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Foreword

EFG 2003: a year of consolidation and delivery

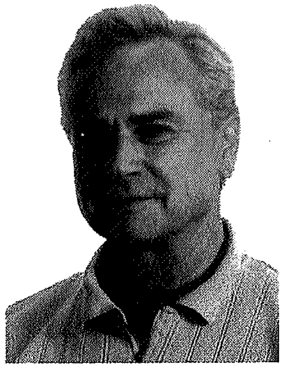
by EurGeol. Christer Åkerman, President

The year 2003 has seen EFG taking a big step forward in establishing itself. An increased level of activity in Brussels has resulted in developing contacts with European Commission officials. Responding in a timely manner has demonstrated the resources of the Federation.

Through the Office and the EU Delegate, EFG has continued to promote the value of the European Geologist title by means of participating in a number of meetings, responding to questionnaires, and producing comments and advice documents submitted to the European Commission and Parliament. EFG has responded to a number of invitations by replying to relevant questions, as posed by the Commission. The importance of geology on a range of issues has been stressed at various meetings within DG Environment. The majority of the contacts have concerned Directorate-Generals Environment, Enterprise, Education and Internal Market. Advice documents have been presented on Environmental Impact Assessment, European Research Policy, Civil Protection and Natural Hazards, Mine Waste Directive and Regulation of the Liberal Professions.

The main theme of our presentations has been to promote the title as a Common Platform in line with the intentions of the Draft Directive on Professional Titles, published by the European Commission in 2002. This includes the importance of the involvement of Competent or Qualified Persons in decision-making.

As part of the EFG mission to improve mobility for and recognition of geologists within Europe we have continued to focus on the draft Directive on Recognition of Professional Qualifications, and contact has been maintained with the Commission with the aim of submitting an application for recognition of the EurGeol. title. As this Directive will be part of the Irish Presidency of the EU, the EFG has written to the Irish Department of Education and Science stressing the importance of the legislation and our support for the Common Platform concept.



If the EurGeol. title is supported as a Common Platform, the Commission will issue a recommendation to all member states that possession of the title should mean that compensation measures are not required in order to get recognition in a member state.

Through the Secretary General, EFG has participated as an observer in a working group within the professional associations that represent ground engineering. There is a need to prepare a statement of the competencies and qualifications required to practise as Engineering Geologists and Geotechnical Engineers. The intention is to present to the European Parliament a broad dossier, building on the existing EFG draft dossier, and signed by the presidents of the involved Learned Societies and professional associations.

EFG had a stand and a lecturer at Green Week in Brussels. Our presentations were received very positively. The theme for Green Week is set by DG Environment and in 2003 it was to be based around water, climate change and natural hazards. The images that we used for the stand illustrated the reason why geology is so important in identifying and understanding the risks and in defining mitigation measures. The issues treated were groundwater (pollution and protection, and sustainable use), volcanic eruption and earthquake hazards, land subsidence and landslides, flooding and coastal erosion.

Colleagues and friends, we are gaining ground!

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

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Mesozoic, Cretaceous sandstones. North Bohemian Adršpach Rockies (rocky town). Area with high frequency of rock deformation

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Engineering geologists: a Hong Kong perspective

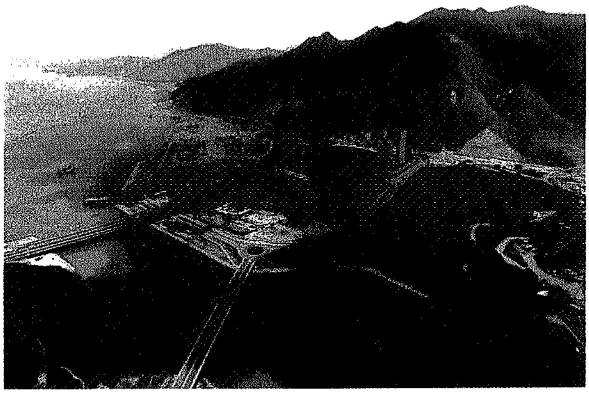
by EurGeol. Steve Parry[1]

Engineering geologists have played a small, albeit significant role in the development of the geotechnical profession in Hong Kong. However, there is a concern that this role may be restricted in the future. In May 1990, the Engineers Registration Ordinance was introduced at the instigation of the Hong Kong Institute of Engineers (HKIE), with the designation "Registered Professional Engineer (Geotechnical)" (RPE(G)). Whilst currently there is no statutory role for RPE(G) there is a proposal for this to be enacted in order that RPE(G) can undertake certain statuary functions (Massey, 2001). In the interim, Government uses RPE(G) as a benchmark qualification. As a result there is now an increasing tendency to employ only RPE(G) for most roles of responsibility in the geotechnical profession.

Geotechnical practitioners in Hong Kong and professional institutes

The Geotechnical Discipline of the Hong Kong Institution of Engineers (HKIE) looks after the professional interests of geotechnical engineers in Hong Kong. There is no Hong Kong professional institution for either engineering geologists or geologists.

The HKIE was originally created as a qualifying body for both geotechnical engineers (GE) and engineering geologists (EG). At the time of application, candidates were required to make a declaration of competence as either GE or EG and were assessed accordingly. Those declaring competence as a GE were assessed against a standard equivalent to Chartered Engineer (UK), those declaring competency as an EG were not. Subsequently, almost all persons admitted to the Geotechnical Discipline, including those with an earth science background, declared competency as, and were qualified as, GEs. In 1996, Hong Kong joined the Washington Accord and the Qualifications and Membership Board of the HKIE required that registrants must hold a degree equivalent which satisfies the Washington Accord Guidelines for First Engineering Degrees. The HKIE position is that they have no objection to continue qualifying applicants with an earth science background but they must seek qualification as engineers and undergo professional assessments as engineers. This, combined with only a small number declaring competency as and being qualified as engineering geologists, meant that this route fell into disuse. The HKIE are currently not willing to qualify in professions other than engineering.



However, since the early 1990s the demand for engineering geologists in Hong Kong has increased. The reasons for this are twofold; the raising of standards by Government in the ground investigation industry, and the increase in geotechnical work associated with the planning and construction of Hong Kong's new international airport and associated infrastructure. At that time there were no local geology degrees, consequently engineering geologists were either expatriates or Hong Kong residents who had trained overseas. As a result, a large number of engineering geologists employed by UK placement companies were seconded to ground investigation companies in Hong Kong. On completion of their contracts, many stayed in Hong Kong, often moving to consulting companies.

To add to this growing number, in 1993 the University of Hong Kong established the Department of Earth Sciences which produced its first earth science graduates in 1996. The course includes final year units in a number of engineering geology subjects. The majority of these graduates are employed in construction or construction related activities in Hong Kong. However, it has been noted that "their careers will be limited by their lack of numeracy and poor general education in civil engineering disciplines. Therefore they will not contribute greatly to Hong Kong's pool of geotechnical human resources in the long term" (Lovegrove, 1996).

As a result of the above, an increasing number of engineering geologists have joined the Hong Kong Branch of the Institute of Materials, Minerals and Mining (IMMM) (the local Branch mainly comprises engineering geologists), with membership increasing from 54 in 1993 to 103 in 1998 and is now over 200. IMMM Members can also apply for Chartered Engineer status through the UK Engineering Council.

In June 2001, a regional group of the Geological Society of London (GSL) was established in Hong Kong. There are some 230 Fellows in Hong Kong of which approximately 50 are Chartered Geologists (CGeol).

Training

In December 1985, the Geotechnical Engineering Office (GEO) of the Civil Engineering Department of the Hong Kong SAR Government began a training scheme for engineering geologists approved by the IMMM, the GSL and HKIE. This was for many years the only formal training scheme for engineering geologists in Hong Kong but recently a Consulting company and a Contractor have established similar schemes. Since the availability of local earth science graduates, the GEO has recruited 2 or 3 graduates each year. In comparison to the HKIE training scheme for geotechnical engineers, under which private companies receive a government training subsidy of US$1300 per month for each graduate on the training scheme, there is no financial

[1]CGeol., MIMMM, CEng. President of the Hong Kong Branch of the Institute of Materials, Minerals and Mining

incentive available for training engineering geologists.

Role of Engineering Geologists in Hong Kong

A survey of employers carried out by Martin et al. in 1996 found that the main activities of engineering geologists in Hong Kong, ranked in descending order were, supervising ground investigation (GI), managing GI contracts, mapping/appraising ground conditions during excavation, carrying out engineering planning feasibility studies, planning/designing GIs, project management and geotechnical design. The survey also noted that persons with a first degree in an earth science related subject and holding a position of responsibility were 183, or about 15%, of the total number of professionals engaged in geotechnical practice. Of these 28, or 15%, were employed by Government. However, if one considered those with a professional qualification (MIMMM+CEng, CGeol or MHKIE) this dropped to 38, of which 23 or some 60% were employed by Government. In a subsequent review of the role of geologists in slope engineering, Martin (2000) considered that there had been little change in either the work carried out or its ranking. What he considered had changed was the more frequent use of broad-based input by experienced engineering geologists functioning as project engineers and dealing with the normal spectrum of geotechnical practice.

One additional area in which engineering geologists have taken an increasing role in the last few years is that of natural terrain hazard studies (NTHS) in particular with respect to landslide hazards. Recent government guidelines (Ng et al., 2002) note that "Given the nature of the work involved, a multi-skilled team is normally required to undertake a NTHS. Engineering geological expertise is needed for aerial photograph interpretation, engineering geological mapping, interpretation of geological data, and development of geological and geomorphological models. Geotechnical expertise is required for analysis of engineering data, assessment of slope stability and design of mitigation measures. Some tasks such as determination of the design event and development of mitigation strategy would be best carried out jointly by engineering geologists and geotechnical engineers".

Current Status

Whilst the IMMM and the GSL are both active in Hong Kong and many engineering geologists are members of both, the Government has stated that they are unwilling to accept overseas qualifications for the purpose of establishing a local registration of engineering geologists (Massey, 2001). Yet paradoxically, the GEO accepts both CGeol and MIMMM as proof of eligibility for employment of earth science graduates to professional grade, subject to interview.

Future of Engineering Geology in Hong Kong

There is an increasing realization that the engineering geology profession needs to ensure a continuing role for engineering geologists in Hong Kong as well as urgently addressing the problem of registration and licensing. Professor Malone of the Department of Earth Sciences, Hong Kong University, summing up at the IMMM Engineering Geology Conference in 2000 (reported in Parry, 2001), expressed concern over the extent of inexpert engineering geological practice by geotechnical engineers. The IMMM Branch in Hong Kong considered both the establishment of an engineering geologist "list" and/or pursuing registration of engineering geologists possibly modelled on RPE(G). After considerable debate it has been decided to adopt a "List" at this time defining Branch members with engineering geological skills, and not directly linking this to a definition of an engineering geologist. The scope and content of this List has now been agreed and has been placed on the Branch web site (www.iom3.org.hk).

The IMMM believes however that an industry-wide definition of what constitutes an engineering geologist in Hong Kong would be beneficial. In geotechnical control and guidance documents in Hong Kong, an "Engineering Geologist" is considered to be an appropriate person to carry out specific tasks. However there is no agreement on how this person is defined. Consequently the IMMM has recently proposed a specification for its members based on the range of duties and requirements as they apply to Hong Kong for the purpose of discussion in the industry.

An Engineering Geologist is a geologist with appropriate engineering training and responsible experience.

A Geologist is a person who has obtained an initial degree in geological sciences.

Engineering training in Hong Kong is normally by means of a second degree with significant engineering content e.g. MSc in Engineering Geology. Alternatively professional experience can be verified by a professional engineering qualification such as Chartered Engineer.

Responsible experience should be gained in the application of engineering geological skills to civil and geotechnical engineering and should be confirmed by a relevant professional qualification such as MIMMM.

This definition has purposely avoided the need for extensive review or a professional interview and has been designed to allow its adoption by other organizations in Hong Kong with engineering geologists as members.

Ultimately a local professional body representing geologists and engineering geologists may be the best way forward for the profession in Hong Kong. Discussions have recently commenced between the GSL, IMMM and the Geological Society of Hong Kong, a local learned society, to explore this possibility.

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Academic geology in the UK: a matter for grave concern

by Euan Clarkson[1]

Teaching Earth Sciences at university level is not cheap, any more than is any other science. One requires academic, administrative and technical staff, microscopes, thin sections, collections of rocks, minerals and fossils, and books and journals. Research, especially in some fields, can likewise be very expensive. When, in the era of Margaret Thatcher, university spending began to be more intensively scrutinized, the 'value-for-money' ethos prevailed as never before, and continues to prevail now. One obvious driver for change was an attempt to limit public expenditure, yet at the same time UK science was expected to continue at a world-wide level of excellence. Earth Science in the UK was a relatively small and compact area, and this field was selected as a pilot scheme for cost-cutting, and if successful, to be applied later to the larger areas of physics, chemistry, and biology.

At that time, the universities had a bad press. There was a prevalent myth that academics were arrogant but lazy, clever, but disinclined to do any real work, and indeed there were a few like that. Academia was seen by many to be in need of a good shake-up. In the mid 1980s there were 33 university Earth Science departments in the UK. In most, if not all of these, competent research was undertaken, teaching was adequate to excellent, and the vast majority of students felt that they had been well served. There was never enough money, of course, where expensive equipment was required, such as in geophysics, geochemistry, and experimental petrology, and there were always complaints about underfunding. At this time student numbers were high but not too high, and retrospectively it was a halcyon time.

[1]Professor Emeritus of Palaeontology in the University of Edinburgh, where he worked for 40 years. Author of 'Invertebrate Palaeontology and Evolution' (four editions) and over 100 original research publications. He is continuing his research work on trilobites and Scottish Lower Palaeozoic geology and fossils

Change

In May 1987 there was published the Oxburgh Report, euphemistically entitled 'Strengthening Earth Science' which had been commissioned by the Thatcher Government to find ways of reducing expenditure, while retaining the integrity, as it was seen, of Earth Science in the UK. Professor Ronald Oxburgh and his team were of the opinion that there were too many university departments. The butter, (i.e. the funding) was spread too thinly over too many slices of bread. If the number of slices of bread were reduced, there would be enough butter for all the remaining pieces, and some might have jam on them as well. At this stage the idea of "research universities" was very much in favour amongst many Government officials and some senior academics as well. It is eminently reasonable to concentrate highly expensive equipment in a relatively few research centres, but there are other kinds of research which do not require such expenditure, and Oxburgh largely discounted these. In many departments essential subject areas such as palaeontology may be taught by only one or two members of staff alone. Such people may work alone or may belong to looser research groupings, spread across several universities, and countries. Such groups are worthy of financial support. But such less defined federations do not seem to have been of great concern to Oxburgh, nor the fact that most academics successfully combine teaching and research. Very often the enthusiasm for research work spills over into teaching and vice versa. The authors of 'Strengthening Earth Science' were not alone in undervaluing such people, and their research. I remember very well hearing one senior Oxford scholar, a vigorous proponent of the "research universities" concept, advising that he was not trying to stop other people researching, but only depriving them of the funds which would enable them to carry it out. There may be some logic here, but I fail to see it.

The fall-out

Having set up this scheme, Oxburgh himself did not participate any further. But clearly, in order to achieve the dream of a few major research universities, other Departments in the UK were to be sacrificed. Accordingly a team of senior investigators was sent round the different universities asking such loaded questions as 'How many of the staff of your Department, Professor, are likely to be Fellows of the Royal Society within five years'. The hatchets were out. It became very obvious that some Departments would be closed or downgraded. And indeed they were. There was not much wrong with the Departments that were closed; most were excellent centres of teaching, and some fine research was done therein. The students, a category largely unconsidered by Oxburgh, were on the whole very happy with the quality of education they had received. What happened to the collections, libraries, and equipment, accumulated over longer periods of time, I have no idea. For the staff of these university Departments, life was very hard, the disruption, uncertainty about finding other positions, loss of research time and facilities, improved morale for nobody. The departments at Dundee, Newcastle upon Tyne, Hull, Sheffield, Nottingham, Swansea, Exeter, eventually Belfast were closed, or in some cases a few staff remained to provide first-year service courses only. Others lost staff. Glasgow and Strathclyde were amalgamated, as were Birmingham and Aston. Reading became an institution for sedimentary research and is now closed. And so it went on. Of those that remained some would become the major research centres, replete with synergy. In these, research resources were to be concentrated in 'well-found laboratories', to use Oxburgh's somewhat archaic phrase. These were to be the powerhouses of UK Earth Science, with large groups undertaking properly-funded research. Such Departments as were not favoured in this way were told that they had to strive for 'excellence in teaching' which is what most of them did already. The UK Earth Science community did not like it at all. It was seen as a destructive, and insensitive imposition. And rather than strengthening Earth Science, it actually weakened it. Oxburgh's draconian measures reduced the number of university geology Departments from 33 to 22. There were, however, several polytechnics which had small but active geology Departments. These lay outside Oxburgh's remit, and they were not considered. They continued as before. And then, quite unconnectedly, an entirely different Government committee recommended that all polytechnics should become universities; the former polytechnics became universities, and there were instantly 39 "university" geology Departments as there had been before the Oxburgh Report. What had happened was that many perfectly good departments disappeared for ever, and were simply replaced by others, some less well equipped for teaching and research. Did not this invalidate one of the key points of the Oxburgh Report? Many would think so. In this and other respects the basic provisions of this wasteful, divisive, expensive, morale-sapping, and destructive report were either ignored or overtaken by events. It is significant that the larger areas of science, physics, chemistry, biology, and engineering, for which the Oxburgh Report was supposed to act as a template, never adopted it. The remembered legacy of Oxburgh, for Earth Sciences in the UK is the closure of many fine Departments. And with it a diminished opportunity for learning. More seriously, however, UK Earth Science had become very vulnerable, and there was more to come.

Further changes

In the later 1980s and 1990s student numbers continued to increase dramatically, yet there was no corresponding increase in funds available to teach them, nor in staff numbers. But then there was initiated a new twin system for evaluation of effectiveness, Teaching Quality Assessment (TQA), and Research Assessment Exercise (RAE). Heads of Departments were invited to submit a substantial report upon all research activity in their institute. This task was often delegated to one member of the Department, and it would take months to complete, to the detriment of that individual's research activity. The one positive thing here was that all research activity was seen to count, and not just that of the powerful groups. So there was even more of a scrabble to obtain research funds than before. The departmental research profile was then evaluated by a team of external assessors and ranked on a scale of 5 (good) to 1 (bad). TQA was conducted in a similar fashion, but usually a few students were interviewed as part of the process. Some Departments had been reduced to a few staff only following Oxburgh. In these, however good those that remained were as teachers, there was no way in which they could compete against the larger departments. There has been further contraction in some places and threats of closure. More waste, more divisiveness, more demoralization. But now, finally, there has been a grudging admission from the Research Councils that the RAE has not worked perfectly, and that the whole concept needs to be re-assessed.

What was achieved?

Was this endless reorganization, so detrimental to time spent in the real duties of an academic, really necessary? Was it not ultimately ineffective, as well as demoralizing and destructive? Such is my own view. But one may ask why it was considered necessary by the politicians in the first place? If there is one reason that could be singled out it would be lack of trust; the belief that the universities were not delivering value-for-money. I doubt if any of the Earth Science Departments of fifteen to twenty years ago were necessarily ideal. Yet they were happy places. Each person on the staff, with the occasional exception, which everybody knew about, was trusted to do their job, and they did it, usually with dedication and enthusiasm. But ultimately, it was the politicians' lack of trust, as well as financial constraints, which led to Oxburgh, TQA, RAE, and all the present mess. And of course, the students, ultimately the customers, were never asked for their opinion. They simply inherited a new and imposed system. At present, staff are more valued, and more likely to be promoted, according to the amount of research money they bring to their Departments, rather than for scholarship, teaching prowess, or publications. And larger groups are likely to pull in more funding. Accordingly many Earth Science Departments are being amalgamated into larger Schools, along with Geography, Meteorology, Geophysics and sometimes other subjects. The aim was to encourage major co-operative ventures, well-supported financially, especially in areas favoured by the Government's scientific advisors, such as global change and environmental geoscience. But geo-shotgun weddings such as this do not always facilitate the co-operation that they are supposed to do. Most people choose their own research partners, after all. One cannot force co-operation. Whether these giant and potentially impersonal Schools are ideal learning environments is open to debate.

Edinburgh

In my own former department at Edinburgh there is now the largest school of Geosciences in the UK. There are 73 academic staff, 68 research staff, 39 support staff, 228 postgraduates, and 1056 undergraduates. There are three Institutes, the Grant Institute of Earth Sciences, the Institute of Atmospheric and Environmental Science and the Institute of Geography. There are four major 'cross-disciplinary' research groups, Global Change, Subsurface Earth, Human Geography, and Edinburgh Earth Observatory, with Maths and Physics in the geosciences. In addition there is the Centre for Study of Environmental Change and Sustainability. Now this is very fine, and it is right and proper that such new disciplines should be developed. But where is the geology? It is increasingly less evident, and likely to be submerged and to lose its identity within the School. My fear is the erosion of the traditional hard disciplines of mineralogy, petrology, palaeontology, structural geology, and field mapping; science being replaced by soundbytes, proper training replaced by what is usually termed arm-waving. There are fewer and fewer staff who can run field trips, and as the older staff retire, and are not replaced who will be able to teach the core disciplines? Instead of our graduate geologists being firmly rooted in hard science, like a forest of strong trees, the graduate landscape will be more like scrubland with tumbleweed. Will these graduates then be employable? With the end of traditional geology in sight in my former Department, I doubt whether in ten years time we shall be able to offer a viable degree course in geological science. It is a chilling prospect.

Dinosaur track sites of the Iberian Peninsula proposed as World Natural Heritage Sites

by Prof. Félix Pérez-Lorente[1]

Dinosaur track sites of the Iberian Peninsula (idpi) are a natural heritage which contain series of fossilized dinosaur tracks. Dinosaur prints represent the mark on the ground made by some part of the anatomy of these animals. Their importance lies in the fact that fossil prints are not organic remains, but rather the remains of activity left behind by the most important group of the Mesozoic vertebrates. Tracks not only record the features of the feet that created them (toes, claws, pads, ... and other characters), but also show how the animals moved and the physical characteristics of the mud on which they stepped.

The everyday activity of the dinosaur, together with environmental conditions, are responsible for the formation, conservation and fossilization of the tracks. Therefore each track is unique and, while not all tracks provide the same information, each adds to our knowledge of the animal and its environment. Each site is a unique association of different footprints in a specific habitat. All palaeontological sites and generally all ancient geological processes are unique and irreplaceable. However, the "non-renewable asset" characteristic of dinosaur tracks in the Iberian Peninsula is greater because almost all types of site and track are found here, along with most of the sedimentary record of the Mesozoic.

Dinosaurs did not leave footprints everywhere they went. It is, however, more likely that some of the thousands of tracks made by a dinosaur during its lifetime will remain than it is for all or part of the dinosaur's skeleton to be conserved. Tracks are the only fossil element shared by the majority of dinosaurs. The impression, preservation, and covering process required the site to have all the sedimentary, palaeogeographic and palaeoenvironmental characteristics to allow production of the imprint, conservation (no erosion), hardening, burial and fossilization.

The feet of many of these animals leave signs that allow us to discover features that cannot be deduced from fossils. For example, prints have been found with the impression of interdigital webs which could not fossilize because they do not contain hard parts. Other tracks conserve the marks of skin structures, toe pads, claws and round nails.

Dinosaurs left a series of tracks creating trails or trackways. These provide elements from which we can extract information about the movement of parts of the foot and limbs and the type of gait with which the animal walked. These elements are summarized as follows: i) the height of the limb of the animal and, consequently, other biometric data; ii) the relative thinness or thickness of the limbs; iii) articulation of the limbs; iv) the arrangement and assembly of limb bones; v) injuries to the foot or limbs; vi) implications of anomalous impressions (for example tail prints); vii) arrangement of the dinosaur's body; viii) speed and gait; ix) swing ability, hopping; x) variation in the hardness of the terrain and the depth of the water ...

Therapod tracks

Ornithopod tracks

The idpi contain examples providing valuable information about the behaviour of the dinosaurs. Analysis of the idpi sites revealed the following: i) evidence of herds (sauropods and ornithopods); ii) coexistence of more ichnotaxa on the same site; iii) large and sinusoidal trackways; iv) swimming dinosaurs; v) family behaviour; vi) hunting scene(?);vii) accumulations of footprints conditioned by a natural barrier.

The idpi also contains:

i) The majority of existing types of dinosaur tracks. These include small tridactyl prints measuring just 4-5 cm in length attributed to bipedal dinosaurs; large tracks (1500 cm) produced by enormous sauropods; and intermediate prints (up to 85 cm long) left by medium and large theropods and ornithopod. More than 15000 prints have been examined.

ii) The largest number of trackways, particularly in the Cuenca de Cameros and south of the Pyrenees. There are more than 1000 dinosaur trackways (one trackway contains a minimum of 3 suitable prints).

iii) The largest number of semiplantigrade trackways, where the dinosaur walked on the metatarsus as well as the toes.

The dinosaur track sites referred to in this document are located in the NE Iberian Peninsula, in the Cantabrian-Pyrenees Mountains and the Iberian Mountain Range with some also in the Asturias, at the coast. Fossilized footprints are concentrated in the following Autonomous Communities and geological periods: Asturias (Jurassic); Castilla-Leon (Triassic-Lower Cretaceous); La Rioja (Upper Jurassic-Lower Cretaceous); Aragon (Upper Jurassic-Upper Cretaceous); Catalonian (Upper Cretaceous); Valencia (Middle ? Triassic-Upper Cretaceous)

Almost all types of dinosaur footprints are well represented in all of the autonomous communities, although each contains exclusive elements. Bones are also found in these sites. Areas containing fossil remains of egg and even nests have been well documented, and the number of sites is increasing (Catalonian, Castilla y León, La Rioja).

The discoveries continue and, year after year, almost all of the communities incorporate new sites containing prints and provide scientists with new information. The cultural awareness campaigns and inherent projects also go on, as evidenced by this continued activity. The most obvious example of this is the opening of centres for the study, diffusion and cultural and tourist benefit of this scientific heritage.

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European Federation of Geologists in the European Parliament: prevention and management of natural and technological risks in Europe

by EurGeol. Dr. Isabel Fernandez Fuentes and Ana Pazos Pozuelo

On 23 March, a Public Hearing was held at the European Parliament on 'Prevention and Management of Natural and Technological Risks in Europe'. This event was a good opportunity for the EFG to promote the profession and practice of geology in preventing and managing natural risks.

EFG was invited by the EC to contribute in the session on 'Prevention and early warning of natural and technological risks' by means of a presentation on 'Risk Mapping: Critical factors - Land Use Planning: integrating risk management, environmental and economic considerations'.

Herald Ligtenberg, Coordinator of the EFG's GeoHazard Working Group, was assigned to represent the federation on this occasion. The presentation was well received, created interest and led to several questions from the participants. Geology had a good profile in this European Parliament event.

One of the more relevant issues for our profession was the prevention concept. Prudencio Perera, Director of Quality of Life - Health, Nature & Biodiversity, DG Environment of the European Commission is one of the most relevant persons in developing this concept in the European Environment Policy.

During the Public Hearing, he spoke about the communication from the European Commission to be presented on 25 March to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions: Reinforcing the Civil Protection Capacity of the European Union COM (2004) 200. The EFG Working Group on Natural Hazards will follow up this communication to further increase the prevention concept for natural risks.

Another important issue presented during this public hearing is a new Communication on Flooding Prevention, from the Directorate B, Unit 1 Water, Marine and Soil, that will be ready in June. The EFG Panel of Experts in Natural Hazards has offered its support to advise in this communication.

The importance of hazard mapping in Land Use Planning: an EFG contribution to the European Parliament

by Herald Ligtenberg, EFG coordinator of the Natural Hazards working group

The DG Environment of the European Commission is working on the setting up of a framework for an EU strategy on natural and technological risks. In February 2003, the EFG was invited to a consultation meeting of the EC on this topic. The EFG contributed, in April 2003, an extensive Advice Document (downloadable from the EFG-website), to provide useful background information to the EC and to emphasize the importance of Geology when taking preventive and mitigation measures against natural hazards.

Following this, the EFG decided to set up groups of experts on various relevant topics. The experts in the EFG Natural Hazards group are from National Geological Surveys, research institutes, universities, a UK working group on geo-hazards, Geologos del Mundo, GEOGI, International Centre for Geo-hazards, ITC (remote sensing specialists), and so on. By means of these groups of experts we are and have been able to provide a high quality response to the European Commission.

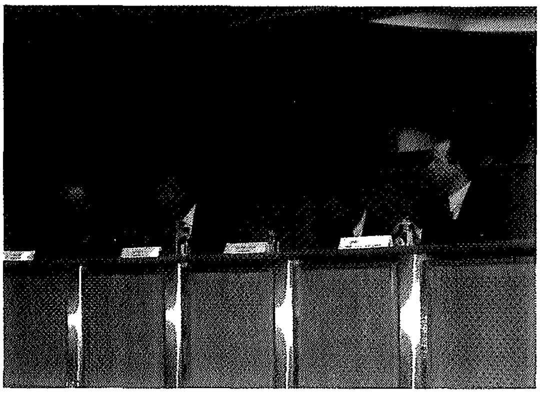
In autumn 2003, we contributed by replying to a questionnaire on hazard maps. As a result of active contributions by the EFG, we were invited by the EC as the only geo-organization to give a presentation at the European Parliament in a special conference on "Prevention and Management of Natural and Technological Risks in Europe", 23 March 2004.

A summary of the message that was presented at the European Parliament follows:

The observed increasing frequency of natural hazards, together with the increasing number of victims and significant impacts on socio-economic infrastructure requires urgent development of preventive and mitigation measures. The trend in increasing natural hazards is in part related to global climate change, but more important is population growth and increasing development of housing, industry and infra-structure within geo-hazardous areas.

It is essential that we gain a better understanding of the subsurface and of the underlying mechanisms causing natural hazards. This will provide a better insight into the problems and will lead to the best preventive measures. The initial objective should be the generation of hazard maps. Firstly, focus should be on those hazards with highest risk and greatest impact. These include floods, landslides and earthquakes.

Although floods may not create many victims, their impact on society is enormous. Accurate weather forecasting is of course a first priority, but a detailed understanding of the subsurface is vital.



Left to right: Simon Perry, Early-warning information systems; Jack Leslie, Chairman, WeberShandwick; Michael J. Lane, Industrial prevention and risk management system; Herald Ligtenberg, Coordinator EFG GeoHazard WG.

One illustration of this is the significant difference of water flow in areas where the soils behave as a sponge, compared to areas where rocks behave as a seal, where water is run off very quickly and flash floods may occur.

Landslides, like floods, have an enormous impact on society, often with many victims and a lot of damage to buildings and infrastructure. There are several important factors that influence landslides, including the occurrence of weak materials, shallow ground water and steep slope angles. All information on these and other factors should be fully integrated in hazard maps. These maps will then provide a good overview of high risk zones. Once these areas are located, preventive and mitigation measures can be taken.

Hazard maps are indispensable in earthquake-sensitive areas. They indicate locations of active faults and other high risk zones, e.g. areas of weak soils where major foundation problems are expected. These high risk areas should, as far as possible, be completely avoided in urban development. There is a need for strict legislation to prevent construction of houses, industrial plants and infrastructure in these geo-hazardous areas.

If we really want to decrease the impact of natural hazards on society, we will have to adapt ourselves to the environment. This can only be done if we really understand the subsurface. Hazard maps contain this information and are crucial in avoiding unnecessary risks. They are essential in land-use planning: 1) to avoid development in geo-hazardous areas; 2) to create or leave space for extreme natural events; 3) to guide preventive and mitigation measures in vulnerable areas; and 4) to provide critical information for effective evacuation and disaster recovery plans.

What should be kept in mind though is that hazard maps are not static but dynamic, due to continuous construction development by humans and variation in nature and climate. Therefore, hazard maps should continuously be updated and the condition of the subsurface in high-risk areas should regularly be investigated by geoscientists. Monitoring of high-risk areas by 'geo-indicators', functioning as early-warning systems, is recommended. Geo-indicators measure subtle changes in geological processes at or near the earth's surface that may be precursors of a larger natural event to come.

We have recommended to the EP and the EC, the establishment of a communication and advice platform for experts; generation of a standard-type of European multi-hazard map system; setting up of legislation for geoscientific investigations in land-use planning (before approval of plans); and continuous monitoring of hazardous areas with geo-indicators.

Following in Ardito Desio's footsteps: from the Karakorum to the Andes

by Giorgio Pasquaré[1] and Giovanni De Caterini[2], with the support of Carlo Enrico Bravi

The year 2004 marks a very important anniversary not only for mountaineers and geologists, but for all of us Italians: 50 years since the first climb on K2.

This venture was an extraordinary event for the Italian post-war period. The event received intense media coverage that led to the beginning of an era of a newly developed "heroic mythology" which millions of Italians, still eager for a redemption of national pride and suffering from post-war political and social separation, closely related to.

During those years after the dramatic chapter of World War Two, countries began again to aim at reaching the highest world mountain tops. Conquering the 8000 m peaks was tinted with some "nationalistic-parochial" hues.

In 1950, France won its first 8000 m peak – Anapurna. In 1953, Great Britain beat the world highest mountain top – Everest – and in the same year Hermann Buhl on a solitary climb finally freed the mountain – Nanga Parbat – from the Austrians and the Germans.

The second highest mountain top, K2, the most beautiful and it is said the most difficult, in the summer of 1953 was still resisting American onslaughts.

Italians considered K2 as their own mountain. Several scientific and climbing expeditions were dedicated to the big K2, starting in 1909 with the Duke of Abruzzi.

It was in 1954 that Ardito Desio, one of the greatest Italian geologists, with the support of the Prime Minister, De Gasperi, attempted the conquest. He organized and personally directed a huge expedition with both alpine and scientific aims.

Italian geologists remember the event mainly because it was thanks to him that the role of the geologist in Italy started to acquire some relevance, to the extent that he promoted the creation of the first Italian Geological Department at the State University of Milan – which is still named after him.

Ardito Desio was also one of the main promoters of the foundation of the National Geologist Association and one of the first to support the importance of geologists in applied sciences, especially in the engineering field.

Nowadays geologists are not so unusual in Italy or worldwide and the era of the heroic alpine expeditions and the fight against the mountain is over: times have changed. Now you can climb the Himalayas alpine style, with the support of relatively small expeditions. Even scientific expeditions have been scaled down, mainly because of poor economic resources.

Desio passed away in 2001 at the age of 104 after a long and intense life – almost two life-times considering that his publications covered 80 years of world-wide episodes. His spirit, enthusiasm and commitment continue to live through the association named after him, which has recently carried out an expedition with scientific and alpine goals in the area of Malargüe in the province of Mendoza, Argentina (Fig. 2).

Figure 1. K2

Alpine goals

One of the expedition's aims was to reach the tops of a group of virgin 4000 m peaks located on the 35th parallel, near the Atuel river, on the Chilean border.

As a commemorative gesture, the four peaks were named after Ardito Desio and some cities either very dear to him or currently actively involved with the association: Cerro Ardito Desio (4046 m),

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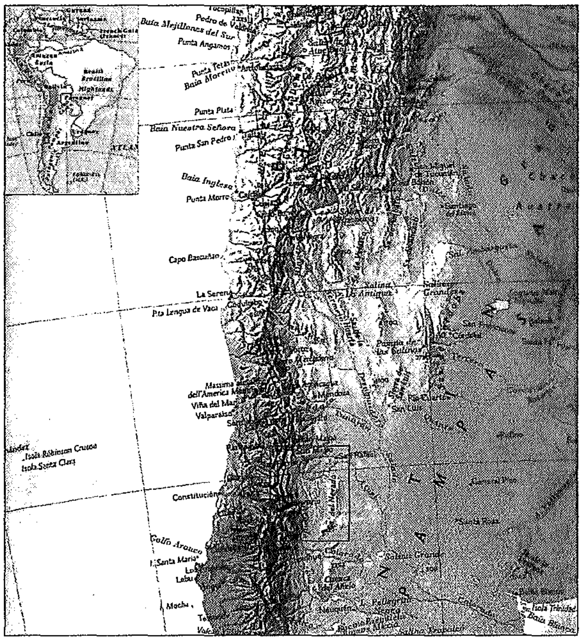


Figure 2. Location of expedition area

Cerro Milano (3960 m), Cerro Lausanne (3904 m) and Cerro Malargüe (3767 m).

The very welcome support given by the topographic surveys and the absolute measurements made by the geologist Alberto Rosselli (University of Lausanne, Switzerland) have triggered the formal procedure at the Argentinean National Geographical Institute for an official mountain-top naming ceremony.

Scientific goals

Scientific analysis was undertaken in several fields: geological, natural and human studies (geology, botany, topography and human geography). The experts involved were: Prof. Giorgio Pasquarè (head of the department – formerly Desio's chair – of Earth Sciences of the State University of Milan), Prof. Annibale Mottana (Roma 3, University of Rome and prestigious representative of the Foundation of the Accademia dei Lincei, Rome), the geologist Alberto Rosselli (Geophysics Institute of the Geosciences and Environment Faculty of the University of Lausanne, Switzerland), the geologist and researcher Giovanni De Caterini (as founder and representative of the tiny but very active Natural History Museum of the Peligna Mountain Community (Sulmona), Italy).

The research programmes were supported by the Malargüe City Council and the *Direccion de Resursos Naturales Renovables – Ministero de Ambiente y Obras Pùblicas del Gobierno de Mendoza* and embraced part of the Andes Cordillera and the volcanic area and natural reserve of the Payunia.

The scientific investigation focused on the geological structure of the Andes, both petrographically and geologically. The friable rocks, which caused a great deal of trouble to our climbers, belong to a formation mainly composed of red sandstone alternated with polygenic conglomerates made up of volcanic clasts, many very large. These were deposited on the slope of a large Jurassic volcano with intervals of lava flows and ignimbrites. Even if the stratigraphy appeared to be monotonous, recent mineralization forms, as well as the late-magmatic ones turned out to be far more interesting.

They can be found along the main faults, which run mostly N-S and E-W, and develop into some "flames" of material presumably mineralized by hydro-thermal phenomena where microscopic-sized copper, iron and sulphur oxides can be traced.

The exploration was supplemented by a geomorphological study on the climbed glaciers focusing on botanical analysis of pioneer plant types, in addition to a topographical survey carried out by state-of-the-art GPS systems which will be processed into basic cartography for the areas not yet covered by the Argentinean maps.

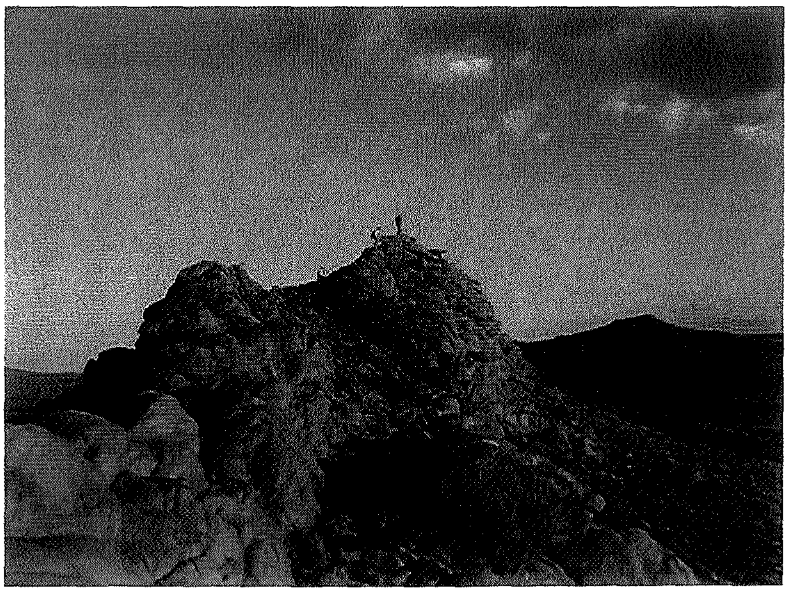
A geological study of the Payunia (Fig. 3), a wild and very interesting area, produced some unexpected results. This is indeed a natural scientific laboratory for volcanic research, protected as a Natural Reserve of the province of Mendoza. This area, a good 20,000 km^2 of desert land, is dotted with over 700 volcanoes of all shapes and sizes with very variable chemical compositions.

When framed in a geological contest, this shows that the Andes were subjected to diverse and opposing dynamic stress forces, as a response to radical and dramatic changes related to convergence of the Pacific and the South-American plates, the main cause of the uplift of the Andean chain.

The growth and evolution of the volcanoes mirrors the main stages of convergence when magma flows were derived from different parts of the Earth's crust and mantle.

During one of these phases, some long and deep lacerations opened, allowing the passage of large volumes of magma directly from deep within the mantle. The length of the flows extends up to 170 km from these fissures, one of the longest worldwide and perhaps unique in this kind of continental margin.

Figure 3. Payunia volcanic area



Fifth anniversary of the NGO World Geologists

by Angel Carbayo, President

As an introduction to the 2nd International Professional Geology Conference, World Geologists make a general analysis of the differences in the quality of life of 175 countries, the problems that this situation implies and the possible solutions. In this context, WG summarize the activities involving international cooperation that the NGO has carried out over the last five years.

Géologues du Monde présente à la 2e. Conférence Internationale de Géologie Professionnelle une analyse sur les différences de qualité de vie parmi 175 pays, sur la problématique impliquée et des possibles solutions. Dans ce cadre s'inscrivent les activités de coopération internationale de Géologues du Monde, dont un résumé est donné pour les dernières cinq années.

Como presentación a la 2ª Conferencia Internacional de Geología Profesional, Geólogos del Mundo realiza un análisis general sobre las diferencias de calidad de vida de 175 países, la problemática que ello plantea y las posibles soluciones. Y, dentro de este contexto, GM hace una síntesis de las actividades de cooperación internacional realizadas durante los cinco años de su existencia.

The use of geological knowledge in humanitarian projects: the NGO World Geologists. On 4th February 1999 a new NGO, World Geologists, was promoted by the Spanish Association of Geologists (ICOG) under the patronage of the European Federation of Geologists. Its main objective was to use the professional experience of geologists to improve man's welfare and to correct and/or mitigate the environmental threats affecting the Earth.

NGO World Geologists was introduced in this way by its former President, Juan Luis García Acedo, at the 1st International Professional Geology Conference held on 10-12 July, at the University of Alicante in Spain. And four years later, in 2004, at the time of its fifth anniversary and the 2nd International Professional Geology Conference to be held in London on 14-16 June, our NGO will be able to show good results in the pursuit of its goals, owing mainly to its connection with ICOG (Spanish Association of Geologists).

The global scene

In 2002, the UN developed a Human Development Index for 175 countries, calculated as an average of three factors; life expectancy; educational level; and GDP, pertaining to each country.

The result was that there is a group of 55 nations included in a high Human Development Index (wealthy nations), corresponding to Western Europe, North America, Australia and others. There is another group of 85 nations with a medium Human Development Index, which are essentially the South American, Asian, South African and North African nations. Finally, a third group of 35 countries have a low Human Development Index, 32 of which are located in Central Africa.

The differences in the quality of life –life expectancy, educational level and GDP- of the inhabitants of the nations included in the first group and those of the second and, especially, of the third group, are enormous and the distance grows as new technologies are developed and put into practice in the wealthier nations, reaching disadvantaged countries only marginally. Therefore, there is a very dangerous situation in the world because of a lack of solidarity, which could be untenable and that is already evident when swarms of immigrants try to get to rich countries looking for an improvement in their quality of life.

Solutions

This global view shows the necessity of increasing the cooperation from wealthy nations – by creating wealth in the more disadvantaged countries and contributing with properly targeted and monitored funds, in order to prevent those funds being diverted to corrupt Governments. Also, it is necessary to raise public awareness among the recipient communities about their responsibility for maintaining and continuing the projects.

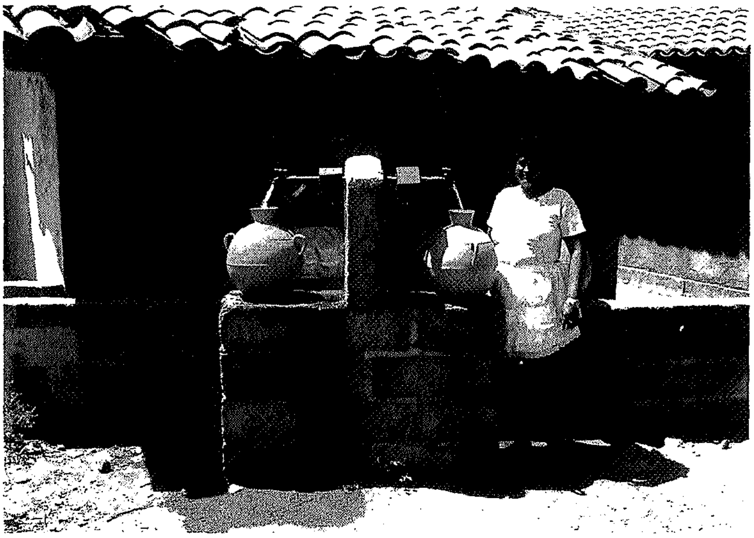
Part of the funds dedicated to this economic aid comes from public resources and is estimated to reach 0.7% of the national budget of wealthy countries. Another important source of funds comes from the private sector, from both companies and individuals. Increasing such contributions, which could be achieved by means of appropriate campaigns to raise public awareness, could reduce existing inequalities.

The so-called Third Sector, made up of Foundations and NGOs, is responsible for management of the international cooperation projects funded by the resources provided by its supporters. An environment of mutual trust is, therefore, necessary based on the ethics and the transparency of the administration of those funds, as well as the success achieved in the execution of the projects.

The role of WG

From a geological point of view, every country in each of the mentioned groups, faces a different set of geological risks. But it is evident that taking adequate measures in order to reduce such risks depends on the availability of economic resources, so the poorer countries, those from the second and third groups, are more vulnerable. The last group, in particular, suffers from serious annual droughts and easing them is a challenge for hydrogeologists.

World Geologists has carried out 24 projects of international cooperation during the last four years, in six countries from the second and third groups of the Human Development Index with a total of 40 geologists taking part. These projects have been carried out alone or in collaboration, while others have arisen in response to



Women with containers in Barrancones, El Salvador.

World Geologists' technicians in a village in Mali.

emergencies.

Funding from the European Union (DIPECHO) was obtained in 2001 in order to carry out the Project in risk management of the San Miguel Volcano, in El Salvador. The beginning of the project coincided with the big earthquakes that shook El Salvador on January 13th and February 13th, so WG itself was involved, with six geologists taking part in emergency activities.

Annual Geology Courses in two Universities in El Salvador began that same year (the subject is not taught in that country). The course continued during 2002 and 2003 with the collaboration of Cataluña Polytechnic University and Madrid Complutense University, among other organizations.

For the last two years, the number of our activities grew remarkably with a variety of projects in both Natural Risks Prevention and Underground Water Supply fields, so we have helped to solve some of the problems of nations such as El Salvador, Burkina Fasso and Mali, countries which lack the means to fight geological risks and droughts. All of this was possible thanks to the professional collaboration of tens of geologists, as well as funding from ICOG, from our partners and from other funding entities, mainly from the public sector, but with private participation too.

A number of projects is currently underway, concerning environmental impact related to tourism and mining, as well as a series of comprehensive geological projects which comprise several topics, specifically the management of geological risks and hydrogeology.

The number of people who have benefitted, both directly and indirectly, from the completed 24 projects totals approximately 300,000.

World Geologists was declared an Entity of Public Usefulness by the Spanish Domestic Affairs Minister in May, 2003.

Our NGO spread and raised public awareness about its activities by means of television and radio interviews, publications, lectures, seminars and exhibitions. Three annual lectures were given in the last three years during the Week of Science of the Community in Madrid.

In addition, ICOG was present on September 10, 2003 when HRM Prince Felipe was conferred with the title of Honorary Geologist. Prince Felipe was informed of the existence and international cooperation activities of WG, in which He showed great interest.

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Editors from Hell

by Stephen K. Donovan[1]

As geologists, we were taught the fundamentals of our chosen subject in lectures at university. Our knowledge base is further enriched by our own laboratory investigations, fieldwork, reading research papers and books, attending conferences and seminars, and in informal discussion with colleagues. However, there are many tasks and responsibilities that may fall to a scientist that do not come from an informed educational course, and thus are not based upon an initial broad knowledge base. We all do things that we've not been taught, usually willingly and competently, because such tasks form part of any active scientist's portfolio and we've picked up at least the rudiments more or less informally. For example, I have being presenting papers at conferences for over 20 years and taught for twelve and a half years in a university, yet have never received any formal instruction on how to speak in public. My philosophy and methodology of lecturing was derived from my own experiences when attending lectures - the most instructive were often those that were poorly presented - mixed with a certain amount of common sense, and an awareness of my own abilities and shortcomings. This 'training,' refined by my own lecturing experiences, has stood me in good stead. I like to think that I was able to differentiate good from bad, what worked and what didn't, and managed to add my own original methods.

Similar methodologies have been invaluable in showing me how to edit scientific papers. Editing geological journals and books is another task that we commonly undertake, based on ideas and methods that have been accumulated along the way. A member of the editorial board of an academic journal wields considerable power over the publishing success of contributors, which in turn may influence their chances of employment or promotion. However, many editors, including me, have received no formal training in editing.

In taking over an editorial position, you may be presented with a stack of files from the outgoing editor, and perhaps an informal discussion concerning which reviewers to avoid, the efficiency (or otherwise) of the current printers and so on, but formal instruction in editorial work is probably not received by most of us. In thinking about my development as an editor, it has occurred to me that I received a lot of good instruction from dealing with the editors of my own research papers. Many editors do an excellent job and good editors are to be found at all levels, from the leading international journals to proceedings of local scientific societies. They are quick to acknowledge receipt of papers, are efficient in obtaining peer reviews and act with an even hand in accepting, asking for revision of or rejecting papers. Some of the most insightful letters concerning my own research have come from editors asking for revisions. However, just as there are lessons to be learned from a bad lecture, so have I learnt something of what not to do from bad editors. I have recently been reviewing my knowledge base for editorship, as part of my own professional development, and have realised how many things I don't do, because of the 'instruction' I received from editors who did it to me, either badly or from a position of ignorance. Of those editors who have acted thus, the following examples are generally instructive.

- The editor of one of the first papers promised me ten copies of the journal in lieu of offprints. Over 20 years later, I'm still waiting.
- In the days before I had access to a personal computer (PC), I retyped two papers after review and revision, putting them in the camera ready format required by the 'Instructions for Authors' of this journal. Only after re-submission did the editor inform me that my papers were to be typeset on a PC as part of a new production method. Communication problem? The editor's office was just down the corridor from mine.
- A short note that I had written was sent by an editor to two external referees for peer review. It took six months for the reviews to be returned, undoubtedly too long for such a short contribution, at which point the editor rejected the paper. Neither reviewer recommended rejection. Perhaps an early editorial decision could have saved the time of everyone concerned?
- The editor of a regional journal rejected a joint paper after one negative review. The paper was subsequently expanded and published in an international journal. An unsubstantiated allegation on the grapevine suggested our reviewer may have been the author of a paper on a related topic whose importance would have been reduced by publication of our findings.
- The editors of a leading international journal 'sat on' two of my papers for over a year and failed to respond to three fax messages during the same period. By the time I received a fax saying that both papers had been reviewed, I had sent a letter withdrawing them; one paper had already been submitted elsewhere.
- The editor of a regional journal, not a geologist, rejected a joint paper after a single poor review (the second reviewer failed to reply). Revision and re-submission led to the same paper appearing in an international journal.
- The editor of a conference transactions admitted, almost five months after submission of a contribution, that it hadn't been sent for peer review because he was still waiting to see if the publication was viable. The paper was withdrawn.
- The same paper was then sent to a regional research journal. After six months, the editor had received two reviews, one positive, one negative. The solution? Write to a third reviewer rather than make an editorial decision. I withdrew the paper for the second time and re-submitted elsewhere (now in press).
- One editor, having solicited a book review, failed to publish it.
- Another book review took five years to appear because I criticized the large number of typographic errors, and both the book and journal belonged to the same publisher.

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A few words from the Union of Geological Associations (UGA), Czech Republic

by Jan Schröfel[1]

We would like to use the opportunity offered to us by the editorial staff of the European Geologist magazine to present an overview of Czech geology on the occasion of our Republic´s accession to the European Union, on the occasion of the International Congress on Geology held in Florence and the 2nd International Conference of Professional Geologists held in London. We want to present our geology as a self-confident branch which, due to its historical development, the level of geological teaching, the type of work presently carried out, we feel is on an equal footing with geological communities in other European countries.

We have become a member of the European Federation of Geologists where we believe, we will become more active and participate fully in the life of the whole community. We accepted the Federation's principles even before submitting the official application for admission: by setting up societies - associations of geologists with different professional specializations, engineering geologists, deposit geologists, geophysicists and hydrogeologists. We have accepted the ethical code and are also trying to fulfill our financial obligations. Individual societies are associated within the Union of Geological Associations (UGA). At present, we have about 500 members. Twice a year, the associations publish information newsletters for their members. Individual associations also organize their own training programmes (seminars, courses, excursions etc.). These training possibilities are also offered to people from the outside; in this way, for example, engineering geologists addressed the Chamber of Authorized Engineers.

The UGA has tried to establish a legal basis for the National Chamber of Geologists. Unfortunately, our efforts were in vain, as there is currently no political will for this. Geologists are "administered" by four ministries, mainly by Environment but also by Industry and Commerce, Agriculture, Transport as well as the Mining Office.

Geological actitivies are regulated mainly by three acts: Geological, Mining and Mining Regulations. By law, geologists are authorized (are awarded certificates) to design, implement and evaluate work by the Ministry of the Environment. It certifies the capability of specialists in terms of knowledge of legal regulations, while the UGA guarantees their professional competence and expert knowledge. Authorized geologists are provided with a certificate when they have complied with other requirements: the necessary qualifications and moral integrity. Then, they are allowed to stamp their work with the state emblem, name and registration number.

Before accession to the EU, the ministries have had to harmonize the above-mentioned acts with European standards.

Our geologists expect not only an opening up of the market for geological work, but also mutual cooperation in solving geological problems.

We are no greenhorns, even though during the last fifty years, our activities have been mostly oriented towards the "East". Still, you may be familiar with some of our colleagues from foreign universities, mapping projects, expeditions, membership in international organizations. A certain isolation in recent decades may have had its effect in a certain forced modesty and toughness at work on our part.

With regard to publication, it is evident that the standard of the work written by our geologists is of an adequate level, and our partnership in international competition has been positively evaluated. It is unfortunate that the involvement of those geologists working in research, those engaged at faculties and those working for the Czech Geological Service, is deemed insufficient. It is difficult to get credit in a profession regarded as an ousider in relation to others. The negative aspect is that, under a complicated economic situation, we are not able to win significant financial support from larger companies working in the branch. We do not always support the acts of government authorities either. They continue to regulate the geological community while failing to respect recommendations we make. There is a barrier separating us which we have not been able to remove or lift. Here also, we still lack significant support, both financial and ideological.

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Field experience: mapping in Czech Rep., Mongolia, Sweeden, Canada

Quido Záruba, founder of Czechoslovak engineering geology

by Jaroslav Pašek and Jan Marek

A graduate of the Prague Faculty of Civil Engineering, Quido Záruba (June 18, 1899 - September 8, 1933) recognized the importance of geology in civil engineering during his work in the family construction company. He was aware of the importance of sound knowledge of geological conditions on construction sites and of the need of assessing the influence of the natural environment on construction conditions. When he took control of the company, he established a geological surveying and construction preparation department. He purchased drilling rigs and basic laboratory equipment. He was also in close contact with former leading geologists whom he consulted about problems encountered during foundation building of major constructions and during tunnel heading. He gathered experience abroad, participated in congresses and professional excursions, and had contact with experts from related branches all over the world.

In this way he gradually established a new discipline. From 1945 he became a professor at the Faculty of Civil Engineering of the Czech Technical University in Prague. His lectures for future civil engineers were full of attractive practical examples. He devoted his time to students even during holidays when they accompanied him on various field projects during which the students gained practical knowledge. In this way he educated several dozens of students who have spread all over the world. Engineering geology formed a new branch of the geological sciences during the 1950s both in Czechoslovakia and worldwide. The term quickly became familiar and universities opened new study programmes and conditions for engineering-geological surveying were established. Záruba published his knowledge in professional journals, as well as in collections of abstracts from various conferences and congresses.

In 1932 he wrote the first methodic handbook on geological surveying in civil engineering and this formed the basis for future textbooks. His Engineering Geology textbook was his most significant work. It was published in 1954 and subsequently in several amended versions. It has been translated into many languages.

Although Záruba was an expert in many fields, he focused mainly on the geological issues involved in dam construction. At many sites planned for dam construction, he recognized unfavourable geological conditions, ignorance of which could later have have had catastrophic consequences. He also dealt with tunnelling geology. As a priority, he focused on land slides and cambering of all types. He also dealt with urban geology for many years. He cared about harmony between technical works and nature, pointing out the unsuitability of non-sensitive technical interventions in nature at the time when ecology and environment were still unknown terms.

Quido Záruba, founder of the Czechoslovak engineering geology school,

was very popular all around the world. In recognition of his contribution to the establishment of the new branch of the science and of his importance, he was elected to the position of the first president of the International Association of Engineering Geologists (IAEG) at its inaugural meeting during the World Geological Congress in Prague in 1968.

Stavební geologie – Geotechnika, a.s. Praha has continued with the activities of Záruba's surveying company, a tradition of more than 70 years of surveying in the field of technical intervention in the natural environment in the Czech Republic. Its main tasks comprise consulting activities in the area of engineering geology, geotechnics, environment, and engineering structures. It is one of the largest companies of its kind in Central Europe. It has established and provided financial backing for the Academician Záruba Award which is granted annually to young experts for excellent results in the area of engineering geology and in related branches.

The Czech Geological Survey

Earth Sciences and Services for Society

by Zdenek Venera[1]

In the Czech Republic, the supreme legal authority in the domain of geology is represented by the Ministry of the Environment, specifically by its Department of Geology. The Ministry supervises the Czech Geological Survey (CGS) and the Czech Geological Survey – Geofond. The CGS was founded in 1919 as a state research institute and CGS – Geofond has been serving since 1975 as a specialized archive of all sorts of geological information available both to the state administration and the public.

The mission of the CGS is to provide impartial expert services to the state administration, the public and other clients, based on systematic geoscientific research into the Czech Republic's territory which is essential for environmental, economical and political decision-making. One of the main tasks is the production of geological and thematic maps at different scales, accompanied by complex research of mapped areas. In 1998, geological and other thematic mapping at a scale of 1:50,000 covered the entire territory of the Czech Republic.

During the last decade, the focus of activities shifted significantly from evaluation of mineral resources, characteristic of the pre-1989 period, towards environmental studies, assessment and mapping of geological hazards (slope deformation, floods, radon emanation), and the impact of the extractive industry (past mining and mineral processing). The CGS leads and participates in many basic and interdisciplinary environmental monitoring of element cycles, mapping of industrial and organic pollution, or biogeochemical studies of forest ecosystems. The CGS has been also involved in the National High Level Waste Repository Development Project. The CGS laboratories have long-standing experience in inorganic analysis of rocks, research projects including long-term soils, and waters as well as the organic matter in them. The laboratories of the Geochemistry Department encompass a wide spectrum of methods within the Earth sciences including x-ray micronalysis, x-ray diffraction, stable and radiogenic isotopes, and other special facilities.

In response to the increasing public demand for relevant geoscience information the CGS developed a data management system for the effective delivery of geodata based on on-line access. The Information Portal provides a broad range of information and db services (Map Server, services of the Library, Archive & Collections) to both professionals and the public. The CGS also continues to publish geological studies and maps, geoscience periodicals and popular publications.

Apart from domestic research and services, the CGS is devoted to projects of the Czech Official Development Assistance Programme. The projects being currently carried out in Mongolia, Zambia, Namibia, Burkina Faso, Nicaragua, Salvador, and Peru, deal with geological and geo-chemical mapping, geological hazards, environmental pollution, and mineral resources.The CGS Headquarters (photo) and the Central Laboratory are located in Prague. The Regional Branch, the organic geochemistry laboratory and the joint electron microprobe facility (shared with the Masaryk University) are situated in Brno. CGS has about 270 employees, of which 170 are re-searchers, and an annual budget of ca. € 4.6 mil.

CZECH GEOLOGICAL SURVEY 1919

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Feldspar raw materials in the Czech Republic

by Jaromír Starý[1], Pavel Kavina[2] and Radoslav Smetana[3]

Feldspar raw materials are among the most important industrial minerals in the Czech Republic. They represent, together with kaolin, clay and silica sand, a fundamental raw material of the domestic ceramic and glass industry, as well as an important export commodity. Fluvial Quaternary feldspar placer and leucocratic granitoid deposits represent at present the most important feldspar resources. The mining production of feldspars in the Czech Republic has been continually increasing. With an annual output of about 0.4 million tons, the Czech Republic ranks among the top+ European (5th place) and world (7th place) feldspar raw material producers.

Le feldspath fait partie des minéraux industriels les plus importants en République tchèque. Il représente avec le kaolin, l'argile et le sable siliceux, un matériau brut essentiel de l'industrie de la céramique et du verre et aussi un produit important à l'export. Les gisements alluviaux quaternaires riches en feldspath et les dépôts de granite leucocrate constituent aujourd'hui les sources de feldspath les plus abondantes. La production de feldspath en République tchèque augmente de façon continue. Avec une production annuelle de 0.4 million de tonnes, la République tchèque fait partie des principaux pays producteurs de feldspath brut, en Europe (5ème place) et dans le monde (7ème place).

Las materias primas feldespáticas se cuentan entre los minerales industriales más importantes de la República Checa. Representan, junto con el caolín, las arcillas y la arena silícea, una materia prima fundamental para la cerámica del hogar y la industria del vidrio, así como una importante mercancía para la exportación. Los placeres de feldespatos fluviales cuaternarios y los depósitos de granitoides leucocráticos representan actualmente la fuente más importante de feldespatos. La producción minera de feldespatos en la República Checa se ha ido incrementando continuamente. Con una producción anual de cerca de 0,4 millones de toneladas, la República Checa se sitúa entre las más importantes de Europa (5º lugar) y del mundo (7º lugar) en la producción de materias primas feldespáticas.

Feldspar raw materials are among the most important industrial minerals in the Czech Republic. They represent together with kaolin, clay and silica sand a fundamental raw material of the domestic ceramic and glass industry, as well as an important export commodity. Continued increase in domestic mining production and export highlight their significance .

General characteristics of feldspar raw materials

Feldspar raw materials are rocks which contain some of the feldspar group minerals in form, quantity and quality favourable for industrial exploitation. The feldspar group includes monoclinic (orthoclase, sanidine) and triclinic (microcline, plagioclase) potassium and sodium-calcium alumosilicates. Feldspars belong, along with quartz, to the most widespread rock-forming minerals and together make up 60% of the Earth´s crust. K-feldspar (orthoclase, microcline) and acid (with Na prevailing over Ca) members of the plagioclase series (albite, oligoclase, andesine) are of industrial importance. Basic (with Ca prevailing over Na) members of the plagioclase series (labradorite, bytownite, anorthite) are of marginal importance. Dyke rocks (pegmatites, aplites), plutonic rocks (leucocratic granitoids) as well as sedimentary rocks (feldspar-bearing sand and sand and gravel), and residues of incompletely kaolinized rocks and metamorphic rocks represent suitable feldspar raw materials. The major contaminant is a high content of iron, which can be present in the feldspar structure (cannot be processed) or as an admixture (can be processed).

Because of its low melting point, feldspar is used as a melting agent in ceramic mixtures, glass batches, glazes, enamels and recently also as casting powders in metallurgy. Almost 90% of feldspar is consumed by the glass and ceramic industry. A small amount is used as filler, mainly in colours and plastic materials.

Apart from feldspar raw materials, rocks with other minerals containing alkalis (mainly nepheline - anhydrous sodium-potassium alumosilicate) are used as their substitutes. It is the nepheline syenites and to a lesser extent, nepheline phonolites, that are utilized in this way worldwide.

Raw material resources of the Czech Republic

Deposits of feldspar raw materials in the Czech Republic (Fig.1) are first of all associated with primary sources, formed mainly by leucocratic granitoids and pegmatite bodies. Nevertheless, the importance of secondary sources, represented by feldspar sand, gravel and sand, has been increasing. The latter types

[1]Czech Geological Survey - Geofond
[2]Ministry of the Industry and Trade
[3]Czech Association of Economic Geologists

are usually of not such a high quality as classical feldspar raw materials in pegmatites, but they form larger deposits and can be therefore exploited in substantially cheaper large-volume industrial ways.

Fluvial Quaternary feldspar placer deposits represent at present the most important feldspar resource. They formed by deposition of disintegrated granitic rocks with a high content of mainly potassium feldspar phenocrysts. The decisive deposits as well as reserves are concentrated into two regions. The first is the upper course of the Lužnice River in south Bohemia, with the deposits Halámky, Tušt, Dvory nad Lužnicí and Majdalena. The highest feldspar contents (about 55 - 60%) occur in 4-16 mm fractions. A large part these reserves are blocked by conflicts of interest with nature protection, especially with the Protected Landscape Area (CHKO) Trebonsko. The second region is located south of Brno within the so-called Syrovice-Iván Terrace of the Jihlava River, with deposits at Bratcice, Hrušovany, Ledce, etc. Feldspar quality in this region is slightly lower, due to higher Fe contents. The highest feldspar contents (around 60%) occur in 1-8 mm fractions. A major part of the local raw material is however used only as construction material

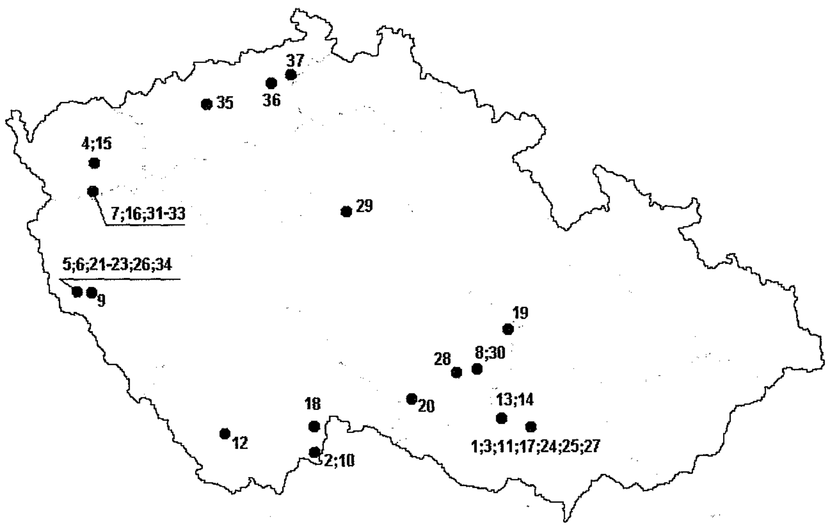


Figure 1. Registered deposits of the Czech Republic

sand and gravel at present. Only a portion is stored in depots for later use as feldspar raw material. Other important Jihlava River accumulations occur in the Ivancice area, south-west of Brno. Feldspar sand and gravel, with a predominance of potassium feldspar over plagioclase, represents the raw material of the fluvial deposits. It is suitable for production of glazes, utility china, sanitary ceramics, glass etc.

Fine to medium-grained leucocratic granitoids (granites and aplites, quartz diorites) represent another important feldspar raw material. They contain usually about 50 - 60%, occasionally even a higher proportion, of feldspar. Deposits developed, for instance in the Krušné hory pluton (Krásno: albite-bearing aplitic granite), Mracnice granitoid massif (Mracnice: quartz diorite - trondhjemite), Trebíc massif (V.Mezirící-Lavicky: aplitic granite). Prospecting was carried out also in other massifs such as the Brno (Moravský Krumlov) and Dyje (Prímetice) massifs or Babylon stock, as well as the Chvaletice, Blanice and Blatná granites/granodiorites. Raw material consists mainly of sodium-potassium feldspars, used for sanitary ceramics, coloured glass, china and abrasive disc production.

Pegmatite deposits known from several regions represented the only source of the raw material used mainly for ceramic production in the past. Contents of feldspar substance are strongly variable, mainly around 60%, but in the case of the Ždánov deposit, for example, they even reach about 80%. Pegmatites of medium to lower quality occur in south-west Bohemia in the Pobežovice- Domažlice region (e.g. Luženicky, Meclov). These pegmatites contain equal proportions of sodium and potassium feldspars and an admixture of dark minerals. In this region there are also deposits of high-quality sodium and sodium-calcium feldspars, used for glazes and pellucid glass (Ždánov). K-feldspars are dominant in pegmatites in the other regions. The Teplá region in western Bohemia with rather abundant occurrences of high-quality feldspar (Beroun, Krepkovice, Zhorec) and low contents of impurities appears to be promising. Pegmatites of the Písek region are also

Feldspar raw material deposits

1 **Bratcice**
2 **Halámky**
3 **Hrušovany by Brno**
4 **Krásno**
5 **Luženicky**
6 **Mracnice**
7 Ždánov
8 Beroun-Tepelsko
9 Bory-Olší
10 Dvory nad Lužnicí -Tušt
11 Chvalšiny
12 Ivancice-Letovisko
13 Ivancice-Nemcice
14 Krásno-Vysoký Kámen
15 Krepkovice
16 Ledce-Hrušovany by Brno
17 Majdalena
18 Malé Tresn
19 Meclov 2
20 Meclov-Airport
21 Meclov-West
22 Medlov
23 Otov-Cervený vrch
24 Smrcek
25 Velké Mezirící-Lavicky
26 Zámelíc
27 Zhorec 1
28 Zhorec 2-Hanov Zone
29 Markvartice by Trebíc
30 Medlov-Smolín
31 Hrušovany by Brno-Protlas
32 Smolín-Žabcice
33 Bozdíš
34 Štíhlice

Feldspar substitutes:
35 **Želenice**
36 Tašov-Rovný
37 Valkerice-Zajecí vrch

Note: exploited deposits in ***bold*** workable. Some smaller deposits of feldspar are known from the Humpolec, Tábor and Rozvadov (Ceská Ves) areas, from western Moravia (Smrcek) etc. Much of the highest quality raw material of the pegmatite deposits (mainly from the Pobežovice-Domažlice and Písek regions) has, to a large extent, been exhausted by mining in the past - this involves especially the more easily accessible subsurface parts. This holds true also for the area of the Bory granulite massif with a small deposit Bory-Olší, linked to a classical but mined-out deposit, Dolní Bory.

Coarse-grained to porphyric leucocratic granitoids could represent an important resource of the feldspar raw material in future. Contents of feldspar substance are 50 - 60% on average. Such rocks occur in the Rícany area in central Bohemia (Štíhlice), in the Cistá-Jesenice pluton, the Krkonoše-Jizera pluton (Liberec granite) etc. Raw material consists mainly of sodium-potassium feldspars which mostly need high-intensity magnetic separation to decrease the Fe content.

Deposits of feldspar raw materials forming lenses in metamorphosed rocks have recently been the subject of new prospecting. Deposits of orthoclasite to

Figure 2. Raw feldspar

microclinite Markvartice by Trebíc (contents of feldspar substance about 90%) are located in the western branch of the Varied Unit of the Moldanubian Zone in Moravia. The albitite deposit Malé Tresné (feldspar contents around 60%) is situated at the north-western margin of the Svratka dome at the contact of the Micaschist Zone and Olešnice Unit. A small deposit of anorthosite to gabbro Chvalšiny (feldspar contents 70 - 80%) occurs within amphibolites of the Ceský Krumlov Varied Unit of the Moldanubian Zone in Šumava.

Kaolinized feldspar raw materials with unaltered or imperfectly altered feldspars can represent another promising resource of the feldspar raw material. This concerns

Feldspar raw material	1998	1999	2000	2001	2002
Deposits – total number	29	27	28	28	33
Exploited	6	7	5	5	6
Total mineral resources, kt	81 913	79 276	77 846	77 447	84 048
economic proved reserves	37 921	37 165	35 738	35 400	35 957
economic probable reserves	40 368	38 173	35 755	35 694	40 747
potentially economic resources	3 624	3 938	6 353	6 353	7 344
Mining production, kt	266	244	337	373	401

Feldspar substitutes	1998	1999	2000	2001	2002
Deposits – total number	3	3	3	3	3
Exploited	1	1	1	1	1
Total mineral resources, kt	200 242	200 217	200 192	200 167	200 137
economic proved reserves	0	0	0	0	0
economic probable reserves	200 242	200 217	200 192	200 167	200 137
potentially economic resources	0	0	0	0	0
Mining production, kt	33	24	24	25	29

Feldspar	1998	1999	2000	2001	2002
Import, t	5 474	6 317	7 658	7 226	7 976
Export, t	57 546	62 273	85 931	131 696	122 206

Leucite, nepheline and nepheline syenite	1998	1999	2000	2001	2002
Import, t	337	465	697	727	699
Export, t	5	0	0	0	0

first of all arkoses of the Plzen and Podborany regions and gneisses and granitoids of the Znojmo region. Average contents of the feldspar substance are usually lower, about 20-40 %.

Tertiary volcanic rocks - nepheline phonolites from Ceské stredohorí (Želešice deposit) - are used as feldspar substitutes in the Czech Republic. They can be used in the glass and ceramic industry only as a melting agent in coloured materials, due to high contents of colouring oxides. A high content of alkalis (10-10.5 % Na_2O and 3.5-5 % K_2O) results in a lower melting temperature and a shorter burning time.

Mining production and reserves of the Czech Republic

Mining production of feldspars in the Czech Republic has been increasing during recent years. The annual mining production did not exceed 150 kt in the period of 1987-1992 but reached about 200 kt between 1993 and1996. The last four years have seen a substantial increase in mining production, up to 401 kt in 2002, when the Czech Republic joined the front European (5th place) and world (7th place after Italy, Turkey, USA, France, Spain and Germany) feldspar raw materials producers.

There were four organizations mining feldspars in the Czech Republic in 2002: Calofrig a.s., Borovany; KMK Granit s.r.o., Sokolov; Chlumcanské keramické závody a.s. (CHKZ) and Brnenské papírny s.p., Predklášterí. At present, the first two produce each about one third of the total amount, the remaining third being mined in approximately equal proportions by CHKZ and Brnenské papírny. Five deposits are exploited at present: Halámky (Calofrig a.s., Borovany), Hrušovany by Brno (Brnenské papírny s.p., Predklášterí), Krásno (KMK Granit s.r.o., Sokolov), Luženicky (CHKZ) and Mracnice (CHKZ).

There are no marked fluctuations in geological reserves of feldspar raw materials other than exploitation and losses. Decrease of reserves in 1999 was caused by re-evaluation of the Meclov-West deposit and in 2000 by re-evaluation of the Dvory nad Lužnicí-Tušt deposit. An increase in reserves in 2002 was caused by prospecting and evaluation of reserves in 7 new deposits: Bratcice, Bozdíš, Hrušovany by Brno-Protlas, Medlov-Smolín, Štíhlice and Tušt-Halámky.

The lifetime of reserves of feldspar raw materials in exploited deposits in the Czech Republic is several tens of years. Future raw material reserves are represented by sand and gravel in south Moravia, granitoid rocks in the Krušné hory pluton in western Bohemia and the Rícany granite in central Bohemia among others..

The only exploited deposit of feldspar substitutes (nepheline phonolite) is mined by Keramost a.s., Most. The lifetime of reserves of this raw material in the Czech Republic is practically unlimited.

The re-use of secondary raw materials from the metallurgical industry's disposal stockpile

by V. Cílek, Z., Z. Adolf and J. Mrácek[1]

The Buštehrad dump, which formed by an accumulation of iron and waste from heavy industry in the Kladno area, represents on the one hand a potentially important source of secondary raw materials, especially of iron and aggregates, and on the other hand, a possible environmentally hazardous site, not only in this area but also in the Dretovice Brook drainage basin as an Elbe affluent (Fig. 1).

The new proprietor of the Buštehrad dump - REAL Leasing Kladno s.r.o. - has a great interest in solving the problems presented by this huge metallurgical stockpile and in further research leading either to elimination of the environmental contamination risk, together with re-landscaping and biological revitalization or to the utilization of the dump as a secondary raw materials source. In the latter case, economical utilization should accompany ecological revitalization of this "industrial" area.

The storage and possible recycling of metallurgical waste is always problematic. Neglect of these processes and the Kladno's iron and steel companies' focus only on the production of iron and steel, led to the creation of this vast dump with a volume of over 14 million m³ (more then 27.5 million t) on an area of more than 50 ha of originally agricultural land.

History

The nature of the waste in the Bustehrad dump has changed through time, from initial iron production in blast furnaces to a transition to electric furnace production and implementation of a large power - production sector, which catered to the increasing demands for metalurgical material production. The blast-furnace production of iron, and subsequently steel, produced an alkaline slag, known as the Thomas' (basic) slag which was stored to the west of the dump. It is slightly weathered on the surface and was used as a fertiliser, in the production of industrial tiles and in civil engineering as a crushed stone. The Kladno steel-mills used to have their own lime works (originally 5 furnaces) which served the metallurgical plants and associated production of lime slag bricks. The eastward part of the dump, but also the bottom part of the new dump, consists of acid and alkaline electric-furnaces slag.

Metallurgical production in the Kovošrot plant supplied scrap to the Drín plant and the waste was stored either on the dump or on a separate stockpile at a lower level underneath the eastward edge of the dump. This is a potential source of water contamination from the non-ferrous metal remains and from other materials, which could not be used in electric furnaces. Some metals, such as copper, had to be segregated, and this led to a gradual reduction in the quality of Kladno steel.

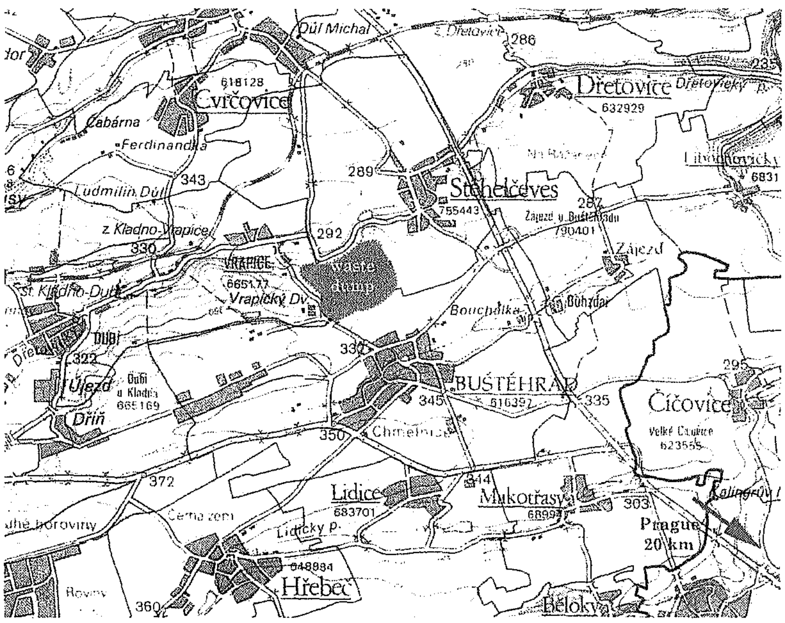
In the dump there is also limonite-hematite iron ore from the Krivoj Rog deposit, which was dumped directly because of its low quality. There are also fragments of a Brazilian itabirit (flaky hematite) and various types of iron scrap. More than 100 kg lens or square-shaped sows are typical. These were formed by the settling of liquid slag poured out onto the slope of the dump.

Developing production literally overloaded this metallurgical dump, initially by boiler clinker, later on with mild flue dust ("powder") from the fluid-fuel burning boilers. This waste has been stored mainly on the north slope of the dump and in the lower beds of the current new stockpile.

The future

It is difficult to estimate how much of the raw material of the dump can be utilized. Access to the body of the dump, via channels, is limited and current technology

Figure 1. Location map of the Buštehrad dump



[1]REAL Leasing Kladno. spol.s.r.o.

can only deal with a small part of the mineral deposits.

Alkaline blast furnace slag

This is of economic interest with an approximate volume of 40% CaO and 12.5% MgO. It has a capacity of 3.5 million t that can be used in road engineering, brick production, mineral wool and aggregates. Economic analysis will show whether this slag can be used, as in the past, for production of fertilizers for agriculture. The content of metallic iron is assumed to be c 2.5% of the weight, i.e. c 90,000 t Fe.

Top gas mud, 1,827 000 t

According to specifications from 1980, this has a composition of 35 - 50% Fe, 1 - 14% Zn, 0.5 - 4% Pb, as well as Cu, Ni, Cr among others. After reduction of this raw material, it would be possible to retrieve 700,000 t of iron, 14,000 t of zinc, 5,000 t of lead as well as other elements.

Steel-mills slag, 5 000 000 t

Found in a part of the dump to the south and west, but mainly in the middle and east of the dump, together with the blast-furnace waste (furnace linings, iron scales and mud, with over 100 kg heavy iron sows from the bottom parts of cups of liquid slag). They have a double composition, both acid and alkaline, and contain up to 10% metallic iron, i.e. 500,000 t of iron and c 25% of bonded iron, c 200,000 t of manganese, 50,000 t of chrome, as well as vanadium and nickel, among others.

Iron scales and scales mud

On the surface of the old dump on its NW slope and still supports no vegetation. They represent a source of iron of c 1 million t. This mud has been discovered in the examination channels and on the top of the dump (dark red colour).

Waste from energy production

Approximate value of 8 million t. It has been mixed with metallurgical waste (NW slope of the dump and selectively in the lower beds of the new stockpile). This was used in civil engineering as a base material, for example in Sokolov, as an additive in the production of cement (flue ash) etc. We can anticipate its use in the greater Prague area in the future.

Summary

The Buštehrad dump as a source of secondary raw materials can provide c 1.3 million t of iron for blast-furnaces, 3 - 8 million t of crushed rock in civil engineering and concrete mixtures as well as other metals and materials for agriculture. A part of the dump has been damarcated as useless waste, which must be safely stored in the dump area and isolated from the underlying geological strata.

Before extraction of secondary raw materials from the body of the Buštehrad dump it is necessary to:

1. preserve the hillside vegetation and dig inside the barrier
2. start with the stage extraction from the westward border of the dump (blast-furnace waste) towards the east along the magnetic anomalies
3. eventually perform a selective extraction of highly ferric parts

The production of secondary raw materials can be a very easy process initially:

primary rough selection with a preliminary magnetic separation of metallic Fe

crushing of oversize material with selection of Fe sows and clinker

selection of aggregate for production of concrete

Processing can continue with:

processing of proportions of the primary selection by milling and low-intensity magnetic treatment (Fe extraction and eventual source material for production of Cr, Mn, Zn, Pb)

utilization of some waste products for civil engineering (backfill materials, bricks, additions to construction parts, etc.)

Additional product can be:

production of phosphorus fertilisers

production of insulation materials

production of alloying metals (amendment of ÚNS - Kutná Hora, 1989)

Materials from the dump can be used not only in the proposed Prague by-pass road, but also in road and railway construction in surrounding areas. New global trends aim to recycle all materials for re-use in industry.

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The hydrogeological situation during uranium mining in Straz Pod Ralskem, Czech Republic

by Jan Slezak[1] and Vladimir Ekert[2]

In the 2nd half of the 20th century there was a large scale development in exploration and production of uranium ores in the Czech Republic. Both classical deep mining ("room and pillar" method) and in situ leach (ISL) mining methods were used in the area. For the processing of ores in both mining methods, sulphuric acid was used as a lixiviant (leaching agent). More than 4 million tons of sulphuric acid was used for the ISL method and injected into the ground. This method influenced an area of more than 28 km^2 affecting approx. 215 million m^3 of groundwater Remediation costs will be over 56 billion CZK over 40 years.

La seconde moitié du 20ème siècle a vu le développement à grande échelle de l'exploration et de la production de minerais d'uranium, en République tchèque. On a eu recours à la fois, aux méthodes d'exploitation classiques, par chambre et pilier, et par lessivage in situ (ISL). Pour traiter le minerai, dans les deux cas, de l'acide sulfurique a servi comme produit de lessivage. Plus de 4 millions de tonnes d'acide sulfurique ont été utilisées pour le lessivage et injectées dans le sol. La méthode à contaminé une surface supérieure à 28 km^2, concernant approximativement 215 millions de m^3 d'eau souterraine. Le coût de la décontamination va dépasser 56 billions de CSK et s'étaler sur une période de 40 ans.

En la segunda mitad del siglo XX se produjo un desarrollo a gran escala de la exploración y producción de depósitos de uranio en la República Checa. En esta zona se utilizaron tanto los métodos mineros clásicos de explotación subterránea (explotación por cámaras y pilares), como los métodos de ataque ácido *in situ*. Para el tratamiento de las menas obtenidas por ambos métodos mineros, se utilizó ácido sulfúrico como agente de ataque. Para el método de ataque *in situ* se utilizaron más de 4 millones de toneladas de ácido sulfúrico inyectadas en el terreno. Este método tuvo influencia en un área de más de 28 km^2 y afectó a más de 215millones de m^3 de agua superficial. El costo de recuperación excederá los 56 billones de CZK a lo largo de 40 años.

In the 2nd half of the 20th century there was a large scale development in exploration and production of uranium ores in the Czech Republic. The biggest uranium deposit area was found in the North-Bohemian Cretaceous area in the mid-sixties. During a period of 30 years of production c 30,000 tons of uranium in concentrate was produced. More than 15,000 drill holes were made in the area and almost 11,000 of them were cased and used as production and monitoring (hydrogeological) wells.

Both classical deep mining ("room and pillar" method) and in situ leach (ISL) mining methods were used in the area. A mill and two tailings impoundments were constructed. For the processing of ores in both mining methods, sulphuric acid was used as a lixiviant (leaching agent).

More than 4 million tons of sulphuric acid was used for the ISL method and injected into the ground. This method influenced an area of more than 28 km^2 affecting approx. 215 million m^3 of groundwater. The undeniable negative influence of these activities will have to be reduced to acceptable limits. The total costs will be over 56 billion CZK over 40 years.

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Uranium mining development

Uranium mining in the area started on three deposits at the end of the 1960s and beginning of the 1970s. The classical deep mining method was used at the Hamr (Hamr I Mine) and Brevniste (Krizany Mine) deposits. On the Straz deposit (Straz ISL Mine) the sulphuric acid ISL method was used. At the beginning of the 1970s dewatering of deposits for classical deep mining began.

During the first ISL tests some acidic solutions escaped into the area of deep mining and therefore the so-called hydraulic barrier (HB) was constructed. It was a set of c 120 wells bordering the eastern part of the ISL area. The wells are used for injection of solutions pumped from the deepest part of the Hamr mine. The hydraulic barrier then creates a hydraulic watershed and limits outflow of strongly acidic solutions from the ISL area to the Hamr mine area.

Hydrogeological condition of the area

The Straz, Hamr and Krizany deposits are situated in the straz block, a tectonic unit of the Cretaceous basin (Fig. 1). Cretaceous sedimentation is represented by Cenomanian and Turonian strata. In the straz block, the Cenomanian sediments form a two-layer aquifer (the lower, 20 m thick with a hydraulic conductivity of 10^{-4} m/s and the upper, 40 m thick with

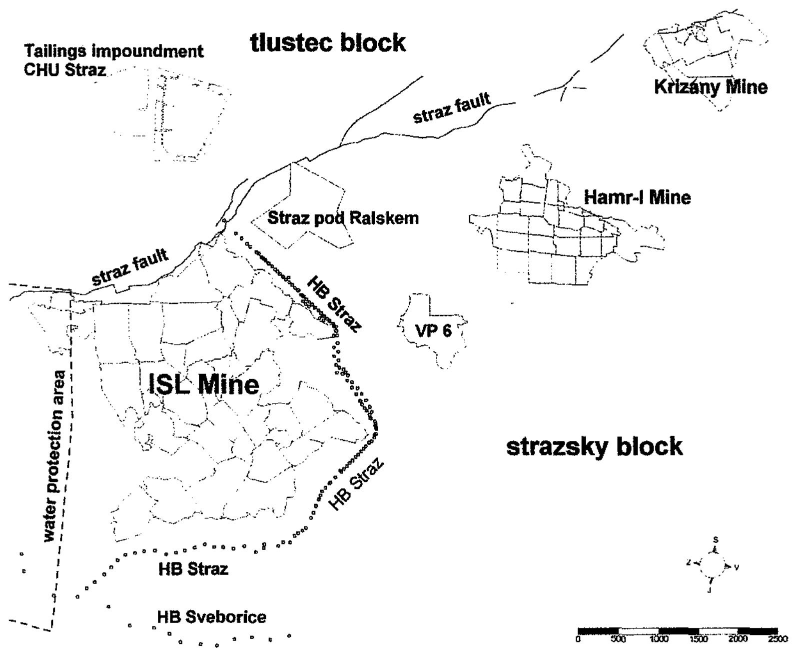


Figure 1. Schematic map of the area

a hydraulic conductivity of 10^{-5} m/s). The lower Turonian sediments form a 40-60 m thick aquitard, being the roof of the Cenomanian confined aquifer. Middle Turonian sediments reach the surface and form an unconfined aquifer of variable thickness, with a hydraulic conductivity of 10^{-5} m/s.

In the sunken tlustec block, sedimentation continued until the Coniacian. This is why the third (unconfined) aquifer in the Coniacian sediments was created. Both Cenomanian and Turonian aquifers are confined to the tlustec block.

Uranium deposits are situated in the lowest part of the Cenomanian aquifer at a depth between 150 and 400 m in the straz block. The Turonian aquifer in the area is a significant source of high quality potable water.

Influence of mining on the geological environment

Since the discovery of uranium deposits in the Straz area, almost 4,500 exploration boreholes have been drilled. In the area of the ISL mine, almost 7,800 production wells have been drilled and cased. An overview is given in Table 1. Almost all the wells will have to be decommissioned before the end of all activities in the area. So many wells create a risk of possible flow between aquifers, depending on the hydraulic conditions. It may cause spreading of contaminants in unexpected areas. Approximately 5,300 wells have been decommissioned. It is expected that 100 wells a year will be decommissioned, due to limited financial resources.

In 1967, the first leaching test field VP-1 started its operation. It was situated on the Hamr deposit. The alkaline lixiviant (sodium carbonate) was applied during the test but did not give a satisfactory result. It should be mentioned that it could not have been successful because of: very primitive conditions used in this test; poor experience with this leaching technology and; reliance on sulphuric acid leaching technology used in the former Soviet Union.

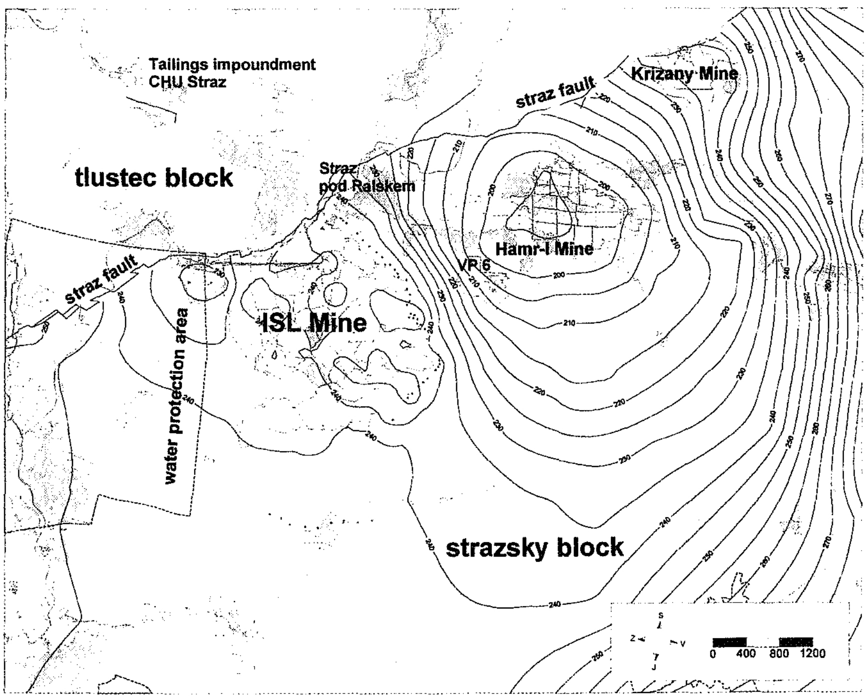
The leaching test field VP-2 was drilled near the new shaft of the Hamr mine and even before testing began, the groundwater level for its operation was too low, due to drainage of the sunken shaft. Later, a decision was made to remove future leaching test fields farther from the deep mine area.

The leaching test field VP-3 was the first one situated in the middle of the Straz deposit. It was drilled in the form of two hexagonal cells with 16 m-long sides and one well in the centre. It was the first leaching test which gave the first real uranium production from ISL technology. The first tank of concentrate was sent for processing to the MAPE Mydlovary uranium mill on December 13, 1967. It was the real beginning of semi-commercial uranium production using ISL.

Afterwards, this leaching test field was extended to 9 ha under the new name VP-4.

The test field VP-5 was situated on the Hamr deposit again. It should have ensured the possibility of leaching into the freshwater low permeable sediment in the lowest part of the Cenomanian sediments. A test with very strong sulphuric acid lixiviant

Figure 2. Cenomanian groundwater level of the area during mining



Area (deposit)		exploration	HG wells	Other wells	TOTAL
Straz bl.	Deposit Straz	1 452	904	7 834	10 190
	Deposit Hamr	1 380	564	953	2 897
	Deposit Mimon	76	37		113
	Deposit Osecna - Kotel	581	185		766
	Deposit Krizany	54	38		92
	Deposit Hvezdov	114	24		138
	Deposit Holicky	188	77		265
	Deposit Brevniste	472	149	26	647
	Straz block - total	**4 317**	**1 978**	**8 813**	**15 108**
Tlustec block		140	110	17	267
Total		**4 457**	**2 088**	**8 830**	**15 375**

Table 1. Drilling Works in the North Bohemian Cretaceous Area pre- June 30, 2003.

(over 200 g/l) was also executed. The results of this test were not promising.

The last leaching test field was also performed on the Hamr deposit and it was named VP-6. It covered an area of over 30 ha. Because this field was situated close to the Hamr deep mine, many problems arose and acidic solutions affected the deep mining area. Corrective action was taken, but it was not successful.

In 1971, after the government decision on future uranium production in the Nortbohemian area, the fast development of ISL fields and production started on an industrial scale. The area of leaching fields increased very rapidly, especially after a flooding accident in the Hamr mine in 1972. Unfortunately this development was undertaken without any consideration of the environment and this will influence future restoration procedures.

Uranium mining influenced groundwater levels in both aquifers, but mainly in the Cenomanian. For deep mines, the area was de-watered and a cone of depression was created. The highest pumping rate was 36 m^3/min in 1980. The groundwater level was influenced over an area of tens of km^2.

Aquifer restoration and project decommissioning

The remediation and decommissioning work will be a long-term process. The first step will be underground remediation (mainly groundwater of both aquifers). Afterwards, all the wells (except for some remaining monitoring wells) will be backfilled and decommissioned. The last step will be decommissioning of the tailings impoundment, which will serve as a final storage of radioactively contaminated materials from the area.The addition of sulphuric acid to the injection stream was stopped in 1996.

Starting conditions for the restoration project are as follows:

a) The contamination of the Cenomanian aquifer

Volume of contaminated water
215 mil. m^3, area 28.3 km^2
Main contaminants
SO_4^{2-} c 3,600,000 t
NH_4^+ c 75,000 t
The total amount of TDS c 5,740,000 t

b) The contamination of the Turonian aquifer

Volume of contaminated water
c 90 mil. m^3, area 7.5 km^2
Main contaminants
SO_4^{2-} 20 000 t
NH_4^+ 800 t.
The total amount of TDS c 30,000 t

c) The risk of the dispersion of contamination to the larger area and to a greater volume of underground water,

d) The risk of the next contamination of the Turonian aquifer, that is a source of drinking water.

The targets of the deposit restoration are as follows:

- to decrease the content of dissolved solids in Cenomanian water gradually to the environmental limit. The research results show that a safe concentration of TDS should be about 8 g/l.
- to decrease the content of dissolved solids in Turonian water gradually to the quality given by the Czech water standards, practically to the pre-operational baseline.

The Cenomanian aquifer restoration is planned in two steps. The first one is to achieve the hydraulic underbalance in a very short time and to obtain full control of underground contaminated solution. The second step is to start with the removal of

	pH [1]	TDS [mg/l]	SO_4^{2-} [mg/l]	NH_4^+ [mg/l]	Na^+ [mg/l]	K^+ [mg/l]	Ca^{2+} [mg/l]	Mg^{2+} [mg/l]	HCO_3^- [mg/l]	U [mg/l]	Ra [Bq/l]
Cenomanian water	6,9	140,00	33,00	<0,05	3,73	1,10	31,72	5,42	86,93	0,02	8,740
Turonian water	6,7	98,70	34,25	0,12	3,72	1,42	21,46	2,12	37,00	0,01	0,073

Table 2. Chemical composition of Cenomanian and Turonian water

Table 3. Some examples of chemical composition of Cenomanian leaching solution and contaminated Turonian water at ISL mine.

well	pH [1]	TDS [mg/l]	SO_4^{2-} [mg/l]	NH_4^+ [mg/l]	Na^+ [mg/l]	K^+ [mg/l]	Ca^{2+} [mg/l]	Mg^{2+} [mg/l]	HCO_3^- [mg/l]	U [mg/l]	Ra [Bq/l]
VP8E1027	1,1	90380	52000	1150	17,9	151	231	67	-	69,00	166,00
VPPT-1209	7,6	12140	6060	3050	68,0	36	754	77	1706	2,16	0,11

solids from the underground.

The Turonian aquifer restoration will be performed by the pumping out of the contaminated water and its treatment.

Desalination Plant Stage I (SLKR I)

The system will treat 6.5 m^3/min of acid solution, recovering 5.5 m^3/min of clean water for discharge to nearby rivers and 1.0 m^3/min of concentrated solutions. The operation began in April 1996. This technology produces two main products after crystallization and re-crystallization of salts from the concentrate:

1. The crystals of ammonia alum, $NH_4Al(SO_4)_2 12\ H_2O$. The assumed production will be about 120,000 t per year for the first 15-20 years of operation, until 2015. The production will decline (3-5% per year) after that year.
2. The crystallization filtrate of alum (the so-called mother liquor). The assumed production will be about 300,000 m^3 per year. The composition of this solution will change very slightly in the first 15 years of operation. A moderate reduction of individual components concentration is expected during the following years. Most of the components from the original solution and practically all of the radionucleides will be concentrated in this mother liquor.

Desalination Plant Stage II SLKR II)

The products of Stage I must be further treated to turn them into commercial products or into products, which can be safely deposited in the environment.

A large research programme for solving the problems of underground water desalination is at present in progress in DIAMO. The first results show possible treatment methods for Stage I products. .

There are several technologies (or their combination) for decomposition of ammonia alum:

1. The calcination of ammonium aluminium sulphate to produce $Al_2(SO_4)_3$.
2. The decomposition of ammonium aluminium sulphate by means of ammonia under atmospheric conditions with production of $Al(OH)_3$ and calcination to Al_2O_3 afterwards.
3. The production of so-called "restoration materials" by mixing the alum with lime and the use of this product for the restoration of the waste pond.

The possible commercial products of these technologies are:

- Al_2O_3, about 10,000 t per year, or
- $Al_2(SO_4)_3$, about 40,000 t per year, and
- restoration materials 100 - 150,000 t per year.

The treatment of concentrate has to have the main goal of minimizing the amount of solid waste deposits. The Desalination Plant Stage II testing operation began in 2002 when the production of $Al_2(SO_4)_3$ was put in operation. The operation of classic neutralization stations is planned for 2006-2030 for the treatment of less contaminated solutions pumped from the borders of the contaminated area.

Conclusions

It is difficult to judge old projects according to present conditions and regulations. But we should learn from past mistakes when developing new projects.

The ISL project in Straz was developed under conditions prevalent in the 1970s and 1980s. There were many attempts to start remediation actions during the operation, but the main priority was uranium production and at that time any other activity would only have raised the operation costs.

For this reason, remediation at present is and will continue to be very costly. The present estimate is 56 billion CZK (over 2 billion USD) during a period of 40 years remediation and decommissioning.

Well logging: how it helps reduce environmental impact on contaminated land

by Dr. Martin Procházka[1]

Modern well logging is a relatively cheap technique offering a wide range of information. Well logging on risk assessment and supervision projects can prevent various problems. Solving of such problems at a later stage is usually either much more expensive or, in many cases, impossible. Unfortunately a very frequent example of this is the percolation of contaminated water to lower aquifers through badly constructed boreholes. The careless location of boreholes in contaminated areas is also a common problem. Methods of well logging have changed substantially over the last few years. The majority of these methods are at present practically unknown to the wider professional public in terms of new equipment as well as new methods and procedures for solving various tasks. The aim of this contribution is not to summarize the new methods but rather to present solutions to certain problems by means of well logging.

La diagraphie moderne représente une technique qui procure un large champ d'informations. Pour l'évaluation des risques et le contrôle de projets, la diagraphie est à même de prévenir nombre de situations à problèmes. La résolution de ces problèmes, après coup, est d'habitude soit beaucoup plus onéreuse soit impossible, dans nombre de cas. Ainsi un exemple très fréquent et désolant concerne la contamination par percolation des eaux polluées vers des aquifères profonds, le long de forages défectueux. L'implantation inconsidérée de forages en zones polluées est aussi un problème récurrent. Les techniques de diagraphie ont changé substantiellement, ces dernières années. Ces techniques, en majorité, sont pratiquement inconnues aujourd'hui d'une communauté professionnelle croissante, en termes de nouveaux équipements comme de méthodes et de procédures pour répondre à des problèmes très divers. Le but de cet article n'est pas de résumer les nouvelles techniques mais plutôt de présenter l'apport des diagraphies pour régler certains problèmes.

En la actualidad la testificación de sondeos es una técnica relativamente barata que ofrece una amplia información. La testificación para el asesoramiento de riesgos y los proyectos de supervisión pueden prevenir problemas muy variados. La resolución de tales problemas en un estadio posterior es generalmente o mucho más caro o, en muchos casos, imposible. Desafortunadamente, un ejemplo muy claro de lo anterior es la percolación de aguas contaminadas hacia acuíferos inferiores a través de sondeos mal construidos. La localización negligente de pozos en áreas contaminadas también constituye un problema frecuente. Los métodos de testificación han cambiado sustancialmente en los últimos años. La mayoría de esos métodos en la actualidad son prácticamente desconocidos para el público profesional más amplio, en términos de nuevos equipos, así como de nuevos métodos y procedimientos para la resolución de tareas variadas. El objetivo de esta contribución no es resumir los nuevos métodos sino presentar soluciones a ciertos problemas por medio de la testificación de sondeos.

The construction and depth of boreholes in contaminated areas is, as a rule, based on knowledge of stratigraphy as well as analysis of rock and water samples. Although this is the usual process of investigation, the methodology can be insufficient. Why? Because the real regime of groundwater flow is not taken into account. Real aquifers and permeable fractures are not studied nor are velocities and the direction of real water movement.

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Almost nothing is known about the preference paths of water flow even though these paths are usually decisive in contaminant spreading. Knowledge of the water level and its changes in the vicinity of several boreholes is insufficient and unfortunately often overestimated. Reliability of hydraulic modelling can be low, especially in areas with fractures. The permeability of rock is usually predetermined by the permeability of fractures and by other preference paths of water movement.

This type of permeability is dominant not only in hard rock formations but also in sediments. Therefore laboratory measurements of permeability on rock samples usually have low credibility because pure porous permeability is rare, occurring most frequently in quaternary sands and gravels. Aquifers are never homogenous. Mistaken conclusions are frequently presented on the basis of the mentioned data alone, leading to badly designed borehole construction.

Percolation of contamination to lower aquifers

One of the common problems is percolation

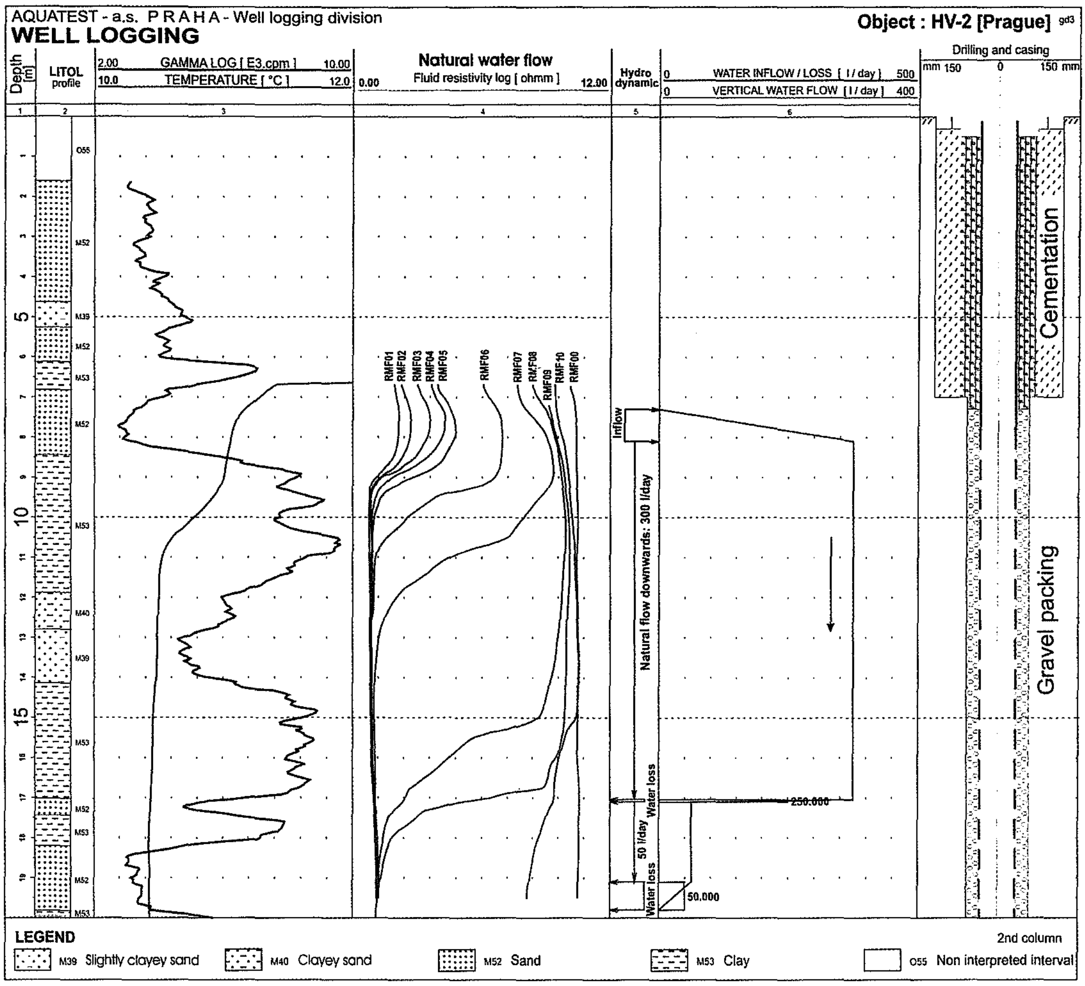

Figure 1. Example of percolation of contaminated water to a lower aquifer due to a badly constructed borehole

of contaminated water to lower aquifers through the borehole-valve, due to badly constructed boreholes. Unfortunately it appears that this effect is not an exception but almost the rule. A paradoxical situation is that various environmental companies actively participate in amplifying problems by bringing the contamination to water-bearing lower aquifers.

Water sampling during the remediation process can yield false results. At first sight the contamination appears to be lowered by the remediation. Apparent optimism in this case can be false because a major part of the contaminant spreads to lower horizons and out of the area.

Contamination usually implicates the subsurface soil layer. Contamination generally spreads downward very slowly due to the relatively low permeability of the underlying rock. Should the well breach naturally isolating layers (e.g. clays) and continue to an aquifer of relatively permeable layers, contamination will usually spread from the well to the aquifer. Outwardly there is no evidence of this process but the result of this adverse phenomenon will be reflected later in increased concentrations in groundwater relatively far from the source of contamination. The higher the number of such inappropriately designed wells, the faster the process of groundwater contamination. These problems can be identified in time if well logging is used. The lithological profile is first determined using specific methods. The simple combination of gamma and neutron well logging is most commonly used for loamy and silty sediments. Filtration methods using resistivity or photometry will determine the possible flow of water into the well. Downward flow may or may not be confirmed, as is the inflow of water to the well. In addition, areas of water loss are identified. It is possible to determine the inflow of the amount of contaminated water from the well to the aquifer over time (Fig. 1). In this way it is possible to monitor even very slow flow in units of liters per day. In cases of very rapid flow, it is possible to use filtration methods with a flow meter. Well logging yields a recommendation on the most favourable well depth or casing. In worse cases, it can propose the decommissioning of the existing wells.

Preferential flow paths

Another common problem is the inappropriate location of remedial wells. These are usually located in contamination hotspot areas. The reason for contamination lingering even a long time after the accident is due to previously non-existent or very slow flow of water in the area of the hotspots. With restriction of a continuous contamination supply, the hotspot will lie just in the area with slow or no flow. Dilution and flow of contamination happens in areas with a rapid water flow, mainly in areas of preferential flow paths. Without knowledge of the groundwater regime, remedial wells are typicaly situated in hotspot areas outside the preferential flow paths However, the contamination is spread via these paths to the surrounding area. It would be best, therefore, to locate several remedial wells in the preferential paths in order to limit the release of contaminants to the surroundings.

Preferential pathways can be tectonic fractured areas, sediment with relatively low content of clay in comparison with the surroundings or also pathways arising from human activity (backfilling etc.).

Well logging measurements can be advantageous in a given location with several wells. Well logging can be a simple method (filtration method). On the basis of the measurement results, it is possible to identify both wells in which flow rarely occurs and wells with rapid water flow.

The flow velocity in individual wells is calculated. In the surroundings of wells with rapid water flow, it is advantageous to measure a further two or three wells in order to specify the direction of the preferential path. It is advisable to complement well logging with subsurface geophysics (combined profiling, shallow seismic refraction etc.). However, due to the fact that subsurface geophysics methods are affected by engineering networks, and existence of buildings, fences, etc., it is often impossible to use them on site. The advantage of well logging is also the fact that it is not affected by engineering networks; thus it is usable in any built-up area. Well logging yields a recommendation on the optimal location of wells in the remedial area.

Conclusion

The main obstacle in the greater application of well logging on remedial wells is the remedial company itself, which often considers knowledge of the real ground water regime as a complication. Therefore the companies usually oppose the use of well logging and sometimes only request its use when the contamination encroaches on drinking water resources.

Incorporating well logging in risk analysis projects and supervision activity is also very difficult, mainly due to current legislation in the Czech Republic, in which risk analysis and supervision accounts for only 2% of the total amount of remedial work. Another reason is that the work is sometimes awarded by people not specialized in geology or geophysics. These people sometimes do not see the geological or geophysical risks.

One of the ways of initiating the use of relatively cheap well logging in projects related to environmental protection is familiarization with this method and illustration of the usefulness of the application of well logging for minimalization of possible damage resulting from other inappropriate methods.

Geophysics in the Czech Republic

by Miroslav Kobr[1]

The history, organization and recent activities of geophysics in the Czech Republic are described. The range includes teaching of geophysics since 1952, geophysical surveys, production of geophysical instruments and research. At present, geophysicists in the Czech Republic are organized under the Czech association of Applied Geophysicists (CAAG), established in 1992. CAAG deals with both the professional and the scientific problems of the members. In 2003 the association organized an international conference on environmental and engineeering geoscience.

L'histoire, l'organisation et les récentes activités d'ordre géophysique en République tchèque sont ici décrites. Cela recouvre l'enseignement en géophysique depuis 1952, les études géophysiques, la fabrication d'appareillages géophysiques et la recherche. Actuellement, les géophysiciens de la République tchèque sont organisés au sein de l'Association Nationale des Géophysiciens en géophysique appliquée (CAAG), créée en 1992. La CAAG s'occupe des problèmes de ses membres aussi bien dans le domaine professionnel que scientifique. En 2003, l'Association a organisé une conférence internationale en géosciences de l'Environnement et de l'ingénieur.

Se describe la historia, organización y actividades actuales de los geofísicos en la República Checa. La relación incluye la enseñanza de la geofísica desde 1952, estudios geofísicos, producción de instrumentos geofísicos e investigación. En la actualidad los geofísicos de la República Checa se agrupan bajo la Asociación Checa de Geofísicos Aplicados (ACGA), fundada en 1992. ACGA trata tanto con los problemas profesionales como científicos de sus miembros. En 2003 la asociación organizó un congreso internacional sobre ingeniería geológica y geología ambiental.

Applied geophysics in the Czech Republic was established as a part of applied geology at Charles University in Prague, in 1952, where all geophysical disciplines were accommodated. Simultaneously, a central geophysical survey was organized in the company, Geofyzika, a.s. Brno. Besides its main focus on oil seismics, Geofyzika has also been active in other geophysical activities, such as mapping, engineering, hydrogeology, manufacturing of instruments and, in recent years, serving the government as manager of the Czech Republic's national geophysical database.

A major part of the geophysical survey of the Czech Republic was focused on searching for raw materials, mostly uranium ores. Logging surveys were not centralized and each enterprise of the Geological survey had its own logging centre. The situation changed in principle in the 1990s. Applied geophysics is now carried out by numerous geophysical groups, all of them dealing, to some extent, with environmental problems. The more active companies carrying out surface geophysical surveys are: G Impuls Praha producing excellent geophysics data for the railroad; TERRATEC, GEONIKA, INSET, GEKON from Prague, working on engineering problems, the last is also a leading hydrogeological company involved in mineral and warm water problems; GEODRILL, SIHAYA in Brno and GEOTEST in Ostrava, dealing with engineering problems. The companies engaged in logging are AQUATEST (hydrologging) in Prague, GEOTREND and PENETRA (cone penetrometers), MND Hodonín (logging and seismics for oil and gas), GEOLOGICAL SURVEY Ostrava (logging for coal and gas reserves). The Czech Association of Applied Geophysicists (CAAG) was founded in 1992 and brings together geophysicists from the private sector, from universities and from academic institutes. Its main tasks are cooperation with the Ministry of Environment in legislative procedures dealing with geological activities, ensuring quality standards in geophysical work and organizing professional courses for its members. The first chairman of CAAG was Dr. Miroslav Kobr from Charles University in Prague, who served for four years and was succeeded by Prof. Jaroslav Knez also from Charles University. At present Dr. Kobr is again serving as president. The members (about 130) are organized in three offices in Prague, Brno and Ostrava. CAAG publishes a Bulletin and a professional journal (EGRSE - Exploration Geophysics, Remote Sensing and Environment) to promote the activities of the members. Members often take part in European meetings of the EEGS-ES Association, now called the Near Surface Geoscience Division of the EAGE. On 1-4 September 2003, CAAG organized the Annual Meeting of this organization in Prague.

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Range of geophysical activity

Nondestructive methods in the construction industry: Consideration of the inherent geological and mechanical qualities of sites of planned building activity (tunnels, buildings, highways, railroad, silos, dams, pipe-lines).

Nondestructive methods in Engineering Geology: Exploration of landslide areas, prospecting of slide surfaces, monitoring of slide movements, determination of slope and embankment stability; mapping of engineering networks, cables, including cable connections, consideration of the environmental impact of metal objects (corrosivity) placed under the earth surface (pipe-lines, reservoirs, etc.), detection of metal objects (e.g. ammunition) and/or cavities; prospecting of foundations in poor geotechnical conditions, detection of sudden changes in geological structure, appreciation of the degree of disturbance of rocks caused by weathering, estimation of geotechnical parameters and breaking characteristics of rocks, determination of bedrock depth and cover character, time distribution of natural high-frequency electromagnetic impulses.

Hydrogeology

Regional and detailed surveys to evaluate groundwater resources (to propose the location of boreholes for capture of water), checking of reservoir permeability (setting pits, dams), tracing of amelioration networks and appreciation of their eventual breakdown, determination of ground water dynamics in water wells.

Solution detection and monitoring of contamination, including borehole investigation, use of induction well logs for groundwater and rock environment remediation (in the area where former uranium mineralization was exploited from boreholes, using acid leaching solutions).

Protection of underground water against various types of contamination (oil, thermal, agricultural, radioactive, etc.) or against excessive exploitation.

Survey and captation of mineral and thermal waters.

Evaluation of the intensity of leakage from water reservoirs, or creation of check and warning systems for detecting defects in the quality of the sealing compounds in earth dams.

Determining geometry of hydrogeologic structures and in favourable cases, evaluation of selected hydrogeological parameters of reservoir rocks under investigation.

Waste disposal and site characterization

Selection of sites for locating dumps, measuring on dumps (and other artificial bodies) to solve stability problems.

Monitoring systems of dumps, searching for liquid and gaseous leakage pathways from dumps.

Evaluation of seismic effects on mining-induced seismic events on surface structures, seismic ground vibration induced by blasts in Tušimice mine, use of long term levelling measurements on surface of the exploited uranium deposit Rožná for mathematical modelling of surface ground subsidence.

Prospecting for archaeological objects, consideration of geological conditions and their influence upon valuable historical monuments.

Geology of deposits

Prospecting for construction and other raw materials, investigation of their quality and proposal of a convenient way of mining.

Determination of the thickness of sediments and the depth of underlying rock, mapping of parts of the deposit that are not suitable for mining.

Radiometric data defining the natural environment.

Terrestrial radiation and nuclear fall out, detection of gamma rays, concentration of K, U and Th in rocks and gamma dose rate (nGy/h) and the detection of long life fall out isotopes 137 Cs and 134 Cs, emitting gamma rays.

Radon risk mapping: radon risk category is determined by the radon activity concentration in soil gas (kBq/m3) and soil permeability, measurements usually taken in situ.

Indoor radon monitoring by short term measurement using continual monitors of the type FRITRA and RADIM (plch-smm@mbox.vol.cz), long term measurements by means of alpha track film detectors provided by SÚJCHBO (in Príbram), the branch of the State Office for Nuclear Safety (lmr@sujchbo.cz).

Laboratory analyses: numerous laboratories carry out laboratory radiometric measurement and analyses of rocks, water, air and building construction materials by gamma ray spectrometry using scintillation or semiconductor detectors.

Natural Hazards

Digital sources of geological data in the Czech Republic for evaluation of geohazards.

Geophysical companies producing geophysical instruments.

GF Instruments, s.r.o., Brno. offers instruments both for laboratory and field use, for data acquisition and processing. The more noted products are: ARES - Automatic Resistivity System, Metal Detectors, Micro Resistivity System MRS - 256, Conductivity Meters and Multipurpose Gamma-Ray Spectrometer..

W&R instruments, s.r.o. Brno, offers a portable logging unit.

RS DYNAMICS, s.r.o, offers a Photoionization Soil Vapour Analyser, type ECOPROBE used for reliable and rapid soil contamination surveys, accurate monitoring of remediation processes, agriculture environmental problems, etc. ECOPROBE locates underground sources and spread of all hydrocarbons, chlorinated compounds and a wide range of other toxic materials.

Research in applied geophysics in universities and academic institutes.

The Department of Applied Geophysics of

the Faculty of Natural Sciences, Charles University, is engaged in the following environmental studies

i. "Microgravity investigations and applications in environmental geology". This work includes both methodological and theoretical studies as well as gravity surveys of sites in the field, including methods of measurement and computing of time-related gravity phenomena (tides, drift) and the influence of time on microgravity measurements. Sites affected by old undocumented coal mining are investigated in the field. Funded by the Grant Agency of the Czech Republic.

ii. "Geophysical control of the contamination/cleanup state of rock polluted by oil and oil products". Research Project funded by the Grant Agency of the Czech Republic in 1998-2000.

The goal of the project is to test geophysical methods for controlling the contamination of soil or rock by light non-aqueous phase liquids (LNAPL). The following methods have been selected as most appropriate: a) geoelectrical methods - dipole electromagnetic profiling, multielectrode resistivity measurements (ERT), ground penetrating radar (GPR) and time domain reflectometry (TDR), b) cone penetration tests (CPT) combined with logging (mechanical cone resistance, mantle friction, gamma-ray logging, density logging and neutron logging. Two test sites 2000 m^2 in area have been selected in the former military area Ralsko-Hradcany for practical testing of these methods. The kerosene contamination of ground water and soil has been proved in both the testing sites. The remediation programme is running on both the test sites under the supervision of the KAP Company, the efficiency of the clean-up processes is controlled: a) by the pumped amount of the free hydrocarbon phase from the water level in monitoring wells, b) taking regular fluid samples from monitoring wells and estimating the thickness of the free hydrocarbon phase on the water level. The depth to unconfined water table is 3.5 to 4.5 m. The above given set of geophysical methods has been applied at least three times within three years and multielectrode resistivity measurements are taken even more frequently. A geophysical survey has been completed, measuring hydrocarbon gases, methane and carbon dioxide in the air soil using ECOPROBE 5. The conclusions are as follows: a) The low resistivity zone in the upper part of the aquifer - documented by results of the resistivity survey (ERT, system of vertical electrodes) and GPR records - is indirect evidence of the LNAPL plume. The extent of the LNAPL plume is clearly demonstrated in the results of the atmogeochemical survey and the evidence of the contaminated zone in the vertical section on results of neutron and permittivity logging in the CPT holes.

The Institute of Geonics, Academy of Science of the Czech Republic, Ostrava, researches the effects of human activity on processes in the Earth's crust.

The Institute of Rock Structure and Mechanics, Academy of Science of the Czech Republic, Praha researches the problems of landslides, such as impact of anthropogenic activities on natural slope stability. Other important tasks deal with earthquake hazard and seismic risk assessment.

The Geophysical Institute of Prague, Academy of Science of the Czech Republic conducts basic research into the physics of the Earth. Nevertheless, the institute dedicates part of the research to environmental magnetism, investigating the relationship between the main magnetic minerals present in soils, fluvisols and lake sediments, on the one hand, and toxic elements produced by industrial activity on the other.

Stability of the Krušné hory mountain slopes: the North Bohemian brown - coal basin foreground

by Dr. Jan Marek[1]

The extension of brown-coal mining activities in the form of large open pit mines extending to the crystalline massif of Krušné Hory has caused numerous problems involving the stability of the slopes of the mining pits and the hillsides in the forefield. The seriousness of these problems has called for detailed investigation, involving the large open pit coal mines themselves, a number of geotechnical analyses, as well as the application of various monitoring methods. As a result, it was possible to prevent extensive damage which would have had huge economic repercussions.

Le développement des activités minières pour la houille, sous forme de grandes exploitations à ciel ouvert, qui s'étendent jusqu'au massif cristallin de Krušné Hory, a occasionné nombre de problèmes concernant la stabilité des pentes au niveau des puits et fronts de taille. La gravité de ces problèmes a conduit à des études détaillées, touchant les puits d'exploitation eux-mêmes, mettant en oeuvre un grand nombre d'analyses géotechniques ainsi que des méthodes diverses de contrôle. Conséquence de ces travaux, il est devenu possible de prévenir des dommages importants qui auraient eu des répercussions énormes du point de vue économique.

La extensión de las grandes explotaciones mineras a cielo abierto de lignito en el macizo cristalino de Kruané Hory ha causado numerosos problemas incluidos la estabilidad de los taludes de las explotaciones y las laderas de las proximidades. La gravedad del problema ha motivado una investigación minuciosa de las grandes explotaciones a cielo abierto, la realización de un número de estudios geotécnicos, así como la aplicación de varios sistemas de control. Como resultado, fue posible prevenir daños generalizados que habrían podido tener grandes repercusiones económicas.

In the early 1970s, a large open-pit coal-mine, 200 m deep and more than 1 km wide, began to expand from the center of the North-Bohemian Neogene coal basin towards the foothills of the longitudinal crystalline massif of the Krušné hory mountains. As the first open cast coal mine in that region, it was expected to expand, including its waste dumps (stripping of overburden), towards the hillsides of the Krušné hory mountains. The exploitation of the coal deposits in the foothills of the mountains were the main reason for the mine expansion. Previously, there had been only a little underground mining, now phased out.

The underground mines gave a low coal yield of 50 % and they had to face a number of difficulties - in the mining process and with the maintenance of the entrances, danger of inflow of ground water, firedamp, mountain pressures, sliding of hanging walls, etc. The entrances needed a lot of support. The mining process in open-pit mines avoids these problems and enables a high level of mechanization while producing almost total coal yield. Its disadvantage, however, has been the removal of a huge volume of clay stone overburden, which had to be transported and deposited onto waste dumps. The mining process through open-pit mines has literally turned the landscape "upside down". Before the expansion of mining activities into a new area, it was necessary to relocate all the residents, to remove all production facilities, roads and highways, utility services networks, water reservoirs (dams, lakes, ponds), forests and farmsteads, and build replacement structures at different locations. This required huge initial investment.

Brown coal from the North-Bohemian basin has been used mainly as a raw material to generate power. Until the change of the political and economic system in 1989, most of the power industry in the country was dependent on these mining activities.

The geology and the mining process

The brown coal seam in this part of the North-Bohemian basin has a uniform development and a relatively constant thickness of about 25 m, almost without heterogeneous partings (Figs 1 and 3). This near-horizontal seam from the lower part of the Neogene series of strata lies below a layer of more than 150 m of loosely consolidated claystone.

Since there was almost no use for the claystone, it was removed to waste dumps, where it subsequently caused problems within the body of the dumps. It consolidates slowly and is susceptible to becoming slushy and sinking into the dump. Stabilization of the dump surface was costly and required specialized treatment. In open-pit mines, the upper 10-15 m (stripping of overburden) were in claystone. Some of the uppermost layers were susceptible to sinking. The claystone up to a depth of several tens of meters was reworked, loosely compacted, and showed signs of being repeatedly frozen and expanded in the Pleistocene Period, due to climatic changes. Additionally, at the edge of the coal basin, tectonic discontinuities from the crystalline subsoil, which penetrated throughout the whole Neogene series of strata, also have had their effect.

The crystalline massif of the Krušné

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hory mountains forms a straight line boundary with the Neogene coal basin, oriented in a NE - SW direction. The existence of this long geological boundary and the 700 m height difference between the mountain chain and the basin plateau clearly indicates the existence of a significant tectonic zone, apparently extending to depth. Alongside this zone, during the Pleistocene Period (older Quaternary era lasting 1.5 to 2 myr), the mountain chain was elevated by up to 1000 m subsequently reduced by the effects of erosion and deformation of the hillsides.

Within the crystalline massif, there are several prominent individual internal arch structures. One of them is "Katerinohorská" arch, which at its center has coarse grained undeformed granitite with significantly lineated, tabularly jointed gneisses surrounding it. Deformation of the covering around the arch core resulted in the fact that, in the zone of the Krušné hory main hillside, over a length of about 1 km, the foliation of the gneisses is inclined in the direction of the Neogene basin.

The existence of the relatively lightweight but hard granitites at the center of the "Katerinohorská" arch has caused a relatively higher lift of this part of the crystalline massif. The combination of intense uplift of the massif, its separation by steep tectonic discontinuities into individual blocks and sheets, and the inclination of the foliation of the schistose elements of the crystalloid mineral, resulted in the highest and steepest hillsides. During the Pleistocene era, the collapsed parts of the crystalloid body rolled down into the coal basin area, up to a distance of over 2 km. The volume of the three largest collapsed bodies was estimated at about 27 million m³. Holes drilled to establish the thickness of the coal deposits as well as hydro-geological drill holes have verified the thickness of the collapsed masses as exceeding 70 m. Below them is a normal sequence of basin sediments, including the coal seam. This was the largest collapse that was identified and verified within the whole Czech massif. The advancement of the large open-pit coalmine towards the foothills of the Krušné hory mountains called for extensive investigations in the 1950s and 1960s to determine the volume of the coal deposits and the position of the coal seam. In the course of the 70s, this has also required extensive hydro-geological investigations of the forefield of the large open-pit coalmine. It was necessary to determine the amount of surface and ground water that would flow into the open pit, and to determine the consequences for the surrounding area of lowering the ground water level.

In order to solve these problems, the investigations also involved detailed geo-technical mapping of the wide forefield of the mine, covering not only the area of the coal basin, but also the hillsides and peaks of the Krušné hory mountains, an area of several tens of km². This was to determine the nature of the Quaternary cover, its heterogeneous characteristics, deposition, thickness, grain size distribution, and permeability. During several years of mapping, it became clear that geo-technical problems, especially in relation to the stability of the slopes of the deep and extensive mine pit and the stability of the hillsides of the mountainous massif in the forefield should be resolved. Failure to tackle these problems could have far reaching economic and environmental consequences.

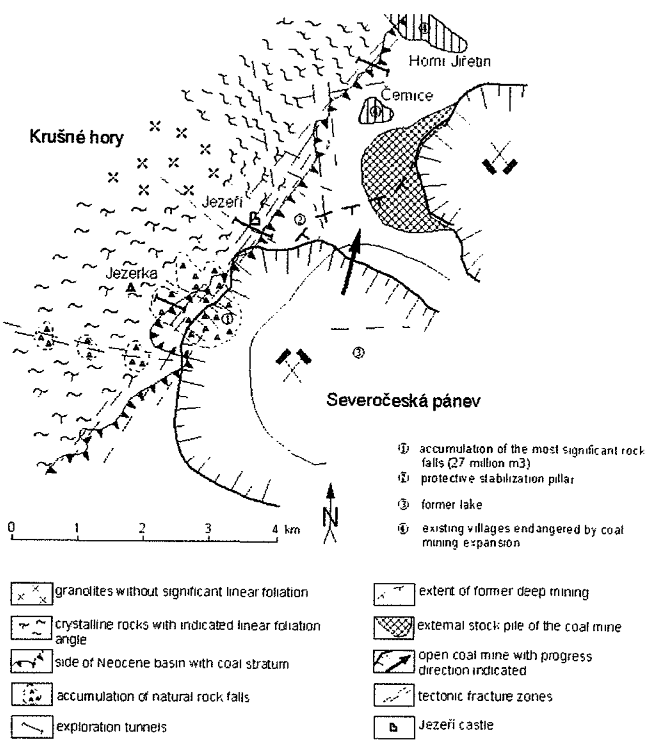


Figure 1. Geological map of the border between Krušné hory and Severoceská pánev near Jezerí

Mining procedure and environmental protection

The conclusions of the geo-technical mapping process evoked surprising reactions from the management of the Severoceské doly (North-Bohemian Coal-mine) Company, primarily, distrust in the conclusions. Concern about a possible catastrophe, during which the coal deposits, large-size excavators, and roads/highways could be buried under fallen rock, and the lives of the miners could be endangered, called for a new investigation, a detailed geo-technical investigation, of the part of the forefield identified as the most dangerous. It was an area, where, on the slope of the crystalline body, on one mountain hillside, there was an

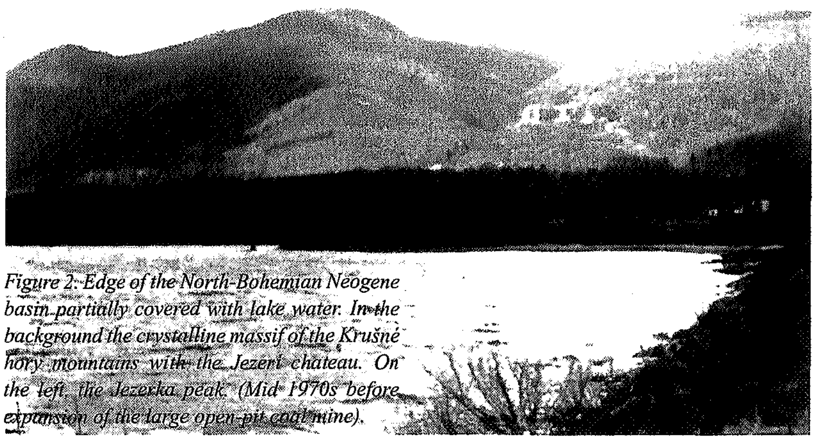
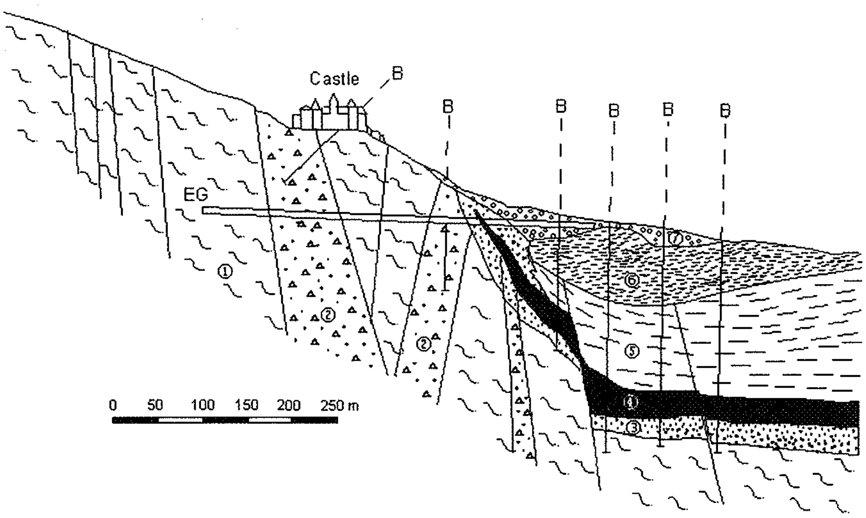


Figure 2: Edge of the North-Bohemian Neogene basin partially covered with lake water. In the background the crystalline massif of the Krušné hory mountains with the Jezerí chateau. On the left, the Jezerka peak. (Mid 1970s before expansion of the large open-pit coal mine).



① fresh crystalline complex ② widespread tectonic zones ③ tertiary basin sediments of sandy character ④ coal seam ⑤ tertiary basin sediments of clayey character ⑥ tertiary clays basically disrupted by pleistocene permafrost ⑦ quarternary deposits /rubble, gravel/
B exploratory bore-holes EG exploratory gallery

Figure 3. The geology of the area around Jezerí castle in Krušné hory. Simplified geological cross-section from the 1977 - 81 investigation

important national heritage monument and the dominant feature of the region - the Jezerí chateau.

The chateau was built on the site of a gothic-style castle, on one morphologically separated crystalline block on the hillside of the Krušné hory Mountains, probably the result of tectonic forces on the main crystalline massif. This block rises to a height of about 100 m above the surrounding plateau of the Neogene basin. When the castle was built, this basin was covered for the most part by the large Komoranské lake (Fig. 2).

Extension of the open pit coal mine could have resulted in the chateau today standing on the edge of a 300 m drop. That is why detailed geo-technical investigation occurred in the area around the Jezerí chateau. The activities in the large open-pit coal mine could have simulated conditions in the Pleistocene where large rock falls occurred on the neighbouring hillside. Apart from endangering operations in the mine, this would risk the collapse of the chateau and destruction of the natural formations on the mountainside, endangering the Quaternary forest cover.

A series of core holes were drilled in the mountain foothills; an underground drill hole from one of these galleries; an oblique drill hole into the subsoil of the chateau; and geo-physical and geo-technical measurements were taken. Additionally, a detailed investigation of the cellars of the chateau was undertaken. It was also necessary to investigate medieval ore mining sites on the surrounding mountainsides and to review documentation related to the former deep mining under the mountain foothills. The investigations lasted four years and confirmed the conclusions of the previous mapping process. The investigations confirmed the existence of tectonic zones of faults/dislocations and the danger of destabilizing the hillside and the chateau if the Neogene sediments at the foothills and in its vicinity were removed.

The investigations were followed up by a hitherto-unique analysis of the stability of the high hillside by the "final elements" method, implemented by independent experts, as well as a unique test on a physical model assembled at the Geo-Technical Faculty of the Technical University in Brno. Again, these investigations confirmed the danger of the hillside's instability, if the foot of the hillside with the chateau as an acting load should be removed.

When the detailed geo-technical investigations at the Jezerí chateau began, the large open-pit coal mine was still at a distance of about 3 km from the foothills, but was progressing rapidly. Therefore, the results of the investigation work called for rapid implementation of additional prospecting activities in neighbouring areas with similar morphological features and geological conditions, specifically, under the Jezerka hill, near Cernice, and Horní Jiretín villages. The new investigation called for a government research initiative to resolve the stability problem related to the progress of mining activities of the large open-pit coal mine throughout the whole area of the foothills of the Krušné hory mountains. A number of experts from scientific institutions of the Czech Republic have worked for several years to solve these problems.

It was necessary to secure the most endangered sections of the foothills by leaving in place the basin sediments together with the coal deposits, to emplace stabilizing pillars. It was therefore necessary to modify the mining process to respect these pillars. For the operation of the large open-pit coal mine, an early warning system and emergency plan were implemented. Within the critical sections, a complex system of geological and geo-technical monitoring was installed in order to evaluate the influence of the approaching mining activities and the development of possible movements. The monitoring systems have been in place for a number of years and are modified as new technology emerges.

At present, the Jezerí chateau is undergoing an overall reconstruction which should help to regenerate this landscape. It is estimated that coal mining activities will terminate in about 40 - 60 years. The repaired state chateau, with its important 600 year history, will become the dominating feature of this carefully reclaimed landscape. In addition, its location near the state border with Germany, should result in the chateau being used by international organizations studing, for example, the impact of large-scale devastation of the landscape and the possibilities for its protection or regeneration.

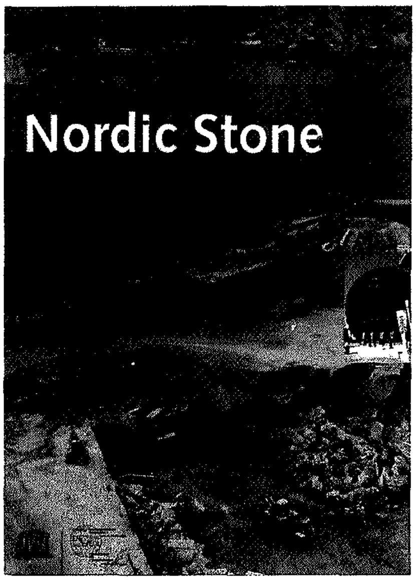
Conclusion

It is certain that, based on exacting geotechnical investigations, an extensive slope stability disaster that would have had huge social, economic, and environmental impact has been prevented. The showcase of the successful resolution of these problems is the existence of the Jezerí chateau, which continues to dominate the surrounding landscape and which is being restored even during continuing large-scale coal mining activities at the edge of the North-Bohemian coal basin. The investments put into the coal-mining expansion were not in vain and coal mining was only partially limited by the stabilizing pillars at the most dangerous sections at the foothills of the mountains.

NORDIC STONE

Edited by Olavi Selonen and Veli Suominen. Geological Science Series. UNESCO PUBLISHING. ISBN 92-3-103899-0. Softback.

Review by David Harper[1]



The geology of the Nordic countries (Denmark, Finland, Norway, Iceland and Sweden) is diverse, tracking earth history through nearly 3 billion years of changing environments, magmatic and tectonic processes, displayed today in a spectacular variety of landforms. Building stone, in contrast to most other exploitable resources, is not associated with a specific bedrock or geological environment. Rather, such stone is extracted from a large variety of rock types: igneous, sedimentary and metamorphic rocks have all contributed to building and construction projects at a range of scales. The diverse geology of Norden is an ideal laboratory to describe and illustrate the use of naturally occurring stone in the construction industry. This attractive book, associated with IAEG Commission C-10, targets three of the Nordic countries, Finland, Norway and Sweden. The other Nordic countries also have building stones; Denmark, for example, too has exploitable resources such as the basement rocks, the Nexø Sandstone and Komstad Limestone of Bornholm together with the Danian limestones of Sjæland; but the focus of this book is on the roots of the Baltic palaeocontinent.

The book is organized into seven chapters covering introductory material; definitions and terminology; requisites for natural stone; history and heritage; stone resources and distribution; technologies; environmental impact of the natural stone industry. The core of the book, stone resources and distribution, lists and illustrates the occurrences of most of the main rock types. Particularly useful are the technical annexes and indices of locations and commercial names. The book is laid out in a readable double-column format. Although most of the colour photographs are sharp, the map of the 'Nordic countries' with natural stone deposits is poorly reproduced. Table 2 is a useful compilation but I am not aware of any Silurian limestones on Öland whereas the very well-known Silurian limestones on Gotland are omitted. Rather the ortoceratitic [*sic*] limestones on Öland are in fact of mid Ordovician age, marginally younger than the Volkhov limestones of western Russia that built many parts of St. Petersburg and its environments. The book is, nevertheless, an excellent work of reference on an exploitable geological resource apparently, as the preface informs, compatible with the concept of sustainable development.

[1]Professor of Palaeontology, University of Copenhagen

Submission of articles to European Geologist Magazine

The EFG calls for quality articles for future issues of European Geologist. Submissions should be in English and between 1000 and 3000 words, although longer articles may be considered. An abstract of between 100 and 150 words should be included in English, French and Spanish. Articles should be sent via e-mail to the Editor at Harper-mccorry@mail.tele.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.

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

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4. To maintain contact with the European Commission and respond in timely manner to requests for information.
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- to promote the harmonisation of education and training.
- to define and protect the title of geologist and related professional titles.
- to promote the code of professional ethics of the EFG.
- to provide advice and assistance to constituent member National Associations.