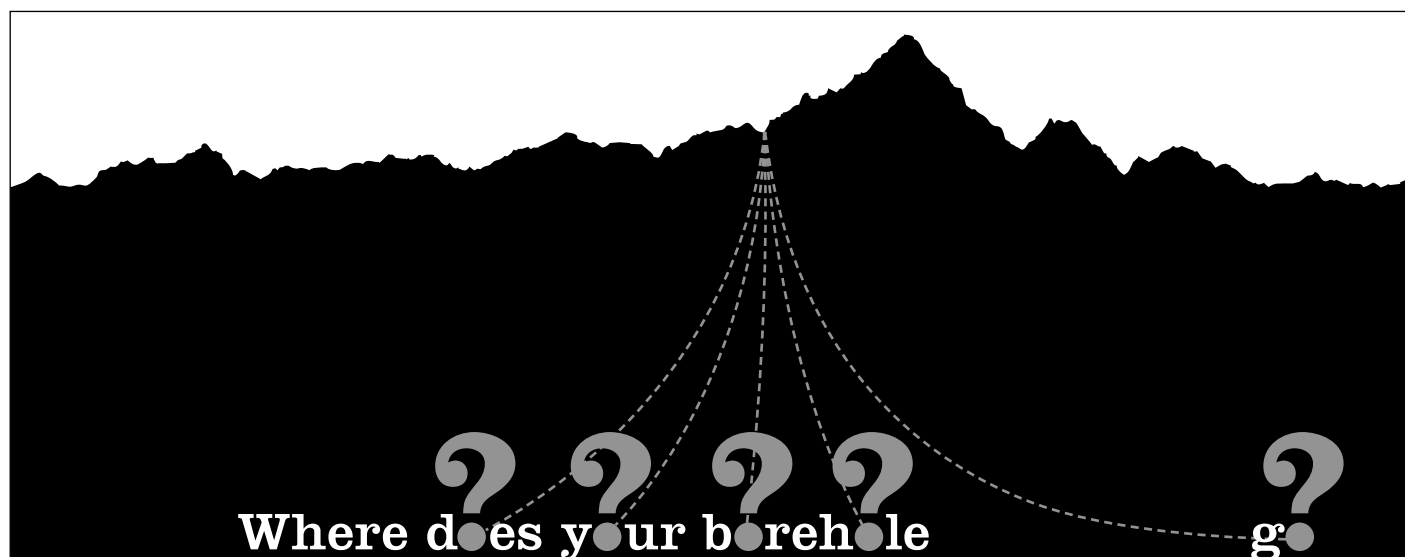
Geological surveys, institutes and faculties work regularly as experts and policy advisers with government and industry and combine up-to-date knowledge and expertise in the area of aggregates. All have constant relationship with decision making bodies in their countries and prepare strategic documents for authorities. Also, 8 decision making bodies are included that have sector extraction areas under their rule and have expressed a desire to participate actively in seeking solutions to the challenges of aggregates production and supply. Emphasis will be given to capacity building activities that will be possible by combining the expertise of partners. Partners have the experience in projects and public awareness-raising in order to manage the project and disseminate outputs and results. Partners have made a long-term commitment by expressing their intention to establish a regional centre for SARM in SEE. In a course of project duration the partnership has been enriched by a pool of stakeholders, a group of interested parties that have access to partnership meetings, events and documents and who have actively participated with their experience.

Cooperation within SARMA has enriched the partnership and the individual stakeholders involved. Partners and stakeholders have been able to discuss details that are not obvious and not visible when general policies are made and implemented. Personal acquaintanceship has been strengthened and ties strengthened among project

participants, partners and countries within SEE in particular. Regional coherence is taking place, and there has been enhanced understanding of and appreciation for each partner and country participating. Moreover, SARMA is already having an impact in every Partner country. Through personal meetings with Partners, as well as public meetings, industry, public authorities, and community members are becoming more aware of the challenges associated with managing aggregate resources and ensuring that a secure, sustainable supply will be available for their communities, countries and economies. Their engagement in SARMA is leading to results and recommendations that will be widely applicable in SEE and beyond the region as well.

14 south-east European partners

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Geological mapping in Spain: cost benefit analysis

by Roberto Rodriguez Fernández¹

The first series of the Geological Map of Spain at a scale of 1:50,000, was developed by the Spanish Geological Survey (IGME) from 1927 onwards. When the last sheet of this first series was printed in 1971, 40% of the 1,180 sheets had been completed. The second series of the Geological Map of Spain at a scale of 1:50,000, is the MAGNA Plan. This new plan of systematic geological mapping was drawn up between 1968 and 1970. The aim was to give the country a geological infrastructure that was homogeneous in quality, worked out with the most up-to-date methods, and published in a format and with norms that were homogeneous. In the evaluation and budgeting of the MAGNA, homogeneous criteria were used, including factors such as geological difficulty, accessibility and climate. Each sheet of the MAGNA has three distinct documents: the Geological Map (Fig. 1), the Geomorphological Map (Fig. 2) and the explanatory Report, along with Complementary Documents, which consists of a map of sampling locations, detailed stratigraphic columns, thin sections, hand specimens, and fossil samples, with files for every study, photograph album, complementary reports and chemical analyses. During the 32 years that the MAGNA Plan took to be completed, about 638 geologists and mining engineers, and over 400 specialists belonging to more than 20 engineering firms, 11 Schools of Geology or Mining Engineering, and two regional geological services, as well as the staff of the Institute itself, took part in its development. It should be noted that each geological sheet of average difficulty requires the full-time dedication of 1.8 geologists per year. This figure includes laboratory and field work and back-up from experts in the various geological disciplines. All this input implies a cost per sheet of around 100,000 euros, making the total investment in the Plan 121.27 million euros (Figs 3&4).

The social and economic evaluation of the MAGNA Plan, adopted a very similar

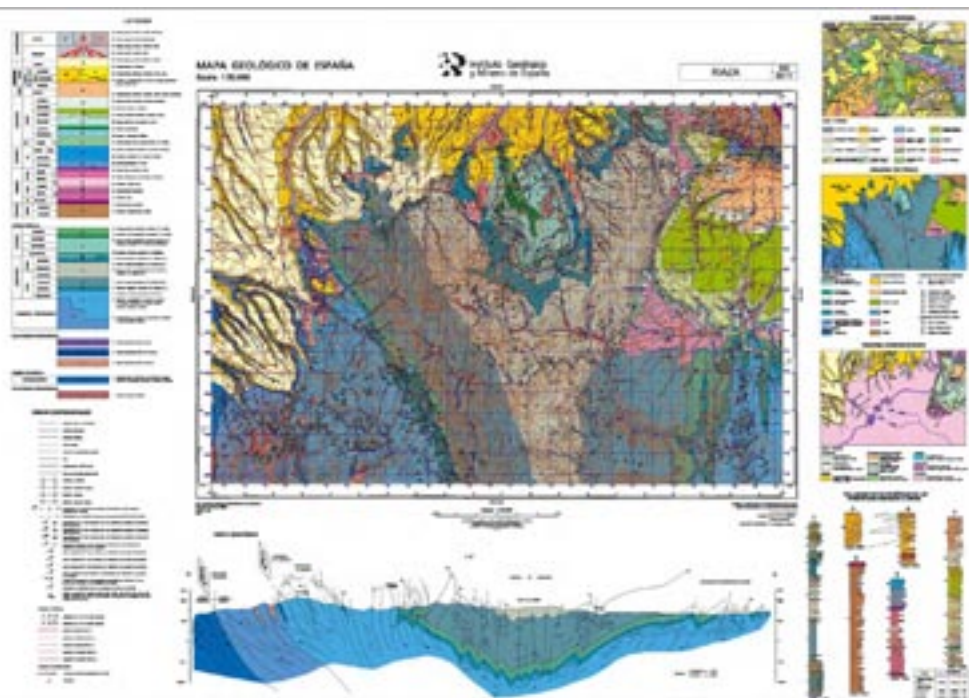


Figure 1. Example of a MAGNA geological sheet, with the various items that it contains

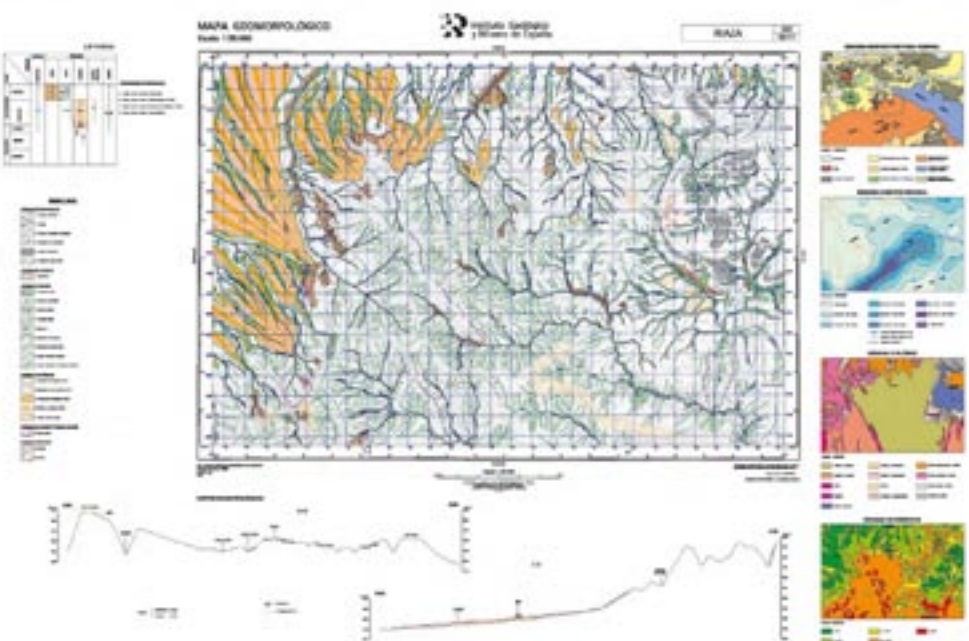


Figure 2. Example of a MAGNA geomorphological sheet, with the various items that it contains

¹Assistant Director of Geoscience Infrastructure IGME

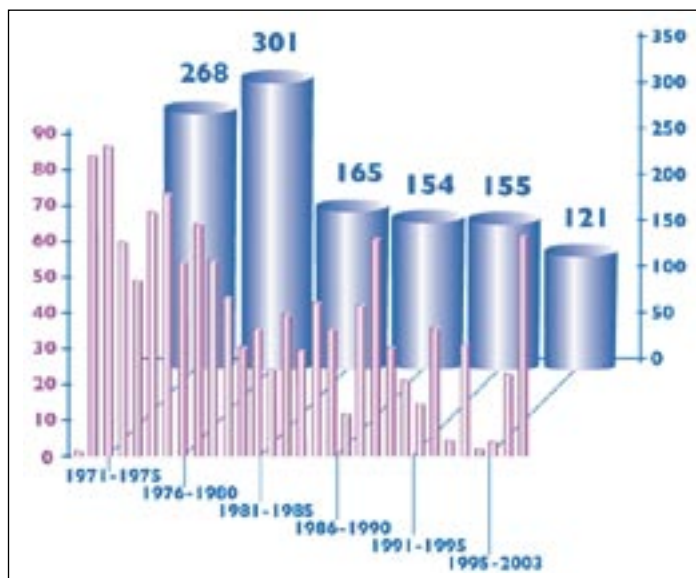


Figure 3. Sheets completed per year and every five years



Figure 4. Evolution of investment in euros. Total investment 121.27 million euros

methodology to that used by the Illinois Geological Survey (USA) for the evaluation of the detailed geological maps of the State of Kentucky. A total of approximately 1,200 current or possible users of geological maps were asked to fill in a questionnaire. We think that the reply ratio of about 26% gives a sufficiently broad sample of MAGNA sheet users. The various users polled included mainly experts active in engineering, universities, mining and hydrocarbons, and also in Government bodies and the environmental, construction and agricultural sectors.

The profits or benefits from the MAGNA Plan, understood as the savings that users made on account of their use of the sheets, were assessed at a minimum of 1,255 million euros and maximum of 3,340 million euros. The cost/benefit ratio of the MAGNA Plan runs in a range from 10.35 to 27.54. It is true that the calculation was subject to the intrinsic uncertainties of such a survey and to not knowing for sure how many copies of the maps had been sold to companies. It is also true that the evaluation was simplified by the assumption that users' appraisal of the sheets in the year 2003 can be extrapolated to other years. Despite all this, the result is undoubtedly a conservative estimate since, as it was explained above, on two major points decisions were taken to calculate "downwards": the calculation of the number of sheets sold and the supposition that each copy bought by a company was used on just one project.

At any rate, it can be concluded that the MAGNA Plan, with a cost-benefit ratio of 19 was an excellent public investment. It greatly exceeded the expectations projected in the PNIM's original economic evaluation reports.

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News from NGO Geólogos del Mundo (World Geologists)

An inter-institutional coordination of disaster risk management in the metropolitan area of San Salvador, El Salvador

One third of the population of El Salvador is concentrated in the San Salvador Metropolitan Area (AMSS), even though it occupies only 3% of the country. Various disasters in the region at the beginning of the decade 2000 (2001 Earthquakes, Tropical Storm Adrian and Stan in 2005 ...) showed the conditions of social vulnerability and physical force in the territory. Vulnerability has increased in recent decades for several reasons, among them: the scarcity of safe urban land, high migration from rural to urban areas (due in part to the 90 armed conflicts and various disasters), the economic impact of dollarization on the population, combined with recurring natural phenomena (such as hurricanes and tropical storms, earthquakes and landslides). The earthquakes of 2001 also showed the institutional weakness to address such situations. Land management, by local and regional institutions, lacked adequate tools (technical, regulatory or political) based on environmental and risk management.

In this context, the IPGARAMSS programme, formally constituted in February 2005, began to take shape, starting with political and technical support from World Geologists and advocating a forward-looking approach to address the causes of disasters instead of a reactive approach to emergency preparedness. The programme was designed to strengthen local government through their environmental and land planning units, to include risk management in development planning.

Partners and beneficiaries of the project are the Council of Mayors of the AMSS, the Planning Office of AMSS, the technical units of the 14 municipalities of AMSS and community organizations as well as cooperation with the University of El Salvador, "Universidad Centroamericana Jose Simeon Cañas", National Autonomous University of Mexico, and local organizations like the Foundation for the Study of Applied Law and Guillermo Manuel Ungo Foundation for those areas in which World Geologists is not a specialist. Finally, the programme has been funded by the following institutions (in order of total amount contributed): Municipality of Barcelona, Spanish Agency for Development Cooperation, "Diputació de Barcelona"

and Barcelona Metropolitan Area.

The programme has been structured into three distinct phases:

Phase I: diagnostic phase and construction of the conceptual framework, which aims to guide the course of the programme. The specific objectives for this stage have focused on strengthening the technical and human capacities, on the organization of a metropolitan system of risk management and characterization of resources and geological hazards; AMSS diagnoses of hazards and water resources; invitation of municipal technicians to join the geological and hydrometeorological work, with on the job training.

Phase II: creation of an environmental and risk information system, and gathering of data to create databases (environmental, geological hazards, land planning, regulatory framework and control mechanisms and public involvement). It has included a study of the volcanic activity threat of the volcanic complex of San Salvador (giving support to a doctoral thesis), the integrated map of threat from landslides and the flooding characterization of the Metropolitan Area of San Salvador; strengthening of the technical capacity to evaluate the territory on the basis of geological hazards and land planning, as well as creating opportunities for coordination at the inter-institutional level. In this phase, the objectives related to the management of hydro-geological resources and environmental aspects have been put aside, in order to focus on risk management (incorporating the social, political and regulatory components, as well as the study of threats).

Phase III: focus on the beneficiaries to improve their understanding of this topic, to put technical information at their disposal for decision making and to implement tools and strategies for disaster risk management.

These three phases have been devel-



Inspection of the community La Fosa



Inspection of the Oro Road landslide, Ciudad Delgado



"Mesa técnica": interpreting aerial photographs

oped around four areas of work:

- Strengthening of technical capacities, with the aim to enhance local technical autonomy in the management of essential tools for risk management and to generate technical inputs for the assessment of risk-based territory. This aims to create the capacity to develop land planning with an environmental and risk vision. The "Mesa Técnica" is created, a work training and coordination phase. In addition to diagnosis, studies on the characterization of geological and hydrometeorological hazards have been made (landslides, floods and volcanic hazards) as well as field support in times of emergency.

- Public participation: aims to involve the public as a relevant actor for risk management in the territory and has been the starting point for the development of environmental and risk management in a participatory manner, in the three municipalities of AMSS that make up the Micrerregión Mérida Anaya Montes (Mexicans and Cuscatancingo Ayutuxtepeque).

- Regulatory framework: analysis, review and update of local and regional regulatory framework on environmental issues and risks, to create the regulatory basis to guide the implementation of sustainable territorial development policies in the council.

- Coordination inter / intra-institutional throughout the programme, which stems from the need to create space to encourage cooperation at different levels of intervention, as well as among municipalities and technical units.

This has been accompanied by a communication strategy for the transmission of knowledge of disaster risk management, which consists of awareness for decision makers, for technicians and for citizens living in the AMSS, making the information accessible.

This article is written based on the internal document Systematization of the programme (2005-2011).

Joan Molinas Daví

Central office and Delegation of Madrid

geologosdelmundo@icog.es
www.geologosdelmundo.org

News from Serbia

Serbian Geological Society celebrates 120 years

The first meeting of the Serbian Geological Society (Srpsko geološko društvo) took place on 10 February 1891, in the building of "The Great School" of Belgrade, when Jovan Žujović gathered a group of his students. Thus began the continuous work on the geology of Serbia and the whole Balkan peninsula, as well as basic geological education in Serbia which enabled keeping up with the latest progress in geology worldwide. Being one of the oldest professional societies in Serbia (the only one older being the Serbian Medical Society), and one of the oldest geological societies in Europe and the world, for decades the Serbian Geological Society

has played a key role in promoting geology and geological heritage all over the region and has served as a model for other professional societies in Serbia and the former Yugoslavia.

The pioneers of the Society were responsible for introducing geology into different institutions of Serbia (The Great School which later became the University, Serbian Academy of Sciences), as well as founding some new ones – the geological Survey of Serbia, the Seismological Survey, etc.

Jovan Žujović, the founder and first president of the Society was a very prominent figure in Serbian science, not only in



the field of geology and other natural sciences, but also in the field of anthropology, all of which earned him the position of the President of the Serbian Academy of Sciences. Last, but not least, he was also active in the political life of Serbia, having served as the Minister of Education and of Foreign Affairs. Being a French graduate, he had very good ties with European scientists of his time which were very helpful in bringing Serbian geology closer to the newest achievements in Europe.

The mission still goes on after 120 years. The Society managed to overcome hard times and to maintain good contacts with its neighbours and friends worldwide, being a full member in all important international geological associations, including the EFG. The members of the Society will be very glad to welcome all its friends and associates to the 17th Meeting of the Association of European Geological Societies, which will be held in Belgrade on 14-16 September, with the core subject "Geology in the Digital Age".

Iris Vukovic

INVITATION: Sustainable Aggregates Resource Management

SARM International Conference, September 20 – 22, 2011, Ljubljana, Slovenia

Organized by: Geological Survey of Slovenia, SARMa project coordinator

Organizing Committee: Dr. Slavko V. Šolar, Dr. Gorazd Žibret, Ana Burger, Alianta d.o.o.

The Conference aims to provide a forum for discussing the development of a common approach to sustainable aggregate resource management at local (production), regional and transnational level, in order to ensure efficient supply. Local site-level activities will focus on environmentally friendly extraction practices, recycling, and stakeholder involvement. Regional/national activities will focus on sustainable management and supply policies, considering EU guidelines and directives. Transnationally, a structure for European-wide aggregates information transfer will be created, and harmonized policies and management promoted.

The SARM International Conference Committee welcomes extended abstract (2-6 pages) contributions with 20' oral or poster presentations (the type of the presentation will be determined by the organizing committee) from stakeholders connected with sustainable management of mineral resources: researchers, public and private sector representatives, various non-governmental and environmental associations and societies. Special attention will be placed to the outcomes of the SARMa project, co-financed by the South East Europe Transnational Cooperation Programme. The official language of the conference is English.

Important dates:

1 April - Opening of extended abstract submission and registration form, SARMa web page <http://www.sarmaproject.eu/>

1 August - Closing of abstract submission

by the 16 August - Notification on the type of presentation (oral 20', or poster)

8 September - Closing of registration form

20 - 22 September - Conference and field trip

SARMa web page:

<http://www.sarmaproject.eu/>

Geological survey of Slovenia

<http://www.geo-zs.si>

Soil and Rock Description in Engineering Practice

Book review by Kevin Privett¹

Soil and Rock Description in Engineering Practice

by David Norbury

Published by: Whittles Publishing [www.whittlespublishing.com]

ISBN: 978-1904445-65-4

Date: April, 2010, 301 pages

Price: £80 (stg), hardback

There is not much point in being an engineering geologist if you cannot describe soils and rocks in such a way that your readers can visualise them for themselves, as if they had actually been there. A key skill of the engineering geologist is the development of the conceptual ground model, because this feeds into the rest of the engineering design process. As Norbury writes, the logger may be the only person ever to see the samples.

He has drawn on 20 years experience of presenting training courses on the subject, derived from a life's work getting his hands dirty and helping to draft the standards we use. This is a very thorough book and is well presented and printed, with clear tables, helpful thumbnail photographs and figures and text boxes containing tips and example descriptions. It is aimed at the doers and the reviewers.

It does not just tell the reader what is required, but how to do it. For example, there is a series of photographs of samples ranging from slightly sandy GRAVEL to slightly gravelly SAND, showing the total sample and its component sand and gravel fractions. A little diagram helps users convert the volume proportions they see to the mass proportions needed to define the boundaries that make up terms such as 'slightly'. Did you know, for example, that 40% gravel by mass is only 28% by volume?

There are photographs of dirty hands to help differentiate between silt and clay, plus some interesting historic background on topics such as the much-debated silty CLAY, SILT CLAY, SILT/CLAY issue. The book covers all the new requirements linked to Eurocode 7. It even lists some descriptions through the ages to show how things have changed - useful if referring to old reports.

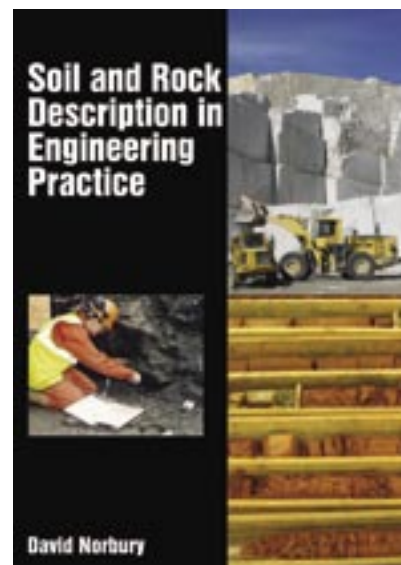
Less common materials are also covered, such as concrete and blacktop. Do

you know the difference between tarmac and asphalt? Do you know what orange mottled grey looks like? Have you actually seen gleying; or is it just something you put on your logs because it sounds good? Do you know how to mark out fractures on the core box to aid the measurement of fracture spacing? Would you be able to estimate the strength of a rock by hitting it with a hammer and listening for a whop, thwack, ploink, plink or dink?

Buy this book.

¹Hydrock, Bristol, UK

Reprinted from Geoscientist, September 2010



Mineral Exploration and Mining Essentials

Book review by EurGeol. John A. Clifford¹

Mineral Exploration and Mining Essentials

by Robert Stevens

Published by: Pakawau GeoManagement Inc.

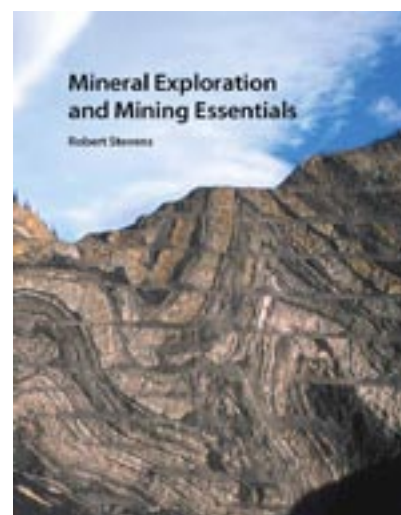
ISBN: 978-0-9867221-0-3

Date: 2010, 322 pages

Price: CAD\$99.95 + \$10 shipping to Europe, paperback

Mineral Exploration and Mining Essentials is aimed primarily at non-technical professionals working in the mineral exploration and mining industry, but is equally useful to students entering a career in those industries. The author, Robert Stevens, is a professional geologist with a background in exploration and academia.

The organization of the book begins with an industry overview and then proceeds with a brief review of geology and mineral deposits with an emphasis on those aspects that relate to exploration and mining. The chapter on mineral deposits includes a synopsis of ten major deposit types describing their significance and distribution; grade and tonnage characteristics; notable exploration drill intersections; typical mining methods; size, shape and form of mineralization; rock types;



economic minerals; formation and typical examples. This chapter also includes a section on terminology that might have been better placed in the very useful Glossary. Chapter 4 discusses the technical aspects of mineral exploration in a very concise, but yet comprehensive manner. In addition, it includes a section on how exploration projects are financed. Chapter 5 describes the essentials of mineral resource project technical studies, with pertinent discussion of mineral resources estimation, and a short section on Canadian reporting and disclosure standards. Chapter 6 discusses

underground and open pit mining methods, touching on critical components of the operations. In Chapter 7 the recovery of minerals and metals during mineral processing is described, with brief, yet adequate, description of leaching and flotation techniques. The critical issue of the environment is addressed in Chapter 8, including discussion of mine closure plans and reclamation. The final chapter presents some of the factors that should be taken into consideration in evaluating exploration companies and how to read between the lines in technical press releases.

Each chapter includes a list of references. This is one area where more detail would have been welcomed. For example, the single reference for a Dictionary of Geological Terms in Chapter One does little to add to the reader's understanding of the industry.

There are two very useful appendices. One with common conversion factors, and the second with grade-tonnage tables for 12 major deposit types. The book also includes a short Glossary of Terms.

As might be expected from the author's background the book is North American centric with example projects predominantly taken from the Canadian and American resource sectors. This however in no way detracts from the value of the book to the target audience as the examples are pertinent and well chosen.

Illustrations are in colour and, in conjunction with high quality photographs, provide good explanatory back-up to the technical text, as well as making the book attractive.

A particular feature of the book is the way it combines discussion of technical and economic issues. This reflects the author's view, correctly in my opinion, that exploration and mining is a business.

This book very successfully meets the objective of presenting an overview of the exploration and mining industry and I can highly recommend it to those in the business community dealing with the resource sector and to those students considering a career in the industry.

The book can be obtained from some associations in Canada (Geological Association of Canada, the Geological Survey of Canada and the Association for Mineral Exploration BC) and the US (Society of Mining, Metallurgy and Exploration) as well as on the website: www.miningessentials.com

¹PGeo
Athlone, Ireland

Diversity's big bang: or impacts and the ordovician biodiversification

Book review by David Harper¹

Incoming or, why we should stop worrying and learn to love the meteorite
by Ted Nield

Published by: Granta Books [www.granta.com]

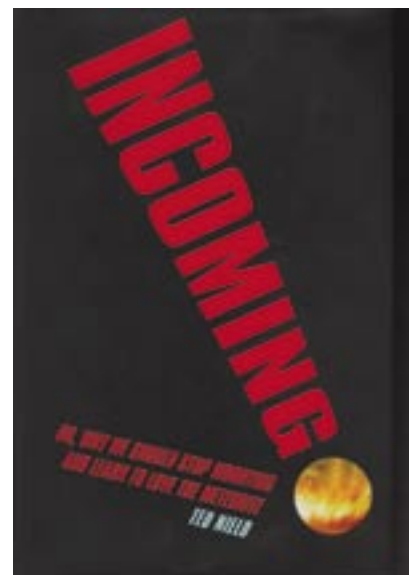
ISBN: 978-1-84708-241-1

Date: 2010, 271 pages

Price: £20 (stg), hardback

The early 1980s witnessed a renaissance in palaeontology. Not necessarily because any new major fossil discoveries or investigative techniques had suddenly emerged but rather the end-Cretaceous extinction event and subsequently the putative 26 million year cycle of post-Palaeozoic extinctions could be explained by meteorite impacts. This attracted the very considerable attention of serious scientists such as astronomers and physicists and the mid-1980s saw a significant number of papers in *Nature* and other high-impact journals exposing the extra-terrestrial importance of such biological events. Palaeontologists' record of the history of life on our planet might after all be of some use. Ted Nield, in this engaging and well-researched book, has delved into the history of our perception of these heavenly messengers: in three sections, rich in scientific detail and appropriate anecdotes, he has targeted our early conception of the meteorite (Dreamtimes), its association with catastrophe (Demons) and some recent research on the positive effects of meteorite showers, back in the Ordovician (Deliverance).

Nield has developed the exciting plot based on his own experiences as a palaeontologist together with careful research based on the literature but also through contact with some of the colourful, key players in the story. The narrative has been skilfully used to illustrate their trenchant views and their polemic stance on any opposing models and theories. An enormous volume of research has been devoted to the possible destructive power of meteorite impacts; it is the stuff of cartoon films and comic books readily consumed by the general public and the media. But what if meteorite impacts were actually beneficial to life on Earth? In a climax to 'Incoming' Nield focuses on the recently-documented coincidence between meteorite showers



and the early stages of the Great Ordovician Biodiversification Event (GOBE).

The GOBE is a relatively new topic (see Harper, 2006) but there has already been a proliferation of reasons for this burst in diversity, the largest ever in marine life, ranging from those associated with the unique palaeogeography of the Ordovician Period (widely dispersed continents, microcontinents and volcanic arcs), its climate (extended greenhouse conditions) and sea level (the highest in the Phanerozoic) to biological or palaeoecological processes (e.g. a revolution in food chains) within the Ordovician biotas themselves (Servais *et al.*, 2009). But there have been a number of other explanations for the event. An extraterrestrial cause ties in the increased flux of asteroids hitting the surface of the Earth, resulting from the breakup of a giant body in the asteroid belt some 470 million years ago, to the biodiversification (Schmitz *et al.*, 2009). Detailed research on the biodiversity of brachiopods and trilobites through the key interval in the shallow-water platform carbonates of western Russia by the Palaeozoic Research Group in Copenhagen had demonstrated a significant hike in diversity (Rasmussen *et al.*, 2007) during the early Mid-Ordovician. This radiation is coincident with a spike in meteorite and meteorite-related material. The increased frequency of impact craters, asteroid fragments and extraterrestrial chromite in Scandinavia match precisely that

huge hike in biodiversity demonstrated by the brachiopod faunas in western Russia. This encouraged the groups in Copenhagen and Lund to combine their data in seeking the possibility of a causal link between the biological and extra-terrestrial data. Normally we relate such impacts to extinctions rather than diversifications but in this case the impacts were probably relatively minor; the devastations were enough to clear ecospace and provide new habitats for the benthos to return in great numbers, a short time after the impacts (Schmitz *et*

al., 2009). This, the Intermediate Disturbance Hypothesis, is developed by Nield in some detail, providing a number of modern analogues for the process. But there is no doubt that the rapid recovery of marine communities around the nuclear test sites in the Pacific Ocean provides a powerful reminder of the resilience of life on our planet and a very appropriate model for the events in the Baltic Province some 470 million years ago.

This book is a compulsive and riveting read. Importantly it emphasizes that careful

and detailed basic research programmes, involving for example palaeontology and geochemistry, embedded in multidisciplinary and multinational networks, and some serendipity, drive forward basic science. Meteorites are not all doom and gloom. These heavenly visitors clearly had a positive impact on diversity and evolution of life on our planet.

¹Head of Geology and Professor of Palaeontology, Natural History Museum of Denmark

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Submission of articles to European Geologist magazine

The EFG calls for quality articles for future issues of European Geologist. Submissions should be in English, 1000 words for short articles and 3000 words for feature articles. An abstract of between 100 and 120 words should be included in English, French and Spanish. Articles should be sent via e-mail to the Editor at Harper-mccorrey@net.telenor.dk or. 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

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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.

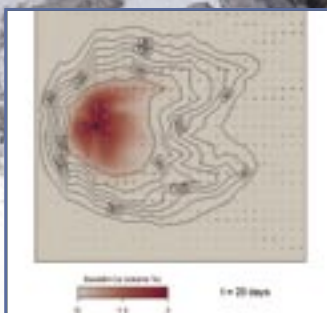
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To promote the profession and practice of geology and its relevance.

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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.
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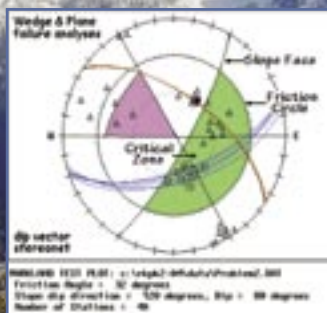
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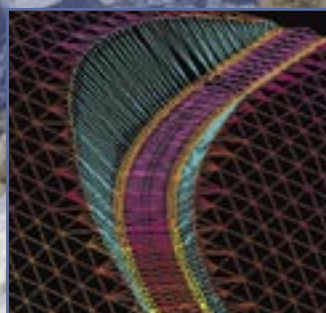
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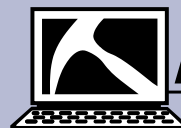
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