N° 26 Dec 2008

European Geologist

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

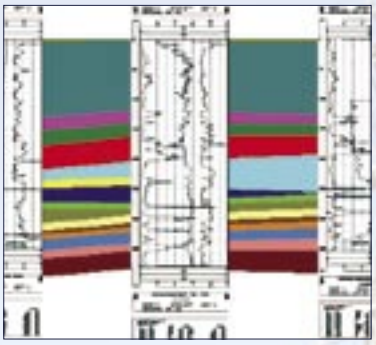
It's Not Just Software. . .
It's RockWare.

For Over 24 Years.

RockWorks™

3D Data Management, Analysis & Visualization

- Powerful measured-section/ borehole database for managing:
  - Lithology - Stratigraphy
  - Hydrology - Fractures
  - Hydrochemistry (e.g. Contaminants)
  - Hydrology - Geophysics
  - … and more
- Create striplogs, cross-sections, fence diagrams, and block models.
- Contour data in 2D and 3D (isosurfaces).
- Extensive on-line help and sample data sets.
- Includes RockWorks Utilities



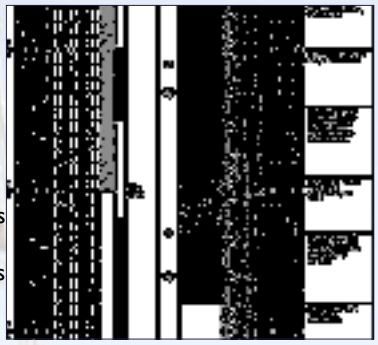
Free trial available at www.rockware.com.

$2,499 (USD)

LogPlot™

Powerful, Flexible, Easy-to-Use Borehole Log Software

- Dozens of templates available or design your own in the drawing-style log designer window
- Tabbed data sheets
- Import/Export data from LAS, Excel, RockWorks
- Paginated and continuous logs at any vertical scale
- Export to a variety of formats
- Free viewer can be distributed to clients



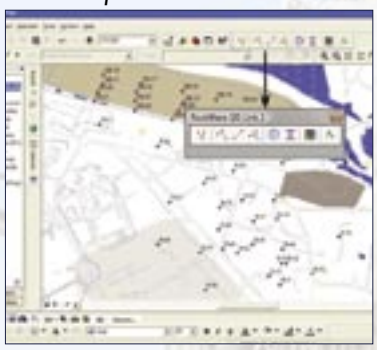
Free trial available at www.rockware.com.

$699 (USD)

RockWare GIS Link 2™

Connecting RockWorks2006 and ArcMap

- Load RockWorks well locations as an ArcMap layer
- Pick profile, section, and fence diagram locations in ArcMap, generate the diagrams automatically in RockWorks
- Create contour maps of formation tops and isopachs, surface elevation
- Generate strip logs



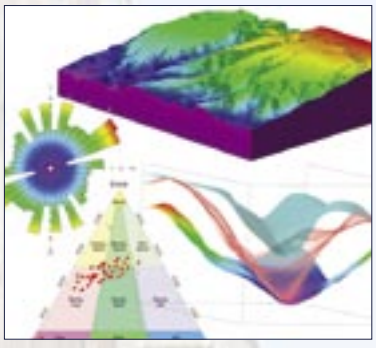
Free trial available at www.rockware.com.

$349 (USD)

RockWorks Utilities™

An Indispensible Collection of Modeling, Analysis, and Display Tools

- Point maps
- Contour maps
- 3D surfaces
- Gridding tools
- Solid models
- Volumetrics
- Piper/Stiff plots
- Rose & Stereonet diagrams



Free trial available at www.rockware.com.

$599 (USD)

RockWare®

Since 1983

RockWare.com

European Sales
++41 91 967 52 53 • F++41 91 967 55 50
europe@rockware.com

US Sales
303.278.3534 • F: 303. 278.4099
sales@rockware.com

EUROPEAN GEOLOGIST

is published by the
European Federation of Geologists
C/o Service Geologique de Belgique
Rue Jenner 13
B-1000 Bruxelles, Belgium
Tel:+32 2 6270412
efgbrussels@gmail.com
www.eurogeologists.eu

The board of EFG

PRESIDENT
EurGeol. Prof. Manuel Regueiro y González-Barros
Geological Survey of Spain
Rios Rosas 23
28003 Madrid
Spain
M.Regueiro@igme.es

VICE-PRESIDENT
Dirk De Coster
VDC Milieu
Koppel Stratt 45A
3650 Dilsen, Strokkem
Belgium
Tel: +32 89798070
Dirk.decoster@vdcmilieu.be

SECRETARY-GENERAL
Seppo Gehor
seppo.gehor@oulu.fi

TREASURER
EurGeol. Piers R.R. Gardiner
51 Upper Canal Street
Dublin 4
Ireland
Tel: +353 872653204
Piers.gardiner@gmail.com

EU DELEGATE
Herald Ligtenberg
Shell International
Tel: +31 592 363820
Herald.ligtenberg@shell.com

Foreword

Geo-future

by EurGeol. Manuel Regueiro, President

Dear reader,

Welcome to yet another edition of the written voice of geologists in Europe.

In these times of financial turbulence, geology continues to be in the frontline of the global headlines. In August we all heard about the launch of **OneGeology** (*www.onegeology.org*), a global effort to make the geo-painted skin of the Earth available to all. It was in the framework of the International Year of Planet Earth (2007-2009) and at the 33rd International Geological Congress in Oslo. The EFG also had its piece of the congress through its own workshop (Issues for geologists in the 21st century), which albeit the troubles of ever-changing meeting rooms by the organizers, was a perfect showcase for our professional view.

Efforts were made during the congress to reorganize the International Consortium of Geological Surveys (ICOGS) into an effective vehicle to coordinate the leading geological organizations at a global scale. Let´s hope they succeed as that will be to the benefit of geology and geologists.

Geo-globalization has also been the theme of an EFG proposal to consider the creation of a World Federation of Professional Geologists, presented in Oslo, but also reiterated in the successful 3rd International Professional Geology Conference held in Flagstaff (Arizona) in September, under the auspices of the AIPG, the CCPG and the EFG.

The outcome of this conference was the Flagstaff Declaration (see this issue), a joint document signed, for the first time ever, by the presidents of the AIPG, the CCPG and the EFG, with the co-signatures of the president of the ICOG and the representatives of the GS and IGI. The text sets the foundation for the development of a possible future international superstructure of professional geologists on a world-wide basis, something that today does not exist.

The future of professionalism in geosciences is filled with lights, shadows and dappled zones: high demand for geologists, more interest of authorities and politicians in geology, increasing salaries and high standards of professionalism co-exist with a severe drop in geosciences vocations, low quality of graduates produced and low social recognition of sciences in general and geosciences in particular.

We are then at a crossroads, and it is us who should be looking forward and paving the way for the future of professional geosciences.

'Think global and act local' is today the key for a successful future for geologists, and this is precisely what we want to do. The recent launch of the EFG-coordinated Geotrainet project for the training and certification of geothermal technicians, designers and drillers (see this issue), is the way the EFG is acting locally. This new opening shows clearly the adapting nature of our organization; we engage on specific practical work with partners from all over Europe, while keeping the pace in our geolobbying activity in the EU, and there are new projects to come (Euro-Ages…). The Flagstaff Declaration is our way of thinking globally. It will be a long and harsh route, but luckily we geologists are 'all-terrain'.

Table of Contents

EUROPEAN GEOLOGIST

EDITOR
Dr Maureen Mc Corry
Harper-mccorry@tele2adsl.dk

EDITORIAL BOARD
Herald Ligtenberg
Fionnuala Collins
Piers Gardiner
Edmund Nickless

Translations by
Antoine Bouvier
Manuel Regueiro

Printed by
One2One
Cikorievej 8
5220 Odense SØ
Danmark
www.one2one.dk

Cover photograph
Geothermal borehole drilling at a house site in Co. Cork, Ireland
(Photo: Gareth Jones)

Photo this page
As cover, reversed

ISSN: 1028 - 267X

© Copyright 2008 The European Federation of Geologists
All rights reserved. No reproduction, copy or transmission of this publication may be made without written permission. No responsibility is assumed by the Publisher for any injury and/or damage to persons or property as a matter of products liability, negligence, or otherwise, or from any use or operation of any methods, products, instructions or ideas contained in the material herein. Although all advertising material is expected to conform to ethical (medical) standards, inclusion in this publication does not constitute a guarantee or endorsement of the quality or value of such product or of the claims made by its manufacturer.

Although the articles in this Magazine are subjected to scientific editing, they are not peer-reviewed.

GIS for urban multi-hazard risk assessment: the RiskCity training package

by Cees van Westen[1]

As part of the capacity-building activities of the United Nations University – ITC School on Disaster Geo-Information Management (UNU-ITC DGIM) the International Institute for Geo-information Science and Earth Observation (ITC) has developed a training package on the application of GIS for multi-hazard risk assessment. The package, called RiskCity, comprises a complete suite of exercise descriptions, together with GIS data and presentation materials on the various steps required to collect and analyze relevant spatial data for hazard, vulnerability and risk assessment in an urban environment. The package has been developed in collaboration with several partner organizations on different continents, and is used as the basis for a series of courses. Currently it is available as a distance education course

En temps qu'activités de développement des compétences de l'Université des Nations Unies – Ecole ITC sur la gestion de la géo-information, concernant les désastres naturels (UNU-ITC DGIM), l'Institut International pour les Sciences de la géo-information et de l'observation de la terre (ITC) a développé un module sur l'application des SIG à l'évaluation de l'ensemble des risques. Le module, dénommé Risk City inclut une série complète d'exercices avec descriptions pratiques, associant les données SIG et la démarche par étapes, nécessaires à la collecte et à l'analyse des données spatiales utilisables pour l'évaluation en environnement urbain des risques et conditions de vulnérabilité. Le module a été développé en collaboration avec plusieurs organisations partenaires venant de continents différents et est utilisé comme support de cours magistraux. Actuellement, il est disponible comme cours d'éducation à distance.

Como parte de las actividades de capacitación de la Universidad de la Naciones Unidas – Escuela ITC para la gestión de Información Geológica sobre Desastres (UNU-ITC-DGIM), el Instituto Internacional de Ciencias de la Geo-informacion y Observación de la Tierra (ITC) ha desarrollado un programa formativo sobre la aplicación de Sistemas de Información Geográfica (SIG) a la evaluación de riesgos múltiples. El paquete denominado RiskCity incluye una serie completa de descripciones de ejercicios, junto con datos SIG y material para presentaciones sobre los diversos pasos necesarios para recoger y analizar los datos espaciales necesarios para la evaluación de peligro, la vulnerabilidad y el riesgo en un ambiente urbano. El programa se ha desarrollado con la colaboración de diversas organizaciones de diferentes continentes, y se utiliza como base para una serie de cursos. Actualmente se utiliza en un curso de educación a distancia.

One of the important components of disaster risk management is capacity building and training of disaster management experts and professionals working in many different disciplines that have an important disaster reduction component, such as planners, engineers, architects etc. The Hyogo framework of action 2005-2015 of the UN-ISDR indicates risk assessment and education as two of the key areas for the development of action in the coming years.

Worldwide, a number of organizations specialize in providing short training courses on disaster risk management-related issues (ADPC, 2005). A number of organizations have also prepared training materials that are accessible through the internet, for example the Disaster Management Training Programme (DMTP), or the International Federation of Red Cross

[1]UNU-ITC DGIM, POBox 6, 7500 AA Enschede, The Netherlands. westen@itc.nl

Figure 1. High-resolution image of the center of RiskCity with some of the hazard and vulnerability features indicated

and Red Crescent Societies (IFRC). Most of these however concentrate on community-based methods. Disaster risk management courses at BSc or MSc level are now available in many Universities on all continents.

Relatively few training materials are available on multi-hazard risk assessment. Good textbooks on the subject are still not available. Online training materials can be obtained for example from the websites of FEMA (2008) and EMA (2008). The development of innovative forms of learning and teaching oriented towards building new curricula in the field of natural risk has attracted attention in European initiatives such as DEBRIS (2006) and NAHRIS (2006).

As far as GIS-related material related to multi-hazard risk assessment is concerned, the HAZUS methodology developed in the US can be considered the standard. This comprehensive loss estimation software which runs under ARCGIS is a very good tool for carrying out loss estimations for earthquakes, flooding and windstorms (FEMA, 2008b), but is restricted to use in the USA because of data constraints. Courses in the use of HAZUS can be followed online from the ESRI Virtual Campus (ESRI, 2008). However, complete GIS-based training packages on spatial hazard and risk assessment using low-cost or free GIS software are still very scarce, to the knowledge of the author. One example is a training package in English and Spanish developed for Central America in the framework of the UNESCO RAPCA project (ITC, 2004)

This paper describes the main aspects of a GIS-based training package on multi-hazard risk assessment, which has been developed by the UNU-ITC School for Disaster Geoinformation Management.

United Nations University - ITC collaboration

The International Institute for Geo-Information Science and Earth Observation (ITC) is an institute for postgraduate training and research in the field of geo-information directed to capacity building and institutional development of professional and academic organizations from developing countries. In 2005, ITC and the United Nations University established a collaborative programme on the use of spatial information for disaster management, which resulted in the formation of the UNU-ITC School for Disaster Geo-Information Management. The main activities of the DGIM School focus on training, education, curriculum development, knowledge development and research collaboration. This is done through the establishment of University networks in Asia, Africa and Latin America, where the member Universities exchange spatial information, course materials and jointly carry out training and research projects.

The DGIM School develops training packages and courses that are given jointly with the partners of the networks in various countries. The materials are uniform, and have been developed in different languages, and the support is given by local University staff who have followed earlier training and by staff from the UNU-ITC DGIM School.

One of these courses is on Multi-hazard risk assessment, which is centred around a case study on the use of Geographic Information Systems, and Remote Sensing for the assessment of hazard, vulnerability and risk in a typical urban area representative of situations in many developing countries. Rapid urbanization, combined with a lack of planning, often leads to the spreading of squatter areas located in hazardous areas, such as steep slopes, flood prone areas etc.

RiskCity training package

The package, called RiskCity, comprises a complete suite of exercise descriptions, together with GIS data and presentation materials on the various steps required to collect and analyze relevant spatial data for hazard, vulnerability and risk assessment in an urban environment.

The exercises deal with a hypothetical case study, hence the name RiskCity. The exercises are based on a case study from Tegucigalpa in Honduras. Tegucigalpa suffered severe damage from landslides and flooding during Hurricane Mitch in October 1998 when the city received 281 mm of rain in three days (Mastin and Olsen, 2002). Due to river flooding, an old landslide was reactivated and an entire neighborhood on top of it was destroyed. The landslide caused the damming of the river and resulted in severe flooding in large parts of the city centre for several weeks (Harp *et al*., 2002). These events are easily identifiable on the high resolution image which serves as the basis for the exercises (Fig. 1). After Hurricane Mitch, USGS and JICA carried out extensive work in Honduras and produced extensive datasets.

Only part of the exercises is based on the actual situation in Tegucigalpa. In order to be able to reach the learning objectives, modifications and additions were made to the original data. It is very difficult to have a dataset for a particular area where all aspects of multi-hazard risk assessment can be properly demonstrated, either because particular hazard types do not happen in the city or because particular data sets are incomplete, restricted or erroneous.

One important consideration in designing the exercises is that people from developing countries should not be restricted in using it due to financial burdens for software acquisition. Therefore the aim

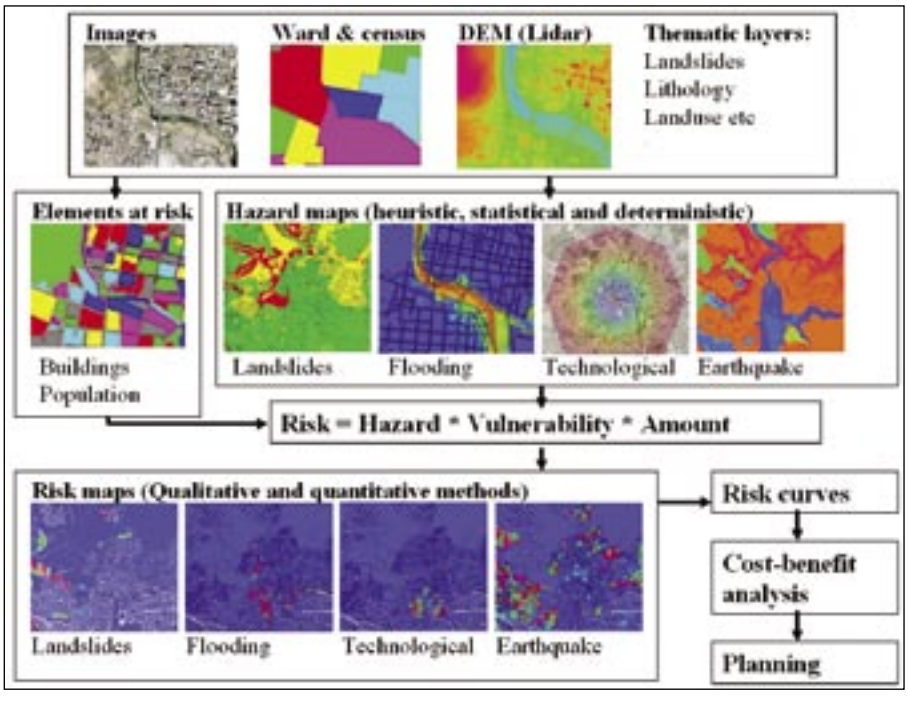


Figure 2. General structure of the RiskCity training package (see text for explanation)

was to use Open Source software as a basis. The exercises are written for the ILWIS software. ILWIS is an acronym for the Integrated Land and Water Information System. It is a Geographic Information System (GIS) with integrated image processing capabilities. It also has its own attribute data analysis, spatial data entry and conversion modules. New modules have been recently added for Spatial Multi Criteria Evaluation, analysis of Digital Elevation Models and for digital stereo image interpretation. The strongest point of the software is the map calculation module that allows extensive modelling with raster maps, also using scripts. The software has extensive help functions and documentation, and can be downloaded from the following web-site: *http://52north.org/ilwis*. ILWIS is very user-friendly, and allows the participants to concentrate on the risk assessment application rather than on the specifics of the software.

Each of the exercises in RiskCity has its own dataset. The data are all provided in separate directories, including the results of the previous exercises that are needed to make a subsequent one. So it is possible to carry out each of the exercises separately. Result files and PowerPoint presentations with instructions are also included.

Structure of RiskCity

The overall structure of the RiskCity training package is given in Figure 2, and an overview of the various components is presented in Table 1. Four different types of hazards are evaluated: landslides, floods, earthquakes and technological hazards. The training package starts with introductory exercises dealing with the software and with the study area, where students learn the various hazard problems by evaluating high resolution images. An important component of RiskCity is the generation of a database of elements at risk in order to evaluate the vulnerability of buildings and population. Here two options are considered. The first is that there is no spatial data available, except for a high resolution image, and the students have to generate mapping units with homogeneous types of buildings by stereo interpretation and digitizing on the image. Sampling is then carried out to define the number of buildings and population per mapping unit. The second option for generating the elements at risk database assumes there are digital data available in the form of building footprint maps, census information and detailed elevation data from a Lidar survey. These are used to calculate

Figure 3. Cover pages of the landslide risk part of the guide for the RiskCity training package, available in English, Spanish and Chinese

the number of buildings per mapping unit and land use type, and to characterize the buildings, for instance by calculating their height and floorspace using Lidar data. The floorspace is then used to distribute the census population over the mapping units, and population estimates are made for day- and night-time scenarios. The elements at risk database contains information on the buildings, with important attributes such as urban land use type, construction type, floorspace and height, as well as on population for a daytime and night-time scenario.

There are a wide range of hazard assessment exercises, not only those dealing with the four types of hazard mentioned before, which are based on the data of RiskCity, but also those which use data from other areas for tsunami, cyclone, volcanic, forest fires and land degradation hazard assessment. They use a variety of approaches, such as inventory-based, heuristic, statistical and deterministic.

The vulnerability assessment includes exercises on the use of vulnerability curves for assessing physical vulnerability, as well as the use of expert-based Spatial Multi Criteria Evaluation for the evaluation of social vulnerability and capacity.

The loss estimation is done using the formula:

*Risk = Hazard * Vulnerability * Amount*

in which the various components analyzed in the previous exercises are combined, and risk curves are generated, plotting annual probability against expected losses.

The risk curves form the basis of subsequent cost-benefit analysis, in which for each hazard type, a number of risk reduction measures is evaluated. The investments to implement certain measures (e.g. relocation of houses, flood control) are estimated and compared to the reduction in annual losses that would result if they are implemented. Based on this, the most appropriate methods for risk reduction are selected.

The last part of the RiskCity exercises deal with a final project in which the participants are given a particular problem they have to solve with the risk information obtained earlier.

Conclusions

The RiskCity training package is intended as a tool to demonstrate the utility and requirements of spatial data in urban multi-hazard risk assessment. Since the preparation of such a training package takes quite some time, it is normally not possible to adapt the dataset easily to local conditions each time a course is given in another place. This is also one of the reasons why the exercises have been made as generic as possible, by excluding most of the references to the actual city where the dataset is obtained.

Why not mine into Golder's resources in Europe – 14 countries, 34 offices, 850 professionals.

Specialising in mining, ground engineering and environmental solutions, Golder gives you global reach and local presence on six continents. For over 45 years, Golder has built a rock-solid reputation on client service, innovative thinking and cost-effective solutions that work.

A World of Capabilities Delivered Locally.

Golder Associates

Africa + 27 11 254 4800 | **Asia** + 62 21 252 1975 | **Australasia** + 61 7 3721 5400
Europe +353 45 874411 | **North America** + 1 800 275 3281 | **South America** + 55 21 3095 9500
Contact: Barry Balding **bbalding@golder.com** | **solutions@golder.com**

www.golder.com

Component	Exercise
Introduction	Introducing the ILWIS software Introducing the study area and the main problems based on a high resolution image and main spatial data
Generating an Elements at risk database	Focusing on buildings and population Two different approaches: - When no data is available: use of high resolution images & screen digitizing - When data is available: use of census data, building footprint maps and LiDAR data
Hazard assessment	Selection of a range of exercises dealing with landslides, earthquakes, floods, technological hazard, volcanic hazard, coastal hazards, tsunami etc.
Vulnerability assessment	Application of vulnerability curves and matrices for physical damage assessment
Loss estimation: qualitative methods	Application of risk matrices, combining susceptibility and vulnerability; use of Spatial Multi Criteria Evaluation for vulnerability and capacity assessment including a range of indicators
Loss estimation: quantitative methods	Annual loss estimation using risk curves for earthquakes, landslides, floods and technological hazards
Cost-benefit analysis for disaster reduction measures	Converting of building losses in monetary values for different hazard types; selection of possible risk reduction measures; cost-benefit analysis to select the optimal measures
Using risk information in urban planning	Spatial Multi Criteria Evaluation in which risk information is combined with other indicator for the planning of new neighbourhoods and infrastructure
Using risk information in emergency preparedness	Modelling of potential sites for evacuation centres, medical support, and emergency centres. Planning of damage assessment campaign

Table 1. Overview of the exercise structure of RiskCity

The RiskCity training package is constantly being updated and further improved. The plan is to incorporate more Participatory GIS approaches in the training package, as well as to include more hazard modelling, using Open Source software. There is also a plan to make a separate version focusing on risk occurring in rural areas, taking into account flooding, forest fires, drought and land degradation as the main types of hazards.

Discussions are ongoing to make the text of the RiskCity training package available in time on the internet page of an international UN organization. The training package is used regularly in courses and is available in English, with major parts also in Spanish and Chinese (Fig. 3). Currently it is available as a distance education course: *http://www.itc.nl/education/courses/course descriptions/C09-ESA-DED-01.aspx*.

Acknowledgments

We would like to thank Gonzalo Funes from Honduras for providing the initial data sets. The Digital Surface Model and flood information was obtained from a study by the United States Geological Survey. The high resolution image was obtained from a project funded by JICA. Ruben Vargas Franco, Dinand Alkema, Lorena Montoya, Michiel Damen, Nanette Kingma, Antonio Naverette, Jean Pascal Iannacone, Manzul Hazarika and Norman Kerle are thanked for their contributions on various aspects of this case study. Colleagues from ADPC, AIT, CDUT, ICIMOD, UNAM, CLAS, IIRS and UGM are thanked for the friendly collaboration and the testing of the training package in various training courses. The following persons are thanked for the translation into Spanish: Carlos Saavedra, Jose Antonio Navarrete, Ruben Vargas, Edward Gonzalez, Estuardo Lira, and Manolo Barillas. Fan Xuanmei is thanked for translating part of it in Chinese. This work is part of the United Nations University - ITC School for Disaster Geo-Information Management (*www.itc.nl/unu/dgim*).

References

ADPC, 2005. Knowledge Development, education, public awareness training and information sharing. A Primer of Disaster Risk Management in Asia. Asian Disaster Preparedness Center. URL: *http://www.adpc.net.*

DEBRIS, 2006. Innovative education for risk management. Development of innovative forms of learning and teaching oriented towards building a family of new curricula in the field of natural risk. EU Leonardo da Vinci programme. URL: *http://www.e-debris.net.*

EMA, 2008. Disaster loss assessment guidelines. Emergency Management Australia. URL:*http://www.ema.gov.au/agd/EMA/rwpattach.nsf/VAP/(383B7EDC29CDE21FBA276BBCE12CDC0)~Manual+27A.pdf/$file/Manual+27Apdf.*

ESRI, 2007. ESRI Virtual Campus Courses. HAZUS-MH (Multi-Hazards) for Decision Makers. URL: *http://training.esri.com/Courses/.*

FEMA, 2008a. Mitigation Planning: "How To" Guides. Federal emergency Management Agency. URL: *http://www.fema.gov/plan/mitplanning/planning resources.shtm.*

FEMA, 2008b. Hazus, FEMA's software for estimating potential losses from disasters. Federal Emergency Management Agency URL: *http://www.fema.gov/plan/prevent/hazus.*

Harp, E.L., Castaneda M. & Held, M.D. 2002. Landslides triggered by Hurricane Mitch in Tegucigalpa, Honduras. USGS Open-File Report 02-0033. *http://pubs.usgs.gov/of/2002/ofr-02-0033/.*

ITC 2004. Módulo de capacitación. Aplicación de Sistemas de Información Geográfica y Sensores Remotos para el Análisis de Amenazas, Vulnerabilidad y Riesgo. Spanish and English version. International Institute for Geoinformation Science and Earth Observation (ITC). URL: *http://www.itc.nl/external/unesco-rapca/start.html.*

Mastin, M.C. & Olsen, T.D. 2002. Fifty-year flood-inundation maps for Tegucigalpa, Honduras: U.S. Geological Survey Open-File Report 02-261. URL: *http://pubs.usgs.gov/of/2002/ofr02261/.*

NAHRIS 2006. Dealing with Natural Hazards and Risks. Swiss Virtual Campus Project. URL: *http://www.nahris.ch/.*

The Terrafirma Project: application of geology in a public service role

by David Norbury[1]

EFG have been involved with the Terrafirma project for four years leading the User Body. Major advances have been made in improving the accessibility of the product, but further work remains to be done. The current position is outlined below, and in the paper by Michele Crosetti *et al*.

Depuis quatre ans, la FEG est impliquée dans le Projet Terrafirma, en temps que principal acteur au niveau application. Des progrès importants ont été réalisés en améliorant l'accès à ce produit mais il reste encore du travail à faire. La situation actuelle est décrite ci-dessous et au sein de l'article proposé par Michele Crosetti et al.

Desde hace cuatro años la FEG está involucrada en el proyecto Terrafirma dirigiendo el grupo de usuarios. Se ha hecho grandes avances en la mejora de la accesibilidad del producto, pero todavía quedan trabajos adicionales por hacer. La situación actual se resume a continuación el el artículo de Michele Crosetti et al.

Terrafirma products are being developed by ESA under the GMES Service Element Programme. Using radar satellite technologies to measure and monitor terrain motions, the service aims at saving lives, improving safety and reducing economic costs of natural hazards. To do this, European InSAR service providers have consolidated services to provide standardized terrain measurement products for interpretation and exploitation.

The motion records show historic and ongoing movements down to sub-centimetric levels of accuracy. This enables assessment of terrain motion arising from a variety of sources. So far, the service has been concentrated on urban subsidence, mining, dewatering and landslides, but is broadening its portfolio to include flood risk, crustal deformation and volcanoes.

EFG represents the professional users in this project to help guide the direction of the project, to promote the activities of the project and to inform geoscientists as to what this technology can do to assist in delivering projects and in the protection of society.

[1]Director, David Norbury Limited

EFG also takes an active role in the monitoring of the take up and exploitation of the technology. This fits well with the EFG mission of maintaining members' knowledge and interest in new technologies at a high level.

Project aims

The current aims of the project are to develop confidence in the products and broaden their appeal and application. This includes combining the records with geological ground truth information, as held by geological surveys, and other sources of ground information. This will greatly enhance the usefulness of the product.

Feedback from users is a requirement of the service agreements in place, and these include reports on product quality, utility and exploitation activities. These reports reveal some common experiences, such as a need for more training and educational materials, better information on product quality and the need for a guaranteed background mission that will ensure adequate data archives into the future. These issues are being taken on board.

Training and education in the understanding, application and analysis of PSI is essential for a wider acceptance of what many practitioners see as a 'black-box' technology. Not only is PSI complex in itself, but there is also an assumption that all users are familiar with GIS, geo-referencing and map projections. There will be a third Terrafirma Training Workshop in 2009 to which all users are invited. There are also dedicated national training days in individual countries where interested parties, such as geologists, engineers and planners congregate to learn more about PSI and its practical application.

Terrafirma includes a Product Validation Workgroup (PVW) (see Crosetto *et al.* in the following article) and which is made up of key partners in geophysics, engineering and geodesy. The main aims of the PVW are to:

- Develop higher-level H-2 causal products from early processing stage products
- Guide product development in H-2 production, as well as reviewing all project output and reports
- Oversee the specific Terrafirma Alkmaar/Amsterdam Validation Project
- Compile a Product Validation Manual. This document will represent the 'Terrafirma Bible' in terms of explaining

PSI, its accuracy and limitations, the range of Terrafirma products, practical application to real-life problems, exemplar case study examples and results of key product validation exercises, such as Terrafirma's own validation campaign.

The future of Terrafirma

The intention behind ESA GMES projects is that they eventually become part of Europe's autonomous monitoring of the environment. Although the detection and monitoring of terrain motions can be of high socio-economic value, and PSI continues to prove its worth in this regard, there are no clear policy drivers on the subject. This is one reason why only the landslide component of Terrafirma has so far been taken up within the Emergency Response Fast Track Service in FP7. It is simply mandatory to monitor various landslide-prone regions and Terrafirma can offer these services. However, there is no general policy to monitor terrain motion in areas such as towns, floodplains, mining areas, inter-seismic deformation, communication networks, tectonic tilts, sea-level rise, reclaimed areas, gas-, oil-, water-abstraction, and so on.

Terrafirma has produced its own cost-benefit analysis and shown the positive benefits for routinely monitoring vulnerable areas. It is common sense, however, that at around €40,000 per survey, needed, say, every three years, it must be cost-effective to use PSI methods to monitor all significant towns and areas where populations are at risk from geohazards. The savings can be huge in terms of hazard mitigation and better planning.

The EFG, as part of the User representative body of Terrafirma, are enthusiastic about the possibilities offered by the Terrafirma products as we enter an important and exciting phase. There is a library of successful case studies building, and the validity of the product in scientific terms has been established. We have been aiming to identify the users of the future – the fund holders that will see cost benefit from buying these products.

The potential users are spread across legislative and planning bodies at European, regional and national level. The EFG, as a European Federation, plays an important role in lobbying the pan-European and regional organizations who contribute to initiatives and suggest appropriate technologies for achieving what society needs. Terrafirma is an appropriate technology. Particular areas which have been identified for future focused activities include:

- Flood protection both in coastal areas and in river basins. The monitoring of land movements due to geological processes along the extensive areas of low lying coastal areas where many people live is going to be extremely important as sea levels rise
- Many areas of Europe are seismically active and monitoring terrain motion in these areas is relevant to civil protection. This cannot sensibly be carried out by land surveying. Terrafirma products offer the ability to monitor theses areas for seismic vulnerability and so offer a new level of protection to the public
- The effects of mineral extraction are an ongoing hazard faced by many across Europe. The work already done in Terrafirma offers new insights into the mechanisms and timing of movement, and so these monitoring products offer better information for society to plan and control development and mitigation
- The abstraction of fluids from the ground (oil, gas and water) for supply or irrigation affects most of Europe. The magnitude and rate of movement are better understood through Terrafirma monitoring. In addition, the re-injection of fluids (CO_2 sequestration, for example) will produce a new sense of terrain motion which could pose as yet unknown problems
- The development of small scale products with simple colour coding to indicate no movement, movement up or down, or no data is being considered. Exploitation reports often refer to apparent complexity and the need for specialist input to obtain products. The availability of small-scale coverage should provide entry level information to encourage potential users. Having identified the relevant small-scale findings, users can look to acquire larger scale project or site specific information. Small-scale products would also indicate hot spots for further study, or null spots where potential clients would be able to feel more comfortable as regards terrain motion.

The Terrafirma monitoring and measurement products offer great opportunities for the geoscience community (*senso lato*) to provide significant input to the development of society. This will be delivered through better information on terrain motion providing the ability to control and mitigate the impact of natural hazards and their effects on society.

Without tools such as those provided by Terrafirma, the public will remain at the mercy of natural processes which will limit realization of potential.

This paper was presented at the 2008 Meeting of the American Institute of Professional Geologists, Arizona Hydrological Society, and 3rd International Professional Geology Conference, Flagstaff, Arizona, USA, September 20-24, 2008. Published by the American Institute of Professional Geologists

Dr. Robert Font, CPG, PG, EurGeol
President
Geoscience Data Management

Our geoscientists specialize in database entry of G&G and engineering records.
Petroleum geoscience and geohazards courses also available on CD ROM

214-213-9331 Cell
www.geodm.com
rgfont@cs.com
P. O. Box 864424, Plano, Texas 75086 - USA

Ground motion monitoring using SAR interferometry: quality assessment

by M. Crosetto[1], O. Monserrat[1], C. Bremmer[2], R. Hanssen[3], R. Capes[4] and S. Marsh[5]

Synthetic Aperture Radar (SAR) interferometry is a relatively new satellite-based remote sensing technique, which can be used to measure and monitor different types of land surface deformation phenomena. Any new technique faces the challenge of gaining acceptability among potential users by demonstrating its performance. This paper focuses on the analysis of the performances of a particular class of SAR interferometry techniques, called Persistent Scatterers Interferometry (PSI). In particular, the paper describes the main outcomes of a major PSI validation project, which was run within the GMES Terrafirma project.

L'Interférométrie Radar à ouverture synthétique (SAR) est une technique récente de télédétection par image satellite qui peut être utilisée pour mesurer et suivre différents types de phénomènes de déformation de la surface terrestre. Démontrer ses capacités, gagner la confiance des utilisateurs potentiels et se faire accepter par eux, représentent un défi propre à toute nouvelle technique. Cet article met l'accent sur l'analyse des performances d'une classe particulière de techniques d'interférométrie SAR, dénommée Persistent Scatterers Interferometry (PSI). L'article décrit en particulier les résultats principaux d'un projet important de validation de la technique PSI qui a été mise en œuvre dans le cadre d'un Projet GMES Terrafirma.

La interferometría basada en imágenes SAR (Synthetic Aperture Radar) es una técnica de teledetección con imágenes satelitales relativamente nueva, que puede ser usada para medir y monitorear diferentes tipos de fenómenos de deformación. Como para cada técnica nueva, demostrar sus capacidades y ganar la confianza de los potenciales usuarios representa un reto fundamental. Este articulo está dedicado al análisis de las capacidades de una clase particular de técnicas SAR interferométricas, conocida con el nombre de Persistent Scatterers Interferometry (PSI). En particular, el artículo describe los resultados principales de un importante proyecto de validación de la técnica PSI, que ha sido realizado en el marco del proyecto GMES Terrafirma.

The monitoring of ground surface motion is an important task in a variety of disciplines. SAR interferometry (InSAR) is a satellite-based remote sensing technique, which can be used to measure and monitor different types of land surface motion. For a general review of SAR interferometry, see Rosen *et al.* (2000). Since its first demonstration in the late 80s, InSAR has been successfully used in a wide range of disciplines, such as geophysics (seismology, volcanology, glaciology, etc.), geology, geotechnics, civil engineering, etc. Comprehensive reviews of different InSAR applications are provided by Massonnet and Feigl (1998), Hanssen, (2001), and Crosetto *et al.* (2005), while *eopi.esa.int/esa/esa* links to an interesting description of the latest InSAR results based on the ERS and Envisat satellite data.

[1]Institute of Geomatics, Av. Canal Olímpic s/n, Castelldefels (Barcelona), Spain. michele.crosetto@ideg.es oriol.monserrat@ideg.es
[2]TNO, Built Environment and Geoscience, Utrecht, Netherlands. chris.bremmer@tno.nl
[3]Delft University of Technology, Delft, Netherlands. R.F.Hanssen@TUDelft.NL
[4]Fugro NPA, Edenbridge, United Kingdom. ren@npagroup.com
[5]British Geological Survey, Nottingham. shm@bgs.ac.uk

Over the past few years InSAR has remarkably increased its capability as a deformation measurement and monitoring tool thanks to two key factors. First, the development of advanced InSAR processing and analysis techniques, which started with the method proposed by Ferretti *et al.* (2000). These techniques, which make use of large sets of SAR images, thus achieving increased deformation measurement performances, are referred to as Persistent Scatterers Interferometry (PSI) techniques in the following sections. The second factor is the availability of different spaceborne SAR systems, which provide suitable spatial and temporal coverage for a wide range of applications. In recent years, different private companies have begun PSI deformation monitoring products based on satellite SAR data. Terrafirma ("A pan-European ground motion information service in support of policies aimed at protecting citizens against natural and anthropogenic ground motion hazards") is an important effort to establish a long-term market for PSI products. It is a project of the GMES (Global Monitoring for Environment and Security) Service Element Programme. Details of this project, now known as 'Kopernikus' can be found at *www.terrafirma.eu.com*.

In order to increase the acceptability of PSI and establish a long-term PSI market, the quality of PSI measurements must be proven. For this purpose, Terrafirma has run a PSI validation exercise that addressed key issues, like quality assessment, assessment of performances, estimation of precision and accuracy, and evaluation of the consistency of PSI results coming from different service providers. The goal of this paper is to summarize the key findings of the above validation exercise, which is referred to hereafter as the Validation Project.

Terrafirma Validation Project

In the first stage of Terrafirma it was concluded that for there to be any significant

adoption of PSI by targeted Terrafirma users, the quality of the PSI technique had to be demonstrated. Parallel to the Terrafirma activities, ESA ran a PSI validation project called PSIC4, which involved PSI service providers and academic institutions (see: *earth.esa.int/psic4*). The Terrafirma Validation Project was a PSI validation exercise run within Terrafirma that focused on the four Operational Service Providers (OSPs) of this project, i.e. Telerilevamento Europa (*www.treuropa.com*), Altamira Information (*www.altamira-information.com*), Gamma Remote Sensing (*www.gamma-rs.ch*) and Fugro NPA (*www.npa-group.com*). The main objectives of the project included the comparison of outputs from the different PSI processing chains to certify that all OSPs produced consistent results; providing independently verified evidence of the quality of the PSI results; characterizing the PSI products; and clarifying the product limitations.

The project included two main parts: process validation and product validation. The process validation involved the inter-comparison of the different OSPs' processed outputs and the analysis of their intermediate results. This analysis was performed in the SAR coordinate system, i.e. the "internal system" of SAR images. This "internal system" is usually not visible to end users, who receive the geocoded PSI products. However, this type of analysis is useful to test the "equivalence" of the OSP chains, and to detect the cause of differences in the results, if any. The second part involved product validation, in which the geocoded PSI products were validated against ground truths. The PSI products considered in the Validation Project concerned two test sites, which have complementary characteristics. The first one is the Alkmaar area, with a spatially correlated deformation field due to gas extraction, studied using ERS-1/2 (1992 - 2000, 83 images) and ASAR-Envisat data (2003 - 2007, 39 images). Ground truth data on this site are available from levelling campaigns. The second area included the city of Amsterdam, which includes, from a deformation viewpoint, autonomous and mainly spatially uncorrelated movements. Ground truths from different geodetic surveys are available for the area corresponding to the N - S metro line. The OSPs had no open access to the ground truth data during the project. However, some basic information was provided as to the nature of the ground motion and ground truth involved. The results of the project were anonymous. The project included the following participants: Institute of Geomatics, project lead and process validation; TNO, ground truth support, and product validation; DLR, process validation; TU Delft, product validation; BGS, link to the Terrafirma project; the four above-mentioned OSPs; Fugro NPA, overall project management.

Three main results of the project are described over the following sections. The first part concerns the inter-comparison of the results from the different OSPs. The second discusses the validation results achieved over the Alkmaar test site. Lastly, the third describes the validation results over Amsterdam.

Inter-comparison results

The inter-comparison of the OSP results is based on intermediate and final PSI outputs in the original radar geometry. The inter-comparison analysis concerned the three main products of PSI: the estimated deformation velocities, the deformation time series, and the so-called topographic corrections. The most relevant results are summarized below. More details can be found at: *www.terrafirma.eu.com/Terrafirma_validation.htm*.

Deformation velocity. The average standard deviation of the velocity differences over Alkmaar and Amsterdam, is 0.56-0.75 mm/yr. Assuming the same precision for the compared teams and uncorrelated results between teams, the estimated standard deviation of the deformation velocity of each team ranges from:

$[]_{VELO} = 0.4 – 0.5$ mm/yr

These values, which are derived from large sets of measured points (hereafter referred to as PS), provide information on the global inter-comparison behaviour of PSI velocities. They can be used to derive error bars to indicate the quality of the PSI velocity estimates, which is key information for end users. It is worth noting that the above statistics have been derived over two sites largely dominated by zero or very moderate deformation rates. For this reason, the above values are representative of all PSI studies that concern areas with similar characteristics to those of the test sites of this project.

Deformation time series. The mean standard deviations of the time series differences range from 1.5 to 5.6 mm. Assuming that the teams have the same precision and uncorrelated results, the estimated standard deviation of the deformation time series of each team ranges from:

$[]_{TSeries} = 1.1 – 4.0$ mm

These values can be used to derive error bars to indicate the quality of the PSI time series. As with the velocity values, the above statistics are largely dominated by PS with zero or very moderate deformations. Since the time series performances probably degrade with increasing velocity values, one should be careful in extending these statistics to sites involving stronger deformation rates.

PS density. There is a remarkable difference among the three datasets in the number of PS delivered by the OSPs. This indicates that the teams effectively used different criteria during the processing and in particular during the PS selection.

Topographic correction. The standard deviation of the "topographic correction" differences ranges from 1.3 to 2.8 m. Assuming that the compared teams have the same precision and that their results are uncorrelated, we can derive an estimate of the standard deviation of each team's "topographic correction" from these values:

$[]_{TOPO} = 0.9 – 2.0$ m

An error in the "topographic correction" has a direct impact on the PS geocoding. Considering the ERS and ASAR geometries, one may expect the following standard deviation in the geocoding:

$[]_{GEOCODING} = 2.1 – 4.7$ m

The above values provide information on the PS geocoding precision. Note that these values only include the stochastic geocoding error due to uncertainty in the estimation of the "topographic correction", i.e. they do not include the global geocoding shift biases that might affect all PS of a given dataset. The above geocoding precision roughly affects the east to west direction. In fact, the impact of an error in the "topographic correction" is in the direction perpendicular to the SAR track, which is approximately in the north-south direction. This is key information for PSI end users.

Validation results: Alkmaar validation

The Alkmaar area, in the Province of Noord-Holland, is an important onshore gas-producing area of the Netherlands. The area comprises 16 gas fields of various sizes. Gas production started in the early 1970s and has continued up to the present for most of the fields. The natural gas withdrawal results in spatially correlated deformation fields. The area influenced by subsidence near Alkmaar consists of a mixture of forests, dunes, beaches, and small villages, whereas the Amsterdam city area is completely urbanized, leading to different characteristics in their radar reflectivity behaviour. Levelling data (sparsely

distributed, in space and time) are available for this area. Two types of analyses were performed on the Alkmaar area. In the first, called "validation in the measurement space", the PSI results were directly validated against levelling measurements. In the so-called validation in the parameter space, instead of a direct comparison of measurements, derived parameters were compared. The main results for the Alkmaar case are as follows. Further details of this analysis can be found at: *www.terrafirma.eu.com/Terrafirma_validation.htm*.

Velocity validation. The maximum subsidence rate over the considered period, as measured by levelling, is about 4 mm/yr. After de-trending and removal of the bias between the PSI and the levelling datum, no systematic effects were found. RMS error ranges from 1.0 - 1.5 mm/yr for ERS, and 1.3 - 1.8 mm/yr for Envisat.

Time series validation. RMS error based on double differences (differences between PSI and levelling and between measurement epochs) ranges from 4.2 - 5.9 mm for ERS, and 4.6 - 6.1 mm for Envisat.

Validation in the parameter space. The approach overcomes the intrinsic limitation of PSI validation, i.e. the fact that PSI and levelling do not measure exactly the same point. The analysis consisted of comparing the modelling parameters (a subsidence bowl or volume changes of underground reservoirs was modelled) derived using PSI and levelling data. Even though the deformation signal was rather weak, the comparison provided good results. It is worth underscoring that even the teams with lower spatial point density had good results. This stresses the fact that it is not the absolute point density, but rather the sampling locations in relation to the deformation phenomenon that matter.

Amsterdam validation

The validation over Amsterdam concerned the N/S line, a 9.5 km long metro line which is currently being built through the city of Amsterdam. The sensitive conditions in Amsterdam place high demands on both settlement control and monitoring of structures which could potentially be affected by the works. About 3.8 km of this line will be constructed by a tunnel boring machine. An extensive monitoring system was set up and installed in 2001 along the 3.8 km, including robotic tachymeters, precise levelling, inclinometers, extensometers, etc. The key results of the Amsterdam validation, which was performed by TNO, are summarized below. For more details, see: *www.terrafirma.eu.com/Terrafirma_validation.htm*.

In Amsterdam, due to geocoding errors, it was not possible to make a perfect one-to-one comparison between PS and buildings. Therefore, intrinsic uncertainties due to geocoding errors should be considered in evaluating the results.

Velocity validation. The maximum settlement rate in the considered period, measured by tachymetry, is about 7 mm/yr. The absolute standard deviation of the difference between PS velocity and tachymetry-based velocity ranges from 0.8 - 0.9 mm/yr. The mean and median differences for all teams are close to zero. All trend lines suggest that PSI slightly underestimates deformation velocity with respect to tachymetry. The absolute standard deviation of the double difference in velocity ranges from 1.0 - 1.2 mm/yr.

Time series validation. The average RMS errors of single deformation measurements range from 4.2 - 5.5 mm.

In general the PS data of all teams show a reasonably good correlation with the tachymetry data. Furthermore, there is no significant difference in validation results between the four teams: all teams show similar results.

Conclusions

Any new technique faces the key issue of gaining acceptability among potential users. The Terrafirma Validation Project is a major PSI validation exercise, aimed at assessing the performances and evaluating the consistency of the PSI results from different Terrafirma OSPs. This paper has summarized the key findings of this validation exercise. The main characteristics of the Validation Project were described at the beginning of the paper, including the types of analysis and the characteristics of the project test sites. Some of the main project conclusions are:

-The direct inter-comparison of the OSP results in radar geometry generated a rich set of global statistics, which concern large sets of PS and provide information on the global inter-comparison behaviour of velocities, time series, PS density, topographic corrections and PS geocoding. The most important results are reported in this paper. These values can be used to derive error bars to indicate the quality of the estimates derived by PSI, which is key information for TF end users. The above values are representative of all PSI studies that concern areas with similar characteristics to those of the test sites of this project.

-The Alkmaar validation concerns a gas extraction area affected by spatially correlated deformation fields, where the PSI results were directly compared against levelling measurements. The key validation results achieved are reported in this paper. The statistics for velocity and time series are slightly worse than in the Amsterdam case. This is probably due to the characteristics of the area, which is more difficult from the PSI viewpoint, and the types of ground truth, e.g. the lack of levelling epochs in the Envisat time span. The above Alkmaar validation was complemented by an innovative analysis, called "validation in the parameter space". Even though the deformation signal was rather weak, the PSI vs. levelling comparison provided good results. The PSI data of all teams enable the estimation of the signal of interest, despite the difference in PS density.

-The validation results over Amsterdam concern the displacements in the N/S-metro line area, which are caused by geotechnical instability and localized construction works. These displacements are mainly spatially variable and need a point-wise PS analysis. The one-to-one comparison between PS and buildings was mainly limited by geocoding uncertainty. This represents an intrinsic source of error, which particularly affects the analysis of small objects, e.g. single buildings.

-The most important results achieved over Amsterdam are reported in this paper. The statistics for velocity and time series in the same region can be found in the inter-comparison. In general, the PS data of all teams show a reasonably good correlation with the tachymetry data. Furthermore, there is no significant difference in validation results between the four teams: all teams show similar results.

-The deformation rates in both Alkmaar and Amsterdam sites are moderately low. For some users, e.g. those interested in mining and landslide applications, it could be of particular interest to know what the expected PSI performances are when the displacement rates are larger, e.g. up to 2 cm/year. An experiment in this direction would be welcome.

-It is worth emphasizing that the analyses described in this work concern the technical validation of PSI. Different estimates of the quality of the PSI deformation measurements were derived through this validation. A further step should include the user validation, where the suitability (fit-to-purpose) of PSI to monitor deformation in a given type of application has to be proved. This requires consideration, besides the precision and accuracy

addressed in the technical validation, of other key aspects, like the spatial sampling density, the type of available temporal sampling, the easiness of the PSI product interpretation, etc.

Acknowledgements
This work has been funded by the European Space Agency, within the GMES Terrafirma Project, ESRIN/Contract no. 19366/05/I-EC. The PSI data of the Terrafirma Validation Project were generated by Altamira Information, Fugro NPA, Gamma Remote Sensing and TRE.

References

Crosetto, M., Crippa, B., Biescas, E., Monserrat, O., Agudo, M. & Fernández, P. 2005. Land deformation monitoring using SAR interferometry: state-of-the-art. *Photogrammetrie Fernerkundung und Geoinformation, 6*, 497-510.

Ferretti, A., Prati, C. & Rocca, F. 2000. Nonlinear subsidence rate estimation using permanent scatterers in differential SAR interferometry. *IEEE Transactions on Geoscience and Remote Sensing, 38 (5)*, 2202-2212.

Hanssen, R. 2001. *Radar interferometry*. Kluwer Academic Publishers, Dordrecht (The Netherlands).

Massonnet, D., & Feigl, K.L. 1998. Radar interferometry and its application to changes in the earth's surface. *Reviews of Geophysics, 36 (4)*, 441-500.

Rosen, P.A., Hensley, S., Joughin, I.R., Li, F.K., Madsen, S.N., Rodríguez, E., & Goldstein, R.M. 2000. Synthetic Aperture Radar Interferometry. *Proc. of the IEEE, 88 (3)*, 333-382.

News from NGO GEOLOGOS DEL MUNDO (World Geologists)

GM at the Zaragoza Expo 2008

by Ángel Carbayo[1]

We sum up here both the conferences and debates from Zaragoza Expo 2008 which focused on "Water Sustainable Development"- at the three participating organizations, Water Tribune, El Faro and Africa Water - Solidarity Federation of Aragón. GM's participation in each of those three is mentioned as well as the preliminary conclusions coming out from each after the Expo closure.

Dans cet article, nous résumons à la fois les conférences et les débats centrés sur l'Eau et le Développement Durable, dans le cadre de l'Expo 2008 de Saragosse à laquelle participaient trois organisations: la Tribune de l'Eau, El Faro et Afrique Eau – Fédération Aragonaise de Solidarité. La participation de GM au sein des trois organisations ainsi que leurs conclusions préliminaires obtenues lors de la clôture de l'Expo ont été mentionnées.

Se realiza una síntesis sobre la Expo de Zaragoza 2008 en su componente de conferencia y debates y cuyo eje lo ha constituido el tema "Agua y desarrollo sostenible" con tres organizaciones participantes, Tribuna del Agua, El Faro y Afric Agua - Federación Aragonesa de Solidaridad. Se indica la participación de GM en cada una de ellas, así como las conclusiones provisionales obtenidas por las mismas después de la clausura de la Expo.

Expo Zaragoza 2008 closed on September 14 after 93 days; Expo exhibited a number of foreign and Spanish pavillions all along the Ebro river, with displays on a number of issues concerning water. From all of these, two of the pavillons are here considered to be the main forums of presentations, debates and discussions around water (both surface and ground water).

Those two are Water Tribune and El Faro, both of them nicely presented and accomodating large audiences.

GM's participation at Water Tribune was focused on a presentation on "GM's experience in water supply at a number of villages in Mali'' that was held by Angel Carbayo, GM's president. This event was part of a cycle called "Rotary meeting at Expo Zaragoza 2008'', dealing with 'Problems with water micro-cooperation around the world'.

Once Expo was closed, a document called 'Letter of Zaragoza' was issued concerning 'Water and Sustainable Development', which can be considered as the main outcome of the 93 days of meetings at Water Tribune. The letter begins by supporting an integrated management of water resources for Man's - and Earth's - survival. Secondly, it outlines the importance of water, in terms of management of forests, watering and rivers, water supply and recycling as well as the financial side of it. Thirdly the Letter addresses some specific contributions to the development of Society, which are mainly addressed to Public Institutions, water consumers and the general public. The final conclusions on this Water Tribune forum will be available in the near future.

The presentations at El Faro Pavillon were held by some Spanish NGOs and based on the structure of the 'NGO Global Village' at the previous Expo in Aichi (Japan).

GM made a presentation at this forum on 'Water supplies in America Centre' as part of the topic 'Human right to drinkable water and recycling'. This presentation was given by Pilar Montero, Coordinator of water for America Centre at GM.

Preliminary conclusions from El Faro have come out already (and will be further developed eventually as part of the more extensive 'El Faro Memory'), as part of the document 'Demands of the citizen proposals pavillion El Faro to governments'. This document asks for governments and international institutions to engage in 12 binding commitments that cannot be postponed and which are summarized as follows:

- to guarantee drinkable water for people from North to South
- to invest in Education

[1]President NGO

- to efficiently manage water demand (savings and efficiency)
- to subordinate urban and industrial developments to water availability.

Another Forum at Expo Zaragoza 08 was Afric Water, which was held at both Water Tribune and the Paraninfo of the Zaragoza University. Its co-organizers were Solidarity Federation of Aragón and a Co-development entity. Four African countries (Gambia, Mali, Mauritania and Senegal) and Spain participated.

This Forum's main purpose was to establish the basis for dynamic and reciprocal cooperation between some African and Spanish locations in terms of water and sewage. GM was also there through a presentation and the subsequent debate, entitled 'Water supplies Management and rural sewage of West Africa' given by Luis Dichtl, West Africa Coordinator for Water supply for GM.

The main conclusion was to increase relations in specific cooperation issues, namely the importance of the progress of both democracy and solidarity as a means for Development.

Figure 1. Lecture by Ángel Carbayo at the Zaragoza Expo 2008

Central office and delegation of Madrid
C/ Raquel Meller, 7
28027 Madrid Spain
Tel.: +34 91 553 24 03
Fax: +34 91 533 03 43
geologosdelmundo@icog.es
www.geologosdelmundo.org

Delegation of Andalucía
geologosdelmundo@icoga.es

Delegation of Aragón
Av. Tenor Fleta, 42 1º 4ª
50007 Zaragoza
Tel./fax: +34 976 37 35 02
aragon@icog.es

Delegation of Asturias
C/ Pérez Ayala 3, Esc. Izq.
33007 Oviedo
Tel./fax: +34 985 27 04 27
geologosdelmundo@hotmail.com
geologosdelmundoasturias@gmail.com

Delegation of Cataluña
Av. Paralelo 144-146 bajos
08015 Barcelona
Tel.: +34 93 425 06 95
Fax: +34 93 325 05 06
info@geologosdelmun.org

Delegation of Castilla La Mancha
xose_antn_6@yahoo.es

Delegation of El Salvador
Colonia Miramonte
Calle Colima, 814. San Salvador

Tel./Fax: (503) 2260 6340
geologosdelmundo@integra.com.sv
coordinacion@geologosdelmundo.org

Delegate in Brussels
efg@tiscalinet.be

Representives in Canarias and La Rioja

Book review

by Herald Ligtenberg[1]

Tectonics of strike-slip restraining and releasing bends
Edited by W.D. Cunningham and P. Mann

Published by The Geological Society Publishing House. Special Publications, 290.
ISBN 978-1-86239-238-0
Date: 2007, 482 pages
Price: £50 (stg) Fellows
£60 (stg) Affiliates
£80 (stg) Corporate

Restraining and releasing bends are interesting and important geological phenomena that occur along strike-slip fault zones. Strike-slip faults originate as *en echelon* fault- and fold systems. With increased displacement, the individual faults link and form a continuous fault system with many irregularities along strike. These irregularities can be under local transpressional or transtensional deformation, resulting in restraining and releasing bends respectively. They can form impressive topographic features

at the Earth's surface, ranging from high mountains to deep depressions.

Restraining and releasing bends may entrap mineral resources, ground water or hydrocarbons. And the pull-apart basins that are formed in releasing bends may have a high heat flow and could form suitable areas for geothermal energy exploration and exploitation. They are therefore of interest to the industry. Furthermore, these restraining and releasing bends may form barriers to earthquake propagation, subsequently building up strain and forming nuclei for major earthquakes. They are one of the key focus areas in earthquake research.

This book is a follow-up to the international meeting on the tectonics of strike-slip restraining and releasing bends in continental and oceanic settings, held at the Geological Society of London (2005). The book contains 17 papers and 1 introduction paper. It is an interesting compilation of papers, addressing the origin and evolution of the bends; their underlying mechanism; their role in earthquakes; and many analogue examples from around the world.

The first paper in the book is a global catalogue of restraining and releasing bends on active and ancient strike-slip fault systems, written by P. Mann, and is based on 50 years of bend-related research. It covers an impressive 129 pages. He clearly describes the different styles of bends, depending on their setting and stages of development and their possible interaction (paired bends). He also proposes standarizing fault bend terminology. The main objectives of his paper are to better understand the tectonic processes behind the development of bends and detect possible differences in bends between different tectonic settings as well as to improve the understanding of these paired (restraining and releasing) bends. While reading through the classification and the many different examples from around the world, one sometimes feels a bit lost in the wealth of information. However, it is a great overview of restraining and releasing bend analogues and a very useful source of information, especially with the extensive list of references.

The editors have subdivided the rest of the book into three sections. The first section addresses restraining and releasing bends and their relation with earthquake hazards (4 papers). The perfect place to study this relationship is California and its

San Andreas Fault system. Three out of four papers describe this fault system, but each paper addresses different issues, such that there is no overlap in information: 1) characterization of geologically recent bends in the southern California borderlands (submarine); 2) fixed or migrating bends along fault strike over strike-slip displacement; 3) new insight into simple deep fault patterns below the complex surface fault system, based on careful study of earthquake hypocentres. The wide perspective provided by these papers is important to improve our understanding of fault mechanisms and their behaviour around restraining and releasing bends, also at depth.

The second section addresses restraining bends, the related transpressional deformation and the basement controls on their development (8 papers). Different strike-slip fault systems and their restraining bends around the world are described. In several cases they interact with neighbouring oblique structural systems and it is interesting to see their merged deformation response. The Lebanon restraining bend is a great example to study this interaction between the Dead Sea fault system with the Palmyride fold belt and related fault zones. Several contributions show a good integration of different sources of information to obtain an improved insight into the fault system. It becomes obvious that restraining bends are very complex features, because of the many different factors that define their structural architecture and topographic evolution. These include the existence of pre-existing faults, the amount of strike-slip displacement accommodated at bends, the (palaeo-) main stress orientations, etc. Investigating the development in sandbox models as an analogue it difficult to reproduce in the lab, due to the complexity of factors, especially the interaction with different fault systems and changes in main stress over geological time. The eight papers provide a good overview of observations around restraining bends and this certainly assists in understanding their mechanisms and knowing the most important issues to address when investigating them.

The third section of the book describes releasing bends, the related transtensional deformation and fluid flow (4 papers). Releasing bends, or pull-apart basins, are very common and well studied. They form weak sections along the fault, with more open fractures and they represent areas that are more prone to fluid flow. This is confirmed by the presence of large-scale mineral deposits, the related occurrence of volcanism and hydrothermal fluids at releasing bends. The papers in this section are not dealing with the basics of pull-apart settings, but are addressing complex elements of releasing bends. It is interesting to read about the interaction between strike-slip fault systems and extensional faults; especially the complexity of the termination of strike-slip faults and their linkage with an extensional back arc rift setting.

The papers in this special publication are all focused on large-scale, regional tectonics. Many of the studied areas are in complex settings with rotating main stress orientations over time; interacting with neighbouring oblique fault systems; or dealing with a pre-existing structural grain. This complexity requires a detailed structural analysis to unravel the different fault systems, the phases of folding and thrusting and the way in which the different fault systems interact. It requires a detailed understanding of the regional structural evolution of the area.

This publication is a must for geoscientists working on strike-slip fault systems. It contains strong contributions and a large set of analogues that assist in improving the understanding of structural styles along strike-slip faults. It is a good source of background information and it could lead to a better and more-structured focus in their research on restraining and releasing bends.

[1]Shell International
Herald.ligtenberg@shell.com

EFG News and Events 2008

The Third International Professional Geology Conference (3IPGC) – a summary

The 3IPGC was held in Flagstaff, Arizona, from September 21-25, 2008. The AIPG was delighted to have the opportunity to organize and sponsor this important meeting and honoured to host a series of distinguished dignitaries from various countries and foreign and domestic organizations. We did our best to give all a taste of our American West and to showcase some of our breathtaking geological features.

The IPGC forums provide us with an opportunity to outline issues affecting the geological profession and professional practice across domestic and international boundaries. The IPGC meetings are also opportunities to exchange ideas on how to solve geoscience-related problems at both regional and global scales.

In regards to the 3IPGC, it was our challenge to follow in the tradition of excellence set forth during our previous two meetings, in Spain (2000) and the UK (2004), where our local hosts (El Ilustre Colegio Oficial de Geólogos de Espaňa and The Geological Society of London) performed so admirably.

We selected a truly outstanding geological location to hold this convention and worked hard to make the 3IPGC an up-to-the-minute professional gathering with expanded international and domestic participation. A special effort was made to have representatives from as many different disciplines as possible within the field of the geosciences in order to address a variety of professional issues of importance to all.

The American Institute of Professional Geologists (AIPG), The European Federation of Geologists (EFG) and The Canadian Council of Professional Geoscientists (CCPG) continued the tradition to act as perennial co-hosts of the IPGCs. At the 3IPGC we were honoured to have additional prominent co-hosts, including the following groups:

- The National Association of State Boards of Geology (ASBOG)
- The Division of Professional Affairs of the American Association of Petroleum Geologists (DPA-AAPG)
- The Association of Women Geoscientists (AWG)
- The Arizona Hydrological Society (AHS)
- Northern Arizona University (NAU)
- International Year of Planet Earth (IYPE)
- The Association of Environmental and Engineering Geologists (AEG)
- The Geological Society of America (GSA)
- The United States Geological Survey (USGS)
- The Association of Earth Science Editors (AESE)
- The American Geological Institute (AGI)

Three basic themes provided the structure for the papers that were presented. These included:

- Training, Credentials and Continuing Professional Development of the Global Professional Geoscientist
- Professional Ethics and the Global Geoscientist; New Horizons in Geology
- Expanding International Influence and Reach; Overcoming Challenges and Mapping Successful Strategies

The discussions were excellent and involved recognized professionals and renowned participants from around the globe.

The subject of "training and continuing professional development of the global professional geoscientist" was addressed specifically in four significant papers:

- AIPG's System of Online Instruction - A Portal to Global Geoscience by Robert Font, AIPG, Geoscience Data Management, Plano, TX.
- Interactive Modules of E-Learning - An Example with Google Earth by Detlev Doherr, EFG-Germany.
- The Significance of Continuing Professional Development and Credentials upon Career Opportunities by William Siok, AIPG, Westminster, CO.
- A Review of the CPD Programs Used by Different Professional Groups by David Abbott, AIPG, Denver, CO.
- Issues concerning "credentials and the global professional geoscientist" were particularly discussed in six important papers by Mr. Gareth Jones, Dr. Tom Ewing, Mr. Robert Tepel, Mr. Rick Ericksen, Dr. Woody Herrod and Dr. Richard Spruill.
- International Recognition and Cooperation, Professional Qualifications as Passports by Gareth Jones, EFG-Ireland, John Clifford, EFG-Ireland, Christer Åkerman, EFG-Sweden.
- Five Points of Professionalism - Professionalism, Certification and Continuing Development in Energy Resource Geoscience: the AAPG Experience by Thomas Ewing, DPA-AAPG.
- The Practicability and Impracticability of Certification by Robert Tepel, AEG-CSMGB.
- Professional Registration/Licensure in the United States - A Summary by Rick Ericksen, DPA-AAPG.
- The Association of State Boards of Geology (ASBOG) and Geoscience Licensure in the United States by Wilson Herrod, ASBOG.
- The ASBOG Fundamentals of Geology and Practice of Geology Examinations: The Development and Administration of a National Examination by Richard Spruill, ASBOG.

Global and regional issues affecting geoscience practice were highlighted in 13 key presentations:

- Attitudinal and Economic Realities in a Global Geoscience Workforce by Christopher Keane, AGI.
- The Profession in Canada - A Review and Update by Oliver Bonham, CCPG, Canada.
- Ten Characteristics of Self Regulation Professions by Derek Doyle, APEGBC.
- A World Federation of Professional Geologists: Why the World Needs One by Manuel Regueiro, EFG-ICOG, Spain.
- Strategies to Successfully Recruit and Retain Women Geoscientists by Laurie Scheuing, Mary Anne Holmes, AWG.
- Women in Geology in Spain by Isabel Gomez, ICOG-Spain.
- The Geologist and Cognitive Diversity as a Key to Problem Solving by Shane McDonald, AIPG.
- The GEOTRAINET Programme by Isabel Fernandez, EFG-Spain, Herald Ligtenberg, EFG-The Netherlands, Gareth Jones, EFG-Ireland.
- Information Age, Globalization and Geoscience Enterprise: Opportunities, Challenges and the IYPE Beyond 2009 by Larry Woodfork, AIPG/IYPE.
- Natural Hazards in Land Use Plan-

ning: The Spanish Perspective by Luis Suarez, ICOG-Spain.
- The Terrafirma Project by David Norbury, EFG-GeolSoc-UK, presented by Ruth Allington, EFG-GeolSoc-UK.
- The 17 August 1999 Turkey Earthquake, What happened and what have we learned? by Aydyn Aras, GDMRE – Turkey.
- Overview of International Mine Closure Guidelines by Dawn Garcia, AIPG, Tucson, AZ.

Matters concerning "professional ethics and the global geoscientist" were covered in three critical papers:

- The Association of State Boards of Geology (ASBOG) and Professional Ethics by John Williams, ASBOG.
- Professional Geologist in the Protection of the Public -- Licensure - Ethics - Society by Chris Mathewson, ASBOG.
- Review of International Professional Disciplinary Proceedings: Procedures and Actions Taken by David Abbott, AIPG, Oliver Bonham, CCPG, Don Larking, AusIMM-Australia, John Gustavson, AIPG.

"Energy issues" of great importance to our global needs were reviewed in three noteworthy presentations:

- Geology-Based Unitization of Reservoirs in the Petroleum Fields of Louisiana: An Overview by M. B. Kumar, AIPG, Baton Rouge, LA.
- Unconventional Gas Resources - Are We Prepared for the Journey or Have We Already Arrived? by Douglas Kenaley, ExxonMobil.
- Geothermal Energy in Europe: Past, Present and Future by Gareth Jones, EFG-Ireland and Harold Ligtenberg, EFG-The Netherlands.

Geoscience and climate-related themes and student topics regarding the future of the geoscience profession were presented in three vital presentations:

- Climate Change and the Salinization of Potable Water Supplies: A Growing Threat Facing Development in Coastal Areas by Bruce Broster, CCPG.
- Information Flows and Policy: Use of Climate Diagnostics and Cyclone Prediction for Adaptive Water-Resources Management Under Climatic Uncertainty in Western North America by Ashley Coles, University of Arizona, Tucson, AZ.
- An Internet Survey of Scholarships Offered by US Geoscience Professional Organizations and Foundations: Totals, Ranges, Means, Medians, Modes, Models, Motivations, and Disappointment by Robert Tepel, AEG-California State Mining and Geology Board.

Countries represented by authors, speakers and/or delegates included the USA**,** Canada**,** Germany**,** Ireland**,** The Netherlands**,** Australia**,** Spain**,** UK**,** Botswana, Nepal**,** Belgium**,** Switzerland and Turkey.

The importance of establishing a potential global federation of professional geoscientists was introduced and discussed by Mr. Manuel Reguerio, President of the EFG. A declaration to establish a global framework to address crucial professional matters was signed by President Regueiro (EFG), Mr. Daniel St. Germain, AIPG President, Dr. Bruce Broster, CCPG President, Mr. Luis Suarez, ICOG President (Spain), Mr. Gareth Jones (representing the IGI, Ireland) and Mr. Edmund Nickless (representing the GeolSoc., UK).

Abstracts and papers submitted by the authors as well as condensed vitae of all speakers were published in electronic format as part of the proceedings of the 3IPGC.

In addition to the technical sessions, a series of outstanding field trips and social events made the conference a very special venue for all attendees. And yes, we can attest that the Grand Canyon is still there and as beautiful as ever!

At the AIPG we are quite pleased with the results of the 3IPGC. We believe that we succeeded in making it a truly memorable experience for all who attended and honoured us with their presence. An invitation was extended to our colleagues from the CCPG to host the 4IPGC in magnificent Canada in 2012.

Robert Font
General Chairman, 3IPGC

Special meetings with the European Commission on Natural Hazards – February/March meetings

On 29 February 2008, EFG Board members met with the European Commission to continue the discussion on natural hazards, the activities of the expert panel on natural hazards and our future collaboration with the European Commission. We met with DG Research, unit on Natural hazards research (Dr. D. Peter & Dr. B. van Gelsten), and with DG Environment, unit on Civil Protection (Dr. Perotto & Dr. T. de Lannoy).

Our history on natural hazards goes back to February 2003, in which we participated in a stakeholder meeting, set up by DG Environment, unit on Civil Protection, to discuss a proposal on European guidelines. To be able to provide high-quality advice and recommendations to the European Commission on this subject, we set up a European panel of experts on natural hazards. Currently the panel consists of approximately 35 experts, from various backgrounds. Experts involved are working for national geological surveys, at universities or research institutes, for commercial companies, for the international centre for geohazards, are members of a national working group on natural hazards, or work as private consultants. Together they represent around 20 European countries. The experts have different specialities, including experts on landslides, earthquakes, flooding, tsunamis, as well as remote sensing specialists.

After the meeting in 2003, we wrote many advice documents on natural hazards and a manifesto with key recommendations. We have participated as the only geological organization in a congress at the European Parliament, organized by the European Commission. We have been requested to provide input to the 7th Research Framework Programme; have regular communication and meetings with the European Commission, and so on. The expert panel on natural hazards has been very active and has again an interesting to-do list after the meetings with the EC in February.

The meetings were very fruitful and have led to new action points that we can take up with the expert panel. For example, DG Research requested specific feedback and improved communication with the expert panel. DG Environment, Civil Protection, is also very interested in feedback. From the latter, we received a special invitation to attend a stakeholder meeting on Disaster Prevention, on 14 April 2008. The meeting was attended by EFG office director Isabel Fernandez, and by the new coordinator of the EFG expert panel on natural hazards, Andrew Gibson (British Geological Survey). DG Environment, Civil Protection, emphasized their strong

interest in our attendance at this meeting. After the meeting we were invited to be involved in more detailed technical discussions with the European Commission on the drafting of the proposal. More information will follow.

To both DGs we have also proposed organizing a one-day conference on natural hazards in Brussels, as we did at our annual meeting in Rome. The main objectives of this conference would be: 1) to bring together policy-makers, land-use planners, geo-experts and insurance companies to continue the discussion on how to reduce the impacts of natural hazards; 2) to have more involvement of members from the European Commission and European Parliament. The proposal was very well received by both DGs of the European Commission. We have discussed close collaboration. The European Commission will assist in the organization by steering its content, so that the topics and discussions will lead to better (geological) insight and will provide answers to optimize (proposals for) their directives. Together with the expert panel on natural hazards we will take this forward.

Herald Ligtenberg
EU Delegate for the European Federation of Geologists and Coordinator EFG Expert Panel on Natural Hazards

Stakeholders meeting towards a community initiative in the field of disaster prevention, 14 April 2008

This meeting was to seek the opinion on the need, the objectives and the content of a possible new Community initiative on disaster prevention. An initiative is needed to share experiences from different disasters, and to encourage links between different actors in the scientific, social and political areas.

Hervé Martin and Thomas de Lannoy from the European Commission, DG Environment, Civil Protection Unit, introduced the meeting by providing the reasoning behind this new initiative on prevention. They recognized that strategies and initiatives already exist in legislation at national and local scale. This consultation involved discussion on whether it is practical or desirable to draw national initiatives together or leave them separate. It was also necessary to consider whether or not there was a requirement to consider all types of disaster, or whether it was better to concen-

FLAGSTAFF DECLARATION

WE

The Presidents and/or representatives of the American Institute of Professional Geologists (AIPG) the European Federation of Geologists (EFG) the Canadian Council of Professional Geoscientists (CCPG) the Institute of Geologists of Ireland (IGI), the Geological Society of London (GS) and the Ilustre Colegio Oficial de Geólogos (ICOG), during the 3rd International Professional Geology Conference held in Flagstaff (Arizona),

AGREE

To nominate a group of representatives to work together to establish a global framework for improved cooperation on issues including, but not restricted to:

- Fostering high standards of professionalism among geosciences practitioners for the greater benefit to society
- Harmonizing codes of ethics and their enforcement
- Sharing professional and technical expertise among geoscientific organizations and enhancing continuing professional development of geoscientists internationally
- Representing the importance of geosciences and geoscientists in international organizations such as UN, UNESCO, ICSU, IUGS, IUGG, and promoting international policies on matters such as natural hazards, land-use planning and the sustainable use of natural resources
- Promoting, encouraging and applying geoscientific knowledge worldwide, for example in sustainable development, natural disaster mitigation and recovery, and the use of natural resources
- Raising the profile of the geosciences and geoscientists in society by disseminating geological knowledge and its application at all levels
- Promoting geoscientific awareness and education for citizens at all levels

Signed in Flagstaff on the 23th of September of 2008

Dan St. Germain, CPG
President AIPG

Manuel Regueiro, EurGeo
President EFG

Bruce Broster, PGeo
President CCPG

Gareth Jones, EurGeo
Representative IGI

Luis Suárez, EurGeo
President ICOG

Edmund Nickless, CGeo
Representative GS

trate resources in priority areas.

The number of disasters, man-made and natural, for which the EC Civil Protection Mechanism has been required, has grown from 3 in 2002 to 17 in 2007. None of these can be managed by a single member state. There is also a growing understanding that Climate Change could increase the occurrence and severity of natural disasters. A strategy is needed to bring shared experiences together, to learn from different disasters and different member state experiences, and to encourage links between different actors in the scientific, social and political areas. The strategy can utilize the many links for civil protection that exist throughout the community.

So far, the commission has funded two studies which examined different approaches to prevention and different community responses. In light of these, a consultation is underway (of which this stakeholder event was part). It is anticipated that a commission will be looking into prevention strategy. This will probably commence in November 2008, working through 2009-10. The aim of this strategy will be to:

- Strengthen prevention in existing policy and instruments
- Work towards the integration of existing structures
- Reinforce links between prevention, preparedness and response
- Support specific research and development
- Reinforce international co-operation.

Dinne Smederup Hansen (COWI) presented the results of two exploratory studies assessing the room for action at community and member state level. The studies explored existing community legislation and policies and their implementation in a number (3) of member states. A number of gaps and weaknesses in existing policy were identified, including a general lack of data and analyses of natural disasters and a lack of trans-boundary methods for data collection or analyses. There is a need for a clear entry point for information and guidance on disaster prevention. The activity at member state level is highly variable; activity has focused on large scale disasters rather than medium scale, and there has been relatively little effort in prevention.

Overall recommendations from the studies include: a review of existing legislation and mechanisms and how these can be better integrated and elaborated to provide a better, more integrated EU policy. Furthermore, development of a 'toolkit' to communicate and share experiences, best practice and lessons learnt by member states and to improve cross-border comparability of hazards and risks and vulnerability assessments. And, not least, raise public awareness and stimulate involvement of the private sector in mitigation.

Subsequently, a discussion took place that was chaired by Fiorella Perotto and Thomas de Lannoy (DG Environment, Civil Protection Unit). Dr Fernandez, and colleagues from EFG and EuroGeoSurveys took the opportunity to highlight the importance of geological information and expertise in land use planning and that it was important to communicate the value of such information. The expertise and input from geoscientific specialists, including National Geological Surveys was highlighted.

It was clear that an initiative to promote prevention and mitigation of natural disasters is highly desirable. There were mixed views from the member states as to whether any initiative should be legislative or advisory. Overall, it was considered unlikely to be legislative. The initiative should establish a mechanism through which information, including *technical standards*, *guidance*, *methodologies* and *case studies* used in disaster mitigation and prevention can be shared. It should also provide a framework for actors to communicate, share experiences, and develop policies. The initiative should be multi-hazard, risk-based, consider natural and human processes and be relevant at levels including policy development and operation.

Any standards and initiatives need to be flexible and take into account the different natural, social and economic environments across member states. Commonality should be achieved through a common funding mechanism and approach. It should not lead to prescriptive common standards for data collection or analyses. EXCIMAP, the exchange circle for knowledge and experience on flood-risk mapping, amongst others, was presented as an example of good practice. EFG has been closely involved in the work of EXCIMAP through several members of our expert panel on natural hazards.

It was recognized that it is important to investigate the causes and processes involved in disasters rather than just concentrate on impacts of previous events. The overall aim must be that citizens are well prepared to protect themselves against disasters in all member states regardless of economic or political circumstance.

EFG will take further action with our expert panel on natural hazards by contribution and guidance in the setting up of research and communication networks, by continued promotion of the importance of geological and environmental information in the integrated assessment of natural disasters and by providing a source for relevant case studies, experiences, resources and other information.

Further Information: *http://ec.europa.eu/environment/civil/stakeholders_0408.htm.*

Andrew Gibson[1] and Herald Ligtenberg[2]
([1]present and [2]past coordinator EFG expert panel on natural hazards)

Directive on the promotion of the use of renewable energy sources

On 23 January 2008 the European Commission presented the Proposal for a Directive of the European Parliament and of the Council on *the promotion of the use of energy from renewable sources*, COM (2008) 19. The same day, EFG in collaboration with the European geothermal industry, EGEC, and EuroGeoSurveys, presented a press release. Our associations jointly welcome the proposal and call for some improvements of the Directive proposal: the definition of geothermal energy, and specific criteria for the certification of shallow geothermal installers.

On 11 September, the relevant committee of the European Parliament voted on the amendments to the Directive. The vote in the ITRE committee (Industry, Research, Energy) was the last step in the parliamentary process before the final vote in the Parliament, expected later this year. In the committee, the legal and technical details were adjusted and approved, and after the vote no further changes are expected to be made before the final vote.

EFG has supported some of the EGEC amendment in relation to the Geothermal energy. EP ITRE Committee agreed to adopt the following definition: *"Geothermal energy" means the energy stored in form of heat beneath the surface of solid earth*. With that definition and the inclusion of "geothermal energy" in the list of

"energy from renewable sources" in art. 2, all the various kinds of geothermal energy use, deep and shallow, for electricity, heat and cold, are covered by the directive.

Another important point that EFG supported was the accreditation of installers (art. 13 and annex IV), which in geothermal energy only makes sense for the mass market of geothermal heat pumps; shallow geothermal installers and heat pump installers now have been differentiated:

- Training programmes shall be offered to installers with working experience, who have undergone, or are undergoing, the following types of training:
- In the case of shallow geothermal installers: training as a driller or pipe layer and basic geological skills.

This does not include the theoretical part required for designing geothermal heat pump systems, so some additions will be needed in annex IV at a later stage.

The RES Directive, as it stands now after the end of the discussion process in the committees of the European Parliament, has been much improved compared to the first draft released by the European Commission in January.

Isabel Fernandez

EFG joins ZEP's Taskforce on Technology: first meeting report

The European Technology Platform for Zero Emission Fossil Fuel Power Plants (ZEP) is the main advisory group for the EU on Carbon Capture and Storage (CCS). First contacts between EFG and ZEP were established on the EU-Sustainable Energy Week earlier this year, resulting in the joining of EFG as a member of the Task Force Technology (TTech). TTech meets 3 to 4 times each year on different locations throughout Europe, the latest on 3 September in Brussels. This group alone counts over 70 members. Information on past meetings, members and published documents can be found on: *www.zero-emissionplatform.eu/website/organisation/ttech.html*. TTech consisits of different subgroups that are dedicated to capture technologies, transport and storage. As the power sector is strongly represented in ZEP, it is mainly capture technologies relevant to this sector that are discussed. Oil and gas companies, geological surveys, and now also EFG make sure that storage aspects are well covered.

One of the main activities of ZEP is to advise on topics during the preparation of EU Framework Programme (FP) calls. Currently they are evaluating what the response is to calls open under FP7, as it is evident that their credibility as a stakeholder advisor group depends on the quality and quantity of the response to these calls.

In relation to these advisory tasks, ZEP also reports on the technical status and outlooks of CCS. Currently, two reports are being prepared by the consultancy company McKinsey. The first report is privately funded by a few members of ZEP, but will probably be released in its intirety to its members. The topic of this report is 'Why CCS?'.

The second report is entirely sponsored by ZEP, and will deal with how to finance demonstration projects. The problem with the first demonstration projects is that they will cost two to three times more, which seems to put early investors in an undesirable position.

An intervention by Niels-Peter Christensen (GEUS) shed some doubts on whether geological storage is sufficiently addressed in the two McKinsey studies. The remark by Christensen was emphasized by Tore Torp (StatoilHydro), with a short intervention showing that the current priority lists for CCS development (considering first the capture plant; storage only getting second line attention) is not justified, having already resulted in fatal conflicts during project development. (Note that my personal experience, and no doubt that of other EFG professionals, shows that geological storage is indeed the last item to be considered when developing a CCS project.)

Next on TTech's to-do list are an inventory of national funded R&D, pilot and demonstration projects on CCS, and an updated overview of generic cost data. These will be discussed further during the next meeting on 4 November 2008 in Berlin.

We would like to invite geoscience experts who are closely involved in Carbon Capture and Storage to join the EFG expert panel on CCS to assist us in our communication with the European Commission and in related advisory tasks. Please contact the EFG office for more information.

Kris Piessens
Royal Belgian Institute of Natural Sciences, Geological Survey of Belgium

EFG Stand in the European Union Sustainable Energy Week, EUSEW, 28 January - 1 February 2008, European Commission, Brussels

The European Federation of Geologists participated in the European Union Sustainable Energy Week 2008 with the stand Geology and Sustainable Energy: http:/www.eusew.eu/

Under the umbrella of the Sustainable Energy Europe Campaign (SEE), the European Commission's Directorate-General for Energy and Transport, the European Institutions, the Slovenian Presidency and major stakeholders concerned with sustainable energy together put on the second EU Sustainable Energy Week (EUSEW).

Some thousands of participants, including politicians, civil servants, business people and conservation groups from around the globe gathered there. Debates, presentations and stands reviewed actions in Sustainable Energy in Europe. You can watch live some of the events at: *http://www.managenergy.tv/*

In the context of the event, EFG prepared a Stand in collaboration with EFG Panel of Experts on Geothermal Energy and CO_2 Sequestration. The topic of the Stand was Geology and Sustainable Energy and covered two main themes:

Geothermal Resources in Europe, posters in collaboration with European Geothermal Energy Council, EGEC. The poster presented the Geothermal Resources in Europe in relation to the temperature basins and the different technologies for electrical power, district heating and shallow geothermal

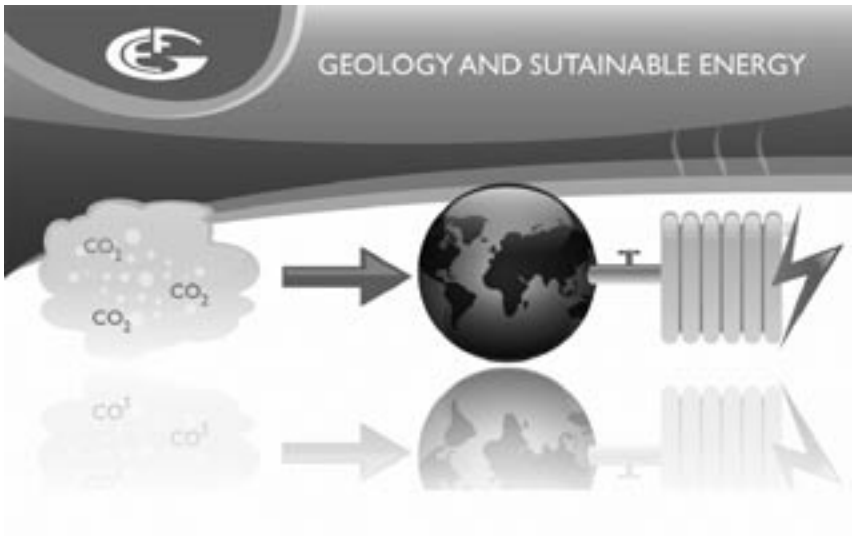
CO_2 Capture and Storage, poster in collaboration with the Geological Survey of Belgium. The poster presented different kinds of Geological Storage, problems and safety.

We distributed information about the EFG: EFG leaflet, EFG Members, EurGeol. Title, European Geologist magazine, and EFG position paper on these topics.

Press release on Directive on the promotion of the use of renewable energy sources

EFG, EGEC and EuroGeoSurvey welcome the proposal tabled on 23/01/08 by the European Commission for a Directive on the promotion of the use of renewable energy sources. The document is available at: *http://www.eurogeologists.de/cms/images/content/EUWSE08/press_release_RES_Directive.pdf.*

EFG News and Events 2008



Geothermal energy is the heat beneath the surface of the Earth. It is a sustainable, renewable, nearly infinite energy source, delivering heat and power 24 hours a day throughout the year and available all over Europe. It is environmentally friendly and contributes to the reduction of CO_2 emissions. It uses very little land, has almost no visual impact and reduces Europe's vulnerabilty to energy imports. It has considerable economic potential, can foster significant development of enterprises and related job creation.

Our associations jointly call for some improvements in the Directive proposal:1. the definition of geothermal energy and 2. accreditation of installers must include specific criteria for the certification of shallow geothermal installers.

A Manifesto will develop proposals on these issues and will present the actions needed to foster the contribution of Geothermal Energy to the targets set in the directive proposal.

This document has been mentioned in reference to the future of Geohermal Energy by Mr. Össur Skarphéðinsson, Icelandic Minister of Industry, during the opening remark on the event organized by the Ministry of Industry in Iceland, Geothermal Energy Benefits and Potential, February 1, 2008, and attended by Mr. Andris Piebalgs, European Commission, Commissioner for Energy.

Andris Piebalgs, Commissioner for Energy and Isabel Fernandez, EFG Office Manager at the Green Week stand

EFG position paper on Carbon capture and geological storage

The European Federation of Geologists (EFG), and especially its panel of experts on Geothermal Energy and Carbon Capture and Storage, emphasizes that Carbon capture and geological storage (CCS) should be strongly promoted, as it is an important and direct path towards a fully sustainable energy future. Document available at: *http://www.eurogeologists.de/cms/images/content/EUWSE08/press_release_RES_Directive.pdf*

During EUSEW, EFG expert, Kris Piessens, participated in the workshop on CCS. EFG PE on CO_2 Sequestration has been invited to apply for membership to the ZEP-CCS Technology Platform (see News, this issue).

During the exhibition we received support from EGEC staff and the Belgium Geological Survey.

The stand received very high attention from the EUSEW visitor, including Commissioner Piebalgs, Transport and Energy Commissioner and Mr González Finat, Director DG Transport and Energy.

Dr Isabel Fernandez, EFG Office Director

News from Ireland

National Association news: the Institute of Geologists of Ireland (IGI)

IGI presence at the American Institute of Professional Geologists Congress in Flagstaff

Gareth Jones, former IGI and EFG President, represented the IGI at the 3rd Professional Geological Conference in Flagstaff, Arizona and the 45th Annual Meeting of the AIPG Recognition on September 20-24, 2008 entitled '*Changing Waterscapes and Water Ethics for the 21st Century and Global Geoscience Practice, Standards, Ethics, and Accountability'*.

Gareth co-authored and presented on the 'Geotrainet Project' (see page 34); 'Geothermal Energy in Europe'; and 'Professional Qualifications as Passports's (see page 32).

Gareth was also a signatory to the 'Flagstaff declaration on International Cooperation' between the IGI, EFG, AIPG, CCPG, ICOG and the Geol Soc London.

EU Directive on recogition of Professional Qualifications (2005/36/EC)

The EU Directive on the Recognition of Professional Qualifications (2005/36/EC)

EFG News and Events 2008

was transposed into Irish Law on May 6, 2008 under Irish Statutory Instrument (SI) 139 of 2008. Geology is *not* a Regulated Profession under the statute. This arises as the profession of geology has no legal, regulatory or administrative recognition here, nor is it likely that this position will change in the near future.

The Department of Education and Science is the Irish National Contact Point and the Designated National Coordinator for the implementation of Dir. 2005/36. The IGI will make contact with the person(s) responsible for managing applications to work as geologists in Ireland so that the IGI can provide guidance and assistance to those wishing to work here as professional geologists.

IGI are currently endeavoring to ascertain how the Directive 2005/36/EC is being implemented across the EU and how the Directive applies to geologists moving from countries where geology is not a regulated profession to countries where it is a regulated profession.

IYPE

An IGI sponsored lecture entitled 'Climate Change and Increased Water Demand: A Volatile Mixture?' and given by Dr. Patrick Leahy was held at Trinity College Dublin on the Wednesday 24 September 2008. Dr. Leahy, Executive Director of the American Geological Institute, presented an international perspective on the impacts of global climate changes which threaten water resources and outlined a range of strategies on how we can adapt.

IAH Fieldtrip

The Internationational Association of Hydrogeologists - Irish Group held their annual fieldtrip on 27 - 28 September 2008. The fieldtrip visited the border counties of Cavan, Tyrone and Fermanagh looking at the impact of a proposed roadway on a wetland designated as a Special Area of Conservation (SAC); a small scale Catchment Hydrology and Sustainable Management (CHASM) project; a quarry in a dolerite dyke bounded by Carboniferous Mudstones which has an unusual groundwater regime; the impact of quarry dewatering on a series of turloughs, also designated SACs and finally to the Marble Arch Caves UNESCO Geopark, part of the Erne Karst system. The Geopark has recently been extended by the European Geoparks Network into west Cavan.

IGI 10th Anniversary Celebrations

The IGI 10th Anniversary celebrations are being planned for 15 - 19 May 2009 in Dublin Castle. The celebrations will coincide with the hosting by the IGI of the EFG Summer Council Meeting. The proposed programme starts with a jointly supported IGI/EFG/CRIRSCO/IAEG and Geol Soc Resources and Reserves Reporting Workshop to be held at Dublin Castle. The workshop, which will be opened by Mr. Eamonn Ryan, the Government Minister with responsibility for the Department of Natural Resources, Energy and Communications, will consider the consistency among the different resource reporting standards that are used in the mineral sector throughout the world. The workshop will also hear how the petroleum industry addresses the issue of reserve reporting and how resource reporting might be applied in the aggregate industry. The initial flyer will issue shortly. Following the workshop, a reception will be held in Dublin Castle for IGI members, EFG delegates and workshop attendees.

Fionnuala Collins

News from Scotland

Announcing the introduction of the Scottish Fossil Code

The Scottish Government Conservation Agency, Scottish Natural Heritage (SNH), has developed a code of best practice in the collection, care and storage of Scottish fossils. Aimed primarily at conserving the fossil heritage of Scotland, the Scottish Fossil Code encourages responsible use of this resource for scientific, educational and recreational purposes.

SCOTTISH FOSSIL CODE

The Scottish Fossil Code applies to everyone that collects fossils in Scotland. The Code may be viewed and downloaded from: *www.snh.org.uk/fossilcode.*

Alternatively, to receive a paper copy contact:

Scottish Natural Heritage
Publications Department
Battleby
Redgorton
Perth
PH1 3EW
Tel: 01738 444177
pubs@snh.gov.uk

The essentials of the Scottish Fossil Code:

- Seek permission - You are acting within the law if you obtain permission to extract, collect and retain fossils
- Access responsibly - Consult the Scottish Outdoor Access Code prior to accessing land. Be aware that there are restrictions on access and collecting at some locations protected by statute
- Collect responsibly - Exercise restraint in the amount collected and the equipment used. Be careful not to damage fossils and the fossil resource. Record details of both the location and the rocks from which fossils are collected
- Seek advice - If you find an exceptional or unusual fossil do not try to extract it; but seek advice from an expert. Also seek help to identify fossils or dispose of an old collection
- Label and look after - Collected specimens should be labelled and taken good care of
- Donate - If you are considering donating a fossil or collection choose an Accredited museum, or one local to the collection area..

A specimen of Diplacanthus crassisimus found at Hugh Miller's collecting locality in Cromarty, one of the specimens used in a workshop for pupils from Cromarty Primary School on the occasion on the launch of the Scottish Fossil Code

Guidelines for quarry developments in Ireland

by EurGeol. Kevin Cullen[1] and EurGeol. Fionnuala Collins[2]

The extractive industries make an important contribution to economic development in Ireland and there will be a continuing need for some new or expanded aggregate quarrying operations on land to meet regional and local requirements. However, the operation of quarries can give rise to land use and environmental issues which require mitigation and control through the planning system. There is a need to identify and protect aggregate resource areas through the planning system to ensure an adequate supply of aggregates to meet the likely scale of future demand while at the same time protecting Ireland's natural and cultural heritage.

L'industrie extractive contribue largement audéveloppementéconomiquedel'Irlande et un besoin constant d'ouverture de carrières nouvelles ou de développement de carrières existantes va se faire sentir pour répondre aux demandes locales et régionales de matériaux. Cependant, l'ouverture de carrières peut poser des problèmes touchant l'occupation des sols et l'environnement qui requièrent de la retenue et un contrôle au niveau du système de planification. Il est nécessaire d'identifier et de protéger les futurs secteurs d'ouverture de carrière à l'intérieur du système de planification pour assurer un approvisionnement convenable en matériaux, ceci pour satisfaire une future demande en augmentation probable, tout en protégeant, en même temps, l'héritage naturel et culturel de l'Irlande.

Las industrias extractivas hacen una contribución importante al desarrollo económico de Irlanda y seguirá habiendo necesidad de nuevas canteras de áridos o ampliaciones de las existentes para satisfacer la demanda local y regional. Sin embargo, las canteras pueden generar alteraciones medio ambientales que precisarán de su mitigación y control por medio de la planificación. Hay necesidad de identificar y proteger los recursos de áridos por medio de los sistemas de planificación territorial para garantizar un adecuado suministro de áridos que satisfaga una futura demanda posiblemente en ascenso, mientras, al mismo tiempo se protege el patrimonio natural y cultural de Irlanda.

The Irish economy experienced an economic boom during the 1990s and during the first seven years of this century. The economic boom was accompanied by a tremendous increase in construction industry activity, while at the same time the Irish Government implemented the National Development Plan, designed to update the country's infrastructure. The combined effect of the increased building activity and the Government's National Development Plan for infrastructure was reflected in the demand for stone and aggregate.

This increase in demand was first met by the existing quarries but soon demand outstripped the available and regulated capacity. The shortfall in capacity resulted in extensions to existing excavations (some approved and others not) and new excavations, many of which had dubious permissions. The often frenzied efforts to meet the demand for stone and aggregate resulted in a lowering of general environmental standards at and around quarries with noise and dust being the principle nuisances. The lowering of standards led inevitably to a public outcry which was responded to by a new legislative framework for operating quarries (Section 261 of the Planning and Development Act, 2000).

With the existing facilities now under regulatory control, the focus of public and regulatory attention naturally has turned onto new quarry applications.

Irish planning regulations require applications for quarries over 25 hectares and sand & gravel pits over 5 hectares in size to be accompanied by an Environmental Impact Statement. In some cases the planning authority can request an EIS even where the applicant area is below the threshold level (Schedule 5 of the Planning and Development Regulations, 2001 (S.I. No. 600)).

Due to the poor environmental reputation of the extractive industry generally, each planning application, and the EISs in particular, have become the focus of intense examination by both the public and the planning authorities. This scrutiny has identified that the dewatering aspects of quarry proposals are particularly important and the demand for detailed descriptions of likely significant impacts on aquifers and dependent eco-systems has resulted in long drawn out planning enquires with many ending in outright refusals.

In its defence, the quarrying industry highlighted the lack of any guide as to the level of hydrogeological information required in an EIS while the planning authorities have been frustrated with the quality of information actually contained in the submitted EISs.

Recognizing this developing impasse, the Institute of Geologists of Ireland (IGI) published a Template outlining the information that should accompany quarry planning applications. The IGI Template gives guidance on the collection, presentation and interpretation of geological and hydrogeological information for quarry developments (pp 26-27).

The Template was developed by the professional members of the IGI who worked within the extractive industry with input from industry representatives (the Irish Concrete Federation). It was designed to meet the demands of the Environmental Impact Assessment (EIA) process while at the same time recognizing that cost control is vital in the early stage of the planning exercise. Critically, the IGI Template recognizes that flexibility must be retained so that the professional adviser can alter the range and extent of studies carried out to reflect the size of the planned excavation and the complexity and sensitivity of the hydrogeological environment.

[1]PGeo., President, Institute of Geologists of Ireland.
[2]PGeo., MCIWEM. BMA Geoservices Ltd.

Recommended Collection, Presentation and Interpretation of Geological and Hydrogeological Information for Quarry Developments

Published By The Institute of Geologists of Ireland

General Information			Comment
Ordnance Survey Maps	Outline of Property Boundary & Limit of Excavation	Ordnance Survey 1:50,000	Map of local and regional drainage catchments and previously [Note 2] identified drainage features with particular attention to karst features.
	Outline of Property Boundary & Limit of Excavation	1:10,560 [Note 7]	Map of local and regional drainage catchments and previously identified [Note 2] drainage features with particular attention to karst features.
	Outline of Limit of Excavation	Ordnance Survey 1:2,500	Map of local and regional drainage catchments and previously [Note 2] identified drainage features with particular attention to karst features.
Geological Maps	Geological & Hydrogeological Maps	1:50,000	Map series (where available) to include bedrock geology, subsoil, aquifer and groundwater vulnerability.
Topographic Survey	Malin Head Ordnance Datum		DTM from Ordnance Survey otherwise ground contours within property boundary to 2m intervals and for 500m outside property boundary to 5m intervals.
	Topographic Levels [Note 4]		Recommended that all surveyed features such as boreholes or water levels be measured to an accuracy of +/- 100mm above Ordnance Datum.
	Grid References		Recommended that all surveyed features such as boreholes and springs be located to 6 digits on the Irish National Grid.
	Aerial Photograph	1:10,560 [Note 7]	Recommended to extend 2km from limit of excavation.
Site Information [Note 1]			
Geophysical Surveys	Resistivity [Note 4]	All Quarries	Sufficient [Note 3] line and data point distribution to characterise subsoil nature and depth over extent of excavation.
		Rock Quarries Only	Sufficient [Note 3] line and data point distribution to identify major bedrock structures such as faults, weathered zones or cavities above or below the water table.
Geological Testing	Trial Pits [Note 4]	Subsoil (Rock Quarry Only)	Sufficient [Note 3] number to characterise and sample subsoil deposits (>4m depth where possible).
	Trial Pits [Note 4]	Sand & Gravel Deposits	Sufficient [Note 3] number to quantify and sample aggregate resource.
	Boreholes [Note 4]	All Quarries	Sufficient [Note 3] number to establish geology and geotechnical framework, confidently prove resource, and to present quarry design.
	Testing [Note 5]	Subsoil Sieve Analyses	Sufficient [Note 3] number to characterise and prove sand and gravel resource.
	Testing [Note 5]	Rock Analyses	Sufficient [Note 3] number to characterise and prove rock resource.
	Geotechnical Testing [Note 4]		Stability studies required to meet Health & Safety Authority requirements.
Hydrogeology	Monitoring Boreholes [Note 4]		Sufficient [Note 3] number to characterise hydrogeological regimes in both the subsoil deposits and the underlying bedrock.
		Subsoil	Required if the winter water table is likely to occur within subsoil deposits.
		Bedrock	Should extend to 3m below the final quarry floor level or to 3m below the summer water table level, which ever is the deepest.
	Groundwater Monitoring [Note 4]		Monthly measurements to include as a minimum, one measurement of the Winter highest level and one measurement of the Summer lowest level.
			Recommended to provide at least 1 No. continuous groundwater level monitoring device for duration of groundwater monitoring period.
	Pumping Well(s) [Note 4]		Ideally located in area(s) of potentially high permeability from geophysical survey and/or drilling programmes.
			Pumping well(s) to extend to 5m below final quarry floor level.
	Pumping Tests [Note 4]	Continuous Yield Tests	Required to provide underlying subsoil and bedrock aquifer characteristics, boundary conditions and water samples.
			Test duration of 12 - 72 hours depending on sustainable yield achieved.
			Test duration >72 hours where projected maximum dewatering rate > 3Ml/day [Note 8]. Test extraction rate to exceed 1Ml/day from 1 No. or more wells.
			Groundwater levels to be recorded at regular intervals at pumping & monitoring boreholes, and recommended at available and nearby wells & springs.
	Groundwater Samples [Note 4 & Note 5]	Pumping Well(s)	Collect samples 1 hour after the start of and before the end of each pumping test. Analyses for major ions, trace metals, hydrocarbons, pH & conductivity.
		Monitoring Wells	Collect 1 No. sample from each monitoring borehole & spring on quarry property. Analyses for major ions, trace metals, hydrocarbons, pH & conductivity.
	On Site Potable Water Source [Note 4 & Note 5]		Establish sustainable yield and show that the supply can meet Drinking Water Standards (S.I. No.439 of 2000).
	Well Survey [Note 4]		Recommended distance of 1km from limit of excavation. A greater distance is recommended where maximum dewatering rate projected to be >3Ml/day.

 (See Notes 1 to 8 Overleaf)

Recommended Collection, Presentation and Interpretation of Geological and Hydrogeological Information for Quarry Developments

Published By The Institute of Geologists of Ireland

Site Information (Continued)			Comment
Meteorology	Nearest Rainfall Station	30 year Averages	Annual & monthly rainfall averages from nearest meteorological station. Evapotranspiration data from nearest available agri-meteorological station.
		Daily Records	For the period of groundwater monitoring above.
	Nearest Synoptic Meteorological Station	Extreme Rainfall Event Data	Recommended to limit quarry outflow to mean annual flood (QBAR) with storm water storage/retention within property/excavation to accommodate 20 year storm.
			Where appropriate, proposed storm water retention and settlement measures should be described.
Hydrology	Surface Water Drainage	1:10,560 [Note 7]	Drainage map to show location, name (where appropriate) and type of each previously identified drainage feature within 2 km from limit of excavation.
			Previously identified features to include seasonal & permanent springs, sinks, streams, rivers, lakes, turloughs and wetlands.
	Flow Measurements [Note 8]		Use EPA /OPW flow data where available or recommended to take a minimum of 3 low flow measurements between August and October.
	Drainage Capacity Survey [Note 8]		Recommended to determine high flow capacity of drainage network from quarry perimeter to receiving water body and for 500m downstream of quarry outflow.
	Surface Water Quality		Use EPA/OPW or Co.Co. data where available and appropriate or take 1 sample at quarry outfall during low flow conditions.
Discharge Licence			A licence is required by Section 16 of the Local Government (Water Pollution Act), 1979 for the discharge of trade effluent to either surface water or groundwater.
Data Interpretation			
Plan Maps		1:10,560 [Note 7]	Base Map showing excavation and Phase outlines, boreholes, wells, identified drainage & geological features together with sampling locations.
		1:10,560 [Note 7]	Copy of base map showing contours of bedrock surface.
		1:10,560 [Note 7]	Copy of base map showing contours of subsoil thickness.
		1:10,560 [Note 7]	Copy of base map showing Winter groundwater contours and flow directions.
		1:10,560 [Note 7]	Copy of base map showing Summer groundwater contours and flow directions.
		1:10,560 [Note 7]	Copy of base map showing groundwater contours, flow directions at appropriate Phase intervals and at end of life.
		1:10,560 [Note 7]	Where dewatering is proposed, copy of base map groundwater showing drawdown contours and flow directions at appropriate Phase intervals and at end of life.
Cross Sections		Existing Conditions	Sections to have consistent horizontal and vertical scales and to extend a minimum of 500m outside quarry perimeter in each direction on a 1:10,560 [Note 7] map.
		Conditions at appropriate Phase intervals	Sufficient number [Note 1] of sections showing relevant boreholes, wells, springs, surface water features together with predicted groundwater levels.
		Conditions at End of Life	Sufficient number [Note 1] of sections showing relevant boreholes, wells, springs, surface water features together with predicted groundwater levels.
Conceptual Model		Existing Conditions	Conceptual model to describe predevelopment geological and hydrogeological environments at and surrounding planned quarry.
		Conditions at appropriate Phase intervals	Conceptual model to indicate likely significant impacts on geology and hydrogeological environments at and surrounding planned quarry.
		Conditions at End of Life	Conceptual model to indicate likely significant impacts on geology and hydrogeological environments at and surrounding planned quarry.
Appendices			Recommended that all trial pit & borehole logs , pumping rates and water level data collected during the quarry investigation accompany the interpretative report.

Note 1: Recommended integrated and flexible field work programmes, scoped on preliminary conceptual model and capable of changing and evolving as geological and hydrogeological models develop.

Note 2: As shown on published Ordnance Survey maps and /or identified within data bases maintained by the Geological Survey of Ireland and other Government agencies.

Note 3: The actual number will be determined by the nature and complexity of the geological regime and the scale of the likely significant impacts associated with the proposed excavation.

Note 4: Recommended that field work be planned, directed and supervised by appropriately qualified and competent persons.

Note 5: Recommended to use accredited laboratory.

Note 6: Mean Annual Flood as per Institute of Hydrology Report No.124.

Note 7: Or appropriate similar scale.

Note 8: 1Ml/day = 1,000M^3/day.

Useful References: (i) Code of Practice for Site Investigations B.S. 5930 of 1999;
(ii) Geology in EIS - A Guide - Institute of Geologists of Ireland, 2002.

Institute of Geologists of Ireland
School of Geological Sciences
University College Dublin
Belfield, Dublin 4
Tel. 01- 7162085 / email. admin@igi.ie

Published by IGI April 2007

The IGI Template is published as a double-sided laminated single sheet and has been distributed to planning authorities, quarry owners and their representative body and professionals working in the aggregate industry. It can be downloaded from the IGI Web page at: *www.igi.ie*

The Template recommends that all the necessary data be collected on both regional and local scales; it recommends that the collected information be interpreted and presented in a set of plans and sections that indicate the base line conditions and which also outline the conditions that are likely to occur at appropriate Quarry Phase intervals and also at the quarrying End of Life.

General Information

This initial section of the IGI Template places the proposed quarry development in its regional context with the provision of geological, hydrogeological and topographic maps with appropriate scales and contour intervals and clearly showing the outline of the applicant area. Maps downloaded from the Geological Survey of Ireland web page indicating bedrock geology, subsoil, aquifer and groundwater vulnerability are particularly recommended and useful in this regard.

It is recommended that the application is accompanied by a recent aerial photograph as this allows the planning authority to readily validate information provided by the applicant and also that proffered by any objectors to the development. The aerial photograph should extend 2 km from the limit of the proposed excavation.

Site Information

At the outset, the IGI Template recognizes that geological and hydrogeological conditions can change even in the early stages of a site investigation. The Template recommends an integrated and flexible field work programme which has been scoped on the preliminary conceptual model and one that is capable of changing and evolving as the geological and hydrogeological models develop.

This section describes the range of site specific geological, hydrogeological, hydrological and meteorological information that will be required to allow the development of a set of representative plans and cross sections. These drawings, together with the results of pumping tests and other surveys, will then be used to develop a conceptual model with which to describe the baseline conditions and the likely significant impacts of the proposed quarrying activity.

The range of investigations that may be required include:

- Geophysical Surveys
- Trial Pits and Boreholes
- Geotechnical Testing
- Groundwater Monitoring Wells
- Pumping Well(s).

The investigations may also include subsoil and rock analyses and groundwater analyses. Additional studies may include a well survey, determination of local rainfall data and measurements of surface water flows, drainage capacity and surface water quality.

The IGI Template is not a prescriptive document and recognizes that every quarry application will be different and that the range and balance of the information required will vary from site to site. It recommends that the number of boreholes, trail pits and monitoring wells for instance be determined by the nature and complexity of the geological regime and the scale of the likely significant impacts associated with the proposed excavation.

Most importantly, it is recommended that the field work be planned, directed and supervised by appropriately qualified and competent persons.

Data Interpretation

The final Template section addresses the need for the interpretation and presentation of the collected data sets to allow a full examination of the quarrying proposal from geological and hydrogeological perspectives. It is recommended that the information be provided in a series of plans and sections at appropriate scales and that the conditions are indicated from the base line position, at appropriate Phases through the operating life of the quarry and quarrying End of Life.

The IGI Template recommends the development of a conceptual model that incorporates the range of geological, hydrogeological, hydrological and meteorological information collected. The conceptual model should describe the baseline conditions and how these conditions will be impacted by the quarrying operation and in particular the assumptions used in determining the scale of any predicted likely significant impact.

Overview

The IGI Template has been in use for 12 months and so far it has found favour with the industry, industry advisors and the planning authorities.

Bringing a quarry application through the Irish planning system can be a lengthy and costly exercise. The IGI Template is an attempt on one hand to inform the Applicant at an early stage of the presence of sensitive hydrogeological environments and dependant eco-systems that may be at risk due to the planned quarrying activity. On the other hand the IGI Template is designed to provide the planning authorities with the necessary information on which to base an informed decision on the likely significant impacts associated with a quarrying application.

Acknowledgements

Irish Concrete Federation; Irish Mining and Quarrying Society; CSA Ltd.; Tobin Consulting Engineers; White Young Green plc; O'Neill Groundwater Engineering.

References

Planning and Development Act, 2000

Planning and Development Regulations, 2001 (S.I. No. 600)

Quarries and Ancillary Activities Guidelines for Planning Authorities April 2004

Geology in Environmental Impact Statements – A Guide -IGI-2002

Guidelines on the Information to be Contained in EISs – EPA 2002

This paper was presented at the EFG/GSG conference on Geology and Water Management, Athens, 30 May 2008.

Master's course on Geological Heritage and Geoconservation

by Diamantino Pereira[1], José Brilha[1] and Graciete Dias[1]

Geoheritage and Geoconservation is a new domain of opportunities to geologists who wish to work with Nature Conservation and land-use actions. The University of Minho (Portugal) has offered a two-year Masters Course in Geological Heritage and Geoconservation since 2005. Curricular units are composed of several modules lectured during the first curricular year, followed by the development of a one-year thesis or project. The success of previous rounds and the cooperation with lecturers from the UK, Switzerland, and Spain underlines the interest in an increasing internationalization of this pioneering post-graduate course.

L'héritage géologique et la géoconservation constituent un nouveau domaine d'opportunités pour les géologues qui désirent mener des activités concernant la conservation de la nature et l'aménagement du territoire. Depuis 2005, l'Université de Minho au Portugal, offre un cours de Maitrise de deux ans en Héritage géologique et Géoconservation. Le cours comprend plusieurs modules dispensés en première année, suivis par l'élaboration d'une thèse ou d'un Projet, de durée un an. Le succès d'initiatives antérieures et la coopération de conférenciers venant du Royaume Uni, de Suisse et d'Espagne soulignent l'intérêt d'accroître l'internationalisation de ce cours post-universitaire d'avant-garde.

El patrimonio geológico y la geoconservación, es un nuevo campo de oportunidades para los geólogos que deseen trabajar en la conservación de la naturaleza y en actividades de uso del territorio. La Universidad de Minho (Portugal) lleva ofertando un curso Master de dos años en Patrimonio Geológico y Geoconservación desde el año 2005. Las unidades curriculares comprenden varios módulos impartidos durante el primer año curricular, seguido del desarrollo de una tesis o proyecto de un año. El éxito de las ediciones previas y la cooperación con profesores del Reino Unido, Suiza y España subraya el interés y la cada vez mayor internacionalización de este curso de postgrado pionero.

In 2005/06, the University of Minho (Braga, Portugal) launched a Masters Course in Geological Heritage and Geoconservation that is now on its third round. This is a two-year Masters Course (2nd cycle course with 120 ECTS) accepting students with a 1st cycle degree in Geology, Biology, Geography, Environmental Sciences or related fields. Up to now, 36 students with different academic and professional backgrounds have enrolled in the course. Efforts are being undertaken to increase the internationalization level of the course, namely extending this post-graduate opportunity to other foreign universities, hence attracting more European and non-European students.

It is our belief that Geoconservation is a somewhat new domain worldwide with the potential to create alternative employment for geologists, usually less involved in Nature Conservation issues.

Background

Nature Conservation deserves to be taken more seriously in our Society. Demographic growth, urban pressure in certain areas, and the uncontrolled use of natural resources are examples of threats that are confronting Nature. Hence, Nature Conservation policies play an increasingly relevant role in sustainable development and land-use planning.

Nature Conservation must be holistic and should consider, above all, the conservation of geological and biological values. The need for biodiversity conservation, one of the natural heritage components, is already well established. Nevertheless, the importance of the other component – geodiversity – has been neglected. The geodiversity concept is rather new, introduced only at the beginning of the last decade. It corresponds to the variety of geological environments, phenomena and active processes generating landscapes, rocks, minerals, fossils, soils and other surface deposits which support life on Earth. Unfortunately, among all the national and international policies related to Nature Conservation, geodiversity is always underestimated when compared to biodiversity. It is easier to engage the public in the protection of certain endangered species rather than in the conservation of a fossil-rich outcrop. The unanimated character of the geological heritage and the lack of awareness of geology contribute to the lower popularity of geodiversity in contrast to biodiversity.

The inventory, characterization and interpretation of our geological heritage are recent objectives. It is noteworthy that the 1st International Symposium on Geological Heritage was held in Digne (France) in 1991 and the European Association for the Conservation of Geological Heritage – ProGEO – was created in 1993. Moreover the 30th International Geological Congress, held in China in 1996, organized for the first time a geoconservation session. In the same year, the International Union of Geological Sciences created the Global Geosites Working Group to promote the inventory of geosites with global relevance. Some eastern European countries had already begun national initiatives. During the last six years, the geopark concept has been implemented all over Europe as well as in other countries such as China, Iran, and Brazil. The first scientific event related to geological heritage in Portugal took place in 1998 during the 5th National Geological Congress. After this event, some comprehensive initiatives took place in order to characterize the Portuguese geological heritage. In particular, a research

[1]University of Minho, Earth Sciences Department, 4710-057 Braga, Portugal. insuad@dct.uminho.pt

CURRICULAR UNITS / MODULES	SD	Hours (1)	Hours (2)	ECTS
Geodiversity	G	196	84	7
Biodiversity	B	140	56	5
Geomorphology and Landscape Evolution	G	140	56	5
Tools Applied to Geoconservation		364	146	13
M1. Techniques of Cartographical Representation	G	(84)	(34)	(3)
M2. Computers Applied to Geoconservation	G	(112)	(45)	(4)
M3. GIS Applied to Geological Heritage	I	(112)	(45)	(4)
M4. Introduction to Projects Assessment	M	(56)	(22)	(2)
Geoconservation Strategies		308	126	11
M1. Inventorying and Characterisation of Geological Heritage	G	(84)	(34)	(3)
M2. Conservation and Management of Geological Heritage	G	(84)	(34)	(3)
M3. Interpretation and Use of Geological Heritage	G	(56)	(32)	(2)
M4. Protected Areas and Geoconservation	G	(84)	(36)	(3)
Geoconservation and Society		224	96	8
M1. History of Natural Sciences	HS	(56)	(22)	(2)
M2. Environmental Legislation	L	(56)	(22)	(2)
M3. Strategies of Education for Sustainable Development	SE	(56)	(30)	(2)
M4. Geotourism	G	(56)	(22)	(2)
Heritage and Culture		168	66	6
M1. Cultural Heritage	H	(56)	(22)	(2)
M2. Archaeological Heritage	A	(56)	(22)	(2)
M3. Mining Heritage	G	(56)	(22)	(2)
Themes and Examples on Geoconservation	G	140	56	5
Thesis or Project	G	1680	120	60

Table 1. The Masters Course structure. (1) Total number of hours including autonomous student work; (2) Number of hours dedicated to lectures and guided fieldwork. SD - Scientific domains: A - Archaeology; B - Biology; G - Geology; H - History; HS - History of Science; I - Informatics; L - Law; M - Management; SE - Science Education

group from the Earth Sciences Centre of the University of Minho, in collaboration with researchers from other institutions, has been working in protected areas from Northern Portugal in the scope of multidisciplinary projects with the aim of proceeding with the inventory and characterization of geosites, creating scientific instruments to support a sustainable management of resources and territory and contributing to the increase in public awareness of Geological Heritage.

The Masters Course on Geological Heritage and Geoconservation at the University of Minho was launched in September 2005, in response to the increasing interest in geoconservation among geoscientists, park managers, politicians, the general public and, particularly, Natural Sciences teachers. This is the first post-graduate course on offer in Europe in this scientific domain. It is supported by the strong experience of the Earth Sciences Department staff and benefits from the collaboration of experts from other national and foreign institutions.

Course aims and structure

This masters course deals with the geological subjects associated with Nature Conservation strategies and actions. The main aims are:

- To provide post-graduate studies for professionals working in state or private institutions related to Nature Conservation, as well as environmental NGOs, wishing for a lifelong learning experience
- To develop the geoconservation skills and expertise of young graduates
- To improve the competence of Natural Sciences teachers in geoconservation and education for sustainability
- To allow national and international exchange of geoconservation experiences
- To foster the development of scientific research in geoconservation.

The masters course is organized into two academic years (120 ECTS). Curricular units are composed of several modules lectured during the first curricular year, which is followed by the development of a one-year thesis or project.

The first semester includes a general overview of Geodiversity, Biodiversity and Geomorphology and a broad curricular unit designated by *Tools Applied to Geoconservation* comprising four modules (Table 1).

The second semester is mainly focused on Geological Heritage and Geoconservation, with four curricular units: *Geoconservation Strategies*, *Geoconservation and Society*, *Heritage and Culture*, and *Themes and Examples on Geoconservation*. The last unit includes fieldtrips and lectures given by invited experts.

Curricular units and modules are organized as sequential intensive courses with a maximum of two simultaneous units or modules. In addition to theoretical lectures, the course is strongly based on practical lectures, fieldwork and autonomous student activities.

Student profile and theses under development (2005-2007)

The majority of enrolled students are from Portugal (31), but five students are from Brazil (3), Mozambique (1), and Cape Verde (1). Foreign students from Africa received grants integrated in cooperation programmes and grants from a private Portuguese foundation (Fundação Cal-

Figure 1. Fieldwork is essential for the training of new experts on geoconservation.

ouste Gulbenkian). Students from South America obtained scholarships from the European Union: (Program Alban*: http://www.programalban.org*).

Regarding professional backgrounds, 46% of students are secondary school teachers, indicating a major interest for lifelong learning programmes; 31% are unemployed young graduates and 23% are members of protected areas staff (geologists and other professionals).

The majority of the masters theses already concluded or under development have local impact; they are mostly concerned with issues related to protected areas (7), geoparks (3), municipalities (3), and with the Côa Valley Archaeological Park (2). These theses deal with different aspects such as making inventories of geological heritage (9), assessment of geological heritage (2), the role of geological heritage in management planning (1) and geoconservation strategies (1). The use and interpretation of geological heritage (7), mainly associated with pedagogical issues, is preferred by students with a teacher training degree. Four theses concern national or state geoconservation strategies, namely in Mozambique, Cape Verde and Brazil and, therefore, have national impact. One thesis is dedicated to the study of the relation between geological heritage and geosciences museums.

Internationalization

Up to now, internationalization has involved only a limited number of students from Africa and Brazil, as well as four invited lecturers from UK, Switzerland, and Spain. Different approaches and experiences prompted by foreign experts and students are a major contribution to the general quality of this course.

However, internationalization can be further enhanced in the near future, with an increased enrolment of students from other European and non-European countries. The EU Erasmus Mundus Programme supports the "enhancement of quality in European higher education and the promotion of intercultural understanding through cooperation with third countries as well as for the development of third countries in the field of higher education." During 2007, informal contacts were established with the Universities of Zaragoza (Spain), Modena (Italy), The Aegean (Greece) and Lausanne (Switzerland) in order to launch a Master Course on Geoconservation under the scope of this EU Programme. Presently, we are waiting for the next call of the Erasmus Mundus Programme to submit a final proposal for the period 2009-2013.

Meanwhile, due to our acquired experience, we have been invited to lecture in international courses such as the Intensive Courses promoted by the International Association of Geomorphologists "Geomorphosites and Landscape" (Bagnes, Switzerland, 2006) and "Geopark management and Geotourism" (Lesvos, Greece, 2007) and the Summer Course "Geological Heritage: Culture, Tourism and Environment" (Moratalla, Spain, 2007).

Final remarks

With almost forty students enrolled in the Masters Course on Geological Heritage and Geoconservation since September 2005, we believe that this course allowed the training and certification of an important number of specialists in these subjects. They are also prepared, in different ways or strategies, to raise awareness of Geoconservation.

In a more specific way, this Masters Course:

- Is preparing secondary school teachers in the subject of Geoconservation, a rather new domain under the broader Geosciences scope
- Constitutes an alternative post-graduate training for young geologists, giving them a possibility to explore new job markets related to Nature Conservation, land-use planning, environmental education, etc
- Allows the training of protected areas staff, usually unaware of Geoconservation issues.

The Masters Course on Geological Heritage and Geoconservation is a successful project that is in increasing demand by students from diverse backgrounds and with different goals, being a step forward in research and research methodologies in this recent domain.

As Geoconservation is a rather new subject, internationalization is needed in order to foster joint efforts, congregating dispersed initiatives and experiences and encouraging the development of new trends and actions. Finally, international courses with the participation of experts and students from different countries promote the visibility of the subject and the chance to apply to financial resources.

International recognition and co-operation, professional qualifications as passports

by G. Ll. Jones[1], J. Clifford[2] and C. Åkerman[3]

Based as they are on a combination of academic qualification and relevant professional experience, typically a minimum of five years, professional qualifications are the international quality standards. They allow for mutual reciprocity and mutual recognition agreements between professional organizations. They further permit financial institutions and government bodies to demand that geologists must hold such a qualification in order to sign technical reports for submission to these bodies. The expansion of this international network of reciprocity is a major requirement for the development and mobility of the geological profession.

Basées en l'état actuel sur une combinaison de qualification universitaire et d'expérience professionnelle appropriées, courant typiquement sur une période de 5 ans minimum, les qualifications professionnelles représentent les standards de qualité reconnus internationalement. Elles permettent des accords de réciprocité et de reconnaissance mutuelle entre les organisations professionnelles. Au-delà, elles permettent aux institutions financières et de gouvernement d'exiger que les géologues possèdent une telle qualification pour signer les rapports techniques qui seront soumis à ces institutions. L'expansion de ce réseau international de reconnaissance mutuelle est une exigence majeure pour le développement de la profession et la mobilité des géologues professionnels.

Los títulos profesionales son actualmente el estándar de calidad internacional, ya que están basados en una combinación de titulación académica con una experiencia profesional relevante, con un mínimo que normalmente es de 5 años. Permiten acuerdos de reciprocidad y de reconocimiento mutuo entre organizaciones profesionales, permiten también que las instituciones financieras y los departamentos gubernamentales exijan que los geólogos dispongan de dicha titulación para firmar informes técnicos que vayan dirigidos a ellos. La expansión de esta red internacional de la reciprocidad es un requisito importante para el desarrollo y la movilidad de la profesión geológica.

Rigorous application of the scientific method, high standards of professional practice and strict adherence to codes of ethics are the cornerstones on which professional technical qualifications are based. All institutes that award professional titles and qualifications require that the recipients hold a recognized academic qualification in the relevant discipline, maintain that qualification through a structured continuing professional development (CPD) programme, have relevant professional experience, and agree to adhere to a code of ethics in their professional practice. Thus, the awarding body must have disciplinary powers, including the power to expel a member. Organizations that award professional qualifications include the American Institute of Professional Geologists, the Institute of Geologists of Ireland, the Geological Society of London and the Canadian provincial associations, whilst the European Federation of Geologists and the Spanish Ilustre Colegio Oficial de Geologos award professional titles.

[1]Convenor of EFG expert panel on Geothermal Energy. conodate@mac.com
[2]cliffordconsultants@eircom.net
[3]christer.akerman@sgu.se

Geology as a science recognizes stratigraphic contacts and understands that invariably these are not coincident with country boundaries. Thus, geologists in their training and practice are consistently to the forefront in globalization trends. This is perhaps best exemplified in the mineral resource industry. In that industry it is not uncommon, for example, for a European-based geologist to consult for an Australian-based company developing a resource in Latin America and reporting to a Canadian stock exchange. This is only possible when there is mutual recognition of professional titles as international professional passports.

Professional titles

At the international level, professional titles are typically awarded with very similar level of requirement. Thus, it has been relatively easy to organize for mutual recognition of them by their awarding bodies.

This recognition has developed in two ways. Firstly, there are agreements to either directly recognize titles, or to fast-track membership applications between a number of the awarding bodies. Examples of such protocols include agreements between the EFG and AIPG, IGI and GeolSoc, GeolSoc and AIPG and IGI and AIPG.

A second approach, which operates within the minerals sector, is a process whereby the professional body itself is recognized. This has led to the development of the Recognized Overseas Professional Organization ("ROPO") concept. ROPO lists are developed, and maintained, by nationally-based professional bodies acting on behalf of, or in association with, stock exchanges. The presence of a professional body on such a list allows members of that body to sign-off, as Competent Persons, technical reports submitted to the particular stock exchange. Requirements for a professional body to maintain its recognition as a ROPO varies between jurisdictions. However, the requirement common to all jurisdictions is a commitment to require all title holders to adhere to a code of ethics and submit to discipline in the event of a breach of that code (Fig. 1).

The role of the competent person in the mineral resource sector

The public reporting of mineral exploration results, minerals resources and min-

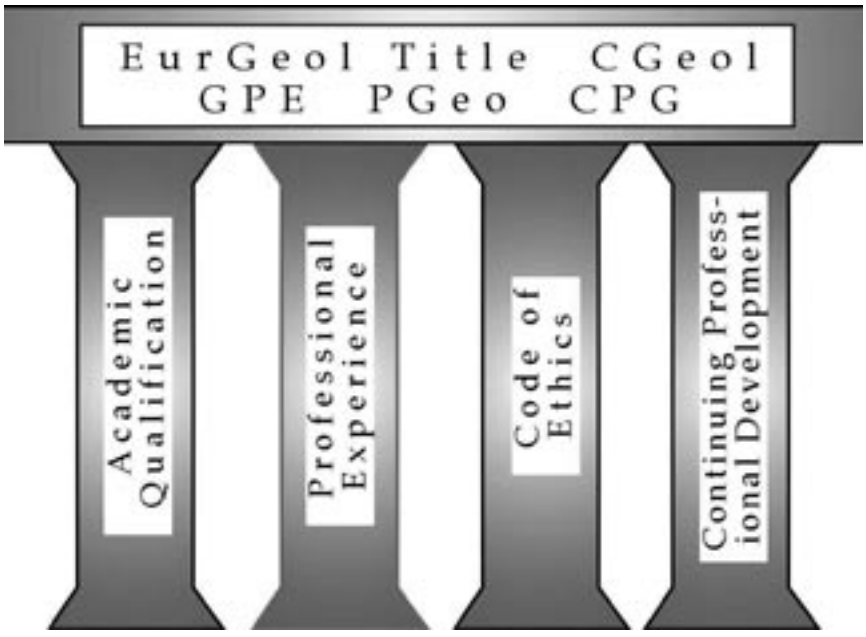


Figure 1. Professional qualifications rest on four solid pillars

eral reserves in the Australian, Canadian, European and South African financial markets requires that the reports, and resource information, be based on work undertaken by a Competent Person. The Competent Person is named in the report and must take responsibility for the disclosure. In order to meet with these requirements a Competent Person must have first hand familiarity with the mineral property being described, and sign a consent certificate in a prescribed format. These certificates include the title and date of the report, a summary of the Competent Persons relevant experience, states whether the Competent Person is independent, or not, of the reporting entity, and makes a statement that to the best of the Competent Person's knowledge the report contains all scientific and technical information that is required so that the report is not misleading.

In signing the Consent Certificate, the Competent Persons accepts a legal liability that may, in the event of misrepresentation, be acted on by the securities regulators, by the professional body of which the Competent Person is a member, or in a civil liability action. Thus, in order to ensure against any such action, the Competent Person must be able to demonstrate that they conducted a reasonable investigation, are appropriately qualified and are practising within the capabilities of their professional title. They should also have a transparent and well documented QA/QC protocol, including a peer review mechanism. It is also essential that the Competent Person be familiar with the jurisprudence in the reporting jurisdiction so as to be aware of potential liabilities. It is also important that the Competent Person have a high level competency in the reporting language so as to ensure clarity of presentation.

One of the first decisions that a Competent Person must make when facing an assignment is – am I competent to undertake this work? This question is addressed in all of the Combined Reserves International Reporting Standards Committee (CRIRSCO) -style reporting codes in the same manner. The key issue is "relevant experience". The CRIRSCO Template expands on this as follows: *"determination of what constitutes relevant experience can be difficult and common sense should be exercised. For example, in estimating vein gold mineralisation, experience in a high-nugget, vein-type mineralisation such as tin, uranium etc. will probably be relevant, whereas experience in massive deposits may not. As a second example, to be considered competent in evaluating and reporting on alluvial gold deposits, a person should have considerable experience in this type of mineralisation because of the characteristics of gold in alluvial systems, the particle sizing of the host sediment, and the low grades being quantified. Experience with placer deposits containing minerals other than gold may not necessarily provide relevant experience. The key word 'relevant' also means that it is not always necessary for a person to have five years experience in each and every type of deposit in order to act as a Competent Person if that person has relevant experience in other deposit types. For example, a person with twenty years experience in Mineral Resource estimation in a variety of metalliferous hard-rock deposit types may not require five years specific experience in porphyry copper deposits in order to act as a Competent Person. Relevant experience in the other deposit types would count towards the required experience in relation to porphyry copper deposits. In addition to experience in the style of mineralisation, a Competent Person reporting Mineral Resources should have sufficient knowledge of sampling and assaying techniques relevant to the deposit under consideration to be aware of problems which could affect the reliability of the data. Some appreciation of extraction and processing techniques applicable to that deposit type is also important."*

As a general guide, persons being called upon to sign as a Competent Person should be clearly satisfied in their own minds that they could face their peers and demonstrate competence in the commodity, type of deposit and situation under consideration.

Company integrity

The need for companies having employees fulfilling the requirements for a "Competent Person" or "Qualified Person", for instance a EurGeol., PGeo, CGeol or CPG, cannot be stressed too much. A EurGeol. must keep to the facts and be honest towards the employer as well as towards the market, and hence not exaggerate for the purpose of having investors to put in capital and deceive the stock exchange. The EurGeol. must have great integrity. This is illustrated by the following example.

A junior company is, according to its own web site, exploring 19, 100% owned, uranium projects including five advanced uranium projects in Sweden and concludes that the company possesses significant uranium resources. On their website the company announces in some detail the work that has been done on each project. Most project descriptions are terminated with a "History", under the heading of which, and under the subheading " World Nuclear Association Brief on Sweden" it is written: "Sweden has an estimated 15% of the world's uranium deposits." This information has been provided at least since year 2006 and is still announced in September 2008.

The company is thus giving the message to the reader, that Sweden has about 15% of the world accumulation of uranium ore, i.e. about 15% of the world's economic concentrations of uranium. This statement is not verified or supported in the most important periodical update, currently pre-

sented every two years, on world uranium resources, production and demand: OECD NEA & IAEA, 2006, Uranium 2005: Resources, Production and Demand, commonly known as the "Red Book". Nor is the company statement supported in any other modern compilation of uranium deposits.

The reported figures in the "Red Book" for Sweden are 0.12% of Reasonably Assured Resources (RAR) and 0.41% of Inferred Resources, in both cases referring to world recoverable resources of uranium as of 1 January 2005. On the list of countries with Undiscovered Resources Sweden is not even mentioned.

The figures given in the "Red Book" are in accordance with the figures reported by the Geological Survey of Sweden to the Ministry of Industry in Sweden: Swedish uranium resources (some of which do not really fulfill the requirements to be called resource) amount to around 0.3% of world resources. It is true that the exploration for uranium in Sweden has increased enormously in the last few years, but this is also the case in many parts of the world, so in reality the Swedish share is probably even less today than year 2006.

So, why is the company consistently and still (September 2008) declaring that Sweden has this huge share of world uranium deposits? Well, the only reasonable explanation is that the company has such great activity and economic interests in Sweden that the economic aspects are allowed to overshadow balanced calculations concerning uranium availability. And how is it possible that the company can keep on tampering with the truth without somebody administering a rebuke to the company? One answer is that the company is not a member of SveMin, the Swedish Association of Mines, Mineral and Metal Producers, the trade and employer's organization for mines, mineral and metal producers, with nearly 40 member companies representing approximately 7000 employees within the mining sector in Sweden. Also that it does not employ any professionally qualified geologists who would adhere to the Code of Ethics which would inhibit them from making incorrect statements.

SveMin recommends its member companies to follow the rules adopted by the Canadian Securities Administration where applicable in accordance with the Swedish legislation. The foundation for this is the Canadian policy document National Instrument, NI 43-101, in which guidelines are given to companies providing information to investors, for instance through electronic publications such as Internet websites. It is said by SveMin that any information published by or on behalf of a company must comply with these standards.

Future developments

Recognition of quality standards comes in the agreements by various stock exchanges to require that geological reports can only be submitted when signed by a professional geologist; so that Stock Exchanges in Toronto and Vancouver Canada, London UK, Dublin Ireland, Johannesburg South Africa and now Lima Peru recognize the professional qualifications of EurGeol., CPG, CGeol and PGeo for this purpose.

Furthermore, in some countries like Ireland, government departments require or prefer reports to be signed by competent professionals. These include mineral exploration reports, reserve & resource reports, geotechnical reports, hydrogeological reports, etc.

The basis for further reciprocity already exists in mutual recognition agreements existing between bodies such as CCPG and EFG. The development of mutual reciprocity agreements, such as between AIPG and IGI and EFG should form the basis of a global system of reciprocity.

GEOTRAINET: a European initiative

by Isabel Fernandez Fuentes[1], Burkhard Sanner[2], Philippe Dumas[2] and Gareth Jones[1]

The aim of the project "Geo-Education for a sustainable geothermal heating and cooling market", GEOTRAINET, is to develop the training of professionals involved in Ground Source Heat Pump installations (GSHP). From the different groups of professionals involved in a GSHP, the GEOTRAINET project is focused on two target groups: designers (feasibility study including geologists) and drillers (who make the boreholes and insert the tubes). The project includes the creation of an EU-wide certification scheme for both planners and installers of GSHP. Another project activity will be the definition and development assistance for the necessary EU-wide technical standards

[1]EFG, Rue Jenner, Brussels.
[2]European Geothermal Energy Council, Rue d´Arlon, Brussels.

Le but du Projet "Géo-Education pour un marché durable de géothermie associant chauffage et refroidissement", GEOTRAINET, est la formation de professionnels impliqués dans les installations de pompes à chaleur à partir de l'énergie du sous-sol (GSHP). Parmi les différents groupes de professionnels concernés par le GSHP, il existe deux groupes que cible le Projet GEOTRAINET : les concepteurs (étude de faisabilité incluant la présence de géologues) et les foreurs (qui forent les puits et les équipent). Le Projet comprend la création d'un système européen de certification largement ouvert, à destination des planificateurs et des installateurs de GSHP. Un autre volet du Projet consistera en une aide à la définition et au développement des spécifications techniques nécessaires à ces utilisateurs européens.

El objetivo del proyecto "Geo-Educación para un mercado sostenible de calefacción y refrigeración geotérmica" GEOTRAINET, es el desarrollo de una formación especifica para profesionales dedicados a instalaciones de bomba de calor geotérmicas (GSHP). De los distintos grupos de profesionales relacionados con dichas instalaciones, el proyecto GEOTRAINET se ha centrado en dos grupos: diseñadores (estudio de la viabilidad del proyecto, incluyendo geólogos) y sondistas (realización de sondeos e instrumentación en los mismos). El proyecto incluye la creación de un plan de certificación europea para diseñadores e instaladores de bombas de calor geotérmicas.

The European Commission's "Intelligent Energy - Europe" Programme has awarded a grant to the European Federation of Geologists to coordinate a large group of partners, to run a project for training professionals to install ground source heat pumps across Europe.

Ground Source Heat Pumps (GSHP) contribute greatly to energy saving and emission reduction. In Europe, a sustainable market has been established only in a few countries, Sweden, Switzerland, Germany and Austria. Research in Europe shows that one of the barriers to a sustainable and growing geothermal market is the lack of appropriate skilled personnel. Quality of design and works are also not always satisfactory. Furthermore, to maintain quality, a certification programme for GSHP workforce is required. This project will develop a European Education programme for the certification of geothermal installations, which will require didactic materials, training courses and an e-learning platform. Training structures in eight EU countries will be established for geothermal professionals. A European certification framework will be proposed and standards and codes will be suggested to permit harmonization.

The need for quality work is evident when looking back at the heat pump industry. With the second oil price crises in 1980, the heat pump sales skyrocketed, as people demanded energy-efficient heating systems. However, with the oil price still high, the heat pump sales collapsed shortly after the peak year 1980 (Fig. 1). So clearly it was not the economic circumstances, but a common lack of quality and experience in both the heat pump manufacturing and the system installation, that caused resentment against that technology. With the oil prices rising again in recent years, another GSHP boom can be seen, and we must ensure that the 1980s experience is not repeated.

The main goal is to promote geothermal energy by training geothermal installers, and so removing one of the main barriers to Geothermal Energy H&C in many European countries. The results will be a European Certificate to support and improve the quality of geothermal installations, with an Education programme to support Continual Professional Development (CPD) for Earth Science Experts and Drilling Professionals.

An international platform of experts on Geothermal Energy H&C will be established to provide training courses and a European E-learning platform for shallow geothermal applications.

The project will also improve access to geological data needed for the design of GSHP installations and propose high standards for professional requirements for Geothermal Energy H&C in Europe.

GEOTRAINET is divided into phases designed to create a certified education programme and geothermal installer training.

- The work will comprise:
- Research into data useful for GSHP installers
- Evaluation of skills required to design, drill and install GSHPs
- Create curricula for designers, drillers and installers
- Create, test and optimize training tools
- Suggest standards and codes for the European market
- Propose a European certification framework
- Launch training courses.

The GEOTRAINET group of partners with the EFG comprise: the industry representative European Geothermal Energy Council; research centers Arsenal Research Austria and BRGM France; private companies GT Skills Ireland and Geoexchange Society Romania; Universities, Universidad Politécnica de Valencia Spain, University of Lund Sweden, Newcastle University UK. The duration of the project will be 30 months from 1 September 2008.

Curricula for GSHP geosciences and design

The training of geologists or geoscientists is necessary for complete GSHP competence.

Environmental protection: consider potential contamination of soil and groundwater, ground stability, hydrogeological knowledge while drilling.

Ground thermal condition: the shallow geothermal installer training will cover geothermal resources and ground source temperatures of different regions, soil and rock identification for thermal conductivity, regulations on using geothermal resources, determination of the most suitable geothermal heat pump system.

Technical condition: familiarity with different drilling and digging technologies, choice of the optimum drilling method, ensuring protection of the environment (in particular groundwater) while drilling, well construction, pressure testing, logistics, building laws, and safety.

A European expert platform will be established which will create a Curriculum for geosciences and design, and assign contents and programmes to the work items identified in the Curricula. Their professional experience will define the most relevant areas and knowledge blocks and the most relevant aspects for a quality technical assessment of GSHP installations. They will develop the programme of education, including necessary content and skills requirement, the didactic materials and also identify the profile and required professional experience of the teachers.

The qualification of geologists covers an extensive spectrum of disciplines. Depending on employment demands geologists continuously adapt their level of specialization. Some, such as Geotechnics, Hydrogeology, Geophysics, are of particular relevance for ground analysis in view of geothermal objectives.

Assessment of geothermal data required for GSHP design and installation

This assessment involves the following activities:

Inventory of data available in the Geological Surveys or equivalent authorities. A first approach to produce a catalogue of ground meta-data dedicated to the GSHP.

Collection and evaluation of data to determine knowledge and skills required for design and installation of geothermal H&C.

Site conditions are factors impacting on the feasibility study of the GSHP (H&C efficiency, drilling methods, heat exchange performance, protected areas..). Designers in each EU-27 country need to know how to access the necessary data. In some countries (Germany, France, UK..), local geological documents are available (Geographical information system (GIS) or specific reports) to support decision makers before installing a GSHP. A catalogue of the types of available information and their mode of presentation is essential for EU countries to compare and to develop new supports and to collect new data.

A best practice case exists in Germany

where the Geological Survey of Nordrhein-Westfalen provides the geological data free, on a CD-rom. Other countries are developing the same products but access can be expensive.

The goal is to present the available geological data from seven EU countries, assess how available they are for designers, and what is needed to make them available, in order to replicate these actions in the other EU countries. The data assessment will also include a *Guideline to facilitate the acquisition of geological data by the geothermal professional*. This Guideline will be included in the didactic material. BRGM will coordinate this task, and EFG's Panel of Experts on Geothermal Energy will prepare a geological study of the influence of the ground on the Geothermal installations. Other partners will collect data for their own countries.

The Geological Survey of France (BRGM) will coordinate the contribution to the project of six National Geological Surveys (CGS Czech Republic Geological Survey; IGME Spanish Geological Survey; PGI Polish Geological Survey; INETI Portuguese Geological Survey; BGS British Geological Survey; TNO Dutch Geological Survey).

An internal group of experts will work on the technical assessment of the project and BRGM will report on the project. This will involve listing and categorizing all the geological data from these countries, as a template for EU-27, looking in particular at the following tasks:

- Metadata on the underground
- Geological maps, hydrogeological conditions, ground physical characteristics and ground thermal conductivity
- Local environment for installation of shallow geothermal systems: geological conditions, climate.

Curriculum for GSHP drilling and installation

A European expert platform dedicated to the drilling and installation part of a GSHP will create a Curriculum for drillers and installers, the contents of the work items in the Curriculum as well as didactic material for the drillers who opt for professional activity in the GSHP area. The platform of experts will define:

- Programmes of education, including necessary content and skills requirement to train drillers
- Didactic materials to prepare the learning materials for drillers
- Profile and required professional experience of the teachers for the training of the trainers.

The objective is to create European materials, update the existing ones, and target them more to professionals. Specific materials have to be created for vocational training for the drillers. Existing training material for drillers is more or less specific for each country (legal aspects, but also focuses on a few techniques used locally).

Existing materials in the EU countries will be collected and homogenized. These can then be translated and completed with national data and legal information.

Creation of necessary teaching/learning materials and of the e-learning platform

The panel of experts will develop the necessary teaching system to support Geothermal H&C and to train professionals (geologists, drillers, installers, salespeople, planners and others) with an e-learning platform and other learning tools.

The goal is to develop best practice documentation to be used during the courses, and also disseminated and used for courses organized after the project. The documents will be in English, German, French and Spanish. They will be adapted for the eight targeted countries to take account of national specifications.

An e-learning platform will be created mainly to train designers around Europe but the information will be available free and online.

Establishment of a certification framework at European level and proposal for standardization

Certification means that an installer has demonstrated necessary skills, knowledge and ability typically required of a practitioner to competently install and maintain a GSHP installation. Certification is provided via training programmes for designers, drillers and installers. These programmes will be accredited by a credible authority to make sure they apply sufficiently stringent and uniform standards and are designed to reach their goals. The certified training programmes can then be replicated across the EU.

The certification will apply to geologists, designers, installers and drillers. It will be issued on a voluntary basis by national competent authorities in close consultation with the relevant stakeholders, allowing it to be recognized at an EU-level.

The project will underline the advantages of Certification: it may become a requirement in respect to environmentally-friendly drilling and installation.

To complete the European certification framework, standards and codes will be suggested for the ground part of a GSHP (existing or new) to contribute to the creation of a uniform market.

The goal is to avoid unskilled work and to develop a harmonized European market. For the heat pumps, EN standards are well adapted and allow for a free circulation of machines and components within the common market. For the ground side of shallow geothermal installations, relevant standards and codes exist only in a few countries with developed GSHP markets (AT, DE, SE and CH). In FR, IE and NL the matter is partially covered, and work is ongoing on developing standards and codes. A common EU-wide harmonization is not in sight. An approach for common standards can be seen between AT, DE and CH, where geology and work practice is similar.

The eight target countries will organize direct training courses. The logistic base for each training course will be ensured by the local partner involved in the project. There will be eight direct training courses: two for trainers, three for drillers and three for designers as well as two e-learning courses for trainers and for designers. Existing skills and knowledge expected of people to be trained are:

Designers/Planners:

Students: post graduate, more than 3 years in geology, hydrogeology, etc

Professionals: engineers, geologists, technicians with 5 years of experience

Drillers:

Students: background in mechanics

Professionals: 3 years of experience.

In the case of shallow geothermal installers, accredited training programmes will be offered to installers with working experience, who have undergone, or are undergoing training as a driller or pipe layer and have basic geological skills as a prerequisite. The course evaluation system consists of:

- an assessment of the skills and knowledge of the professionals
- an evaluation questionnaire filled in by the course participants on the quality and relevance of the course
- an overall evaluation report on the training courses summarizing the course results and the students' evaluation questionnaire.

The theoretical part of the shallow geothermal installer training will cover geo-

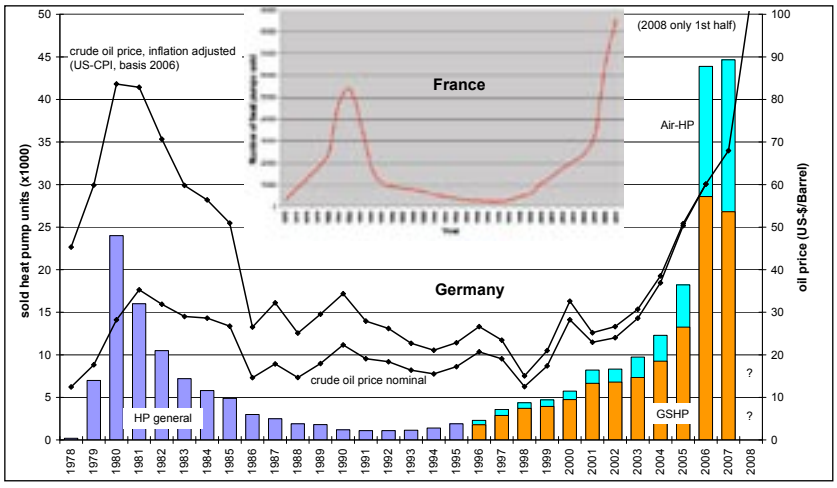


Figure 1. 30 years of heat pump sales in Germany (large graph) and France (inset), after data from EHPA, BWP, EIA, and others

thermal resources and ground source temperatures of different regions, soil and rock identification for thermal conductivity, regulations on using geothermal resources, determining the most suitable geothermal heat pump system, system layout, drilling technologies, installation of borehole heat exchangers, well construction, pressure testing, logistics, building laws, and safety, plus European standards for shallow geothermal, and relevant national and European legislation.

At the end, as a result of the proposed training courses, the installers will demonstrate the following key competences:

Knowledge of geological and geothermal parameters of the ground, an ability to identify and name soil and rock types, preparation of borehole reports incl. lithology, groundwater, etc.; basic geological and hydrogeological knowledge; familiarity with different drilling and digging 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 incl. identification and drawing of drilling locations

ENWAT: Hungarian-Slovakian transboundary groundwater bodies

by Károly Brezsnyánszky[1], Peter Malik[2], Gábor Gaál[1], Teodóra Szőcs[1], György Tóth[1], András Bartha[1], Gergely Havas[1], Jozef Kordik[2], Juraj Michalko[2], Dušan Bodiš[2], Jaromír Švasta[2], Igor Slaninka[2], Jussi Leveinen[3], Juha Kaija[3], Katalin Gondár-Sőregi[4], Károly Gondár[4], Éva Kun[4], Sándor Pethő[4] and Viktor Ács[4]

Groundwater bodies along the Hungarian-Slovakian border form interconnected systems, which supply both countries with drinking water. Surface waters, rivers and wetland ecosystems are dependant on the underlying groundwater. The EU Water Framework Directive deals with the quantitative and qualitative status of groundwater and protection of the ecosystems which depend on groundwater as first priority objects. Results of the project, based on hydrogeochemical evaluations and hydrogeological models, local needs, cost aspects and best practices, are a step forward in the creation of a joint Hungarian-Slovakian water management plan by supplying basic data and fresh information on transboundary groundwater bodies.

Les aquifères localisés le long de la frontière entre la Hongrie et la Slovaquie constituent un système interconnecté qui alimente les deux pays en eau potable. Les écosystèmes formés par les eaux de surface, les rivières et les zones humides dépendent des eaux souterraines sous-jacentes. La directive européenne sur « le Cadre de l'Eau » traite des aspects quantitatifs et qualitatifs des eaux souterraines et de la protection des écosystèmes considérés comme éléments prioritaires du Projet eaux souterraines. Les résultats du Projet, basés sur les modèles d'évaluations hydrogéochimiques et hydrogéologiques, les besoins locaux, les coûts et un souci d'efficacité, représentent une première avancée dans le projet de création d'un plan hongrois et slovaque de management de l'eau, en fournissant des données de base et une information au jour le jour sur les aquifères transfrontaliers.

Las masas de aguas subterráneas existentes a los largo de la frontera entre Hungría y Eslovaquia forman sistemas interconectados que proporcionan a ambos países agua potable para consumo humano. Las aguas superficiales, los ríos y los ecosistemas de humedales dependen de las aguas subterráneas subyacentes. La Directiva Marco del Agua de la UE versa, como objetivo prioritario, sobre el estado cuantitativo y cualitativo de las aguas subterráneas y los ecosistemas que dependen de ellas. Los resultados del proyecto, basado en evaluaciones hydrogeoquímicas y modelos hidrogeológicos, necesidades locales, aspectos relativos a los costes y las mejores prácticas, son un paso adelante para la creación de un plan conjunto Hungaro-Eslovaco de gestión del agua proporcionando los datos básicos y información actualizada sobre las masas de aguas subetrraneas trasfronterizas.

Between 2006 and 2008, the Geological Institute of Hungary - MÁFI and the State Geological Institute of Dionýz Štur - ŠGÚDŠ have been cooperating in data and information collection and exchange to contribute to a water management plan for three transboundary groundwater bodies in Northern Hungary and Southern Slovakia. The three regions are: Ipoly/Ipel‘ river region, Aggtelek - Slovak Karst region, and Bodrog river region (Fig. 1). The ENWAT project based on hydrogeochemical evaluations, hydrogeological models, local needs, cost aspects and best practices, was founded by the INTERREG III A Programme. During the project, the Geological Survey of Finland - GTK, came in, bringing its expertise in water management practice.

Groundwater bodies along the Hungarian-Slovakian border form interconnected systems, which supply both countries with drinking water. Surface waters, rivers and wetland ecosystems are dependant on the underlying groundwater. The EU Water Framework Directive (WFD) deals with the quantitative and qualitative status of groundwater and protection of the ecosystems which depend on groundwater as first priority objects.

Objectives of the project:

- To supply a water management plan for three transboundary groundwater bodies to support a safe and healthy water supply in the studied regions
- To serve as an environmental base for decision-making processes involving major cross-border investments
- To supply information on the quantitative and qualitative status of groundwater concerning the potential negative health impact of the use of groundwater
- To inform the population of the region on rational use of water.

Target groups

Clean drinking water is crucial for the region and the most important stakeholders are in this respect the local municipalities.

The protection and restoring of ecosystems, which depend on the underlying groundwater is the concern of nature protection organizations and the municipalities.

Tourism is an important activity which depends on clean groundwater. This interest circle includes municipalities, nature protection organizations and tourist enterprises.

Sustainable agricultural activity is dependant on groundwater and interested users are agricultural enterprises, farmers, muncipalities and waterworks

Water suppliers and local waterworks in the border regions in Hungary and Slovakia are beneficient as suppliers of clean water for the local poulation.

The ultimate beneficiary of an adequate water management plan is the local population which has its water supply from groundwater, for drinking, domestic use, recreational activities etc.

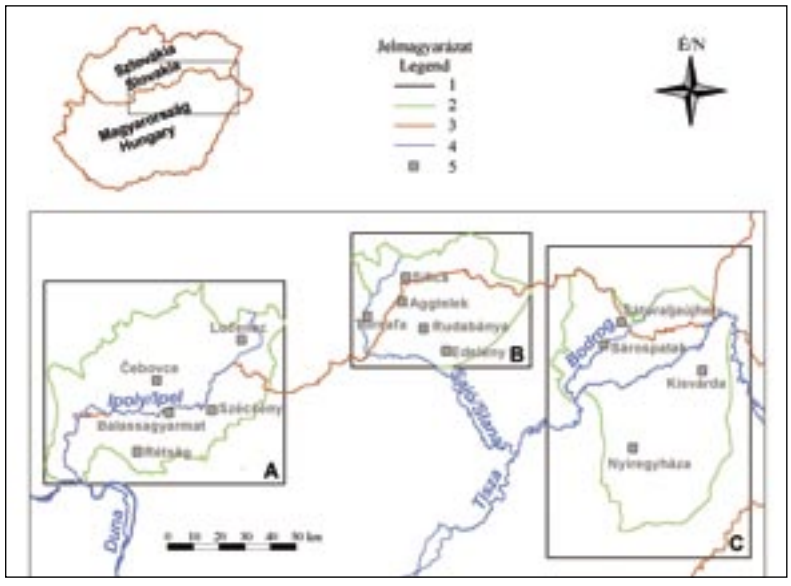


Figure 1. Locations of the studied areas (1: state border, 2: model frame, 3: model boundary,4: stream, 5: settlement. A: Ipoly/Ipel' river region,, B: Aggtelek-Slovak karst area, C: Bodrog-river and its catchments region

Ipoly/Ipel' Region

This area and its broader vicinity suffer from lack of sources of drinkable water. The improvement of the quality problems and increased utilization of the water from Ipoly/Ipel‘ alluvium for water supply on both sides of the border is the reason why this area is important.

The area of interest is delimited by the extent of the youngest alluvium of the river Ipoly/Ipel' and partially also of some of its tributaries. The alluvium lies on the impermeable clayey sediments of the Neogene filling of the Juhoslovenská and Podunajská panva basins in the Slovakian side, and on the Nógrád Paleogene and Neogene (sands, aleurites, clays and rarely limestones) sediments, and partly volcanic rocks on the Hungarian side.

The main aquifer is the alluvial sediments of the river Ipoly/Ipel‘ and the connecting terraces. Their thickness is about 4 - 10 m, sometimes more. The gravels and sands are covered with 1.5 - 4 m of clayey flood sediments. The changing thickness sometimes causes the occurence of the confined groundwater. The gravels and sands have good transmissivity. The width of the river flood plain is about 1 - 2 km, but sometimes only tens of meters.

Groundwater recharge occurs by infiltration of precipitations and infiltration of surface water at high water levels. The changing (decreasing) surface water level of the river has negative impact of the water supply possibilties.

Groundwater model

The model created for Ipoly/Ipel' valley and its catchments showed firstly the existence of the sensitive hydraulic state of equilibrium between the alluvium of Ipoly, the older porous medium filling the basin, and the mountains in the surroundings built up by volcanics.

The very close relationship between the Duna/Danube river and the lower section of the Ipoly valley; secondly, the sustainable status of water production under the circumstances.

Hydrogeochemical results

Strong variability of groundwater chemical composition and quality is characteristic for the Ipel' region. Ca-Mg-HCO_3 dominates the groundwaters as the result of dissolution of carbonates and hydro-

[1]Geological Institute of Hungary MÁFI. brezscyanszky@mafi.hu
[2]State Geological Institute of Dionýz Štur ŠGÚDŠ.
[3]Geological Survey of Finland GTK.
[4]SMARAGD-GSH Kft.

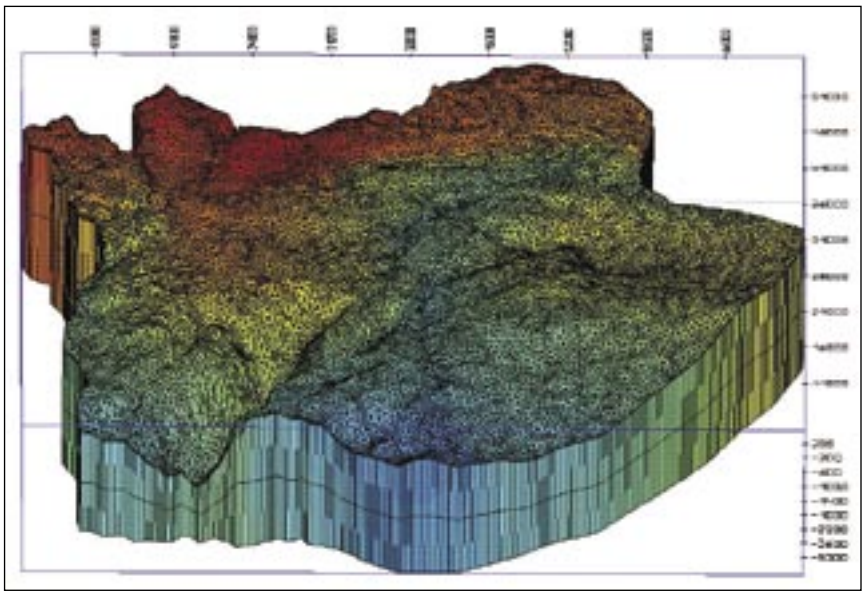


Figure 2. Modelled view of Aggtelek-Slovak karst in the FeFlow software

lytical decomposition of silicate minerals. Groundwater qualitative properties in the region reflect either the natural character of the area or the addition of compounds due to anthropogenic activities.

Anthropogenic contamination of groundwaters is mostly produced by agricultural activities and production of waste waters. It is mainly contamination of the uppermost groundwater horizons that occurs in the area.

Deteriorated groundwater quality is mainly characterized by high contents of nitrates, chlorides, ammonia ions, phophates or specific organic parameters (PAH, COD) and occassionally pesticides. One of the project goals was to fill the gap in our knowledge regarding organic contaminants by additional sampling and analyses. One can find the most contaminated groundwaters aroung settlements; every site needs detailed surveys in the future.

Mineral and thermal waters play a significant role in the area. Their characteristics are described in the special project report.

Water management

In the Ipoly/Ipel' valley, the water production is sustainable, however, some parts of the groundwater bodies have poor chemical status. Locally high pesticide concentrations (> 0.5 mg/l) are found in both surface water and in groundwater along the Ipoly/Ipel' valley. Pesticides in unsaturated soils can be released by erosion, and climate change may increase this risk. Nitrates have also a substantial impact on the shallow parts (0-20 m) of the groundwater systems. In general, the pesticide concentrations detected suggest that water quality can be considered to be at risk until further investigations have been made and the additional measures as defined by WFD, have been taken. More information on the pesticide concentrations in groundwater, unsaturated zone and surface water are needed to be collected urgently.

The investigations indicated that there are local pollution problems and direct and indirect sources of hazardous pollutants that may also cause groundwater pollution in the future. Evidently, there is a need to continue the characterization of pollution spread and the risks for groundwater resources by more detailed sampling and modelling on both sides of the border. Coordination and implementation of such activities jointly could provide logistical advantages, reduce overlapping activities and lead to savings in time and money. If not a prerequisite then at least a great benefit for integrated water resources management and successful implementation of the WFD, are the direct links and cooperation between regional and even municipal authorities and expert organizations. One of the underlying objectives of WFD is to create a common understanding of activities dealing with transboundary water resources. Particularly in the management of pollution cases and in crisis situations requiring fast response and actions, it is important that cross-border authorities are ready to exchange information and communicate directly with their transboundary counterparts rather than using high-level representatives as middle-men without a good knowledge of the conditions in the field.

Aggtelek – Slovak karst region

The Aggtelek Mountain and the Slovak karst form a large common karstic aquifer system in the eastern part of the countries. It is selected in the Danube-basin report as a highly-important transboundary water body. National Park covers the majority of its surface, where the role of the groundwater is presented by springs and stalactite caves. This significant drinking water resource in Slovakia and regionally important resource in Hungary is in a vulnerable area and requires protection.

The groundwater body is in a Mesozoic complex with morphologically visible karstic plateau and canyon-like valleys of water courses, separating different units (Fig. 2). Hydrogeological units are very different according to the character of permeability, character of groundwater circulation, type of groundwater regime, and also in the resulting yield of groundwater springs. From a hydrogeological point of view, the most important tectonic unit in the area is the Silicikum unit, mainly its Middle Triassic and Upper Triassic part. The most important aquifer here is the Middle and Upper Triassic limestone and dolomites with karst-fissure type of permeability. Similarly important hydrogeological units in the Hungarian side are Alsóhegy, Nagyoldal, Haragistya and Galyaság, which contain the Aggtelek-Domica cave system. Tertiary basins act as a regional impermeable barrier for the groundwater accumulated in Triassic limestone.

The transboundary karstic aquifer is divided into two water bodies by the state-border. The horizontal extensions are 598 km^2 and 471 km^2 respectively in Slovakia and in Hungary, thus the total area is 1069 km^2.

Groundwater model

Based on the modelling procedure of the Aggtelek – Slovak karst region, the following statements were proved:

Budget of karst-water system is determined by natural factors, mainly effective precipitation. Therefore, the system is very sensitive to changes of climate.

The main discharge of springs controls the natural balance.

Significant increase of water withdrawal combined with effects of climate change would dry out some of the springs, causing problems for water supply.

Hydrogeochemical results

Groundwater chemical composition and quality originates mainly from the processes of the water-rock interactions.

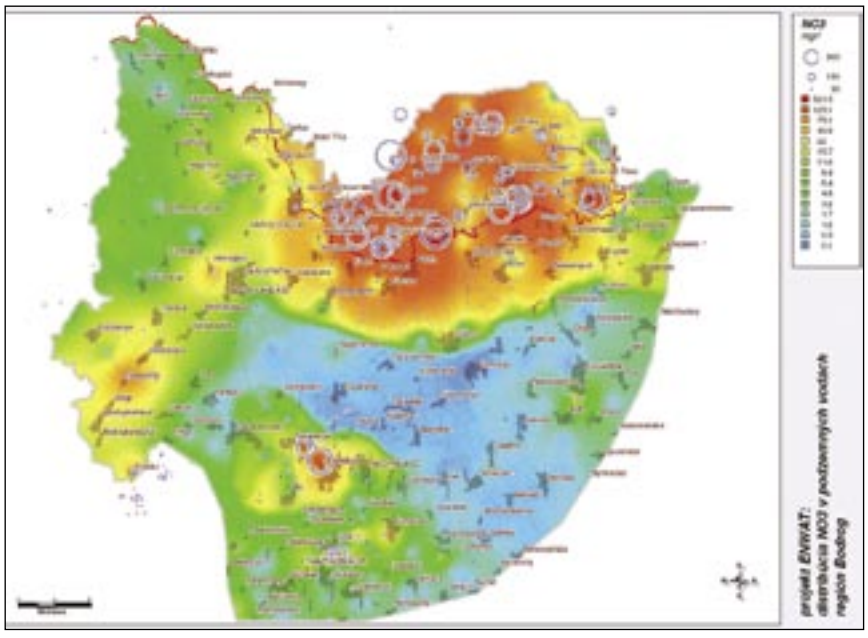


Figure 3. Distribution of nitrates in groundwater in Bodrog / Bodrogköz - Rétköz region. (Not valid inside the settlements)

Groundwaters mostly circulate in limestones and dolomites of the Mesozoic rock formation (Middle and Late Triassic). Ca-HCO_3 and Ca-Mg-HCO_3 dominate the groundwaters that are not affected by anthropogenic activities. The natural character of the groundwater circulation system conditions good qualitative properties of the groundwaters.

Most of the area consists of groundwaters of the best quality. These groundwaters fully meet the criteria determined for their use for drinking purposes. In most cases, concentrations of trace elements are very low and mostly below quantifiable limits . Anthropogenic contamination was documented only rarely, usually close to settlements. It was mostly indicated by higher contents of nitrates, chlorides, sulphates, chemical oxygen demand, potassium. High iron and manganese can be found at the adjoining Tertiary artesian aquifers with reductive conditions.

Water management

In the Aggtelek - Slovak karst area, the chemical status of groundwater can be considered to be good, but future climate change may increase extreme hydrological events. In the worst scenario, higher and more rapid flood peaks will set pressures to water channels by erosion while drought periods damage the ecology of the fragile karst area and thus chances for ecoturism. A significant threat in this poor part of Slovakia and Hungary is the uncontrolled land use and building on flood-prone areas. Rehabilitation and creation of wetlands provides water storage and prevention of basal erosion in flow channels as well as cost-efficient measures to reduce local nitrate problems and eutrophication of surface water (e.g. by constructed wetlands).

Bodrog region

At the common eastern border of Slovakia and Hungary, the alluvial aquifer system corresponding to the Bodrog River catchment area in Slovakia and the Tisza-valley between Záhony and Tokaj (confluence with the Bodrog River) has been selected as being important due to (i) its significance in meeting the water demand of the region, (ii) contamination threat of the groundwater in the vicinity of the state border between Slovakia and Hungary. Some part of the aquifer system is in Ukraine.

The aquifer is the alluvial deposit of the Bodrog River and its tributaries. The Tisza divides the lowland area in Hungary into Bodrogköz (northern part) and Rétköz (southern part). Holocene silty-clayey layers cover the surface with peaty areas. The Quaternary aquifer is around 60 m thick in the Slovakian side and its thickness gradually increases in Hungary towards the South (50 - 200 m). The fluvial sediments (from sandy gravels in the North to sands is the South with intercalated silt and clay lenses) can be characterized by 5 - 30 m/d hydraulic conductivity.

In the Slovakian part, only the Quaternary aquifer system is part of the transboundary water body-complex while in Hungary the Upper part of the Pannonian formation is also attached (depth is app. 500 m, corresponding to water temperature less than 30 °C). The horizontal extension of the water body in the Slovak side is 1466 km^2, while in Hungary the two water bodies cover an area of 1300 km^2.

The main recharge area is in Slovakian territory, and partly in the Tokaj Mountains. The rain waters infiltrate at the marginal mountains and penetrate into permeable deep aquifers. In the upstream part of the catchment area surface waters also contribute to the recharge.

Groundwater model

The results of the model created for the area of the Bodrog basin and its catchments are as follows:

The main recharge areas are situated to the south of the Bodrog region, from where the effectively infiltrating water forming the regional flow system migrates toward the central region of the basin.

The Tokaj Mountains to the west are a significant recharge area as well, where water flows through the weathered, fissured vulcanic rocks or in the alluvial sediments of the streams and reaches the basin deposits, where it is discharged into the Bodrog-valley and the west side of Bodrogköz.

The regional discharge-factor is the groundwater evapotranspiration in the Bodrogköz and Rétköz regions, while along the Tisza River a line-discharge is subsidiary.

At present there are no adverse effects of the groundwater abstraction on the dependent ecosystems, or on the safe yield of groundwater in both countries.

Hydrogeochemical results

Strong variability of groundwater chemical composition is characteristic for the Bodrog region. In respect of prevailing processes of chemical content formation, Ca-HCO_3 and Ca-Mg-HCO_3 dominate the groundwaters as the result of dissolution of carbonates and hydrolytical decomposition of silicate minerals. Groundwater qualitative properties reflect either the natural character of the area or significant addition of compounds due to anthropogenic activities. Anthropogenic contamination of groundwaters is mostly produced by agricultural activities and production of waste waters. It is mainly contamination of the uppermost groundwater horizons that occurs in the area.

High nitrate concentrations (> 50 mgl^{-1}) and very low contents of dissolved oxygen (less, than 5 mgl^{-1}) were documented in most groundwater samples (first aquifer

of the Slovak area). Moreover, high concentrations of chlorides, sulphates and phosphates or specific organic parameters (PAH, COD) and occassionally pesticides are also documented. The character of groundwater quality on the Hungarian side is different. Generally lower concentrations of nitrates, sulphates and chlorides and higher contents of iron, manganese, ammonium ions and in some cases arsenic were recorded. This is caused by the fact that groundwater analyses of Hungarian side represent relatively deeper aquifer horizons, in which anoxic conditions can be expected. Lack of dissolved oxygen usually in combination with high concentrations of iron, manganese and ammonia were quite frequently observed in groundwaters. In most cases, the concentrations of trace elements correspond with natural conditions of the groundwater circulation, i.e. their concentrations are very low. Locally higher concentrations of trace elements were reported only for aluminium, zinc and selenium.

Water management

The drainage basin of Bodrog is in a state of equilibrium but the chemical status of groundwater is strongly affected by human activities. In spite of lower average nitrate concentrations in Hungary, data includes high measured nitrate concentrations particularly in association with potential pollution sources such as rural settlements (Fig. 3). Increasing evaporation due to warming climate or changes in river dynamics can critically increase concentrations of dissolved components in shallow groundwater. Due to the relatively high TDS and Cl^- concentrations in shallow groundwater the future management of water resources should pay attention to the potential impacts of increasing evaporation in a warming climate.

Conclusions

The investigations indicated that there are local pollution problems and direct and indirect sources of hazardous pollutants that may also cause groundwater pollution in the future. Evidently, there is a need to continue the characterization of pollution spread and the risks for groundwater resources by more detailed sampling and modelling on both sides of the border. Joint coordination and implementation of such activities could provide logistical advantages, reduce overlapping activities and lead to savings in time and money. If not a prerequisite then at least a great benefit for integrated water resources management and successful implementation of the WFD, are the direct links and cooperation between regional and even municipal authorities and expert organizations. One of the underlying objectives of WFD is to create a common understanding of activities dealing with the transboundary water resources. Particularly in management of pollution cases and in crisis situations requiring fast response and actions, it is important that the cross-border authorities are familiar with exchanging information and communicating directly with their transboundary counterparts rather than using high-level representatives as middle-men without a good knowledge of the conditions in the field.

Details of ENWAT projects and complete results are available at: *http://www.enwat.eu* and on DVD available on request from: *dvd@enwat.eu*.

Submission of articles to European Geologist Magazine

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

Deadline for submission 30 March and 30 September.

Advertisements

Prices for advertisements

	One Insertion	Two Insertions
Full page (colour)	820 Euro	1320 Euro
Half page (colour)	420 Euro	670 Euro
Quarter page (colour)	220 Euro	350 Euro
Full page (black and white)	420 Euro	670 Euro
Half page (black and white)	220 Euro	350 Euro
Quarter page (black and white)	120 Euro	200 Euro
Business card size	90 Euro	150 Euro
Preferential location	25% plus	
Price for special pages:		
Outside back cover (colour)	1200 Euro	1900 Euro
Second page (colour)	1000 Euro	1600 Euro
Second last page (colour)	1000 Euro	1600 Euro

Data for European Geologist Magazine	
Number of issues printed:	6500
Periodicity:	2 times a year
Print mode:	Offset
Size:	A4 (210 mm x 297 mm)
Deadline:	30 March, 30 September.
Published:	30 May, 30 November
Advertisement delivered as computer file:	EPS, TIFF
For graphics remember to include fonts.	

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

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

Method of payment:

Invoice after publication

Subscription Rates: Annual subscription to the Magazine: 25 Euro

Contact:
Dr. Maureen Mc Corry
e-mail: Harper-mccorry@tele2adsl.dk
Tel: 0045 45831970

Solutions for Today's Environment

In June 2008, CSA Group Holdings Ltd. joined the SLR Group, an international consultancy with over 650 employees working from offices in the UK and North America. SLR Consulting (Ireland) has over 25 geoscience professionals based in Dublin.

SLR provides a full range of services in the following areas:

- Minerals & Mining
- Infrastructure/Geotechnics
- Competent Person/Independent Reporting
- Carbon Management
- Geothermal Energy
- Environmental Impact Studies
- Waste Management
- Strategic Planning/Valuations

To find out more, contact:

Deirdre Lewis
SLR Consulting (Ireland) Limited
7 Dundrum Business Park, Windy Arbour
Dundrum, Dublin 14
T: +353 1 296 4667
F: +353 1 296 4676
dlewis@slrconsulting.com

www.slrconsulting.com

1. Multilevel barrier
   Merdenson, Switzerland
2. Woody debris barrier
   Lobental, Germany
3. Multilevel barrier
   Milibach, Switzerland

How to protect people, infrastructure and property from debris flow events?

In comparison to rigid barriers, each flexible ring net barrier can stop as much as 1000m^3 of material derived from rocky torrents containing boulders, trees, and other vegetation, while allowing continued water flow; culverts are kept from clogging; roads and railway tracks can be kept open; property is protected from devastation.

The flexible ring net barriers filled with debris can be kept in place as check dam, erosion control of the riverbank or be cleaned out in preparation for subsequent events. In comparison to rigid barriers, ring net barriers are relatively inexpensive and easily installed.

Contact us in order to obtain more information and to discuss your natural hazard problems with one of our specialists.

GEOBRUGG®

Geobrugg AG
Protection Systems
Hofstrasse 55 • CH-8590 Romanshorn
Tel. +41 71 466 81 55
Fax +41 71 466 81 50
info@geobrugg.com
www.geobrugg.com

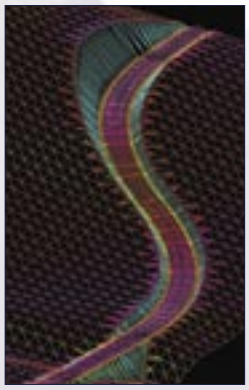
It's Not Just Software...
It's RockWare.

For Over 24 Years.

QuickSurf™

Fast, Powerful, Surface Modeling System for AutoCAD

- Runs inside of AutoCAD 2006-2008
- Converts surface mapping data such as point or break line data into contours, grids, triangulated irregular networks (TIN), and triangulated grids
- Dozens of imports and exports
- Topography, slope analysis, thickness maps, volumes, visibility analysis, road design
- Profiles and sections along polyline paths



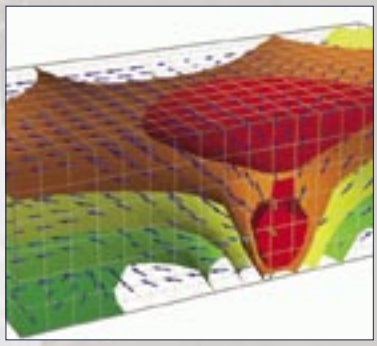
Free trial available at www.rockware.com.

$1,195 (USD)

PetraSim™

A Preprocessor and Postprocessor for TOUGH2, T2VOC, TMVOC & TOUGHREACT, TOUGH-FX/HYDRATE, and TETRAD

- Model multi-component fluid flow, heat transfer and reactive transport process
- Saturated and unsaturated conditions
- Fractured and porous media
- Mesh generation, parameter definition, and display of results

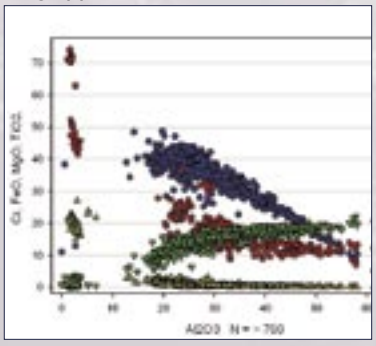


Call for pricing

DeltaGraph™

The Most Comprehensive Charting Application Available

- Analyze, visualize and customize your numbers efficiently with high quality output
- Formula Builder with 50 mathematical/statistical functions
- Curve fitting with advanced regression tools
- Over 80 different chart types and 200 different styles
- High quality screen and printer output



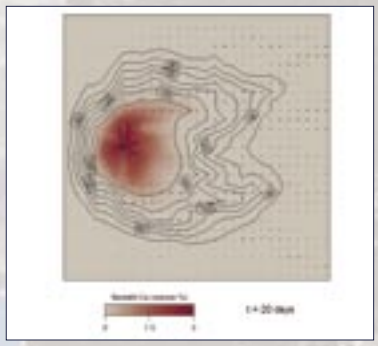
Free trial available at www.rockware.com.

$295 (USD)

The Geochemist's Workbench™

GWB is the premiere software solution for simulation of:

- Scaling
- Souring
- Flooding
- Formation damage
- Frac jobs
- Fluid compatibility



GWB Professional
1D/2D Reactive Transport Modeling

$7,999 (USD)

GWB Standard
Reaction Path Modeling

$3,499 (USD)

The Geochemist's Workbench® is a registered trademark of the University of Illinois.

RockWare®

Since 1983

RockWare.com

European Sales
++41 91 967 52 53 • F++41 91 967 55 50
europe@rockware.com

US Sales
303.278.3534 • F: 303. 278.4099
sales@rockware.com