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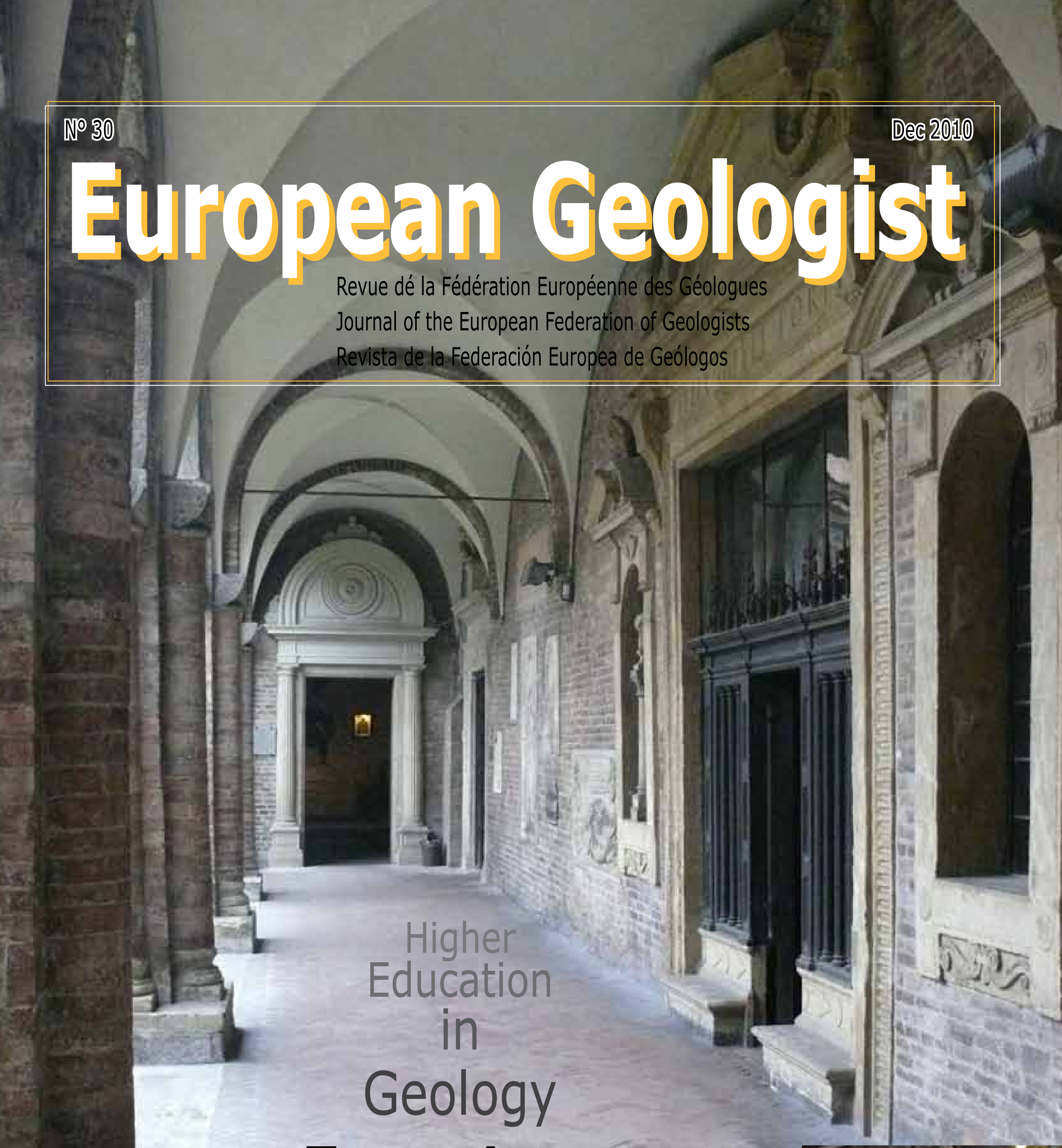
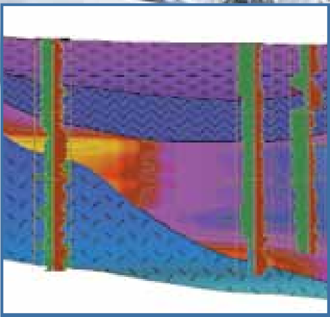
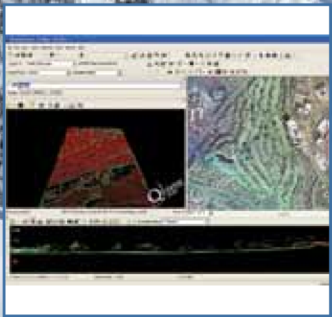
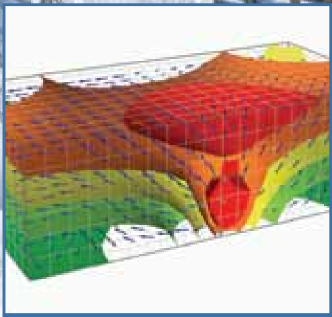


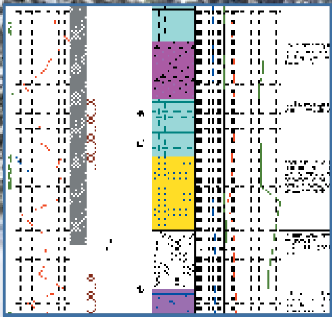
Higher Education in Geology

Euro-Ages









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Cover photo:
Main photo: Bologna, which houses the oldest continuously operating university in the world, established probably in 1088 (Photo: D. Harper). Smaller photos, from left: Graduation day at Bologna University (Photo: D. Harper); Student on practical training in a mine, Hungary.
Photos this page:
From left: Participating countries in mapping European Qualification; Students on mining practical training, Hungary; Students at the GeoMining Museum, Geological Survey of Spain (Photo: A. Calonga).

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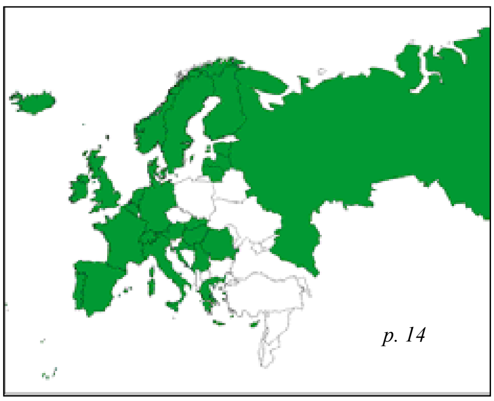

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Foreword

Euro-Ages

by EurGeol. Ruth Allington, President

This edition of European Geologist is a thematic issue on higher education and lifelong learning to mark the conclusion of the Euro-Ages project[1]. The final conference took place on 22 October 2010 and the final report will be completed during December 2010 and the early part of 2011.

The principal objective of the Euro-Ages project has been to review quality standards and criteria for the assessment of higher education study programmes in geology across Europe and to propose a framework for Europe-wide standards.

This is not a project about developing and attempting to impose prescriptive Europe-wide curricula for geological study programmes, but about articulating a set of high level learning outcomes (the quality standards) based on existing quality frameworks, and defining appropriate levels of attainment in terms of learning outcomes achieved on completion of each of the key Bologna cycles (including cycle 4, the stage at which professional qualifications may be attained). The vision is for the establishment of a Europe-wide accreditation scheme for geological programmes (based on assessment/certification against delivery of the Euro-Ages learning outcomes) that can sit alongside national and regional accreditation schemes that determine content and course structures in accordance with national laws and norms. The potential advantages of developing a shared understanding of an appropriate set of high level learning outcomes from geological programmes of study across Europe (and elsewhere in the World), and of agreeing the progression of skills and experience appropriate at the end of each Bologna cycle include:

- Supporting university teachers of geology in designing and developing their programmes having regard not only to the Bologna requirements (inputs and credits) but also to ensuring that graduate geologists possess the appropriate skill sets and experience to go on and become professional geologists
- Providing a common framework within which geologists can demonstrate progression and development from first cycle graduation to attainment of a professional qualification (such as European Geologist (EurGeol.))
- Facilitating mutual recognition of higher education programmes and professional qualifications through programme validation and certification on a Europe-wide basis
- Supporting the mobility of geology graduates and professional geologists
- Providing a 'quality label' for accredited geology programmes of first and second cycle.

Intermediate results of the project are available on the Euro-Ages website: (http://www.euro-ages.eu), or via the EFG website: (http://www.eurogeologists.eu). As the final results become available, they will also be posted on this website. Feedback on all these materials and an ongoing discussion within the wider geological community will be welcomed both now and when the project is finished. This will be co-ordinated via the EFG and reported periodically in this magazine.

[1]Project Partners: ASIIN Consult GmbH; European Federation of Geologists; Official Spanish Association of Professional Geologists (ICOG); Hungarian Geological Society (MFT); Swedish Natural Scientists Association - Geological Section.

Advisory Board: Dr. Hans-Jürgen Weyer (German Professional Association of Geoscientists - BDG); Dr. Paul Ryan (Tuning Educational Structures in Europe); Dr. Luca Demichelli (EuroGeoSurveys).

Euro-Ages

A leap towards transparency, comparability and mobility in geology in higher education across Europe

by André Rieck[1]

Combining the common interests and individual strengths of ASIIN (Germany), EFG (Belgium), ICOG (Spain), MFT (Hungary) and SACO (Sweden), Euro-Ages provides important reference points for the development and quality assurance of geology and geosciences in tertiary education. Within the scope of the project lifetime (2009-2011) this was primarily implemented by compiling a set of outcome descriptors for Bachelor's and Master's degree programmes. This reference framework can be used for programme development by individual higher education institutions, for the establishment of national sectoral qualification frameworks in geology and geosciences as well as for the improvement of accreditation and evaluation efforts across Europe.

Combinant les intérêts communs et la motivation de l'engagement individuel de l'ASIIN (Allemagne), EFG (Belgique), ICOG (Espagne), MFT (Hongrie) et SACO (Suède), le dossier Euro Ages fournit des points de référence importants en matière de développement et d'assurance qualité pour l'enseignement supérieur de la géologie et des géosciences. Dans l'optique du projet de toute une vie (2009-2011), un premier pas a été réalisé en compilant une série de fichiers rendant compte des programmes conduisant aux diplômes de Licence et de Maîtrise. Ce système de référence peut être utilisé pour le développement de programmes par des institutions individuelles en enseignement supérieur, pour la création de cadres de qualifications sectorielles nationales en géologie et géosciences et aussi pour plus de réussite dans les efforts en accréditation et évaluation consentis en Europe.

Al combinar los intereses comunes y las fortalezas de ASSIN (Alemania), FEG (Bélgica), ICOG (España), MFT (Hungria) y SACO (Suecia), el proyecto Euro-Ages aporta importantes puntos de referencia para el desarrollo y el aseguramiento de la calidad en la educacion terciaria de la geologia y las ciencias de la tierra . Dentro de los objetivos del proyecto, que cubre un periodo de 2009 a 2011, esto se llevó fundamentalmente a cabo compilando un conjunto de descriptores de los resultados de la formacion para los programas de Licenciado y Master. Este marco de referencia se puede utilizar en el desarrollo de los programas por instituciones de educacion superior concretas, para el establecimiento de marcos sectoriales de cualificaciones en geologia y ciencias de la Tierra asi como para la mejora de los esfuerzos de acreditación y evaluación en toda Europa.

Euro-Ages aimed at developing a qualification framework for geology, based on learning outcomes rather than input factors on the European level, thereby increasing transparency of the Earth Sciences qualifications and ultimately facilitating academic and professional mobility across Europe while at the same time stimulating students and graduates in the field of geology as well as professional geologists to pursue Lifelong Learning. The project allowed a structured exchange of best practices, expertise and country characteristics of professional practices in geology in the different European countries. The project moreover provided important reference points for quality assurance and related recognition issues focused on learning outcomes. At the same time, a pan-European set of outcome descriptors for the EQF level 6 ("Bachelor/ 1st cycle"), and 7 ("Masters/2nd cycle") serves as a reference framework for programme development by individual higher education institutions, for the establishment of national sectoral qualifications frameworks in geology and for the development of a sectoral qualification framework for geology encompassing all levels of the EQF. The persistent lack of comparable subject-specific tools for assessing and enhancing the quality of geology degree programmes on a national or transnational level in the past has proven to be a potential obstacle to the mobility of geologists, geology students and graduates. In response to this need, and in line with previous efforts undertaken by EU-supported projects, this joint project has involved the major stakeholders in the field of higher education in geology in order to develop a Europe-wide applicable qualifications framework and procedural guidelines for the assessment of geology degree programmes.

The manifold obstacles to academic and professional mobility are key challenges for the achievement of the Lisbon goal of making the EU the most competitive knowledge-based economy in the world. In many countries geology is a regulated profession, the exercise of

[1] ASIIN Consult GmbH

which is dependent on predefined academic achievements (frequently defined in input factors), practical experience and continuous professional development. Thus mobility will greatly be facilitated by the existence of tools for the recognition of qualifications and competences, such as the Tuning Education Structures in Europe Initiatives, the European Qualification Framework, ECTS as a Euroepean "academic currency", accreditation bodies acting as strong and independent systems of external quality assurance, and mutually respected standards and guidelines such as the ones developed by the European Association for Quality Assurance in Higher Education and adopted by the Bergen Conference in 2005. While the Framework for Qualifications of the European Higher Education Area, as adopted by the European Ministers of Education in 2005, provides a generic tool for the recognition of higher education qualifications, it needs to be translated into the specific fields of study in order to be applicable to the individual degree programme. For degree programmes in some disciplines, notably engineering, chemistry and informatics, sectoral qualifications frameworks have already been developed by pan-European networks to fit the needs of specific disciplines. For geology this gap remained to be closed by this project.

The roadmap

The Euro-Ages project started in February 2009 within the scope of a meeting at the EFG office in Brussels, Belgium. On this occasion the initial survey about geology study programmes across Europe was prepared. After refining the questionnaires and improving the approach of the survey in Lund, Sweden in May 2009, the questionnaires were distributed to all major stakeholders and the survey started to yield valuable information. These results were then compiled and edited to benefit the first draft of the qualification framework which was adapted in the aftermath of the third project meeting in Madrid, Spain in November 2009. The final project meeting took place in Düsseldorf, Germany in February 2010 and brought together the various aspects of Euro-Ages. Furthermore, planning for the test evaluation as well as the final conference was started in Düsseldorf.

Ultimately, in October 2010, the qualification framework including a first draft of the accreditation standards could be tested within the scope of an evaluation at the University of Miskolc, Hungary for the B.Sc. in Earth Science & Engineering. Valuable information for both the Euro-Ages peers and the programme managers at Miskolc were gathered during this process so that the feedback will continue to flow in the development of the qualification framework in the months ahead.

Also, on 22 October, the final project conference was held in Budapest, Hungary. On this occasion, participants from across Europe (and even beyond) had the chance to discuss the results, actively participate in the development of the qualification framework and exchange ideas for the future of geology in higher education.

The partners

The project was initiated and carried out by a consortium of five partners:

- ASIIN Consult is a subsidiary of ASIIN e.V., a not-for-profit accreditation agency carried by an all-embracing grand alliance of academic and professional associations and higher education institutions in Germany. All activities of ASIIN are aimed at securing and further expanding high standards and the quality of higher education in the fields of engineering, informatics, mathematics and the natural sciences, including geology.
- The European Federation of Geologists (EFG) with its 22 member country organizations is a Belgium-based organization. Its mission is to represent the geological profession in Europe and to safeguard and promote the present and future interest of the profession as well as to promote best practice policies with regard to the responsible use of the Earth´s natural resource.
- The Ilustre Colegio Oficial De Geologos (ICOG) is a professional association of geologists, a non-profit organization created to defend and support the interests of geologists in Spain. Its main objectives are to promote activities and studies regarding geology and facilitate the associated members the practice of the profession and to carry out studies, produce reports and assessments, elaborate statistics and other activities.
- Magyarhoni Földtani Társulan (MFT), was established as the Hungarian Geological Society in 1848. It represents the Hungarian experts and students involved with geology. Its main activities are bringing together professionals from geology and related sciences, representing their interests and presenting and disseminating practical and scientific achievements
- The geology section of the Swedish Association of Scientists (SACO) is a rapidly-growing professional association in Sweden. As a professional association SACO is working with questions related to their members' professional career status. Important issues are quality control of education and training, professional and ethical criteria, career coaching and the progress of science and research development.

Additionally, an international advisory board, consisting of three members with backgrounds in the educational as well as professional field, supported the project throughout the entire project lifespan with valuable advice and critical comments:

- Prof. Dr. Luca Demicheli (EuroGeoSurveys)
- Prof. Dr. Paul Ryan (Tuning Educational Structures in Europe)
- Dr. Hans-Jürgen Weyer (BDG - German Professional Association of Geoscientists).

The outcomes

Within two years, two sets of learning outcomes as well as criteria and procedural guidelines for both the internal quality management and external assessment of geological degree programmes have been developed for EQF level 6 and 7 and made public (www.euro-ages.eu). These European outcome descriptors will serve as a reference framework for programme development by individual higher education institutions in the process of conceptualizing or remodelling Bachelor and Masters programmes in the discipline.

Graduates having completed a First Cycle degree should have demonstrated the following capabilities:

Underlying basis

Basic knowledge and understanding of the natural sciences (Physics, Chemistry, Mathematics) underlying the study of Geology

Knowledge and understanding of the essential features, processes, materials, history and the development of the Earth and life

Basic knowledge and understanding of the key aspects and concepts of geology, including some at the forefront of that discipline

Knowledge of the common terminology and nomenclature and the use of bibliography in geoscience

Awareness of the wider spectrum of geological disciplines

Awareness and understanding of the temporal and spatial dimensions in Earth processes

Awareness of the applications and responsibilities of geology and its role in society including its environmental aspects

Awareness of major geological paradigms, the extent of geological time and plate tectonics

Knowledge and understanding of the complex nature of interactions within the geosphere

Appropriate knowledge of other disciplines relevant to geology.

Analysis, design and implementation

Ability to create simple geological models

Some understanding of the complexity of geological problems and the feasibility of their solution

Understanding the need of a rational use of Earth resources

Basic ability in the formalization and specification of problems whose solution involves the use of geological methods

Knowledge of appropriate solution patterns for geological problems

Basic ability to describe a solution at an abstract level

Knowledge of the range of applications of geology

Ability to integrate field and laboratory evidence with theory following the sequence from observation to recognition, synthesis and modelling

Appreciation of issues concerning sample selection, accuracy, precision and uncertainty during collection, recording and analysis of data in the field and laboratory

Ability to formulate and test hypotheses.

Technological, methodological and transferable skills

Basic ability to become familiar with new geological methods and technologies

Ability to select and use relevant analytic and modelling methods

Basic ability to apply appropriate technology and use relevant methods

Ability to use simple quantitative methods and to apply them to geological problems

Basic ability to independently analyze earth materials in the field and laboratory and to describe, process, document and report the results

Ability to undertake field and laboratory investigations in a responsible and safe manner, paying due attention to risk assessment, rights of access, relevant health and safety regulations, and sensitivity to the impact of investigations on the environment and stakeholders

Basic ability to combine theory and practice to complete geology tasks

Ability to undertake literature searches, and to use data bases and other sources of information

Ability to receive and respond to a variety of information sources (e.g. textual, numerical, verbal, graphical)

Ability to conduct appropriate experiments, to analyze and interpret data and draw conclusions

Basic awareness of relevant state-of-the-art technologies and their application

Basic ability to solve numerical problems using computer and non-computer based techniques

Basic knowledge of the application of information technology to geological science

Ability to use spreadsheet and word-processing software.

Other professional skills

Ability to complete assigned tasks in a range of technical, economical and social contexts

Ability to learn and study including effective time management and flexibility

Awareness of the concept of professionalism and professional ethics

Knowledge of the economic, social, environmental and legal conditions expected in professional practice

Basic awareness of project management and business practices and understanding of their limitations

Ability to work effectively as an individual and as a member of a team

Recognition of the need for, and engagement in self-managed and life-long learning

Ability to organize their own work independently

Basic ability to formulate an acceptable problem solution using geological methods in a cost-effective and time-efficient way

Basic knowledge in estimating and measuring costs and productivity

Basic ability to communicate effectively in written and verbal form with colleagues, other professionals, customers and the general public about substantive issues and problems related to their chosen specialization

Basic ability to prepare, process, interpret and present data, using appropriate qualitative and quantitative techniques and packages.

Graduates having completed a Second Cycle degree should have demonstrated the following capabilities:

Underlying basis

Advanced knowledge and understanding

of the principles of geology

Deeper knowledge of a chosen specialization

Critical awareness of the forefront of their specialization

Advanced understanding of Earth system relevant to their specialization

Appreciation of the learning capacity needed to progress to independent research.

Analysis, design and implementation

Ability to specify and complete geological tasks that are complex, incompletely defined or unfamiliar

Some ability to formulate and solve problems in new and emerging areas of their discipline

Ability to apply state-of-the-art or innovative methods in problem solving, possibly involving use of other disciplines

Ability to think creatively to develop new and original approaches and methods.

Technological, methodological and transferable skills

Ability to design appropriate experiments, to analyze and interpret data and draw conclusions integrating knowledge from different disciplines, and handling complexity

Ability to use advanced, and develop customized, quantitative methods

Comprehensive understanding of applicable techniques and methods for a particular specialization, and of their limits

Awareness of the limits of current knowledge and the practical application of the state-of-the-art technology

Knowledge and understanding of geology to create geological models of complex systems and processes

Basic ability to contribute to the further development of geology in practice and research.

Other professional competences

Ability to produce independent work in their professional and scientific fields

Ability to manage and work effectively as a leader of teams that may be composed of different disciplines and levels

Basic ability to work effectively and communicate in national and international contexts

Appreciation of the role of geology in the development of knowledge, wealth creation and improving quality of life

Ability to evaluate performance as an individual and a team member

Ability to identify individual and collective goals and responsibilities and to perform in a manner appropriate to these roles

Ability to critically evaluate professional and research papers

Ability to plan an appropriate programme of continuing professional development.

Further, within the scope of the surveys, a state-of-the-art report concerning the current status of geology in higher education across Europe has been developed. Accordingly, the project provided benefits to departments of geology and the academic community by engaging them in the most important endeavour of defining leaning outcomes in geology. Also, in this process, the employment side, companies, and corporate members and further stakeholders were able to feed in their expectations about the qualification profile of their future employees. The Standards and Criteria are intended to provide a means for reviewing the quality of higher education geology qualifications in the European Higher Education Area (EHEA), in a way that encourages the dissemination of good practice and a culture of continuous improvement of geology programmes. Given the great diversity of education in geology across Europe, the attempt to create framework standards comprising all areas of the geology discipline appears ambitious. In the course of the project the traditional education of geologists at European universities appeared to be in a transition period. The design of study programmes in geology actually drifts to more interdisciplinary and/or specialized focuses and "classical" geology is inserted in a selective way in new programmes under different titles. Therefore the number of mere geological study programmes decreases all over Europe whilst the interdisciplinary approach focusing on "geosciences" gains strength. Despite this observation the project partners decided to continue the work on sectoral geology outcome descriptors as they would also be useful for the design, implementation and quality control of study programmes following a broader and or more interdisciplinary and or more specialized educational objective. From this perspective the framework descriptors would serve as departing point for further amendments describing competencies also for the related fields of study and the respective interdisciplinary combinations. The Euro-Ages framework is thus intended as a broad common denominator, or overarching reference point, for the variety of geology programmes. In order to allow for possible inclusion of existing geology specializations within European Higher Education Institutions, the framework must be formulated in rather general terms. The Standards and Criteria represent a quality threshold. All graduates of programmes assessed against the Euro-Ages standards are expected to achieve the programme learning outcomes stated therein. Accreditation of a geology degree programme is the primary result of a process used to ensure the suitability of that programme as providing the education base for the entry route to professional practice. It involves a periodic assessment against accepted standards of higher education in geology. Independent, third-party accreditation is essentially based on a peer review process, undertaken by appropriately trained and independent teams comprising peers from both academia and geology practice, in accordance with agreed principles. It is important that accreditation processes go beyond judgement on the achievement of a minimum standard, and effectively promote the idea of continuous improvement of the quality of higher education programmes. The Standards for Accreditation can be used in both the design and the evaluation of programmes in all specializations of geology. They are expressed as broad generic programme-learning outcomes that describe in general terms the capabilities required of graduates from accredited First Cycle and Second Cycle geology programmes, as defined in the Framework for Qualifications of the European Higher Education Area. Consequently, they can be interpreted and elaborated by users to reflect the specific demands of different cycles and specializations.

This project has been funded with support from the European Commission. This publication reflects the views only of the author, and the Commission cannot be held responsible for any use which may be made of the information contained therein.

The Bologna Process: an introduction

by Paul D. Ryan[1]

The Bologna Process, initiated in 1999 and not yet completed, aims to create a single European Higher Education Area in which degrees and diplomas are transparent and transportable. The degrees will be based upon a Bachelor, Masters, Doctoral system and should be described in terms of what the student is expected to know, understand and demonstrate after a course of study. Mechanisms are being put in place which will facilitate degree recognition throughout the 47 signatory states. There will also be a Europe wide system of quality assurance to ensure standards. The Tuning Project has developed tools to facilitate the development of such degrees at the Institute level and has produced a template for the Earth Sciences. The Bologna Process will be of great value to the Geoscience Profession as it will facilitate professional mobility throughout Europe.

Le Processus de Bologne, initié en 1999 et pas encore achevé, vise à créer un Espace européen unique de l'enseignement supérieur dans lequel les niveaux de qualification et les diplômes sont clairement définis et validés d'un pays à l'autre. Les qualifications seront basées selon un système comprenant trois niveaux : la Licence, la Maîtrise et le Doctorat et devraient être présentées de manière à préciser ce que l'on attend de l'étudiant en matières de connaissances, de compréhension et de mise en application, à l'issue de son cursus d'études. Des mécanismes sont mis en place qui faciliteront la reconnaissance des qualifications dans les 47 états signataires. Il existera aussi un système européen complet d'assurance qualité pour garantir des niveaux standard. Un Projet d'Harmonisation a mis au point des outils pour faciliter le développement de ces trois niveaux de qualification et a créé un système référent pour les Sciences de la Terre. Le Processus de Bologne aura une valeur importante pour les professionnels des Géosciences car il va faciliter leur libre circulation en Europe.

El proceso de Bolonia, que comenzó en 1999 y todavía no ha terminado, tiene como objetivo crear un Área de Educación Superior Europea en que los títulos y diplomas sean transparentes y transportables. Los grados se basarán en un sistema de Licenciaturas, Másteres y Doctorados y se deberían describir en términos de lo que se espera que un estudiante sepa, entienda y pueda demostrar que sabe, tras un curso de estudio. Se están poniendo en marcha mecanismos que facilitarán el reconocimiento de títulos entre los 47 estados firmantes del acuerdo. Habrá también un sistema europeo de aseguramiento de la calidad para garantizar la calidad de los estudios. El proyecto Tuning ha desarrollado herramientas para facilitar el desarrollo de dichos grados a nivel de facultad y ha producido una plantilla o modelos para el caso de las Ciencias de la Tierra. El proceso de Bolonia será de gran ayuda para la profesión de geólogo ya que facilitará la movilidad profesional en Europa.

The Bologna Process, adopted currently by 47 European Nations, aims to reform higher education in Europe and is best summarized by the following statement: "*The Bologna Process aims to create a European Higher Education Area by 2010, in which students could choose from a wide and transparent range of high quality courses and benefit from smooth recognition procedures. The Bologna Declaration of June 1999 has put in motion a series of reforms needed to make European Higher Education more compatible and comparable, more competitive and more attractive for Europeans and for students and scholars from other continents. Reform was needed then and reform is still needed today if Europe is to match the performance of the best performing systems in the world, notably the United States and Asia. The three priorities of the Bologna process were: introduction of the three cycle system (bachelor / master / doctorate), quality assurance and recognition of qualifications and periods of study*." (European Commission, 2009a). This Process requires substantial changes in the structure of degrees in countries not already using the three cycle system, the implementation of quality assurance procedures and of standardized mechanisms to ensure recognition of qualifications throughout the signatory states. The legal framework for recognition of degrees is the Lisbon Recognition Convention (Council of Europe, 2010) which states that signatories must recognize each others' degrees unless substantial differences can be demonstrated. Thirty seven countries had either signed or were in the process of signing this Convention by 2009. The ultimate aim is that a graduate from one country has a degree that is recognized in 46 other European countries. In the geoscience profession, involving large amounts of trans-national working, such as that of the geologist, these reforms are long overdue and are to be welcomed.

This Bologna process is supervised by a conference of Government Ministers from the signatory States who meet every second year to measure progress and set priorities for action. After Bologna (1999), they met in Prague (2001), Berlin (2003), Bergen (2005), London (May, 2007) and Leuven/Louvain-La-Neuve (April, 2009) (see the Official Bologna Process website, 2010, for details). At the London meeting Ministers adopted a strategy on how to reach out to other continents. They also gave the green light to create a Register

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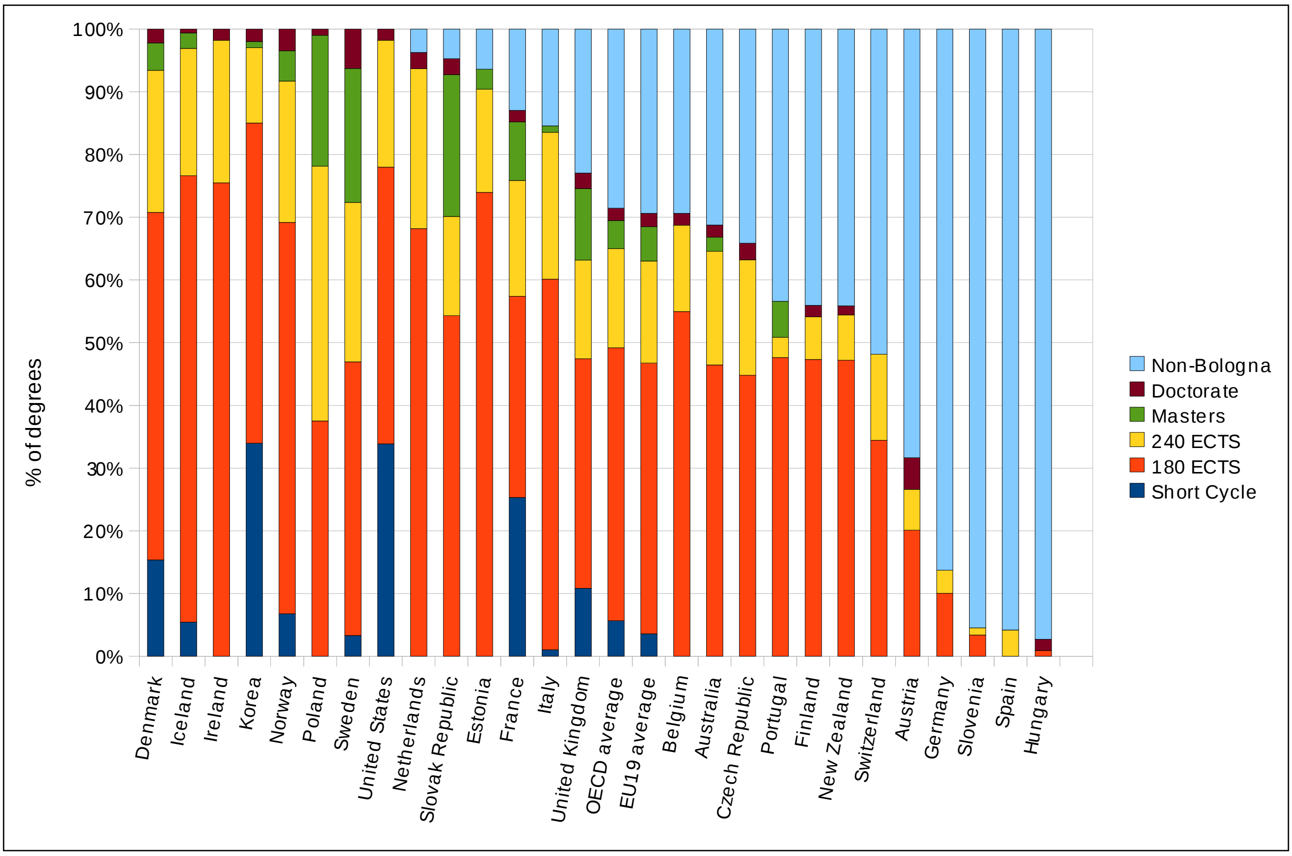

Figure 1. The proportion of Three Cycle System degree types in some Bologna signatory nations and in other countries worldwide. The data is extracted from OECD Education at a Glance (2010). The degrees that are 'non-Bologna compliant' do not correspond to the Three Cycle System (see text)

of European Quality Assurance Agencies. These meetings define the action lines that each nation needs to undertake to establish the legislative, administrative and academic framework to implement the Process. The action lines have been revised with time, making the Bologna Process a vital and ongoing process. It was originally intended that this process should be completed by 2010. However, in spite of considerable progress being made at institutional, national and international levels, these reforms are not yet complete. On 12 March 2010, Ministers from the countries participating in the Bologna Process adopted the Budapest-Vienna Declaration and officially launched the European Higher Education Area. In this declaration they note "*further work, involving staff and students, is necessary at European, national, and especially institutional levels to achieve the European Higher Education Area*" (see the Official Bologna Process website, 2010, for details). Much work has taken place outside of these conferences, in particular the Tuning Project (Tuning, 2010) has developed tools to assist change at the level of the Institutes of Higher Education and professional programmes. The Tuning Project is an EU-funded project of the European Universities in which the subject of Earth Science has been an active area of investigation since its inception in 2000. This article will review the role of Bologna action lines and Tuning in implementing the Bologna Process within Earth Science Higher Education in Europe.

Principle components of the Bologna Process

The 'Three Cycle System'

The Bologna Process requires that higher education in signatory states follows the so-called 'Three Cycle System'. The basic Bachelor (Cycle 1) degree should take either three or four years with the Masters (Cycle 2) degree being attained after a total of five years of study. The Doctorate or Cycle 3 degree should then take another three years after having completed both Cycles 1 and 2. There is, however, some variation in this system. There is a 'Short Cycle' degree, usually available after two years, in some professional courses. Also, the length of Masters programmes varies from one to two years to complement the three to four years of Bachelor programmes. In a community in which free movement is a fundamental right some students may achieve a Masters in four or in six years, whilst most do so in the prescribed five years. Also, some countries allow students to proceed from a Bachelor directly to a Doctorate, although increasingly the Masters is deemed to be covered in a programme of certified Doctoral training which is in addition to the research requirement of that degree. Whilst there has been considerable debate within Europe these matters are not yet fully resolved. Figure 1 shows the proportion of degrees awarded by countries both within and outside the Bologna Process that correspond to the 'Three Cycle System' (OECD Education at a Glance, 2010). The number of non-Bologna compliant degrees will decrease with time as new courses are initiated.

Quality Assurance

The development of a pan-European Quality Assurance system for higher education will be the driver which monitors and promotes the implementation of the Bologna reforms. This is currently a work in progress with, in 2009, about one third of signatory nations still only embarking on the process. In general, the model that is followed is that where the discipline, programme, department, office, or institute produces a self-assessment report that is critically evaluated with feedback. The evaluation process also involves a site visit. This process must involve students and should be externally, preferably internationally, validated. A set of guidelines have been published by the European Association for Quality Assurance in Higher Education (ENQA, 2009) whose purpose is to establish European standards for internal and external quality assurance, external quality assurance agencies and a European register of quality assurance agencies. The quality of degree programmes in all signatory states will, therefore, follow similar, regular, validated assessments, effectively removing the argument that degrees in one state are of a different quality from those in another.

Recognition of Degrees and Diplomas

The main international legal text that aims to further the fair recognition of qualifications is the Council of Europe/UNESCO Convention on the Recognition of Qualifications concerning Higher Education in the European Region (Lisbon Recognition Convention, see Council of Europe, 2010). The recognition of qualifications is the responsibility of each country, meaning that higher education institutions are responsible for the recognition of qualifications for the purpose of further study whereas professional bodies or employers are responsible for recognition for the purposes of the labour market. There are many aspects to the recognition of higher educational qualifications throughout Europe; however, the European Credit Transfer and Accumulation System, the Diploma Supplement and Qualification Frameworks are essential requirements for this to happen.

The European Credit Transfer and Accumulation System

The European Credit Transfer and Accumulation System (ECTS) is the fundamental tool that allows comparison of courses and degrees across Europe. ECTS grew out of the need for transportable certification for students who took part of their course work abroad under such schemes as Erasmus Mundus. However, this system must now be applied to all courses and programmes and a comprehensive set of guidelines for the correct implementation of ECTS has recently been published (European Commission, 2009). A year of study, which comprises about 1500 hours of total student commitment (not to be confused with formal timetabled contact hours), permits the award of 60 ECTS credits on satisfactory completion, that is when the student passes all the assessments for that year. A Bachelor degree, therefore, requires a minimum of 180 and a maximum of 240 ECTS credits. It should also be noted that these credits must be cumulative, in other words the student needs to acquire them at the level of each year of study. Some ECTS credits can be acquired at a lower level, but this limited facility exists only to allow students to take other 'minor' subjects. The European Commission may award an ECTS Label to an institution of higher education that '*has shown excellence in applying the European Credit Transfer and Accumulation System (ECTS) and the Diploma Supplement (DS)*' (see below). At the time of writing only 65 IHEs (approximately 1% of the total) have been awarded such Labels, but this number is bound to grow especially as it will give a competitive advantage to those IHEs who possess such Labels in terms of attracting international students.

Diploma Supplement

The Diploma Supplement is the instrument whereby an institution of higher education gives a full and transportable account of a student's achievements. It accompanies a locally awarded higher education diploma and provides a standardized description of the nature, level, context, content and status of the studies completed by its holder. This product should not only make it easier for students to study abroad, but also should assist with professional mobility. IHEs can be awarded a Diploma Supplement Label in addition to the ECTS label.

National and European Qualification Frameworks

These Frameworks (NQF/EQF) describe the qualifications of an education system and how they interlink. National qualifications frameworks describe what learners should know, understand and be able to do on the basis of a given qualification as well as how learners can move from one qualification to another within a system. They apply to all levels of educational attainment covering school, workplace training, and higher education. The European Qualifications Framework (European Commission, 2008) provides a meta framework through which individual NQFs can be compared. The NQFs take priority and may differ in detail from the EQF, but must have an agreed mapping onto the EQF. The aim is to provide both individuals and employers with a tool to compare the qualifications levels of different countries, different education and different training systems. Few countries yet have fully implemented externally validated NQFs and about one third of signatory states are only embarking on the process. An example of the mapping between an NQF and the EQF is provided in Ireland where Cycle 1 degrees can be either of 180 ECTS credits (Level 7 or 'Ordinary Bachelors Degrees') or 240 ECTS credits (Level 8 or 'Honours Bachelors Degrees' or 'Higher Diplomas') in the NQF (see www.nqf.ie) which map to Level 6 (Bachelors Degrees) of the EQF.

Mobility

The Ministers responsible for Higher Education in the countries participating in the Bologna Process in the communique following the London Conference in May 2007 issued the following statement. "*Mobility of staff, students and graduates is one of the core elements of the Bologna Process, creating opportunities for personal growth, developing international cooperation between individuals and institutions, enhancing the quality of higher education and research, and giving substance to the European dimension*".

Workplace and society

In the Leuven Communiqué of 2009 the Ministers identified a list of priorities for the coming decade, which included: the social dimension of higher education; lifelong learning; employability. A recent Eurobarometer Survey, FLASH 260, (European Commission, 2009b) among students in higher education reported that the vast majority of students want: wider access to higher education; universities to further develop cooperation with the world of work; wider access to lifelong learning. In particular: 97% wanted the knowledge and skills they needed to be successful in the labour market, 91% recognized the need for personal development; 87% supported the principal that education should facilitate people to play an active role in society; a similar proportion agreed that higher education should "*foster innovation and an entrepreneurial mindset among students and staff, and that there should be a possibility to undertake work placements in private enterprises as part of a study programme*" (European Commission, 2009b). The Bologna Process should provide a platform for better cooperation between IHEs, industry and society. Something that may prove crucial if the geoscience profession is going to meet the challenges of the future.

The recognition of prior learning (RPL) and lifelong learning (LLL) are also essential in this regard. RPL will allow a professional to apply to an IHE to have their prior learning assessed. RPL provides a mechanism by which individuals with prior learning obtained through life experience and/or formal education and/or work experience are assessed for entry onto, for credit towards and/or for exemption from components of a higher education qualification. Correct implementation of RPL should well provide a platform for better industry-IHE cooperation and, by allowing access to educational programmes, will contribute significantly to a professional geologist's lifetime programme of continuous personal development. Lifelong learning, which will now be integrated into the NQFs is also very important in this context, as well as helping serve the needs of an ageing population and the economic requirement to move towards 'knowledge based economies'. Both RPL and LLL require more flexible, student-centred modes of delivery (for example, part-time course work at times convenient for in-job training and new methods of distance learning) and the widening access to higher education.

The London Ministerial Communiqué, May, 2007, (see UK Government, 2007) states "*Higher education should play a strong role in fostering social cohesion, reducing inequalities and raising the level of knowledge, skills and competences in society. Policy should therefore aim to maximize the potential of individuals in terms of their personal development and their contribution to a sustainable and democratic knowledge-based society*".

Joint Degrees

The Bologna Process has paved the way for increasingly innovative, cooperative, cross border study programmes. The so-called "Joint Degree" has recently become one of the most cited examples, and such joint degree programmes are springing up across Europe. The programmes leading to Joint Degrees are developed or approved jointly by several institutions. Students from each participating institution study for a significant part of the programme (as opposed to short exchanges) at institutions other than the one in which they register. Teaching staff from each participating institution devise and administer the curriculum together and participate in mobility for teaching purposes. Periods of study and exams passed at the partner institution(s) are recognized fully and automatically by all institutions and countries involved. The students who have completed the full programme should obtain a degree awarded jointly by the participating institutions, and fully recognized in all countries. Whilst the current development of Joint Degree programmes is relatively slow, mainly because many countries are still in the process of implementing the Bologna reforms at institutional level, this exciting development will undoubtedly become very important in the future, especially for careers in geoscience, which require workers to be mobile and able to work in different societies and under different conditions.

Tuning higher educational structures in Europe

This started in 2000 as a project to link the political objectives of the Bologna Process and the Lisbon Strategy to the higher educational sector. Over time, Tuning has developed into a Process, adopted by 58 countries world-wide, designed to assist in the (re-)design, development, implementation, evaluation and quality enhancement in first, second and third cycle degree programmes. The motto of Tuning is "*Tuning of educational structures and programmes on the basis of diversity and autonomy*". This project was initiated by Julia Gonzalez, University of Duesto, Bilbao and Robert Wagener, Groningen University. Whilst funded by the EU, Tuning was in effect the Universities' response to the challenges of the Bologna Process. Subject area groups of experts from across Europe, which included geoscience from the outset, were set up to try to develop the educational tools required by the Process. These groups also met in plenary session to develop the broader language and policies required. Tuning has been highly influential within the Bologna Process. The adoption by the Ministers in their Berlin Communiqué of 2003 of the following statement "*Ministers encourage the member States to elaborate a framework of comparable and compatible qualifications for their higher education systems, which should seek to describe qualifications in terms of workload, level, learning outcomes, competences and profile. They also undertake to elaborate an overarching framework of qualifications for the Higher Education Area*" was directly a result of this work. This policy required a move from 'input, teacher oriented' programmes such as defining a degree by giving a list of topics to be studied, to 'outcome, student oriented' programmes. A learning outcome is defined as '*statements of what a learner is expected to know, understand and be able to demonstrate after completion of a learning experience*' (Tuning, 2008). Competences, be they subject specific or generic and more related to life and the workplace, '*represent a dynamic combination of cognitive and meta-cognitive skills, knowledge, and understanding, interpersonal, intellectual and practical skills and ethical values*' (Tuning, 2008). This model for a programme of study requires careful definition of the competences the student must acquire, the outcomes they must successfully demonstrate at the end of the course, the exact profile and level of the course and the student commitment required in terms of total workload, not just contact hours. It not only gives students a clear idea of what is expected from them but it also provides a platform whereby outcomes other than exam scripts, for example publicly presenting the results of project work, can be assessed and assigned ECTS credits. Whilst there is considerable variation between educational traditions, students can expect to receive 1 ECTS credit for every 25 ± 5 hours of study satisfactorily completed.

The SAGs have developed internationally validated templates to assist in the development of courses following this model. The template for the Earth Sciences (Ryan *et al*., 2010) is available from the Tuning website. This template recognizes the enormous breadth of subjects that fall within the remit of Earth Science (let alone the wider Earth System Sciences) and is extremely careful not to recommend a 'standard curriculum'. However, it does elucidate the fundamental underlying Generic and Subject Specific competences which are required to study the Earth. The template also requires that any Earth Science training programme should include an appropriate amount of field work, particularly at the Cycle 1 level, as "*it is impossible to properly analyze and interpret field-based data, whether collected directly or remotely, without an understanding of its inherent limitations*" (Ryan *et al*., 2010).

Although the Tuning Europe Project formally ended in 2009, a Tuning Academy was launched in September 2010 whose aim is to promote training and research to support the Bologna Process. The Minsters state in 2009 (see: http://www.ond.vlaanderen.be/hogeronderwijs/bologna/conference/documents/Leuven_Louvain-la-Neuve_Communiqu%C3%A9_April_2009.pdf) that "*the potential and widespread significance of learning outcomes is only just beginning to be realized .... For* *this sort of bottom-up approach there is a need for fundamental change at institutional level*". It is the aim of the Tuning Academy to meet this challenge. The Earth Sciences will be represented in this endeavour.

Conclusions

Although there is still a lot more work to do, the Bologna Process is creating a European framework in which professional geologists should find it much easier to work in countries other than the one where they qualified. The need to restructure degree programmes in a manner that is more student centred and takes into account the needs of society and the workplace provides our profession with a unique opportunity to contribute towards high training standards in European higher education.

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Mapping the European geological qualification

by Dr. Isabel Fernández Fuentes[1] and David Norbury[2]

European geologists sometimes ask themselves how their qualification is related to similar qualifications in other European countries. The European Federation of Geologists has tried to answer this and other questions on European qualification in Geology under Euro-Ages, a European project funded by the European Union, DG Education and Lifelong Learning Programme. One of the first challenges of this project has been to map geological qualifications within the EU countries. The main data from this study are presented in this article.

Les géologues européens se posent parfois la question de savoir à quoi correspond leur niveau de qualification par rapport à des qualifications comparables, délivrées dans d'autres pays européens. La Fédération Européenne des Géologues a essayé de répondre à cette question et à d'autres interrogations touchant la qualification des géologues en Europe, à travers Euro-Ages, un Projet européen financé par l'Union européenne, le Programme pour l'Education et la Formation, tout au long de la vie. L'un des premiers défis de ce projet a consisté à recenser les qualifications en géologie pour chaque pays européen. Cet article présente les principaux résultats tirés de cette étude.

Los geólogos europeos a veces se preguntan en qué medida su título académico se relaciona con títulos similares en otros países de Europa. La Federación Europea de Geólogos ha tratado de responder a esta y otras inquietudes sobre las titulaciones europeas de geología con el proyecto Euro-Ages, un proyecto financiado por el Programa de Aprendizaje de por Vida de la DG de Educación y Cultura de la Comisión Europea. Uno de los primeros retos del proyecto ha sido cartografiar las titulaciones geológicas en los países de la UE. Los principales datos de este estudio se incluyen en este artículo.

Over the past year, the partners in the Euro-Ages project have worked towards developing a European qualification framework for geology, in the first and second cycles defined by the Bologna Process, based on learning outcomes rather than input factors (course curricula). The objectives of the work are to increase transparency of Earth Sciences qualifications across Europe and therefore to facilitate improved academic and professional mobility across Europe. At the same time, the project aims to encourage students and graduates in the field of geology, as well as professional geologists, to pursue Lifelong Learning. The project objectives are being achieved through a structured exchange of best practices, expertise and characteristics of professional practices in geology in the different European countries. Important reference points have been identified for quality assurance and related recognition issues focused on learning outcomes. The project is supported by the European Commission, DG Education and Culture.

One of the first steps was to map the existing qualifications for geology in formal, non-formal and informal settings and to link these to national qualification systems. The European Federation of Geologists was the coordinator of this study.

[1]EFG Office Director
[2]Chairman, EFG Registration Authority

A precedent of this study is the *Report on Education, Professional Activity and Recognition of Qualifications*, EFG Office, July, 2005. The objective of this document was to report on the status of Earth Sciences education and professional training, with the aim of achieving the harmonization of Earth Sciences curricula, to inform on general aspects of Earth Sciences professional activities, to establish the map of different specialties and to promote the recognition of qualifications and the mobility of professionals. The data analyzed in this report were derived from a questionnaire on education and training that was sent to the EFG National Associations.

The present article is based on the report for European Accredited Geological Study Programmes, Euro-Ages project, 2010. The data come from the summary reports produced by 27 European Countries: Austria, Belgium, Croatia, Cyprus, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Netherlands, Norway, Portugal, Romania, Russia, Serbia, Slovakia, Spain, Sweden, Switzerland and United Kingdom (Fig. 1).

Each country has produced a summary with the following structure:

- Status of implementation of Bologna process
- Education in Geology, including;
  - •The structure of education
  - •Universities offering geological pro grammes
  - •Number of freshman students and graduates in the country
- Learning outcomes;
  - •Definition of learning outcomes
  - •Academic and professional learning outcomes and competence profiles for study
  - •Programmes in geology
  - •Example of programme structure for education
- Professional input to course structure
- Teaching course accreditation systems.

The full report with the 27 summary countries is available on the Euro-Ages Project website, European Accredited Geological Study Programmes, Euro-Ages project, 2010.

This article is focused on the implementation of the Bologna Process, education in geology, professional prerequisite and accreditation systems. The Learning Outcome is presented in this magazine (p. 19).

Status of implementation of the Bologna Process

In most European counties the establishment of education in accordance with the Bologna process is well advanced. Most geology degree courses have switched to the three cycle style of courses and the first students are now undergoing this training. Figure 2 presents the Bologna implementation status in the 27 countries of this study, indicating the year for first graduates from Bologna in the different countries.

The implementation of the Bologna agreement in tertiary education is now being achieved. At national level this has resulted in the consolidation of the number of Higher Education Institutes (HEI) and in the number of courses taught. The amount of change to the existing education framework has varied from minimal in countries such as the UK, to very substantial in countries such as Germany and Italy.

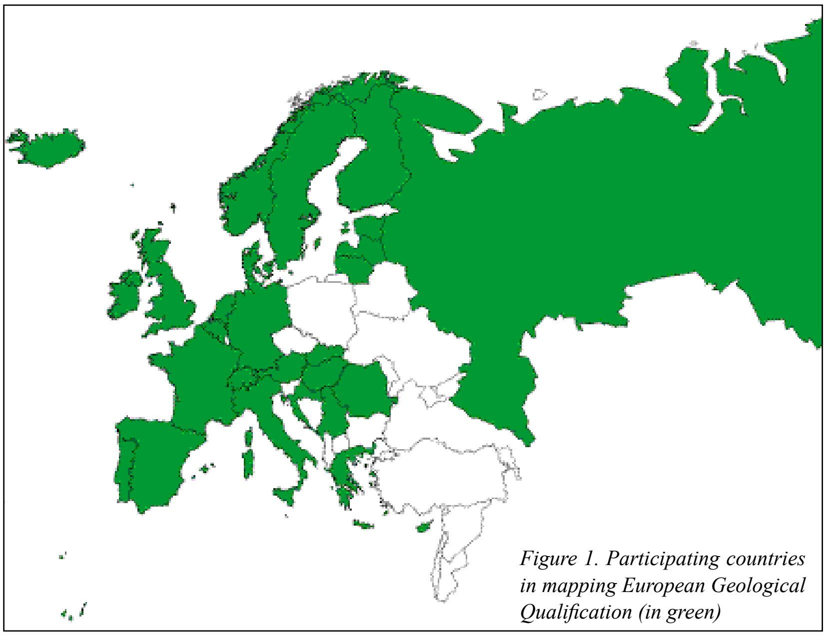

Figure 1. Participating countries in mapping European Geological Qualification (in green)

Education in Geology

The structure of education

The implementation of the Bologna agreement has resulted in most countries now offering three cycles of tertiary education:

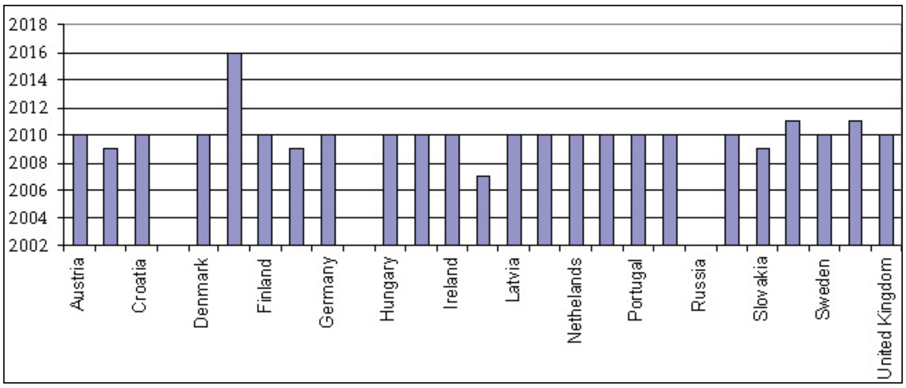

Figure 2. (Left) First graduates from the Bologna implementation

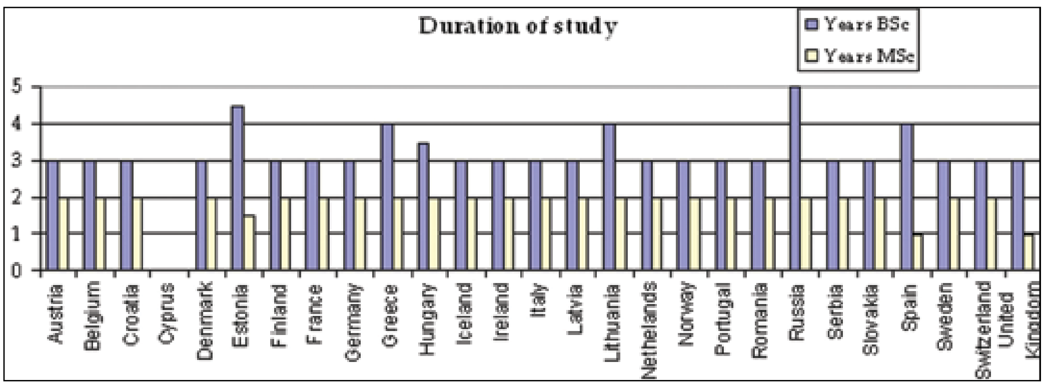

Figure 3. Duration of first and second cycle courses

- The first cycle B.Sc. is generally now of three years duration, although in some countries longer courses still operate
- The length of second cycle M.Sc. courses is mostly two years, but remains at one year in some countries
- There is also then the third cycle Ph.D., which is also generally of three years duration, but this is not covered further in this report.

The duration of these courses is shown by country in Figure 3 and by percentages in Figures 4 and 5.

The responses show that, in 80% of the countries involved in this study, the first cycle in Geology is 3 years. The exceptions are Hungary with 3.5 years, Greece, Lithuania and Spain with 4 years and Estonia with 4.5 years. Russia still has a 5 year first cycle but has not implemented Bologna.

For the second cycle, Masters degrees are mostly of two years duration. The exceptions are the UK with 1 year and Estonia with 1.5 years.

The total years of study for first and second cycles can vary from 4 years in the UK to 6 years in countries such as Estonia, Greece, Lithuania or Spain.

The content of courses is more accurately and transparently measured by the credit scheme (European Credit Transfer System, ECTS). It is generally accepted that a year of study equates to 60 ECTS credits and thus to graduate at B.Sc. level, the student needs to have collected 180 ECTS credits, with the exception of Ireland (210) and Spain (240). The number of ECTS credits required for the award of an M.Sc. varies from 120 to 180.

The requirement for award of a degree is shown by country in Figure 6.

It also notable that there is not universal agreement on the number of hours of work that make up a single credit: in 86% of countries this figure is 30 hours, but in the remaining 14% the requirement is 25 hours (Fig. 7).

Universities offering geological programmes

The number of education institutions has

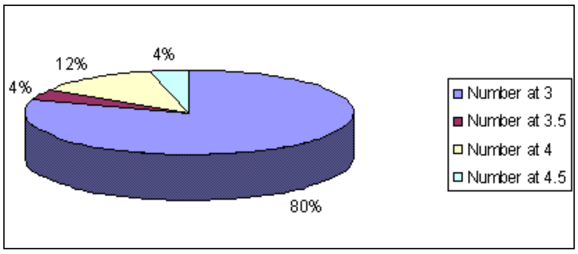

Figure 4. Duration of the first cycle (%) in the countries involved in mapping European Geological Qualification

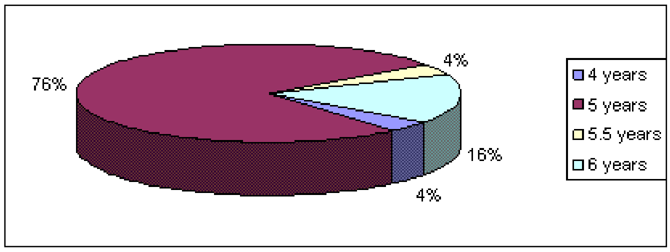

Figure 5. Total duration of the first and second cycles (%) in the countries involved in mapping European Geological Qualification

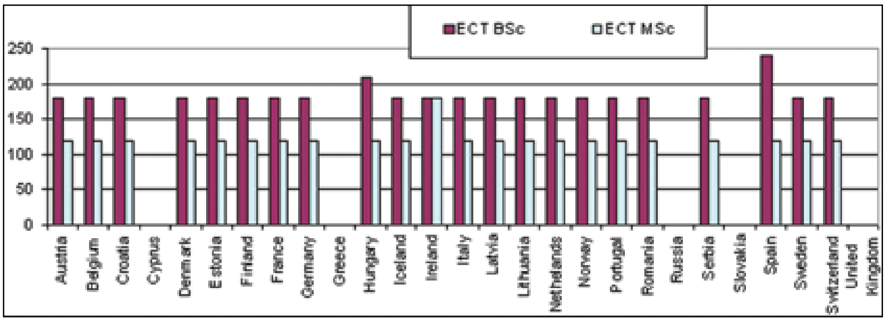

Figure 6: Credits required for first and second cycle degrees

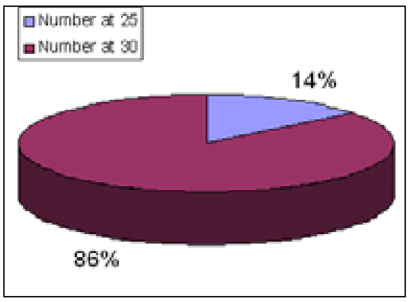

Figure 7. Numbers of hours per ECTS credit

generally reduced as a result of implementation of the Bologna agreement, although this may have been due to other factors. For instance, in Denmark, the number of HEIs has reduced from 12 to 8, but there is a view that this has contributed to a strengthening of teaching and research activities.

The number of universities offering geology degree courses varies widely from country to country (Fig. 8). The number of places available is usually higher than the intake of students each year.

Number of freshman students and graduates

The number of freshmen taken onto B.Sc. geology courses varies widely, as might be expected. The number of freshmen is generally lower than the number of places available nationally to study geology. The number of graduates per year is markedly lower than the number of freshmen. The number of B.Sc. graduates with respect to B.Sc. freshmen per year ranges from 92% in the UK to 35% in Germany.

The number of places on M.Sc. courses is lower and the fall-off rate is also lower (Fig. 9).

The UK is the country with the largest number of B.Sc. graduates in geology (1300/year), of which just over 11% continued to the M.Sc. degree. However in other countries, students continuing to the second cycle is over 80%.

Incomplete information has been provided on employment of graduates, but it appears that the countries with the larger number of students achieve lower employment rates in geology than smaller countries.

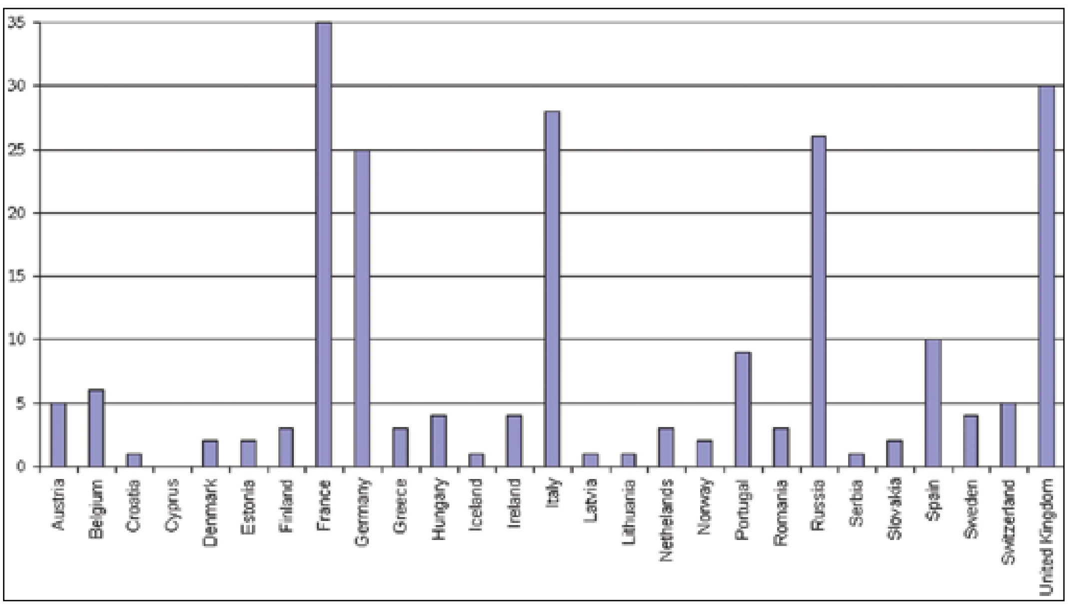

Figure 8. Number of universities teaching geology

Professional prerequisites

It is generally the situation across Europe that the requisite knowledge and skills are set by the course developers within the universities rather than by the institutions that represent the profession in post graduate practice. There is however likely to be an implicit linkage in that the course designers and providers are themselves practising professionals and will be aware of the requirements of professional practice and incorporate these matters into their teaching programmes. This linkage is most apparent in Finland in connection with the strong mining influence, in Italy and Spain where the profession is regulated by law, and in the UK where degree courses are accredited by the professional body (Geological Society of London).

Accreditation systems

Most countries offer some form of accreditation of their degree programmes. The level of accreditation varies from internally within the university, to review by the government education ministry to national quality agencies. In addition, the accreditation is provided by the relevant professional institution in Italy and UK.The distribution of use of the various accreditation providers is shown in Figure 10.

Conclusion

Using the information obtained in the 27 summaries of national reports on the Bologna process, higher education in geology, professional pre-requisites and accreditation, the following conclusions can be reached:

- In most European counties the establishment of education in accordance with the Bologna process is well advanced
- Most geology degree courses have switched to the three cycle style of courses and the first students are now undergoing this training
- The cycles of education being delivered are in accord with the Bologna three levels, namely Bachelor (normally 3 years), Masters (1 – 2 years) and Ph.D. (3 years). The data collected in this study show that the duration of each cycle varies between different countries
- The required number of ECTS credits for a Bachelor degree in Geology varies between 180 and 240, and the number of ECTS credits at Masters level varies between 120 and 180
- The number of universities offering geology degree courses varies widely from country to country. The number of places available is usually higher than the intake of students each year
- The number of graduates per year is markedly lower than the number of freshmen
- Accreditation of course materials is carried out by a variety of agencies including internally in the university, external quality agencies, the relevant government ministry and national professional bodies.

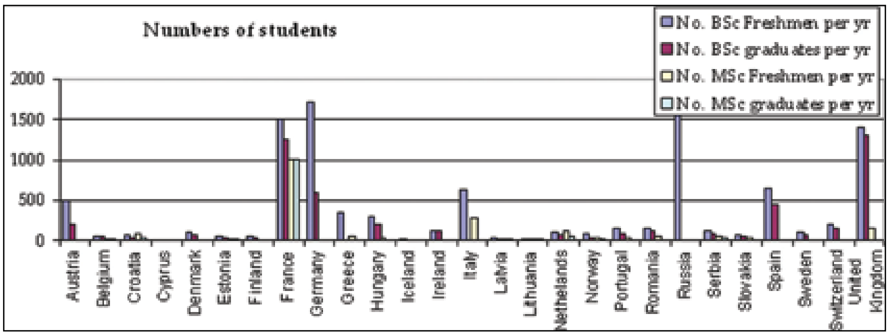

Figure 9a. Numbers of freshmen and graduates (full scale)

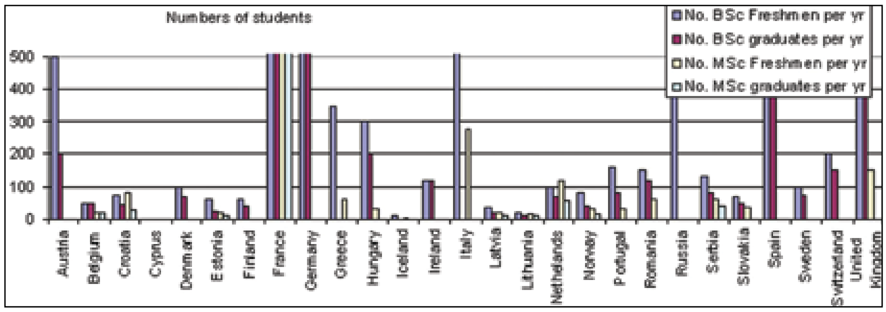

Figure 9b. Numbers of freshmen and graduates (expanded scale)

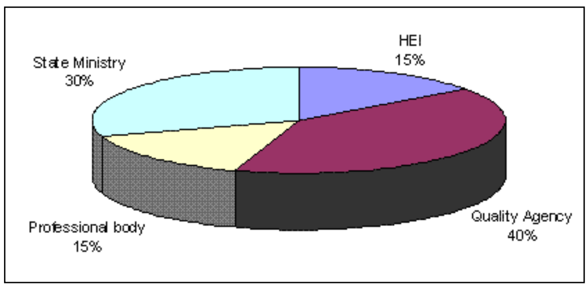

Figure 10. Use of course accreditation providers

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The Euro-Ages programme and Ireland

by Michael J. [Ben] Kennedy[1]

Irish Universities provide taught and/or research degrees at B.Sc., M.Sc. and Ph.D. levels which accord with the Bologna process. The Irish Geoscience Graduate Programme, launched in September 2010, allows students to acquire credits for modules in generic or research topics which may be taken in any Irish University. The Institute of Geologists of Ireland, a member of the EFG, accredits graduates from approved universities with sufficient professional experience.

Les Universités irlandaises délivrent des diplômes d'enseignement et de recherche aux niveaux Licence, Maîtrise et Doctorat, qui sont en conformité avec le Processus de Bologne. Le Programme diplômant irlandais en Géosciences, lancé en septembre 2010, permet aux étudiants d'acquérir des unités de valeur de modules appartenant à des matières génériques ou de recherches qui peuvent être reconnues par n'importe quelle Université en Irlande. L'Institut des Géologues d'Irlande, membre de la FEG, accrédite les diplômes d'Universités agréées, tenant compte d'une expérience professionnelle suffisante.

Las universidades irlandesas imparten formación docente y en investigación para licenciaturas, másteres y doctorados que cumplen el proceso de Bolonia. El Programa Irlandés de Graduados en Ciencias de la Tierra, que se lanzó en septiembre de 2010, permite a los estudiantes conseguir créditos para módulos en temas genéricos o de investigación que luego pueden utilizarse en cualquier universidad irlandesa. El Instituto de los Geólogos irlandeses, que es miembro de la FEG, acredita a los graduados de las universidades oficiales que demuestren suficiente experiencia profesional.

Ireland has had a professional body for geoscientists, the Institute of Geologists of Ireland [IGI], since 1999. It was therefore very appropriate that the Euro-Ages programme was initiated when it was. The Bologna process has had an increasing influence on university education in Ireland and this is no better seen than in developments in geological education.

Geology is offered in Irish universities as part of Bachelor degree programmes in Science [B.Sc.] and at the Masters [M.Sc.] and Ph.D. levels. There are presently no taught M.Sc. programmes though there have been in the past.

At the B.Sc. level, geology is included in 3-year [level 7] and 4-year [level 8] degrees. In the 3-year degree, geology is included with one or two other sciences whereas in the 4-year degree there is increased specialization in the last two years and the final year is entirely or almost completely concentrated on geology. The final year is dedicated to enhanced specialized teaching in the main areas and exposure to specialities that may be unique to a particular institution. All programmes contain elements of Applied / Economic Geology. The 4-year geology degree programmes are only offered in four universities in the Republic of Ireland but programmes with some geological content are also available in Northern Ireland. In the Republic the proliferation of choice has resulted in a variety of degrees with significant geological content. There are three 4-year degrees in Geology, two in Earth Science, one in Earth and Ocean Science, one in Climate and Earth System Science and four in Environmental Science. Geology can also be combined with another science or Archaeology. In Northern Ireland, geology forms part of degrees in Environmental Science and in Geography. All courses have specified learning outcomes and courses in mathematics and other sciences are required as a foundation. Particular subjects in geology are compulsory for all degree programmes.

At the M.Sc. level, students submit a dissertation but there are no formal course requirements as it forms part of the Bologna 3+2 combination, but some students may be required for some courses, to fill gaps in their backgrounds. The B.Sc. and M.Sc. combination takes 5 years of which 4 come from the Honours B.Sc. and one for the M.Sc. Taught M.Sc. programmes in geoscience were discontinued several years ago due to staff shortages.

At the Ph.D. level, all universities are introducing structured Ph.D. programmes wherein students are required to attend courses that are considered necessary by their supervisors. The loads will vary according to the needs of the individual and will normally be completed in the early part of the Ph.D. programme.

The Irish Geoscience Graduate Programme [IGGP] was launched in September 2010 and is designed to develop complimentary to structured Ph.D. programmes. Sixteen modules are presently offered which are generally valued at 2.5-5 ECTS credits. Modules offer both generic and speciality-based skills and include lecture / seminar, laboratory and field-based training. Irish geoscience departments / schools are typically small with up to ten academic staff, many with unique specialities. IGGP is intended to develop as a virtual graduate school. Although it was conceived to support Ph.D. students, it can be developed in the future to include M.Sc. students as well. This may be a way to reintroduce taught M.Sc. programmes by combining the expertise of two or more institutions to mount a particular single programme.

The IGI would demand that universities produce graduates who would expect to become professionally accredited after 5 years professional experience. Those whose work takes them abroad, a large number in Ireland, would also expect to apply for the professional European accreditation of European Geologist (EurGeol.). Geologists can be accredited by IGI and/or EFG. Both organizations require a minimum of 3 years academic training at an approved 3rd level institution, 5 years professional experience and a demonstration of their professional competence with submission of professional client reports and/or published peer-reviewed papers and they will be called for interview

Universities awarding geology degrees to geologists who are applying for the Professional Geologist title (PGeo) have been examined to ensure that they are of a sufficient standard. IGI maintains a list of these approved academic bodies. IGI does not accredit particular degree programmes but accredits individuals based upon academic background and professional experience.

[1]Retired Dean of Science, University College Dublin

Learning outcomes and skill levels for qualification as a Professional Geologist

by David Norbury[1]

The primary aim of the Euro-Ages project is the development of a European level qualification framework for geology based on learning outcomes. In this context, learning outcomes are defined as statements of what a learner is expected to know, to understand and/or be able to demonstrate. The expectation of the level of learning or ability that a student should be able to demonstrate will increase through the gathering of training and experience until such time as they apply for the award of a professional title.

Le premier objectif du Projet Euro-Ages est le développement d'un cadre européen de travail concernant le niveau de qualification en géologie basé sur les compétences acquises. Dans ce contexte, ces compétences sont définies comme le niveau de connaissances qu'un étudiant doit posséder, comprendre et être à même d'utiliser pratiquement. Le niveau de connaissances acquises et la capacité de l'étudiant à les utiliser représentent une forte attente qui augmentera conjointement avec son niveau de formation et son expérience jusqu'à ce qu'ils lui permettent d'obtenir un titre professionnel.

El objetivo principal del proyecto Euro-Ages es el desarrollo de un marco de requisitos mínimos para la formación en geología, basado en los resultados del aprendizaje. En este contexto los resultados del aprendizaje se definen como aquellos conocimientos que se espera que un estudiante aprenda, entienda o sea capaz de demostrar que sabe. Las expectativas del nivel de aprendizaje o de habilidad que un estudiante sea capaz de demostrar aumentará a medida que va adquiriendo formación y experiencia hasta que pueda llegar a solicitar un título profesional.

The learning outcomes identified in the programme have been defined elsewhere (see Fernandez, I. and Norbury, D., this magazine, p. 14) and represent quality standards for competencies, skills and knowledge. Graduates of an accredited course at first or second cycle programme level (Bachelor and Masters level respectively) would be expected to have achieved initial levels of ability from their academic training and studies as the basis for starting to practise geology professionally.

This paper describes the learning outcome level that would be expected when students have gained sufficient professional post-graduation experience and are ready to submit their combined training and experience profile for validation by their peers, in other words to apply for the professional title of European Geologist (EurGeol.) or similar in their own country.

Attainment levels

Four levels of attainment are generally identified which have to be demonstrated for the geologist to progress from one cycle to the next. These are given in Table 1.

In general terms, the graduate at first cycle level is expected to be able to demonstrate Appreciation or Knowledge in all learning outcome categories. The second cycle graduate will have progressed to a demonstration of Knowledge or Experience in nearly all categories. The applicant for a professional title will be expected to display Ability in all categories, as outlined in Table 2. This will normally require an absolute minimum of three years post-graduate professional experience and more will usually be required, notwithstanding the length of the academic training, in order that the applicant will have been able to gather sufficient experience to be able to demonstrate this depth and breadth of Ability.

Learning outcomes

The requisite learning outcomes identified within the project are ranged under four categories as shown in Table 2 which also identifies the relevant professional qualification criteria levels which are discussed below.

Professional qualification criteria

The demonstration of Ability in all of these learning outcomes will be assessed by the

Symbol	Title	Explanation
Ap	Appreciation	Awareness and general understanding of a subject or an appreciation as to how to undertake an activity
Kn	Knowledge	Knowing how to undertake an activity using observation and recall of information
Ex	Experience	A depth of knowledge of a subject or activity sufficient to enable it to be actually undertaken although generally under supervision
Ab	Ability	A sound knowledge of a subject or activity actually undertaken without supervision; ability to direct others in the activity

Table 1 Levels of attainment

[1]Chairman, EFG Registration Authority

Learning Outcome Categories	Qualificaiton Criterion
Underlying Basis	
• Understanding of the natural sciences (Physics, Chemistry, Mathematics) underlying the study of Geology	1
• Understanding of the essential features, processes, materials, history and the development of the earth and life	1
• Understanding of the key aspects and concepts of geology, including some at the forefront of that discipline	1
• Understanding of the common terminology and nomenclature and the use of bibliography in Geosciences	1
• Awareness of the wider spectrum of geological disciplines	1, 4, 5
• Awareness and understanding of the temporal and spatial dimensions in earth processes	1, 2
• Awareness of the applications and responsibilities of Geology and its role in society including its environmental aspects	3, 4, 5
• Awareness of major geological paradigms, the extent of geological time and Plate Tectonics	1, 5
• Understanding of the complex nature of interactions within the geosphere	1, 2, 3, 5
• Understanding of other disciplines relevant to geology	1, 3, 5
• Knowledge of a chosen specialization	1, 2, 4, 5, 6
Analysis, Design and Implementation	
• Creation of geological models	2
• Understanding of the complexity of geological problems and the feasibility of their solution	2
• Understanding the need of a rational use of earth resources	2, 3, 4, 5
• Formalization and specification of problems whose solution involves the use of geological methods	2
• Awareness of appropriate solution patterns for geological problems	2, 3, 5
• Description of a solution at an abstract level	2, 3
• Awareness of the range of applications of Geology	1, 2, 5
• Integration of field and laboratory evidence with theory following the sequence from observation to recognition, synthesis and modelling	1, 2, 3, 5
• Awareness of issues concerning sample selection, accuracy, precision and uncertainty during collection, recording and analysis of data in the field and laboratory	1, 2, 3, 4, 5
• Formulation and testing of hypotheses	2, 3, 4, 5
Technological, Methodological and Transferable Skills	
• Familiarization with new geological methods and technologies	1, 2, 5
• Selection and use of relevant analytic and modelling methods	1, 2
• Application of appropriate technology and use of relevant methods	1, 2, 5, 6
• Use of quantitative methods and their application to geological problems	1, 2, 5

• Independent analysis of earth materials in the field and laboratory and description, processing, documenting and reporting of results	1, 2, 3, 4, 6
• Undertaking field and laboratory investigations in a responsible and safe manner, paying due attention to risk assessment, rights of access, relevant health and safety regulations, and sensitivity to the impact of investigations on the environment and stakeholders	1, 2, 4, 6
• Combining theory and practice to complete geological tasks	1, 2, 3
• Undertaking literature searches, and using data bases and other sources of information	1, 2, 3
• Receiving and responding to a variety of information sources (e.g. textual, numerical, verbal, graphical)	1, 2, 3, 4
• Conducting appropriate experiments, analysis, interpretation of data and drawing conclusions	1, 2, 3, 4, 5, 6
• Awareness of relevant state-of-the-art technologies and their application	2, 4, 5
• Solving numerical problems using computer and non-computer based techniques	1, 2, 3
• Application of information technology to geological science	1, 2
• Use of spreadsheet and word-processing software	1, 2, 3
Other Professional Skills	
• Completion of assigned tasks in a range of technical, economical and social contexts	3, 4, 5
• Learning and studying including effective time management and flexibility	1, 2, 4, 5
• Awareness of the concept of professionalism and professional ethics	4
• Consideration of the economic, social, environmental and legal conditions expected in professional practice	4, 5
• Project management and business practices and understanding of their limitations	4, 5, 6
• Working effectively as an individual and as a member of a team	4, 5, 6
• Recognition of the need for, and engagement in self-managed and life-long learning	5
• Organization of their own work independently	1, 2, 4, 5, 6
• Formulating an acceptable problem solution using geological methods in a cost-effective and time-efficient way	3, 4, 5, 6
• Estimating and measuring costs and productivity	2, 3, 5
• Communicating effectively in written and verbal form with colleagues, other professionals, customers and the general public about substantive issues and problems related to their chosen specialisation	3, 4
• Preparing, processing, interpreting and presenting data, using appropriate qualitative and quantitative techniques and packages	3, 4, 5

Table 2. (pp 20 & 21) Learning Outcome categories mapped onto professional qualification criteria

peer reviewers in accordance with the following criteria which are set down by EFG regulation.

Although these criteria are shown as applying to particular examples of learning outcomes in Table 2, all criteria should be taken as applying to all aspects of a professional competence. This applies in particular to criteria 3, 4, 5 and 6.

Additional detail on the learning outcome categories and the professional achievement levels is given at the following link: http://www.euro-ages.eu/pages/intermediate-results.php

The framework of criteria and achievement levels developed within the Euro-Ages project should increase awareness of the Earth Sciences qualifications. This is intended to facilitate academic and professional mobility across Europe while at the same time stimulating students and graduates in the field of geology as well as professional geologists to pursue Life Long Learning. The mapping carried out will provide important reference points for quality assurance and related recognition issues focused on learning outcomes, thereby adding value in the implementation of the 2005 Directive on recognition of qualifications.

The major stakeholders in the field of higher education in geology can therefore use the results from this project to develop a Europe-wide qualifications framework for the teaching and training of geologists to provide the qualified professionals that are needed by industry in Europe.

No	Criterion
1	An ability to understand the complexities of geology and of geological processes in space and time.
2	An ability to use geoscience information to generate predictive models and the critical evaluation of geoscience information to generate predictive models.
3	An ability to communicate effectively verbally and in writing.
4	A clear understanding of the professional and ethical responsibilities of a professional geologist. This includes a clear understanding of the Code of Conduct and commitment to its implementation.
5	A clear commitment to developing and maintaining expertise as a professional geologist through a programme of Continuing Professional Development that is relevant to the speciality and professional work of the applicant.
6	A knowledge of and commitment to safe working practices in accordance with good practice and relevant statutory requirements applicable to the applicant's discipline or area of work.

Table 3. Qualifiation criteria as referenced in Table 2

How academia and industry create Professional Geologists

University of Miskolc, Hungary

by Janos Foldessy[1] and Ferenc Madai[2]

The University of Miskolc is the only place in Hungary where Earth Science for engineers is taught at BSc, MSc and PhD levels. Industrial relations are very important for the university, the students and industry. During recent decades several types of cooperation have been developed. Among these, the compulsory company contributions for the Professional Education Fund is perhaps the most important. This contribution sets the financial background for practical training, student internships and scholarships as well as acquisition of equipment and provision of laboratories. The universities became entitled to this grant from 2003 onwards. All the various types of cooperation play a significant role in the training of students and the formation of well-trained professionals.

L'Université de Miskolc est le seul endroit en Hongrie où l'enseignement des Sciences de la Terre au niveau ingénieur respecte les niveaux de qualification : Licence, Maîtrise et Doctorat. Les relations avec l'industrie sont capitales pour l'Université, les étudiants et l'industrie. Durant les dernières décennies, plusieurs types de coopération se sont développés. Parmi ceux-ci, la contribution obligatoire des compagnies au fond d'Education Professionnelle est peut-être la plus importante. Cette contribution fixe le niveau de base du budget permettant de financer une formation pratique, des bourses d'études ainsi que l'acquisition d'un minimum d'équipements nécessaires aux laboratoires. Les Universités ont le droit de bénéficier de cette manne depuis 2003. Tous les types de coopération jouent un rôle significatif dans la formation des étudiants et aussi des professionnels confirmés.

La Universidad de Miskolc es el único sitio en Hungría donde se imparten Ciencias de la Tierra para ingenieros a nivel de licenciatura, máster y doctorado. Las relaciones industriales son muy importantes para la universidad, los estudiantes y la industria. Durante las últimas décadas se han desarrollado varios tipos de cooperación, entre las cuales la contribución obligatoria al Fondo para la Formación Profesional es la más importante. Esta contribución representa la base financiera para una formación práctica con becas y prácticas en empresas para estudiantes, así como para la adquisición de equipos y materiales para los laboratorios. Las universidades tuvieron derecho a esta financiación a partir de 2003. Todos los diversos tipos de cooperación universidad-empresa juegan un papel significativo en la educación de los estudiantes y en la producción de profesionales bien formados.

The predecessor of the University of Miskolc, the Bergschule in Schemnitz (now Banska Stiavnica, Slovakia) is one of the oldest mining schools in Europe. Since its foundation in 1735, we are now completing the 265th academic year. The early focus on mining and metallurgical engineering has been widely diversified today; the teaching now extends to eight faculties and one institute of music. The Faculty of Earth Science Engineering preserves the mining traditions and deals with both the traditional and pioneering branches of Earth Sciences and technologies, from mining through petroleum engineering to environmental engineering and geoinformatics. To date, there are more than 1,000 students and 60 teaching staff in the faculty. Since the industrial companies are our main customers, special attention has always been paid to the industrial relations of the Faculty.

[1]Professor, Head of Department
[2]Vice-dean, Faculty of Earth Science Engineering

Earth Science Engineering curricula

The Bologna system was introduced in 2006. Before that date, 5-year courses offered a Diploma from the different branches of Earth Science Engineering, with the possibility of continuing with 3 years of PhD studies.

Since that time Earth Science and Engineering subjects have been taught at B.Sc., M.Sc. and Ph.D. levels. Three curricula are offered at a B.Sc. level (Earth Science Engineering, Environmental Engineering, Geography). The Earth Science and Engineering B.Sc. covers all main areas of the extractive industry with minor specializations in: exploration geology and geophysics, mining and geotechnical engineering, process engineering, as well as oil and gas production and upstream activities. This B.Sc. programme in Hungary is offered uniquely in the University of Miskolc.

Several engineering M.Sc. courses are linked to these basic courses, such as Hydrogeology, Petroleum and Gas Engineering, Applied Earth Sciences (Geology and Geophysics) and Process Engineering. The Faculty is affiliated to international M.Sc. programmes, such as the Federation of European Mining Programmes (in consortium with TU Wroclaw, TU Freiberg, U of Exeter, TU Delft, TU Aachen and TU Helsinki). At the Ph.D. level several students graduate each year, from Geology, Geophysics, Mining Engineering, Petroleum Engineering, Hydrogeology and Environmental Engineering.

Training of geologists and geophysicists

In these training schemes geologists and geophysicists graduate as Earth Science Engineers, with Geology, Geophysics, Hydrogeology or Geoinformatics as major subjects. The number of students vary widely, from 1-3 graduates to 6-10 graduates annually in each major line.

The B.Sc. training includes compulsory 6 weeks practical work in industry and institutes; generally this work is the introduction to the problems of the thesis work by the student (Figs 1&2).

Legal framework and incentives

Law supporting professional training

Governments have uniformly recognized the utmost importance of practical professional training at medium and higher levels of education, and the industrial involvement in the practical training has been supported by different legal measures. Of these the most important is the Law 86/2003 which has obliged every industrial stakeholder to contribute to the Professional Training Fund by 1.5% of its wage and salary expenditures. Of this amount, 70% is collected centrally, and 30% can be offered directly to schools and universities for medium and higher level professional education.

Tax allowances

The accumulated sums in the 30% portion of the Professional Training Fund can be used in several ways:

- internal training schemes in companies given by accredited institutions
- purchase of high value equipment and instruments related directly to the practical courses
- offering internship programmes and practical training to medium and higher level education students.

Since these forms of utilization are tax deductible, i.e. organized practical training programmes reduce the amount of payable corporate tax, the costs for the participating companies are borne by the Fund.

Only those high schools and universities which provide at least six weeks practical training outside the university at industrial partners or in the tertiary or agricultural sector are entitled to obtain funds.

This form of support provides a constant and significant financial source for the University to keep its instrumentation and practical training facilities up-to-date (Fig. 3).

Forms of industry involvement

Corporate involvement in European courses

Strong international industrial support

From top:
Figure 1. Students working on ore exploration mapping, Rudabanya

Figure 2. Students on industry site visit at the Boda exploration site (Radioactive waste disposal storage development)

Figure 3. JEOL 8600 EDX-WDX Microprobe in the Institute of Mineralogy and Geology. The instrument has been purchased through the Professional Training Fund

backs up the Federation of European Mining Programmes (FEMP), in which Miskolc is a participating partner. The travel costs and accommodation costs of students are sponsored by the supporting companies. Among the industrial partners, such global mining companies as Rio Tinto, BHP Billiton, Barrick Gold, Anglo American, RWE, Outukumpu and Boliden are encountered. The companies open job opportunities for the students graduating in these courses.

Industry representatives on the Faculty Board
The Faculty Board has 5 members (out of 27) representing the industry, industrial associations and professional authorities. The Board meets 10 times a year. These meetings are excellent opportunities to express opinions about the academic training as well as to request assistance from the industry players when needed.

Road-shows
The most frequent contact between students and industry is provided by the periodical road-show events organized by the companies which are interested in recruiting students from our faculty. Such meetings were organized in 2009 by both petroleum companies and service companies (Exxon-Mobile, RWE DEA, MOL, Schlumberger, etc) and mineral mining companies (Rio Tinto, RWE).

MOL department
The first Department devoted to industry-oriented training was organized by the MOL in 2009. Its objective is better organizing and focusing MOL activities amongst the students as well as providing specially focused industry-oriented training courses in-house and in the field. The department is actively involved in the starting M.Sc. programme in Petroleum Engineering. Further modules in Petroleum Geology and Geophysics are planned.

Summer internships
One of the key factors of high quality professional training is the direct and real-life involvement of students in company practices. The summer internship programmes offer very good opportunities for the students to get acquainted with possible future employers, industry practices and disciplines. Several companies offer internship programmes, which are used to fulfil the 6-weeks practical training requirement at B.Sc. level.

Scholarships for students
Several national and international companies offer scholarships for the students, such as Nabors Industries Ltd (scholarships for B.Sc. and M.Sc. students specializing in oil engineering); RWE (joint training programme with the TU Bergakademie Freiberg).

Consultancy on thesis work
Normally the industrial relationships do not stop, rather are intensified, at higher, M.Sc. and Ph.D. levels. It is now increasingly frequent to have industry development and innovation problems announced as Ph.D. thesis topics, with adjoining financial support to carry out the laboratory investigations related to the thesis work. The Institute of Mineralogy and Geology now cooperates with exploration firms working on metallic and non-metallic projects. These projects are now run partially by students whose theses relate to one of the unsolved scientific questions arising during the execution of the project. Such involvement is being realized in ongoing base-metal Pb-Zn-Cu explorations at Rudabanya (Hungary), and Cu-porphyry supergene mineralization at Zafranal (Peru).

Support for competitions
In some cases, non-traditional forms of cooperation are proven to be fruitful. One example of these relations is the different competitions offered for student teams. A very good vehicle to carry high professional knowledge to students was the AAPG initiative of the Imperial Barrel Award, in which our student teams have participated. Although they were not amongst the winner teams, the training and preparation work was far more efficient than normal classroom lectures. This world-wide competition is for teamwork on geological evaluation of petroleum exploration projects, from discovery to economics, based on real databases. A similar competition is organized annually by the MOL as Fresssh competitions. Our B.Sc. student team won this in 2008, out of 270 teams from 20 countries.

Leonardo programme
EU-funded schemes, such as the Leonardo programme, have been proved to be useful in opening doors for our students towards the European industry. In 2009 the Environmental Centre Kjeøy (Norway) provided places for our students, thus providing them access to highly specialized knowledge in treating acid mine drainage problems related to ore and coal extraction.

Participation in student chapters of the major global professional associations
The professional student associations have become increasingly active with the structural changes in education. Student chapters of the American Association of Petroleum Geologists, the Society of Petroleum Engineers and the Society of Economic Geologists have been founded in recent years. The national societies play similarly important roles in the students' development. In this field the annual joint meetings of the Hungarian Geological Society and the Hungarian Society of Geophysicists should be mentioned. Students take part in other international student networks for engineers, such as AIESTE.

Significant gains for the students/ strong benefits for the companies/vital for universities
Industrial involvement in university education programmes creates significant advantages for students, companies and the university. In the first place, the graduates obtain practical experience, while still in the academy, and learn about the economic side of their profession, corporate behaviour and ethics. They encounter and learn to solve real problems.

The internship schemes provide opportunities for the companies to find the right candidates for the different jobs and responsibilities, while tax allowances help reduce the financial burden of these activities. The tutoring of thesis work and participation in course work has also advantageous feedback for industrial geologists, who can refresh their theoretical background during the intense communication with the university staff. Finally, by having industry representatives on the Board, the University may and can fine-tune the different education programmes and courses, adjusting them to the ever-changing needs of the market.

Geology-related higher education programmes in Hungary

by Éva Hartai[1]

In Hungary there are four universities where geology-related programmes are offered. The traditional ten-semester academic programmes started for the last time in 2005. Since 2006 the Bologna System has been adopted. The programmes at B.Sc. level take 6 or 7 semesters. A full year of studies equals 60 ETCS; 1 ECTS equals 30 hours of workload. At B.Sc. level there is no separate 'geology' profession; the graduates get their diploma as Bachelor of Earth Sciences or Earth Science and Engineering. About 60 % of B.Sc. graduates enter the M.Sc. cycle, which started in 2009 and 2010. The "Earth Science" B.Sc. courses offer geology, geophysics, meteorology, geoinformatics, mining engineering, oil engineering, etc. The M.Sc. courses are more specialized. The expected annual number of graduates specializing in geology (including engineering geology and hydrogeology) is about 30. The curricula are rather input-oriented, with no official expectations on learning outcomes from the employers' side.

En Hongrie, il existe quatre Universités où sont enseignés des programmes de cursus géologique. Les programmes académiques traditionnels, de durée 10 semestres, ont eu cours pour la dernière fois, en 2005. Depuis 2006, le Processus de Bologne a été adopté. Les programmes au niveau licence représentent un cursus de 6 à 7 semestres. Une année complète d'études correspond à 60 ETCS ; 1 ETCS représente 30 heures de travail. Au niveau Licence, il n'existe pas de qualification professionnelle bien individualisée en Géologie, les diplômés obtenant un titre de Licencié en Géosciences ou en Géosciences et Sciences de l'Ingénieur. Le cursus de licence comprend des cours de géologie, de géophysique de météorologie, de géo informatique d'ingénierie minière et du pétrole, etc. Environ 60% des diplômés en licence suivent le cycle de Maîtrise qui a commencé en 2009 et 2010. Les cours en Maîtrise sont plus spécialisés. Le nombre annuel total de diplômés en Maîtrise incluant les domaines de la géologie de l'ingénieur et de l'hydrogéologie est de 30 environ. Les programmes d'étude dépendent plutôt des débouchés offerts sans contrôle officiel des connaissances acquises du côté des employeurs.

En Hungría hay curto universidades que ofrecen programas relacionados con la geología. El programa académico tradicional de diez semestres empezó por última vez en 2005. El sistema de Bolonia se ha adoptado desde 2006. El programa de grado ocupa 6 o 7 semestres. Un año completo de estudios es equivalente a 60 ECTS, 1 ECTS equivale a 30 horas de carga de trabajo. A nivel de grado no se producen profesionales de geología individualizados, los graduados reciben el título de Licenciado en Ciencias de la Tierra e Ingeniería. Aproximadamente un 60% de los graduados entran en el ciclo de máster, que empezó en 2009 y 2010. Los cursos de los grados en "Ciencias de la Tierra" ofrecen geología, geofísica, meteorología, geoinformática, ingeniería de minas, ingeniería del petróleo, etc. Los cursos de máster son más especializados. El número anual previsto de graduados especializados en geología (incluyendo ingeniería geológica, geología e hidrogeología) es de unos 30. El currículo es bastante orientado a lo impartido, más que hacia los resultados del aprendizaje desde la perspectiva del empleador.

The conventional ten-semester academic programmes in geology started for the last time in Hungary in 2005. There were two universities which offered these programmes. At the Eötvös Loránd University, Budapest the graduate students were *certified geologists*. At University of Miskolc they were *certified engineering geologists*. The last students in these programmes completed their studies mostly in 2010 but there are some students in the conventional programmes whose studies last more than ten semesters.

Programmes in the Bologna System

The Bologna System was implemented in Hungary in 2006. In the new system there are four universities where geology-related programmes are offered (Fig. 1). The programmes are validated and accredited by the Ministry of Education and Culture.

The workload of a full-time student for one academic year of study is defined as 60 ECTS credits, normally 30 ECTS credits for each semester. 1 ECTS credit equals ~ 30 hours of workload. The Bachelor programme in Earth Science and Engineering involves 210 ECTS credits and the Earth Science programmes involve 180 ECTS credits. The Masters Programmes include 120 ECTS credits. The curricula in the geology-related programmes are rather input-oriented and there are no outcome-oriented requirements.

In the B.Sc. in Earth Science programmes for students specializing in geology and in the M.Sc. programmes in geology the most important subject areas are as follows: mathematics, chemistry, informatics, mineralogy, petrography, geochemistry, palaeontology, physical, structural and historical geology, environmental geology, applied geology, geology of mineral deposits and mineral exploration.

For Earth Science and Engineering programmes the B.Sc. students specializing in geology the subject areas are: engineering physics, applied chemistry, economics, informatics, mineralogy, petrography, geochemistry, physical, structural and historical geology, environmental geology, geophysics, engineering geology, hydrogeology, mineral exploration, mineral resources. In the M.Sc. programmes in

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Figure 1. Location of the universities offering geology-related programmes

Geo-Engineering and Hydrogeology the subject areas are more detailed.

B.Sc. programmes are offered in the following universities:

- Eötvös Loránd University, Budapest: *B.Sc. in Earth Sciences* (6 semesters). Specialization starts in the 3rd semester. Students can specialize in astronomy, cartography and GIS, meteorology, geography, geophysics or geology.
- University of Szeged: *B.Sc. in Earth Sciences* (6 semesters). Specialization starts in the 3rd semester. Students can specialize in applied earth sciences or geology.
- University of Debrecen: *B.Sc. in Earth Sciences* (6 semesters). Specialization starts in the 3rd semester. Students can specialize in meteorology, geography or geology.
- University of Miskolc: *B.Sc. in Earth Science and Engineering* (7 semesters). Specialization starts in the 5th semester. Students can specialize in mining and geotechnical engineering, processing engineering, oil and gas engineering or Earth sciences.

M.Sc. programmes all last for 4 semesters. These programmes are offered in the following universities:

- Eötvös Loránd University, Budapest: *M.Sc. in Geology*
- University of Szeged: *M.Sc. in Earth Sciences*
- University of Debrecen: *M.Sc. in Earth Sciences*
- University of Miskolc: *M.Sc. in Geological and Geophysical Engineering*
- University of Miskolc: *M.Sc. in Hydrogelogy and Engineering.*

As the Bachelor programmes embrace a large spectrum of specialities the number of freshmen students is relatively high. In the four universities which offer geology-related programmes their numbers are about 300. The number of graduate Bachelor students (including all specializations) is about 200. The number of graduates specializing in geology-related programms is about 50. From this, about 25 enter the geology-related M.Sc. programmes.

In Hungary there is no national definition or standard for learning outcomes in the field of geology; it is the right of each university which offers the programme to define the learning outcomes. This definition is necessary for the accreditation of the offered programme.

Geology as a profession in Hungary

Geology is a regulated profession and the officially recognized geological body is the Hungarian Geological Society. The Society has about 1000 members and from this about 500 are practising geologists, the others are students or retired persons.

Graduates do not need to pass an exam to join the Society. The Hungarian Geological Society does not have continuous development programmes. These are offered by universities. It is the specific company which can require improvement of professional knowledge by postgradual courses. There are no professional prerequisites for entering a job as a geologist, the academic degree is sufficient to practise.

In the Bologna System about 25 geology-related Bachelor and 25 Masters graduates enter the labour market annually. About 80% of these are expected to get a job in the profession, the rest will work in other fields.

Geological higher education in Serbia

Between demand and capability

by Vladica Cvetković[1]

Serbia is a relatively small country located at the crossroads between central and south-eastern Europe. The country experienced severe political and scientific isolation during the 1990s entering into a turbulent transition after October 2000. In 2005 Serbia adopted a new Law on Higher Education to enable the reforms in line with the Bologna Process but there is a line of evidence suggesting that the implementation is not progressing smoothly. Higher education in the earth sciences is also facing many difficulties and some of them are given here.

La Serbie est un pays de taille relativement petite, au carrefour de l'Europe centrale et du Sud-Est. Le pays a traversé une période d'isolement sévère du point de vue politique et scientifique dans les années 1990, entrant dans une phase de transition tumultueuse après octobre 2000. En 2005, la Serbie a adopté une nouvelle loi concernant l'Enseignement Supérieur pour pouvoir mettre les réformes en phase avec le Processus de Bologne mais il est clair que cette mise en œuvre n'avance pas de façon régulière. L'enseignement supérieur en Sciences de la Terre rencontre beaucoup de difficultés dont certaines sont explicitées ici.

Serbia es un país relativamente pequeño situado entre la Europa central y la Europa sur-este. El país ha experimentado un aislamiento político y científico en los 90 y pasó por una transición turbulenta tras octubre 2000. En el año 2005 Serbia aprobó la nueva Ley de Educación Superior para permitir las reformas del proceso de Bolonia, pero hay una serie de evidencias que sugieren que la implementación no progresa adecuadamente. La educación superior en las ciencias de la Tierra también se enfrenta a muchas dificultades, algunas de las cuales se incluyen a continuación.

The only institution in Serbia in charge of higher education in geology is the Faculty of Mining and Geology. Although formally belonging to the University of Belgrade (the Faculty's official name is 'University of Belgrade, Faculty of Mining and Geology' - hereafter UB-FMG), it is a single legal entity as are most state faculties in Serbia. The UB-FMG consists of two Divisions: one for Mining and one for Geology, each enrolling around 120 students per year. At present, the whole Faculty has around 1000 active students and about 125 teaching staff. The Geology Division encompasses all geological disciplines, which are distributed throughout eight Departments: Regional Geology, Palaeontology, Mineralogy and Crystallography, Petrology and Geochemistry, Economic Geology, Hydrogeology, Geotechnics and Geophysics.

In spring 2007 the Faculty completed the first stage of the Bologna Process and was successfully accredited by the Serbian Ministry of Education. In some respect, the 'Bologna story' helped very much because it was more than a blind re-organization of curricula following simple rules. It was a milestone at which we had to observe ourselves through a prism of European standards and to think seriously about how to continue further. However, as Musselin (2005) pointed out, change in higher education is more about layering the new on top of the old than about substituting the old with the new. Therefore, it is not surprising that many goals of the Bologna Agreement still need to be achieved. Higher education in geology suffers some general problems that are common for other sciences and for other state higher education institutions in Serbia. Some difficulties, on the other hand, are typical for geological education in Serbia, because they are related to the history of geological schools in Serbia and to the internal structure of the Faculty of Mining and Geology.

The most important general problem is related to the fact that the decision to join the Bologna agreement was not followed by a change of the system of financing higher education in Serbia. This means that the system remained to be entirely controlled by the input criteria, which has important implications given that the state faculties are legal entities. Albeit the faculties have full financial independence, they are left on their own. For instance, if the number of students substantially decreases, this inevitably causes a proportional decrease of financial contribution from the State. This is exactly the present situation with the UB-FMG: a continuous loss of annually enrolled students causing gradually poorer financing from the Ministry. Indeed, this is valid for most technical and natural science faculties of the University of Belgrade. They are all going to share the same destiny until something happens either with the system of financing higher education or with the structure of Belgrade University. Naturally, the UB-FMG may try to attract more students and that is what we desperately do. However, this is not by definition a perfect idea because the attempt to have more students usually leads to erosion of studying criteria. On the other hand, the number of c. 120 students that are presently being enrolled at the UB-FMG is roughly balanced by the recent needs in Serbia. Hence, do we need a common-sense number of better educated geologists and geological engineers or many more of them who will be more poorly educated? The first should belong to the priorities of higher education in Serbia but the second may easily be important for the UB-FMG employees who claim their salaries.

Apart from this labyrinth that can be

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Faculty of Mining and Geology

solved only by a ‘New Deal’ in higher education in Serbia, there are some problems which are typical for geological education. Geology has a long tradition in higher education in Serbia dating back to 1880. Ever since that time the structure of geological education underwent many changes. The last one occurred in the mid-60s when the decision makers decided to attach natural science-oriented geological departments to the Faculty of Mining and Geology. From that moment onwards, these departments never felt at home at the UB-FMG which became a single institution in Serbia for teaching and research in all branches of geology. What is strange in having natural science and applied geological disciplines (along with mining) together? Nothing, except that they are together in the single geological school in the country! So that, if the predominating engineers of the UB-FMG decide to close some apparently unattractive departments which continuously lack students and have low potential of attracting extra funds - and that, indeed, from a pure (and blind) management point of view might be a rational idea - this would practically signify the end of the given geological discipline in Serbia. One can decide to shut down the chair in petrology or palaeontology at the University of Salzburg (in order to prioritize something else) because there are other Austrian Universities with good petrologists or palaeontologists. However, if it is done in Belgrade then these disciplines will die out in Serbia completely. The fact that geological departments are not only providing the study programmes but they are also a sort of oasis of particular scientific disciplines is almost unique. This situation induces many difficulties in the UB-FMG organization including those in successfully applying the Bologna Agreement.

These are circumstances under which Earth scientists are being taught in Serbia. In spite of the mentioned difficulties, we are continuously improving our education process and trying to bring Earth science to everyone. Our best students have long been recognized as of good quality and to have no problems obtaining Ph.D. or post-Doc positions worldwide - from UBC in Vancouver to Macquarie University in Sydney. Now we want our average students to be better because they will be among the very significant players in building a sustainable society in Serbia.

Reference

Musselin, C. 2005. Change or Continuity in Higher Education Governance? Lessons Drawn from Twenty Years of National Reforms in European Countries. In. Bleiklie, I., Henkel, M. (eds). *Governing Knowledge*, 65-79. Springer.

The higher education system for professional geologists in Italy

by Marino Trimboli[1] and Enrico Nucci[1]

The application of the Bologna Agreement in Italy was approved in 1999-2000. The structure of the new courses in Geology is divided in two cycles: a 3 year Bachelor level and a 2 year Masters degree. After five years, 28 Universities in Italy offer higher education programmes in geology with c. 900 graduates per year. Regulation of the professions in Italy follow a Government Agency Model and the government administers state exams for entry into the profession. The State examination in geology is the final test with a complete check of skills and competences.

L'application du Processus de Bologne en Italie a été approuvée en 1999-2000. Le cadre des nouveaux cursus en Géologie comprend deux cycles: un niveau Licence obtenu en 3 années d'études et un diplôme de Maîtrise obtenu en 2 années. Après 5 ans d'études, 28 Universités italiennes offrent des programmes d'enseignement supérieur en géologie avec 909 diplômés par an. La régulation de la profession en Italie est conforme aux critères établis par l'Agence gouvernementale et le gouvernement reste en charge des examens d'état pour une admission comme professionnel. L'examen national en Géologie représente le test final contrôlant les connaissances pratiques ainsi que les compétences.

La aplicación del Acuerdo de Bolonia en Italia se aprobó en 1999-2000. La estructura de los nuevos cursos de geología se divide en dos ciclos: una licenciatura de 3 años y un máster de 2 años. Tras cinco años las 28 universidades italianas ofrecen programas de educación superior en geología que producen 909 graduados al año. La regulación de las profesiones en Italia sigue un modelo de Agencia Gubernamental y el Gobierno administra los exámenes de estado para el acceso a la profesión. El examen de Estado en geología es la prueba final con una comprobación exhaustiva de las habilidades y competencias de los candidatos.

The Italian higher education system has complied with the Bologna Agreement since November 1999, when the Ministry of University and Scientific Research & Tecnology adopted Decree n.. 509/99. One year later, a new Decree of the Ministry of the University, defining the different classes of titles, was adopted by the Italian Government. According to these two Decrees higher education is based on a three-level scale; "Laurea Triennale" Bachelor (3 years), "Laurea Specialistica o Magistrale" Masters (2 years) and Ph.D.-level (Dottorato di Ricerca) (3 years). Every degree has a fixed number of credits and a full year of studies equals 60 ECTS credits (European Credit Transfer System).The workload of a full-time student for one academic year of study is defined as 60 ECTS credits, normally 30 ECTS credits for each semester. 1 ECTS credit equals ~ 25 hours of workload. The Bachelor programme involves 180 ECTS credits and the Masters Programme 120 ECTS credits.

The structure of education in geology

The usual modus operandi is the existence of several different study programmes at both the Bachelor and Masters levels. Some examples of these are: Geological Sciences and Technology, Geophysical Sciences, Engineering Geology or Applied Geology, Georesources & Geomaterials, Geohazards (Tables 1&2).

Since 1999 the National Council of Italian Professional Geologists has been involved with the Italian Government during the implementation of the new higher education programmes in geology according to the Bologna Agreement; in this period many documents and proposals were sent to the Ministry of Education. These proposals were studied according to the structure of the Italian market for professional geology.

Universities offering geological programmes

After the approval of the National Decree, the structure of different courses, as well as the learning outcomes and goals of education, were re-written by the Universities. In Italy there are 28 Universities currently offering higher education programmes in Geology and Geosciences.

The typical outcome of an Italian Bachelor learning programme in Geology is:

- knowledge and understanding: on scientific basis and in Earth Sciences, of the history of the planet, of geological processes and phenomena in the formation of rocks; of recognizing geometry and composition of rock bodies
- Applying knowledge and understanding: of analysis and description of geological materials in field and laboratory activities, in the application of professional instruments, mathematical instruments and GIS
- Making judgements: in the evaluation of the complexity of natural systems, in the design of ground investigations programmes, in data collection with analysis of quality and reliability; in the evaluation of the importance and responsibility of geological sciences in land protection and management, in the evaluation of geological hazards, protection and sustainable use of raw materials and georesources, in the conservation and protection of stone built monuments and geoheritage
- Communication skills: for information, ideas, problems, solutions in geological sciences, writing and discussing these aspects in Italian and other European languages (especially English) with the application of principal instruments of informatics and internet
- Learning skills: using advanced publications,

[1]Members of the Italian Council of Professional Geologists (CNG)

ACTIVITIES	GROUPS	UNIT DESCRIPTORS	ECTS
Basic knowledge	Mathematics	Logical Mathematics	18
		Algebra	
		Geometry	
		Complementary Mathematics	
		Calculus	
		Probability & Statistics	
		Mathematical Physics	
		Numerical Methods	
	Physics	Experimental Physics	
		Theoretical Physics	
		Atomic Physics	
		Astronomy & Astrophysics	
		Physics of the Earth	
		Applied Physics	
		Physics History	
	Computer Science	Computer Programming	
		Computer Applications	
	Chemistry	Physical Chemistry	
		General and Inorganic Chemistry	
		Organic Chemistry	
Geological knowledge	Geology & Palaeontology	Palaeontology & Palaeoecology	50
		Stratigraphical Geology and Sedimentology	
		Structural Geology	
	Applied Geomorphology & Geology	Physical Geography	
	Applied Geomorphology & Geology	Engineering Geology	
	Mineralogy, Petrology, Geochemistry & Geophysics	Mineralogy	
		Petrology & Petrography	
		Geochemistry & Volcanology	
		Raw materials environmental applications, mineralogy and petrography for monuments and geoheritage	
		Geophysics & Applied Geophysics	
		Oceanography & Physics of the Atmosphere	
Complementary knowledge	Complementary Sciences, Tecnologies, Legislation & Economy	Field Hydraulics and slope engineering	18
		Pedology	
		Environmental Chemistry	
		Hydraulics	
		Topography & Mapping	
		Geotechnics	
		Engineering Theory & Structure Design	
		Estimation	
		Legislation	
		Economics	
Knowledge & Skills		Thesis	9
		Training	9
		European Language	9

Table 1. Specific Unit Descriptors of the Bachelor in Geosciences (Class n. 16 of the National Decree)

ACTIVITIES	GROUPS	UNIT DESCRIPTORS	ECTS
Basic knowledge	Mathematics	Logical Mathematics	30
		Algebra	
		Geometry	
		Complementary Mathematics	
		Calculus	
		Probability & Statistics	
		Mathematical Physics	
		Numerical Methods	
	Physics	Experimental Physics	
		Theoretical Physics	
		Atomic Physics	
		Astronomy & Astrophysics	
		Physics of the Earth	
		Applied Physics	
		Physics History	
	Chemistry	Physical Chemistry	
		General and Inorganic Chemistry	
		Organic Chemistry	
Geological knowledge	Geology & Palaeontology	Palaeontology & Palaeoecology	78
		Stratigraphical Geology and Sedimentology	
		Structural Geology	
	Applied Geomorphology & Geology	Physical Geography	
	Applied Geomorphology & Geology	Engineering Geology	
	Mineralogy, Petrology, Geochemistry	Mineralogy	
		Petrology & Petrography	
		Geochemistry & Volcanology	
		Raw materials environmental applications, mineralogy and petrography for monuments and geoheritage	
	Geophysics	Solid Earth Geophysics	30
		Geophysics & Applied Geophysics	
		Oceanography & Physics of the Atmosphere	
Complementary knowledge	Complementary Sciences, Tecnologies, Legislation & Economy	Field Hydraulics and slope engineering	
		Pedology	
		Environmental Chemistry	
		Hydraulics	
		Topography & Mapping	
		Geotechnics	
		Engineering Theory & Structure Design	
		Estimation	
		Legislation	
		Economics	
Knowledge & Skills		Thesis	30
		Facultative Training	15

Table 2. The specific Unit Descriptors of the M. Sc. in Geosciences (Class n. 86 of the National Decree)

- database and information available on the net to improve personal knowledge.

Table 4 shows the structure of the Bachelor course in Geological Sciences at Milano Bicocca University.

The outcome of an Italian Masters programme in Geology is:

- knowledge and understanding: at a high scientific level in Earth Sciences, with skills in the original application of research methods
- Applying knowledge and understanding: solving geological problems in several and multidisciplinary fields applying special techniques in various new situations
- Making judgements: solving complex situations with incomplete dataset (hazard management, active processes study, geological evaluations in civil engineering). Special skills in the analysis of consequences from personal judgements and evaluations made
- Communication skills: with communication of results and personal evaluations with national or foreign specialists and citizens in Italian and other European language (especially English).
- Learning skills: using advanced publications, database and information available on the net improving personal knowledge in the resolution of geological and technical problems.

COURSE	ECTS
Calculus	12
Physics	12
Informatics for Earth Science	4
General and Inorganic Chemistry	8
Principles of Geology	8
Physical Geography	8
Introduction to geological mapping	2
Mineralogy	8
Field activities	2
European language	3
Total: 67	

Table 4a. First Year

COURSES	ECTS
Petrography	12
Introduction to computer science	4
Structural geology	4
Geological maps and cross-sections	4
Field geology and mapping	8
Geochemistry	8
Field geological mapping 1	4
Total 44	

Table 4b. Second Year
Bachelor in Geological Sciences and Geotechnology programme from Milan Bicocca university

Number of freshman students and graduates
The evolution of the number of students in geology in the Italian Universities is shown in Figure 1.

Prior to the introduction of the Bologna programme in Italy the number of graduates in geology each year was 1240; in 2007, after 5 years of the application, Italian universities graduated 632 Bachelors and 277 Masters. One quarter of Bachelor graduates did not continue to the Masters HE programmes. The total number of garduates at both levels is only 73% of the total before Bologna; also the number of freshman compared to graduates shows a marked decrease. The explanation of these results is not to be found in the changes introduced by the Bologna Process; HE programmes in geology have not the same appeal as others (e.g., Envinronmental Engineering). Only 51% of Masters graduates in geology has a job after three years (27% for Bachelors).

Professional Prerequisites
Italy has a long tradition of regulating the profession and is one of two countries in Europe that requires registration of geologists by law. Regulation of the professions in Italy follow a Government Agency Model and the government administers state exams for entry into the profession. Italian Law prescribes two different professional titles for B. Sc. (Junior Geologist) and M.Sc. (Geologist). The State Examination is the final test with a complete check of skills and competences; exams are managed by the State. A candidate can apply to register and take the exams at any time but in practice, a

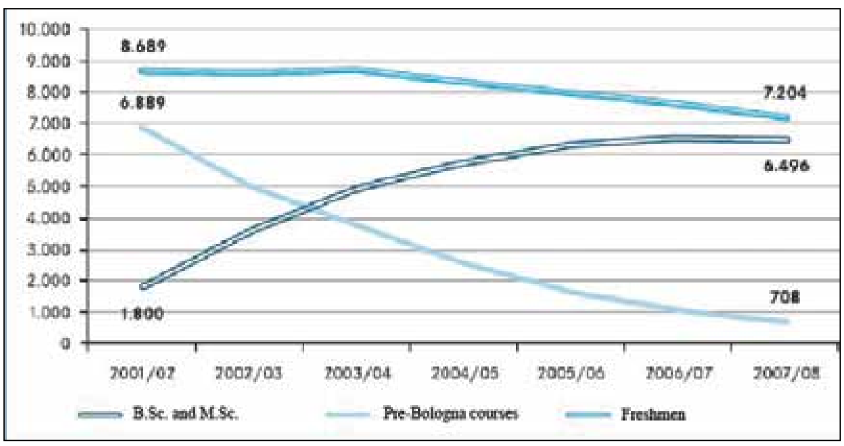

Figure 1. Geological Sciences students in Italy

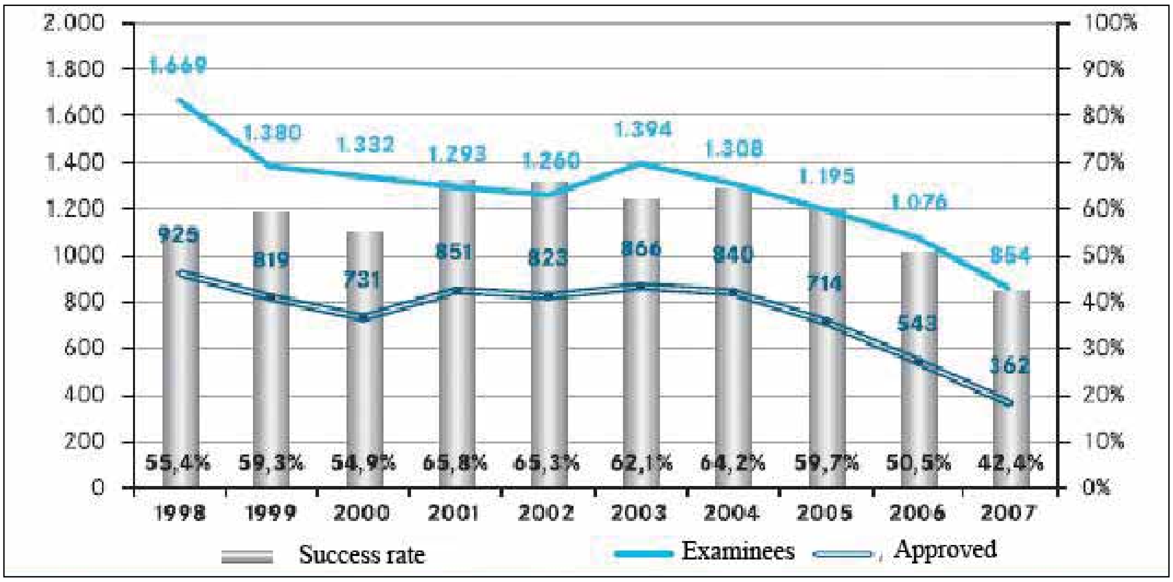

Figure 2. Geology State Examination statistics

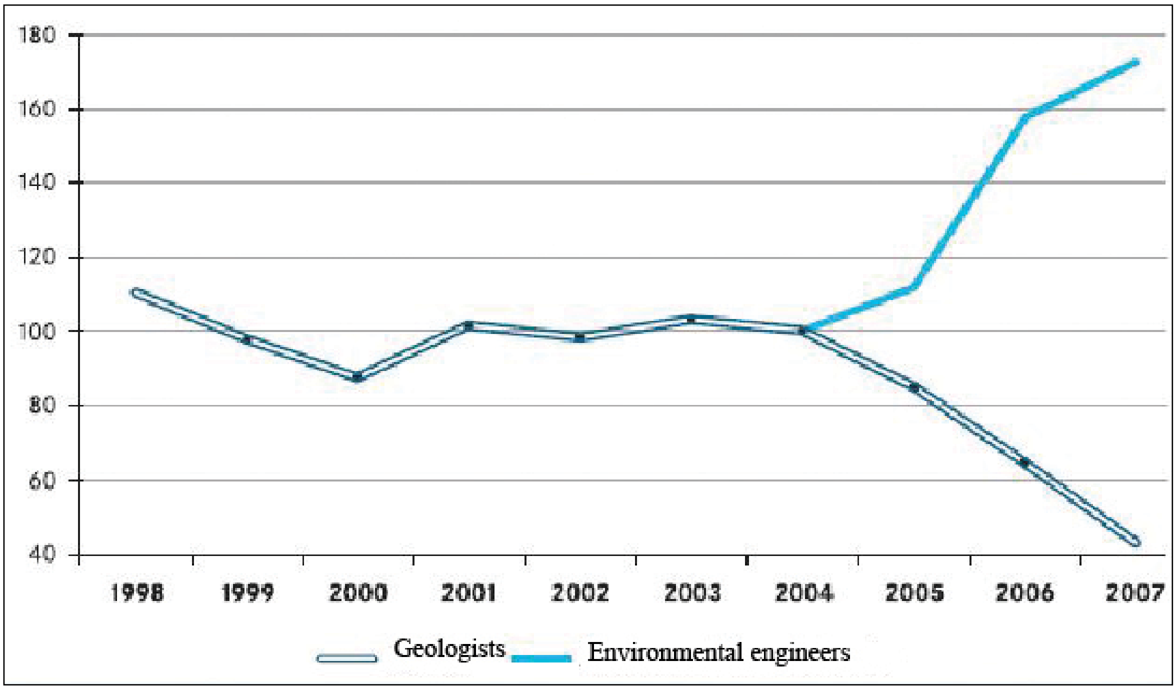

Figure 3. Number of new professionals after Bologna

minimum of 2-3 years of work experience is needed to acquire an adequate level of knowledge to pass the 35-40% range.

Structure of the State Examination

Written Examinations

The written test is related to the fields of knowledge listed in the published legislation decree.

The candidate should collect a minimum of 30 points to advance to the oral examination.

Oral examination

The oral interview will be related to the topics listed in the published legislation decree, plus professional ethics, CNG rules and regulations. The candidate should collect a minimum of 30 points to advance to the practical test.

Practical Test

The practical exam requires the candidate to complete a report based on a problem related to the topics listed in the published legislation decree.

In case of a negative result the candidate can repeat the test, but not before 6 months have elapsed.

Professional registration in Canada

Geoscience knowledge and experience requirements

by Oliver Bonham[1] *and Gregory Finn*[2]

In April 2009, Geoscientists Canada published the document "*Geoscience Knowledge and Experience Requirements for Professional Registration in Canada*". This paper is a summary of a presentation describing the development and content of this document made at the Euro-Ages Final Conference in Budapest, Hungary on October 22, 2010.

En avril 2009, les professionnels canadiens en Géosciences ont publié le document intitulé "*Obligations en matière de connaissances et d'expérience en Géosciences pour une reconnaissance professionnelle au Canad*". Cet article est un résumé de ce document avec description de son développement et contenu, tel que présenté à la Conférence Euro-Ages, tenue le 22 octobre à Budapest.

En abril de 2009, la organización Geoscientists Canada publicó el documento "*Conocimientos y experiencia en ciencias geológicas requeridos para el registro de profesionales en Canadá*". Este artículo es un resumen de una presentación que describe el desarrollo y los contenidos de dicho documento y que se expuso en la conferencia final del proyecto Euro-Ages en Budapest, Hungría el 22 de octubre de 2010.

Geoscience is a regulated profession in 11 of Canada's 13 provinces and territories. Professional registration and governance of practice in Canada is the responsibility of the independent regulatory body set up under legislation in each province and territory. There are approximately 8,900 P.Geos registered across Canada.

In recent years, annual graduations from geoscience programmes at Canadian universities averaged 800 B.Sc., 200 M.Sc. and 100 Ph.D. degrees.

Geoscientists Canada and the Canadian Geoscience Standards Board

The Canadian Council of Professional Geoscientists Canada - now operating under the business name Geoscientists Canada - is the national organization of the regulatory bodies. The mission of Geoscientists Canada is to develop consistent high standards for licensure and practice of geoscience, facilitate national and international mobility and promote the recognition of Canadian professional geoscience.

The Canadian Geoscience Standards Board (CGSB) is a national standing committee reporting to Geoscientists Canada. It is made up of appointees - one from each of the regulatory bodies. Typically those appointed to CGSB are P.Geos, who are faculty members of Earth Science departments at Canadian universities. CGSB collaborates closely with admissions officials of the regulatory bodies.

Geoscience Knowledge and Experience Requirements for Professional Registration in Canada

The Geoscience Knowledge and Experience Requirements for Professional Registration in Canada (GKE) is a consensus document that has been agreed to across the profession and among the regulatory bodies in Canada. It must be emphasized however that it is only a summary and requirements are set out under legislation in each jurisdiction.

With the decision by the profession not to pursue national accreditation for degree programmes in Canada, the need was recognized to develop and publish clearly articulated information on expectations concerning both the knowledge (formal geoscience education) and experience (on-the-job geoscience practice skills) considered necessary to be suitably qualified for independent professional practice.

Geoscientists Canada's GKE originated as a preliminary set of requirements initially released in 2000. After use for admission purposes for a 5-year period, a revision process commenced in 2005. The revision took 4 years to complete, and benefited enormously from experience and feedback from usage of the earlier document. Multi-stage consultations occurred both internally (with all the regulatory bodies) and externally (with stakeholders in the broader geoscience community) during the revision process.

A full text version of the GKE can be viewed in either English or French by visiting the Geoscientists Canada website at: www.ccpg.ca. It is recognized that, with further changes and improvements, new versions will be released over time. A brief synopsis of the requirements follows:

Geoscience knowledge requirements

Geoscience education in Canada generally falls into three distinct streams: Geology, Environmental Geoscience and Geophysics. The geoscience knowledge requirements are based on a typical 4-year honours degree in geoscience from a Canadian university. The basic unit of counting is the Education Unit (EU) which is defined as formal instruction equivalent to one term (one semester), amounting to 3 hours of lecture time or equivalent, with or without a lab component, for a 13 week term.

Identical requirements, for all three streams exist in Compulsory Foundation Science (Chemistry, Physics and Mathematics: - 3EUs); and Additional Foundation Science (Biology, Computer Science and Statistics plus Chemistry, Physics or Mathematics: - 6EUs) with no more than 2 additional EUs in any one subject area.

Similarly, for all three streams there are identical requirements in Compulsory Foundation Geoscience (Field Techniques, Mineralogy and Petrology, Sedimentology and Stratigraphy, and Structural Geology: - 4EUs). Additional Foundation Geoscience totals 5 EUs, from listed sub-groups of subjects that differ, depending on the stream, with a minimum I EU countable from any one sub-group.

The remaining geoscience knowledge is made up of Other Geoscience/

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Science for 9 EUs. These are obtaining through choices from the normal range of upper year elective courses; this provides for some specialization at the undergraduate level, while at the same time ensuring a broad base of knowledge across the Earth Sciences, and other sciences. The document includes a list of Other Geoscience/Science courses; but this list is for illustration purpose only and is not exhaustive.

For all knowledge requirements listed in the document, there is a brief statement of the learning outcome expected from each unit of study.

This represents an overall requirement of 27 EUs in science/geoscience subjects. The typical university requirement for a B.Sc. honours degree at a Canadian university is 40 EUs, with the remaining EUs needed to satisfy degree requirements for university graduation coming from other study areas.

Groups: 1A - Compulsory Foundation Science and 1B - Additional Foundation Science				
		Streams		
	Groups	Geology	Environmental Geoscience	Geophysics
1A	**Compulsory Foundation Science*** **(Total 3 EUs - One EU in each area required)** Mathematics, Physics and Chemistry are the foundation sciences on which the principles and processes of geoscience are founded. A strong foundation in these sciences provides the grounding necessary to understand and apply geoscience concepts.	Chemistry Mathematics Physics	Chemistry Mathematics Physics	Chemistry Mathematics Physics
1B	**Additional Foundation Science*** **(Total 6 EUs)(6 EUs required, no more than 2 EUs in any one subject.)** A strong background in a range of sciences allows the geoscientist to understand how the geosphere interacts with other parts of our world, to communicate and interact with scientists from other disciplines and with other professionals, and to adapt to the many challenges encountered in practice. "Geo" subject areas containing the foundational topics listed in the linked descriptors may be substituted - e.g. Geostatistics for Statistics, etc. °Biology is highly recommended for those in the Environmental Geoscience stream	Biology Chemistry Computer Programming Mathematics Physics Statistics	Biology ° Chemistry Computer Programming Mathematics Physics Statistics	Biology Chemistry Computer Programming Mathematics Physics Statistics
	* NOTE – Requirements in this table must be met by EUs at a first year or higher university level course acceptable for credit towards a degree in science, applied science or engineering. Remedial secondary school level courses, such as algebra, chemistry, geometry, physics or trigonometry are not accepted.			

Figure 1. Compulsory and Additional Foundation Science requirements as set out in GKE

Geoscience experience requirements

Professional registration in Canada requires 48 months of cumulative geoscience work experience covering the following areas: application of geoscience theory and practical work experience; understanding of geoscience processes and systems; management of geoscience; communication skills; and awareness of societal implications of geoscience. Work experience is generally obtained following graduation; however there are provisions to allow geoscience employment during the undergraduate programme and post graduate thesis work to count towards these requirements.

Work experience must be independently verified by a minimum of three referees (two of whom must be P.Geos), who are familiar with the applicant's work and can comment on their technical ability and suitability for licensure.

Groups: 2A - Compulsory Geoscience and 2B - Additional Geoscience				
		Streams		
	Groups	Geology	Environmental Geoscience	Geophysics
2A	**Compulsory Foundation Geoscience** **(Total 4EUs)(1 EU in each area required).** All geoscientists share common core knowledge around which the profession of geoscience is practiced. These subject areas define the common knowledge base in geoscience required to practice in all three streams of geoscience.	Field Techniques Mineralogy and Petrology Sedimentation and Stratigraphy Structural Geology	Field Techniques Mineralogy and Petrology Sedimentation and Stratigraphy Structural Geology	Field Techniques Mineralogy and Petrology Sedimentation and Stratigraphy Structural Geology
2B	**Additional Foundation Geoscience** **(Minimum Total 5 EUs)(Geology and Environmental Geoscience require – a minimum of 1 and at most 2 from each sub-group; Geophysics requires 1 EU from each sub-group)** Beyond common foundation science and geoscience knowledge documented above, training in geoscience generally falls into three broad specializations or streams (geology, environmental geoscience and geophysics), that reflect the basis of three broad sub-disciplines of practice in the profession. Each of these sub-disciplines requires a different set of foundational geoscience knowledge.	Geochemistry Geophysics Igneous Petrology Metamorphic Petrology Sedimentary Petrology Sedimentology Glacial Geology or Geomorphology Remote Sensing	Geochemistry Geophysics Hydrogeology or Hydrology Engineering Geology Geomorphology or Soil Science Glacial Geology Remote Sensing	Digital Signal Processing Global Geophysics / Physics of the Earth Seismology/Seismic Methods Exploration Geophysics Radiometrics/Gravity & Magnetics Electrical & Electromagnetic Methods

Figure 2. Compulsory and Additional Geoscience requirements as set out in GKE

Other requirements

To become registered all candidates must sit and pass a Professional Practice and Ethics Exam covering: ethics, professionalism, business law, professional liability and responsibilities concerning protection of the public. It is not a technical exam.

Conclusions

While the primary purpose of the Geoscience Knowledge and Experience Requirements for Professional Registration in Canada is to serve as a common reference among the regulatory bodies, its other important purpose is to provide information to:

- those studying to enter the profession of geoscience, and those preparing to become registered
- educators and trainers of geoscientists, including professors, university counselors, and those developing geoscience curricula
- persons migrating to Canada and internationally mobile professionals intending to practise professionally in Canada
- law and policy makers, governments and those involved in the registration and regulation of the geoscience profession
- employers, or users of professional services offered by geoscientists and the general public.

Acknowledgements

Support for travel to attend and participate at the Euro-Ages project final conference was covered through Human Resources and Skills Development Canada's Foreign Credentials Recognition Program funding for Geoscientists Canada's International-Trained Geoscientists Framework Project (Project #8556957). The authors would also like to thank Bruce Broster for assistance in reviewing the text of this paper.

Reference

Canadian Council of Professional Geoscientists. 2009. *Geoscience Knowledge and Experience Requirements for Professional Registration in Canada.*

Quality assurance of higher education in geology

Perspectives from employers

by Luca Demicheli[1]

EuroGeoSurveys (EGS) is the organization of the Geological Surveys of Europe. Currently 32 national geological surveys are members of EGS. The Geological Surveys of Europe are public government organizations and their staff is mainly hired through public competitions. The profiles required are continuously changing to meet the new priorities of European geosciences. This implies that prospective employees are able to provide a uniform level of education across Europe, and have a high degree of flexibility in rapidly adapting to the required changing skills.

Eurogeosurveys (EGS) est l'Organisation regroupant les Services Géologiques Européens. Actuellement, 32 Services Géologiques nationaux sont membres de l'EGS. Les Services Géologiques européens sont des organisations gouvernementales, publiques, et leurs membres sont en majorité sélectionnés à l'issue d'un concours public. Les profils requis varient de façon continue pour tenir compte des nouvelles priorités des Géosciences en Europe. Cela implique que les candidats soient aptes à démontrer un niveau d'éducation équivalent pour les pays européens et soient à même, grâce à un haut niveau de flexibilité, de s'adapter rapidement aux compétences requises, en permanente évolution.

EuroGeosurveys es la organización que agrupa a los Servicios Geológico de Europa. Actualmente son miembros de EGS 32 servicios geológicos. Los servicios geológicos de Europa son organizaciones gubernamentales y su personal se contrata por medio de oposiciones públicas. Los perfiles de los puestos solicitados cambian continuamente en función de las nuevas prioridades en las ciencias de la Tierra europeas. Esto implica que los futuros empleados de estas organizaciones deberían tener un nivel de educación uniforme en toda Europa y un mayor grado de flexibilidad para adaptarse rápidamente a las cambiantes destrezas que se requieren.

EuroGeoSurveys (EGS) is the organization of the Geological Surveys of Europe. Currently 32 national geological surveys are members of EGS, which promotes the contribution of geosciences to European Union affairs and action programmes to publish, or see its Members publishing, expert, neutral, balanced and practical pan-European technical advice and information for the European Union Institutions. It also provides a permanent network between the Geological

[1]Secretary General, EuroGeoSurveys - The Geological Surveys of Europe

Surveys of Europe and a common, but not unique, gateway to each of the Members and their national networks to jointly address European issues of common interest in the field of geosciences. According to its Statutes, EGS shall pursue activities that lie exclusively in the public interest or in the interest of public administration that will benefit from the combined and coordinated expertise of its members and in the direct interest of the European Union and/or of the European Free Trade Association. EGS areas of expertise include:

- the use and the management of on- and off-shore natural resources related to the subsurface of the Earth (minerals and water, soils, underground space, land and energy, including renewable geothermal energy)
- the identification of natural hazards of geological origin, their monitoring and the mitigation of their impacts (deficit or excess of trace elements in soils and waters, earthquakes, natural emissions of hazardous gases, landslides and rock falls, land heave and subsidence, shrinking and swelling clays)
- the development of interoperable and harmonized geo-scientific data at the European scale
- environmental management, waste management and disposal, land-use planning
- sustainable urban development and safe construction
- e-government and the access to geo-scientific metadata and data.

With an overall work force of over 20,000, the Geological Surveys of Europe can be considered a major employer in the field of geoscience at continental level. As such, EGS has a specific interest in education systems and their level, especially in the field of higher education.

EGS is a particular type of employer, being composed only of public organizations. Nevertheless, the size, mandate and priority of the Geological Surveys of Europe are not homogeneous. Each Geological Survey belongs to a specific ministry in its own country. It is possible to state, with a good level of approximation, that about 30% of the EGS members are part of ministries in charge of environmental protection; 30% of ministries in charge of research; 30% of ministries in charge of economy/industry/energy; 10% in various others. Moreover, the size and mandate vary very much too. Some surveys have many hundreds of staff members with duties ranging from civil protection support to oil and gas exploration, while others are considerably small in size and operational capability. It has also to be considered that the hiring procedures are very seldom straightforward, since public administrations in most of the cases require the establishment of open competitions to fill vacant positions.

Nevertheless the need for very highly-qualified staff is continuously increasing among Geological Surveys, at the same rate of their joint activities at international level. This situation tends to level towards the top the capabilities of the survey which more and more operate at the forefront of European technological development.

One the one hand this has led the Geological Surveys to further strengthen their relationships with the universities for the preparation of graduates and post-graduates, in a way that is more harmonized and flexible throughout Europe. Young members of staff are expected to be able to respond to the rapidly changing geo-scientific applications, and to be able to apply their competences in any country in Europe, according to the priorities of each national Geological Survey.

The Young Earth Scientists (YES) Network is also seen as a major contributor to achieve these goals, as it indeed facilitates exchange of experience and knowledge among students and early career geoscientists, increasing their ability to operate internationally.

In order to increase the level of specialization of young geologists, the Geological Surveys of Europe are also active in organizing postgraduate courses and highly specialized training. A recent notable example is represented by the National School for Applied Geosciences (ENAG) of the French Geological Survey (BRGM). The school aims at completing the training of specialists in geosciences by developing the talents needed by governments, the mining industry and international institutions, such as geographic mobility (multinational/national), cultural adaptability, knowledge of field geology, capacity for synthesis from multiple-source data, interpretation of field (mining) data, expertise in modelling tools, ability to manage projects, ability to manage people (relations/communication, …).

On the other hand, secondary education sets the base framework to enable students to enroll in any European university and be directly able to deal with the study matters in a comparable way with their colleagues from other countries.

For these reasons we look very much forward to seeing the results of the Euro-Ages project in the years to come and to benefit from them.

Euro-Ages and geology in Sweden

by Vivi Vajda[1] and Linda M. Larsson[2]

There are five Higher Education Institutes in Sweden producing graduates in geology. Besides these universities, courses and programmes are also offered in technical geology and marine geology at several other schools in Sweden. However, these are usually offered to engineers only. The Swedish universities adapted their education towards the Bologna process in 2007 and the Higher Education Institutes in Sweden have basically the same framework for their geological education programmes. They are all organized according to the Bologna process where education in geology is based on a three-level scale; Bachelor (3 years), Masters (2 years), and Ph.D. (3 years). Every degree has a fixed number of credits and a full year of studies equals 60 ECTS credits. In total 75-100 geology graduates come through the Swedish Universities per year. The number of freshmen students entering the geological programmes is stable and unemployment rates are low, and continue to decrease.

Il existe cinq Etablissements d'Enseignement Supérieur en Suède, à l'origine des diplômés en géologie. Outre ces universités, des cours et programmes en géotechnique et en géologie marine sont également dispensés auprès de plusieurs Ecoles suédoises. Cependant, ils sont d'habitude l'apanage des seuls ingénieurs. C'est en 2007 que les universités suédoises se sont conformées au système d'éducation du processus de Bologne, basé sur les trois niveaux de qualification; Licence (3 ans), Maîtrise (2 ans) et Doctorat (3 ans). Chaque niveau comporte un nombre défini d'unités de valeur et une année complète représente 60 unités. Au total, 75 à 100 diplômés en géologie sortent chaque année des universités suédoises. Le nombre d'étudiants en première année de cursus géologique est stable et le taux de chômage est faible et en diminution.

Hay cinco centros de educación superior en Suecia que producen graduados en geología. Además de estas universidades, varias escuelas de Suecia ofrecen cursos y programas en técnica geológica y geología marina. Sin embargo estos últimos se ofrecen sólo a ingenieros. Las universidades suecas adaptaron su sistema educativo al proceso de Bolonia en 2007 y los centros de educación superior suecos tienen el mismo marco de referencia para sus programas de educación en geología. Todos ellos están organizados de acuerdo con el proceso de Bolonia en el que la educación en geología se basa en un sistema de tres niveles: Grado (3 años), Máster (2 años) y Doctorado (3 años). Cada grado tiene un número fijo de créditos y un año completo de estudios equivale a 60 ECTS. Anualmente las universidades suecas producen entre 75 y 100 graduados al año. El número de nuevos estudiantes que se incorporan a los programas geológicos esta estable y las tasas de paro son bajas y siguen disminuyendo.

Sweden has with its 9.2 million inhabitants the largest population of the Nordic countries. It is separated in the west from Norway by a range of mountains and shares the Baltic Sea with Finland. Sweden joined the European community in 1995 but has kept its national currency, the Swedish krona. Geology plays an important role in local society and economical development, Sweden being one of the more productive mining countries in Europe. Sweden is a major iron ore exporter – the largest one in Europe. The country further exports copper, lead and zinc.

The number of geologists in the country is uncertain but c1000 geologists are members of the Swedish Association of Geologists within SACO (Swedish Academic Central Organization). There are five Higher Education Institutes (HEI) in Sweden producing graduates in geology (Fig. 1). The institutions are located in Lund, Göteborg, Karlstad, Stockholm, Uppsala and Umeå and are within traditional well-known universities in which geology has been a recognized topic in the sciences catalogue. The one in Umeå is related to the existence of important mineral resources in the region. Besides these universities, courses and programmes are also offered in technical geology and marine geology at several other schools in Sweden (Fig. 2). However, these are usually offered to engineers only.

The programme is open to students from all over the world and was until 2010 free of charge, apart from a small fee for compulsory membership in the Student's Union. Since 2011 however, a fee for Masters studies is required from students from non-European community member states. Applicants should have a B.Sc. in Geology or Earth Sciences or equivalent proficiency. Non-Nordic students who do not have English as their mother tongue must have passed an internationally-acknowledged test in English, such as TOEFL (at least 550/213), IELTS (at least 6.0) or Cambridge Certificate of Proficiency.

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The Bologna process in geology

The Swedish universities adapted their education towards the Bologna process in 2007 and are, therefore, accredited by the Swedish government. The aims for joining the Bologna process were primarily to simplify the mobility between different universities both on a national and international level. The goal was further to increase the employment opportunities after graduation

Education in geology is based on a three-level scale; Bachelor-, Master-, and Ph.D.-level. Every degree has a fixed number of credits and a full year of studies equals 60 ECTS credits The Bachelor level is three years and to achieve a Masters degree, two years must be added. The usual modus operandi is the existence of only two or three different study programmes at both levels. As a few examples one can mention Palaeontology, Bedrock Geology and Quaternary Geology. The workload of a full-time student for one academic year of study is defined as 60 ECTS credits, normally

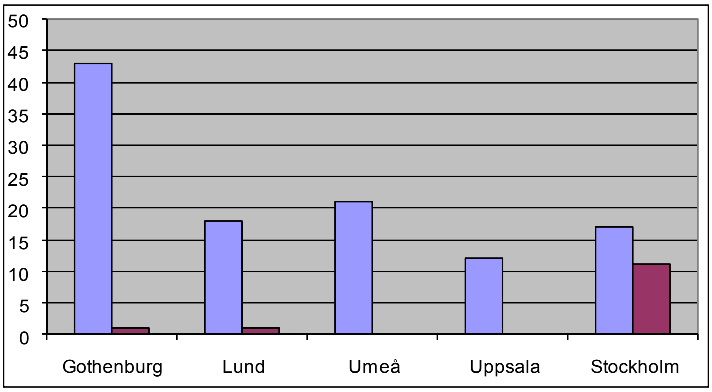

Figure 1. Number of freshmen students (blue = Bachelor; red = Masters) in the Swedish universities

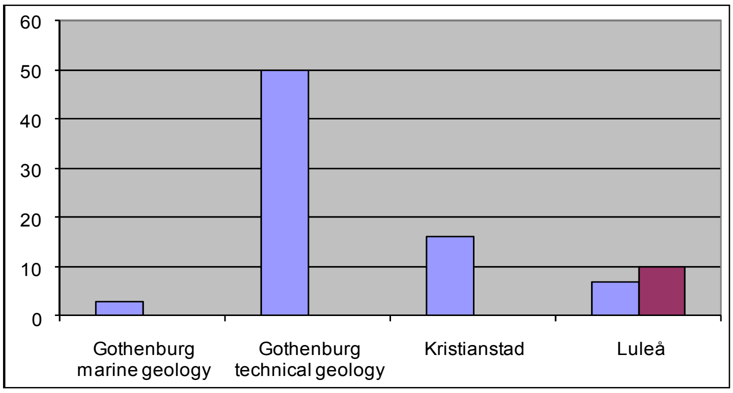

Figure 2. Number of freshmen students (blue = Bachelor; red = Masters) in the Swedish geotechnical system

30 ECTS credits for each semester. 1 ECTS credit equals ~ 30 hours of workload. The Bachelor programme involves 180 ECTS credits and the Masters an additional 120 ECTS credits. The structures of the different courses, as well as the learning outcomes and goals of education, have been re-written according to the Bologna Process. All courses have learning outcomes. For each type of geological education one has to complete particular courses to fulfill the specific learning outcome for the chosen type of exam. Since Sweden has not yet graduated any students within the Bologna Process, it will only be possible to see the full outcome and its advantages after 2010.

Number of freshman students and graduates in the country

The total number of places offered in geology programmes by all universities in Sweden is around 250 per year but the total number of freshmen that finally join the programmes each year is only 100. In parallel with the reduction of freshmen students, the number of study places has increased, and as a consequence the universities have specialized their teaching programmes in order to attract students.

Besides the shorter Bachelor programme, most students choose to continue with the two-year Masters (120 ECTS credits) in geology. The M.Sc. programme covers nearly all aspects of geology, from minerals to climate changes and the evolution of life. It aims to provide students with a broad knowledge of geology and exposure to areas on the cutting edge of research, a thorough understanding of the practical applications of geology, and transferable and subject-specific skills necessary for academic research or entry into various employment opportunities in private companies or governmental agencies. Training in writing and oral presentation skills are promoted throughout the period of study.

The learning outcomes in the field of Geology are not defined at a national level. It is entirely the responsibility of the individual HEI to define its own learning outcomes for the geology programmes. There are no professional bodies that define additional prerequisites. However, the institutional board at each HEI bases the learning outcomes partly on expectations of national stake-holders. Sweden does not yet have a system for accreditation of geology programmes. The unemployment rate among geologists is low in the country and continues to decrease.

On regulations and renewals

Regulations
The EFG Statutes and Regulations are important documents that underpin the smooth running of the Federation. In addition, the statutes and regulations can be used to demonstrate to members and other professional organizations that EFG is organized and run in a structured and professional manner.

The Statues had remained unchanged for most of the life of the EFG whilst the Regulations were last updated in 2002. In 2008, Council decided that the time had come for a fundamental review of these documents by the Registration Authority. The main reason that a review was deemed necessary was that a series of changes over the years had resulted in a number of inconsistencies, and that the regulations no longer reflected the way that the EFG wanted to operate.

This process has now been completed with updated Statutes which are published on the EFG web site. The full set of regulations has also now been completed and was approved by Council in May 2010.

The main change that has arisen in the review is that the regulations have been split into a series of separate documents which will make it much easier to maintain in the coming years. The schedule of regulations is shown in the box below.

The task of editing and updating the statutes and regulations largely fell to Bob Chaplow my predecessor as Chair of the Registration Authority, and the EFG owes him a big vote of thanks for the huge contribution this task has made to the professional operation of EFG; thanks are also due to those Council members who assisted in the review process.

Renewals
One of the changes that the revision of the regulations has confirmed is for the renewal of the EurGeol. title to be now made on an annual basis, rather than the previous triennial arrangement. This means that every EurGeol. has to provide all the details for renewal to the relevant Licensed body annually. A renewal consists of payment of the annual EurGeol. fee and the provision of a CPD record.

The provision of an annual CPD return is a requirement of maintaining your EurGeol. status. This return can either be electronic or on a proforma summary sheet sent on paper or as a pdf and although there is no particular required format, templates are provided on the EFG web pages. It is not necessary for all evidence and documentation in support of the statement to be provided.

Once a return is provided to the Licensed Body, the EurGeol. should assume that it has been received and is satisfactory unless there is correspondence to the contrary. A small number of returns are randomly selected for audit, and in these cases the Licensed Body might call for further supporting information.

CPD reports are sent to the relevant Licensed Body. This is either a National Body (IGI Ireland, ICOG Spain, CHGEOL Switzerland and GSL UK) or the International Body which is administered through the EFG Office in Brussels.

David Norbury
Chair, EFG Registration Authority

General

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G2	Statutes and Regulations: compliance
G3	Publications and Communications
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Code of Ethics	
C1	Code of Ethics
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N1	Membership of the EFG
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N3	Working Groups and Panels of Experts
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European Geologist	
E1	Criteria for award of title of European Geologist
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News from Spain

First Spanish Geological Olympiad
Geology as a science, wishes to join the Scientific Olympiad and in order to do so, several Spanish geological associations, coordinated by the Spanish Association for the Teaching of Earth Sciences (AEPECT), decided to organize the 1st Spanish Geological Olympiad.

This Olympiad was held for the first time internationally during the International Year of Planet Earth (IYPE). Its first call took place at Seoul National University (Korea) in September 2007. AEPECT presented the project to the IYPE Commission but funding failed, but the first Geological Olympiad was carried out in Spain in the Basque Country in 2009. The extraordinary success of this call encouraged us to promote this Olympiad at a national level.

We aimed to stimulate students of Earth Sciences as well as to promote the advancement and dissemination of geology in today's world. So that geology, as a branch of science with an enormous educational value, can also have an important cultural aspect. It is hoped that the Geological Olympiad, more than a mere exam, is turning into a true celebration of geology.

During this first event, participation was voluntary. Some regions had no participants, but the objective in future calls is a global participation so that we will be able to attend the International Geological Olympiad. The regional phase was conducted at the provincial level throughout February 2010 with 600 participating students.

Development of the national phase of the Olympiad
The national phase took place from 27-28 March in Madrid (Figs 1&2), with the participation of three winners from the regional phase. During this first part of the competition, participants had to demonstrate their knowledge by answering questions at the Faculty of Geology in Madrid.

On 27 March, 36 students from 14 provinces (Alicante, Barcelona, Gerona, Guadalajara, La Coruña, Huelva, Madrid, Málaga, Murcia, País Vasco, Sevilla, Valencia y Zaragoza) were received by the Dean and Deputy Dean of the Faculty of Geology, accompanied by the president of AEPECT.

Then, the test began by following a route marked by Dinosaur footprints. The tests comprised a questionnaire on geology and the identification of samples (51 questions in all), were held in classrooms and laboratories. Two questions had to be solved by a team of three participants from different provinces. The development of these tests had the cooperation of the Organizing Committee and the support of 7 students of the Faculty.

The test was followed by a workshop on "Discovering our steps through Atapuerca" concerning research on human evolution. The workshop was chaired by Dr Ignacio Martinez and Dr Alejandro Mendizábal, who do research on this wonderful deposit of human fossils located near Burgos. In the afternoon, participants moved to the GeoMining Museum at the Geological Survey of Spain, to enjoy a guided tour by its director, Dr. Isabel Rábano (Fig. 3).

The awarding ceremony took place on 28 March at the premises of the Official Spanish Association of Professional Geologists (ICOG). It was chaired by the President, Mr. Luis Suarez, accompanied by the Director of the Geological Survey of Spain, Dr. José Pedro Calvo, the Dean of the Faculty of Geology of Madrid, Dr. Eumenio Ancochea, the President of the Geological Society of Spain, Dr. Ana Crespo and the President of the Spanish Association for the Teaching of Earth Sciences Dr. Amelia Calonge, who coordinated this event.

We must congratulate all the participating schools for the high level of geological knowledge of the 36 students who reached the finals. Out of a maximum score of 52 points no one obtained less than 26 and all 6 winners exceeded 40 points. The winners were:

1. Manuel Ledesma Rodríguez. IES Emilio Prados (Málaga).
2. Andreu Vinyoles Busquets. Escola Pia Nostra Senyora (Barcelona).
3. Sergio Linares Fernández. IES Fuente Juncal de Aljaraque (Huelva).
4. Ignacio Fernández Herrero. IES La Serna de Fuenlabrada (Madrid).
5. Irene García Ruíz del colegio El Armelar de Paterna (Valencia).
6. Manuel Ibáñez Gabarrón de Lorca (Murcia).

Figure 1. Geological Olympiads held in Madrid 26 February (Photo: L. Quintanilla)

Figure 2. A group of participants in the 1st Spanish Geological Olympiad with accompanying teachers (Photo: A. Calonge)

Figure 3 .- Visit the GeoMining museum (IGME), supervised by Dr Isabel Rábano, Museum director (Photo: A. Calonge)

All finalists received a certificate and a gift, depending on the position obtained in the ranking (Fig. 4), as stated in the website of the Olympics: (http://www.aepect.org/olimpiadasgeologia/index2010.htm).

At the end of the awarding ceremony, a questionnaire was distributed among the participants which was completed by 30 students. Although we would have liked to have the views of all the students, we believe that the results are representative of the general feeling. Broadly speaking, it is noteworthy that the Olympics were rated with a 4 or 5 on a scale of 1 - 5. Specifically, 60% of survey respondents assessed the Olympics as excellent (4), and 40% considered it more than excellent (5). It should be noted that 100% would recommend that this activity should be carried our annually and 15% suggested that the exams should be made in the four regional languages existing in Spain. Moreover, the reply to open questions such as "your opinion about the best thing of the Olympics" highlighted the friendly atmosphere generated from the beginning.

In view of these results, all members of the Organizing Committee and the Board of AEPECT consider that these results somehow compensate the important effort and dedication that have been made during this year to organize this first edition of the Olympics.

Final thoughts

The great success of this initiative leads the organizers to propose that these Olympics of Geology should be held every year, to support the promotion of careers in science and hoping to add Geology as a new subject during the 5th edition of the International Olympics.

The second National Geological Olympics will also be held in Madrid to help to consolidate the project, with the hope of rotation through different provinces in the future.

This second event (http://www.aepect.org/olimpiadasgeologia/index.htm) will use the facilities of CosmoCaixa in Madrid, a special place with an interactive science museum. The aim is that 4 finalists will then participate in the next International Earth Science Olympiads (September 2011).

The II Olympics of Geology will be held to encourage students to know and understand Geology and Earth Sciences better, to be more involved in Planet Earth and the way geologists try to understand how it works and to explain the many outstanding problems waiting for the next generation to solve. Others will become more responsible citizens thanks to a deeper and extended knowledge of the planet were we live.

Earth itself is not in danger, but humanity needs the planet and we need future geologists and scientists to find the solution to living on Earth without making it inhospitable. We recognize that the great effort of organizing the Spanish Geological Olympics has been adequately rewarded by the enthusiasm of bringing geology close to all our citizens - especially younger ones - who will be in the future responsible of the protection of our planet.

Acknowledgements

We would also like to thank the financial support of Repsol and AEPECT. We have also received staff and merchandising support from IGME, CosmoCaixa, Fundación Ancestros, Geonatura, Official Association of Professional of Geologists (ICOG), Complutense University of Madrid (UCM), University of Alcalá de Henares (UAH), and the Faculty of Geology of the UCM.

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News from GsF

GEÓLOGOS SINFRONTERAS ITALIA

The TOGO Project (West Africa) 2007-2010

The GsF TOGO project started in March 2007, with a preliminary mission to the country, in order to evaluate, in a central plateau North of Notse town, the possibility of supplying drinking water to a certain number of rural villages (total inhabitants around 10,000), where water was very scarse.

During the first visit, the project area was defined and a preliminary hydrogeological survey of the plateau carried out - mainly granite outcrops of the basement- wherein a sketch topographic map of the area at 1:5.000 scale was drawn.

The villages concerned are: Agbatitoe (the only Village close to the main National Road), Simbao, Koledjikope, Avovo and Yava.

Shallow water wells had previously been drilled in the area with negative results; where water was found, wells generally dry up during drought periods.

The results of the hydrogeological investigation suggested that drillings had to be deep, looking for productive faults and fractures in the granite basement.

In February 2009, the project entered the operational stage.

Two deep water production wells have been drilled in the area of Koledjikope village, choosing the central portion of the plateau, an area known as Fadakope, where a Pilot Farm has been put in place, offering working opportunities for the plateau people.

The drillings, at depths of 75 and 98 m, have proved to be very positive and have been equipped with screen casing and electric submergible pumps, working with solar panels. The average water yield for each well is around 10,000 litres/day.

Simple water distribution systems, consisting of pipeline connections from the well to suspended plastic (polythene) water tanks and fountains with water taps, have been put in place for both drilled wells.

Two water retention basins have been excavated (centre of the plateau and northern area (Yava Village), with capacities of 6,000 / 8,000 m^3. They have proved to be of great benefit to the whole population of the surrounding villages, especially for agricultural purposes.

During May and June 2010, a further two deep-water wells (depths of 160 and 115 m) were drilled in the Villages of Yava (North - population around 1,900) and Avovo (Centre-East - population 2,500).

It is important to point out that in both areas several drilling attempts had been previously made with negative results.

Both drillings have proved to be positive. Water was found at considerable depths - 85 and 140 m in Yava and 70 and 105 m in Avovo.

The wells have been equipped with screen casing and provided with electric submergible pumps and solar panels (manufactured by FLUXINOS Italia Srl - Grosseto. IT).

Chemical analysis has proved the good quality of water in both wells.

The works have been completed with the installation of water distribution systems, similar to those achieved in 2009.

The people of the plateau can now benefit from the drinking water obtained from the four drilled wells.

Considering the water retention basins,

as well, that have been excavated, which mainly provide water for agricultural purposes and domestic uses, it can undoubtedly be seen that living conditions have very much changed and improved in Agbatitoe and the surrounding villages.

TheTabarre and Leogane water projects in Haiti

The Tabarre and Leogane Water Projects were described in detail in European Geologist 29, May 2010.

At present,GsF is in the phase of "fund raising", in order to raise the necessary amount of money to start the project.

Fund raising has been organized on an International basis.

We have had a good response from Italy, France, UK and Spain.

The "EXPO 2015 MILANO Organization" is considering the project with great interest, as the topic of the "EXPO 2015 Exibition" is "Feeding the Planet".

For more information and to make a contribution to this worthy and much-needed project, please contact:

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Senior Hydrogeologist and President of GsF - Italia - Onlus

Drilling operations in Yava village

Water distribution system in Fadakope

Avovo village: songs and dances to celebrate the arrival af drinking water

Solar panels for the submergible pump installed in the Avovo village water well

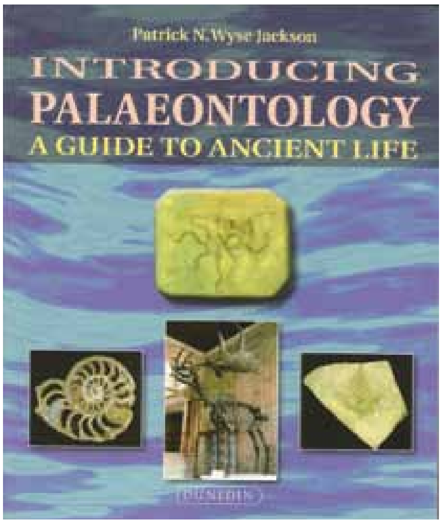
Introducing Palaeontology

A Guide to Ancient Life

by Patrick N. Wyse Jackson

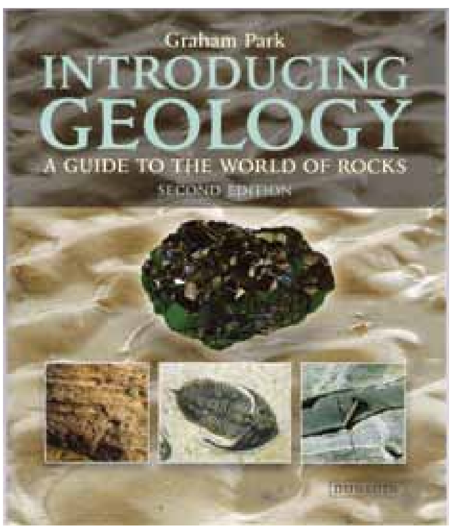
Book review by David Harper[1]

Published by: Dunedin Academic Press Ltd. [www.dunedinacademicpress.co.uk]
ISBN: 978-1-906716-15-8
Date: 2010, 152 pages
Price: £9.99 (stg), paperback



This is the third in a short series of concise introductions to aspects of the geosciences published by Dunedin Academic Press. Those already published, on geology (2nd edition, see below)) and volcanology, are clearly written and lavishly illustrated. This new addition to the stable, Introducing Palaeontology, is no exception. Patrick Wyse Jackson in some 150 pages and 100 figures has attempted to summarize the history of life on our planet, a journey that stretches back almost four billion years, underpinning the planet's biodiversity today of some 20 million species. The book is logically arranged. The first part, some 50 pages, is devoted to concepts such as taxonomy, the use of fossils in, for example, biostratigraphy and the reconstruction of ancient climates and environments; the occurrence and significance of exceptionally-preserved biotas of the fossil Lagerstätten is a particular focus. The history of life is reviewed and the main extinction events exposed. Particularly useful are the sections of the collection and study of fossils and a collectors' code of conduct. The second part, the bulk of the book, addresses the 18 main groups that characterize the fossil record; everything from algae and the vascular plants to dinosaurs and human evolution is tackled in an engaging style ably supported by John Murray's clear and didactic illustrations. About three pages are devoted to each group, enough to introduce the morphology, distribution and ecology of each with essential terminology that can be pursued further in a comprehensive glossary.

There is, however, already a range of excellent textbooks in palaeontology. Is there need for yet another? Well, yes there always is a need for another, particularly one that is ambitious, as well as competent and well focused. This book is aimed at both the general public and students taking introductory courses in palaeontology. Wyse Jackson admirably crosses this divide between an informed coffee table book and an academic text, with a lucid and informative narrative, illustrations that really jump from the page and a core of very useful information for the amateur and professional alike. One slight irritation is the lack of scales on the photographs; microscopic radiolarians, for example, appearing at almost the same size as dinosaur footprints. Some of these data can be gleaned from the text but scale bars would be an advantage. I would recommend this as one of the best introductory texts on the subject around at present and no doubt its fine illustrations will soon begin to punctuate many introductory courses in our science.



Introducing Geology

A Guide to the World of Rocks

by Graham Park

Review by David Harper[1]

Published by: Dunedin Academic Press Ltd. [www.dunedinacademicpress.co.uk]
ISBN: 978-1-906716-21-9
Date: 2010, 134 pages
Price: £9.99 (stg), paperback

Graham Park, in his first edition of Introducing Geology, captured the excitement of the Earth Sciences in an accessible, elegantly-written, beautifully-illustrated guide to the composition and history of our planet. In his second edition, some four years later, the text has been revised, many of the line drawings redrafted and a short list of references to the literature and useful web links added. This remains a key resource for both amateur and professional geologists alike, remarkably squeezing virtually all of the basics of our subject into some 135 pages with many informative illustrations.
For a review of the First Edition (2006), see European Geologist 22, p.40.

[1]*Professor of Palaeontology and Head of Geology, Natural History Museum of Denmark, University of Copenhagen*

Submission of articles to European Geologist magazine

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

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