

N° 21

May 2006

# European Geologist

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



# 1<sup>st</sup> cycle Geology programmes in the European Higher Education Area

by A. Mateus<sup>1</sup>, C. Andrade<sup>1</sup>, J. Munhá<sup>1</sup>, F. Noronha<sup>2</sup>,

A 1<sup>st</sup> cycle degree in Geology must rely on internal consistency and diversity of competences to be achieved during the planned courses and on the identification of specific learning outcomes; these should support the criteria to professional certification (quality label). A correct curricula organization can open other scientific fields of interest facilitating mobility at the end of the 1<sup>st</sup> cycle and helping students who will change direction when moving to subsequent degrees, without weakening the employability goal. On this basis, a 4 year long 1<sup>st</sup> cycle in Geology (i.e. 240 credits ECTS) is strongly favoured.

Un diplôme de 1<sup>er</sup> cycle doit se baser dans une cohérence interne et une variété des compétences à acquérir pendant les cours planifiés et aussi dans l'identification des résultats de l'apprentissage. Ces objectifs doivent supporter les critères pour la certification professionnelle (garantie de qualité). Une correcte organisation curriculaire peut ouvrir autres domaines scientifiques permettant la mobilité à la fin du 1<sup>er</sup> cycle, aidant les étudiants qui veulent changer de direction dans les cycles suivants sans affaiblir leurs perspectives de travail. Dans ce contexte est beaucoup plus favorable un 1<sup>er</sup> cycle en Géologie avec 240 ECTS.

Un diploma de 1<sup>er</sup> ciclo en Geología deberá basarse en la consistencia interna y diversidad de competencias a adquirir a través de una estructura curricular adecuada y en la identificación de resultados específicos de aprendizaje; estos objetivos fundamentarán los criterios de certificación profesional (garantía de calidad). Una organización curricular adecuada podrá abrir otros horizontes científicos de interés, posibilitando la movilidad al final del 1<sup>er</sup> ciclo y ayudando a los estudiantes que lo deseen a cambiar de rumbo en ciclos siguientes sin perjudicar expectativas laborales. Bajo esta perspectiva, se privilegia un 1<sup>er</sup> ciclo en Geología de 4 años (i.e. 240 créditos ECTS).

The evolution of the Bologna Process, ratified in the Prague (2001) and Berlin (2003) Summits, shows that the initial and apparently simple proposals of the Bologna Declaration pose a large number of complex questions that have been addressed in many national and international meetings, involving working groups with distinct, although complementary, objectives. The higher education degree structure has opened a comprehensive discussion about competences, levels, qualification descriptors and professional profiles in the contemporary context of employability, bringing also to the debate the dual viewpoint involved in the academic-oriented and professional-oriented *curricula*; these subjects represent, indeed, a fundamental key in science and technology study programmes given:

- the vocational crisis demonstrated by younger generations in Europe regard-

<sup>1</sup>Departamento de Geologia, Faculdade de Ciências da Universidade de Lisboa, Ed. C6 Piso 4, Campo Grande, 1749-016 Lisboa, Portugal

<sup>2</sup>Departamento de Geologia, Faculdade de Ciências da Universidade do Porto, Campo Alegre, 4169-007 Porto, Portugal

ing these matters (thus demanding an increase of attractiveness and opportunities)

- the major political, educational and economic goals expressed at the Lisbon Conference in 2000.

Moreover, the need to ensure mutual evaluation criteria and high standards led also to the crucial question of regulation (accreditation). Among the large number of problems, one of the most contentious issues concerns the degree structure and its respective length, particularly for the 1<sup>st</sup> cycle study programmes. Herein, the main topics concerning the Bologna Paradigm will be reviewed, commenting on its implications to *curricula* design in Geology.

## The Bologna Paradigm

From statements in [www.bologna-berlin2003.de/pdf/Communique1.pdf](http://www.bologna-berlin2003.de/pdf/Communique1.pdf), the need emerges for a common understanding of competence fields in order to guarantee *comparable and compatible qualifications* in a three-cycle degree structure. A shared measurement framework is also needed i.e. a credit system recognized by all, the *European Credit Transfer System* (ECTS). Finally, the statement itself justifies the usefulness of a transparent, self-explanatory Diploma Supplement to promote:

- international comparability of study programmes
- mobility in Europe
- employability of graduates.

In this context, the Bologna Paradigm includes three main changes, as follows:

- from teacher-oriented to student-oriented study programmes (i.e. from teaching to learning)
- broadly-based education in the 1<sup>st</sup> cycle degree, allowing the choice between directly entering a job and specializing at post-graduate level (2<sup>nd</sup> and 3<sup>rd</sup> cycle(s))
- curricula focussing on requirements of employers.

Concurrently, the requested qualifications should be described and organized in terms of different descriptors (workload, level, learning outcomes, competences and profile) facilitating the transition from academic training to the work place and from one country to another. Therefore, the development of a "common normative language" for *curricula* in the European Higher Education Area (EHEA) represents a fundamental task. Work has already been done in this complex field, coherently linking the learning outcomes,

competences and profiles with content (cognitive value) – see, e.g., the Subject Area Group reports from the “Tuning Higher Educational Structures in Europe” (2002). Lifelong learning and qualification increasing (CPD), as recommended in the Lisbon Conference (2000) and further stressed in other summits of the European Ministers responsible for higher education, are two other features of the Bologna Paradigm; these should be flexible, requiring that higher education institutions continually adapt to the challenges posed by the new process.

As a result of the Bologna Process, movements were made to restructure higher education degrees in Europe, involving firstly two cycles, but shortly afterwards considering a three-cycle arrangement, and to study the endorsement of joint degrees, (Stockholm Seminar 2004). However, there is no general consensus on introducing the “3-5-8” model (*i.e.* 3+2+3), the main divergence occurring because of the length of the 1<sup>st</sup> cycle study programme (3 or 4 years). The “3-5-8” model, very often misunderstood as the Bologna “recommendation”, represents only a possible solution to re-organizing the higher education study programmes and its “universal” application raises serious problems in many scientific areas. It may be incompatible with the training needed (mainly in the 1<sup>st</sup> cycle degree) to perform some professional activities. That is why, at the Helsinki conference (2002), a relatively wide agreement was achieved concerning the 1<sup>st</sup> cycle extent: 180 to 240 ECTS credits, *i.e.* 3 to 4 years of full-time study.

In accordance with the qualification descriptors of Dublin, the 1<sup>st</sup> cycle degree represents an important step in any higher education path and its planning has to fulfil a three-fold purpose. The first is the programme that involves *international comparability of study programmes* and promotes *mobility*. The second goal is *employability*; indeed, following the Bologna Declaration the “*degree awarded after the 1<sup>st</sup> cycle shall also be relevant to the European labour market as an appropriate level of qualification*”. The third concerns *access to 2<sup>nd</sup> cycle study programmes*, as envisaged by the Lisbon Recognition Convention [www.bologna-berlin2003.de/pdf/Lisbon\\_convention.pdf](http://www.bologna-berlin2003.de/pdf/Lisbon_convention.pdf), which should be characterized by greater flexibility, diversity, and increasing specialization. The search for solutions to properly address this three-fold purpose is, therefore, the major challenge in each country committed to the Bologna

Paradigm. Different paths are acceptable, allowing convergence to a common objective in a multi-step approach. Thus, accepting that a general consensus can soon be achieved, the 1<sup>st</sup> cycle *curricula* design cannot ignore differences within education in many European countries. Examination of the best higher study programmes is also needed to fully accomplish the main changes imposed by the Bologna Paradigm. Moreover, the social and economical frameworks in European countries are also distinct and should be addressed in the employability issue. Finally, it is worth noting that the concepts of honours or pass degrees are also quite variable all over Europe, thus not easily transferable but with no major implications to the EHEA consolidation.

#### Geology first cycle study programmes

Detailed characterization of natural resources (such as water, mineral, soil, fossil and nuclear combustibles, geothermal energy) and natural hazards / risks (including seismic, volcanic, flood, slope mass movements, toxic metal distributions, *etc.*), besides comprehensive studies on the composition, architecture and dynamic of earth systems play a vital role both in the European economy and in the European policies of Land Planning and Management. These are issues intimately associated with the application of geo-scientific knowledge, supporting new lines of interdisciplinary research triggered by emerging complex problems, where a geological background is widely recognized as essential. Therefore, maintaining the present high standard in teaching and research in Geology is of critical importance; particularly, if the EU political goal is indeed to ensure high competitiveness patterns with the most dynamic economies supported by extremely attractive higher study and research programmes. This implies, necessarily:

- the consolidation of the basic fields of scientific knowledge
- a good grounding in fundamental concepts and techniques common to all branches of Geology
- the integration of novel fields of knowledge which are evolving both in Geology and in interface scientific domains

#### Competences and learning outcomes

Geology is a consolidated domain of knowledge, congregating many specialization fields that are essential for a large number of relevant activities. Therefore,

any 1<sup>st</sup> cycle study programme should provide a qualification based on a broad scientific background in Geology, enabling the development of *competences* required for standard levels of performance in different professional profiles. The 1<sup>st</sup> cycle should cover all of the above-mentioned areas.

It is important to note, however, that although subject knowledge is one criterion for *employability*, other competences developed during the degree programme are vital to a coherent academic training. It is possible to fulfil the *comparability / mobility* requisites and promote high levels of quality without losing diversity and preserving the identity of 1<sup>st</sup> cycle degrees designed for particular country-backgrounds and specific market needs.

#### Study programmes organization, levels and assessment

As recognized by the Geology Subject Area Group in its 2002 report, the organization of 1<sup>st</sup> cycle degrees in Geology provided by European institutions are quite varied, the diversity significantly increasing when the wider labelling “Earth Sciences” is considered. This variety reflects either the country-oriented academic and economic cultures or the institutional strategic options taken to face specific problems (e.g. those related to student recruiting and institutional funding). Therefore, the available and upcoming 1<sup>st</sup> cycle degrees in Geology offered by individual European institutions will logically have their own particular characteristics; the depth in which individual issues are treated will vary with the nature of specific study programmes, so as to give their students good chances in the national and international job market as well as a good starting point of eventual transference to other academic programmes.

Geology requires specific methods of teaching and learning, including theoretical, laboratory and field training. Disciplines included in 1<sup>st</sup> cycle study programmes can thus be ordered into a gradual and coherent sequence of levels (1 to 4) that follow a given framework.

- Level 1 may be an introduction, assuming no previous knowledge of Geology.
- Level 2 should provide an essential grounding in many fundamental concepts and techniques common to all branches of Geology
- Level 3 must offer a core programme of advanced topics involving complex databases and simple numerical modelling for common problems in Geology

oriented towards the study programme specific objectives

- Level 4 should be designed to favour the consolidation of the professional profile defined for the study programme. Additional courses in Mathematics, Physics, Chemistry and Biology; if appropriate, training in a foreign language and in introductory Informatics may be considered.

Assessment procedures and performance criteria must be adapted in order to satisfy the requirements involved in the Bologna Paradigm; that is, assessment should be planned to cover the following aspects:

- knowledge base
- conceptual understanding
- problem-solving ability
- experimental and related skills
- fieldwork skills
- transferable skills.

One way to reach these goals is through the development of continuous assessment and tutorial work, measuring the student's progress and encompassing formative and summative components; the formative assessment should include a pre-designated number (depending on the course) of self-evaluation forms (lecture programme) and lab assignments; the summative component should involve a pre-designated number of interim tests where students must demonstrate an acceptable level of achievement ( $\geq 50\%$ ). Alternatively, a final examination might be considered. Some courses require a specific practical examination focusing on field/lab performance.

#### **ECTS credits distribution and study programmes length**

Using the ECTS credits as an organizational tool represents a fundamental task in any curricula design compatible with the Bologna Paradigm. The number of credits assigned to fundamental geological subjects (vocational) should be greater than those assigned to generic scientific education which in turn should be greater than those assigned to, for example, a foreign language. A plausible ratio could be:

- 75% to 80% : 15% to 20% :  $\leq 5\%$  of the total credits assigned to the study programme. As a result, an acceptable distribution of credits between groups of vocational courses planned to satisfy the descriptors mentioned above for successive levels can be settled as:
- 5% to 10% (level 1),
- 20% to 25% (for each level 2, 3 and 4)

- 2.5 to 5% devoted to a curricula designed to introduce students to research (e.g. Undergraduate Project).

Given the above structure, the most appropriate length for a 1<sup>st</sup> cycle study programme in Geology is 4 years (i.e. 240 credits ECTS). Promoters of more broadly based study (such as Earth Sciences or Earth Sciences and Environment) and 180-credit degrees claim that these study programmes open more fields of interest, facilitate mobility at the end of 1<sup>st</sup> cycle and help students who will change direction to other knowledge domains when moving to subsequent degrees. However, on a 240-credit base degree, all these issues can be properly assessed with the additional advantage of ensuring a higher standard of training in Geology; therefore, preparing students for a wide range of professional activities that need a solid scientific and technical base can hardly be achieved in a 180-credit training.

The opening of new fields of scientific interest can be achieved through partial or total replacement of vocational level 4 courses by a corresponding number of credits dedicated to other knowledge domains. Therefore, after completion of a 240 credit degree, the student will have a Major in Geology and a Minor in another scientific field.

In order to promote mobility, institutions that offer a 240-credit degree in Geology should promote a 180-credit Mobility Diploma for those students wishing to move to another University after graduation. In this approach, the generic scientific background and the fundamental training corresponding to vocational courses of level 1, 2 and 3 will be ensured.

Institutions offering a 240-credit degree in Geology also have the option to easily expand their 2<sup>nd</sup> cycle study programmes to professional-oriented degrees (1 year of traineeship in a particular field of applied geology) and to academic-oriented qualifications (1.5 year long training in a specialized field of Geology or in interdisciplinary areas, including research). These 2<sup>nd</sup> cycle study programmes together with the Mobility Diploma produce two slightly different higher education progressions ("3+1+1" and "3+1+1.5" full-time study) sustained in two-degree structures ("4+1" and "4+1.5" years long) that fully satisfy all the requirements of the Bologna Paradigm.

#### **Quality assurance and professional title**

The highest level of qualification (D) in the EU Draft Directive is the level relevant

to the professional title of geologist, upon completion of a minimum of three years full-time study at post-secondary level. Considering the arguments reported in section 3, a four-year training in Geology (240 credits ECTS) is strongly favoured.

The higher education system regulation (accreditation) in EHEA should assure high quality standards of learning and assess qualification comparability and compatibility, besides mobility and employability. Therefore, the quality label related to Geology practice must involve national geological societies (wherever possible) and their pan-European counterpart, i.e. the European Federation of Geologists (EFG). For that reason, it is of crucial importance that EFG continue its efforts with the "EurGeol Professional Title – Common Platform", regulating the profession of geologist through the identification of minimum standards for the duration and content of training. Certification of the 1<sup>st</sup> cycle and Continuous Professional Development will strengthen the intrinsic value of the profession.

#### **Conclusions**

The current European high standards of teaching, learning and research in Geology should be reinforced.

Comparability and mobility in EHEA must rely on the recognition of general competences and specific learning outcomes. ECTS credits for core and complementary courses should be evaluated for each study programme considering the particular characteristics of each institution and the precise circumstances and needs of the country.

The character of a 1<sup>st</sup> cycle degree in Geology must rely on internal consistency of competences achieved during the study programme and on the identification of specific learning outcomes.

A 4 year long 1<sup>st</sup> cycle study programme in Geology (i.e. 240 credits ECTS) is favoured, and a correct curricula organization can also open other scientific fields of interest, facilitating mobility at the end of 1<sup>st</sup> cycle and helping students change direction to other knowledge domains when moving to subsequent degrees.

It is of crucial importance that EFG continue its efforts on the "EuroGeol Professional Title - Common Platform", regulating the practice of Geology through the identification of the minimum standards for degree length and content.