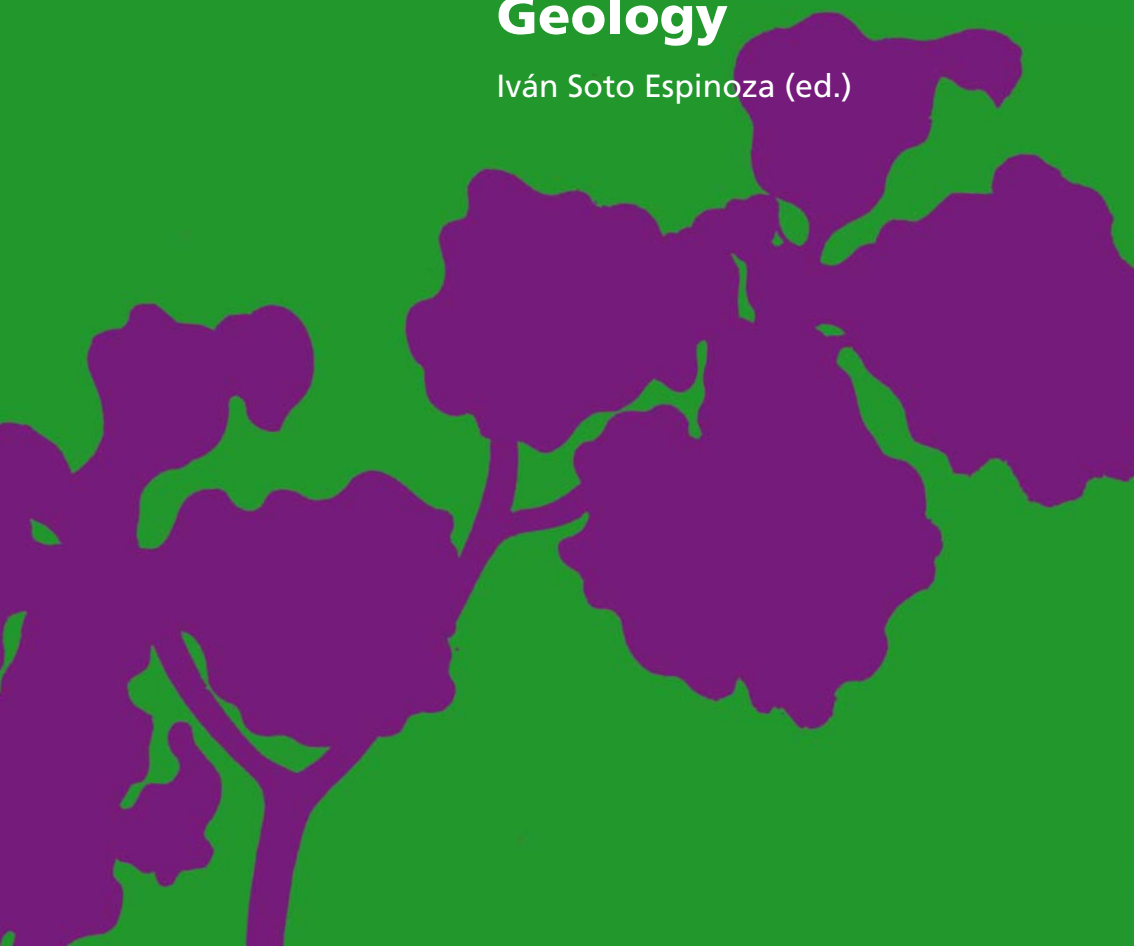
Tuning

Latin America

Higher Education in Latin America: reflections and perspectives on **Geology**

Iván Soto Espinoza (ed.)



Higher Education in Latin America: reflections and perspectives on Geology

Tuning Latin America Project

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Iván Soto Espinoza (ed.)

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Tuning: past, present and future
An introduction

Major changes have taken place worldwide in higher education over the last 10 years, although this has been a period of intense reflection particularly for Latin America, insofar as the strengthening of existing bonds between nations has been promoted and the region has started to be considered as being increasingly close. These last 10 years also represent the transition time between Tuning starting out as an initiative that arose as a response to European needs and going on to become a worldwide proposal. Tuning Latin America marks the start of the Tuning internationalisation process. The concern with thinking how to progress towards a shared area for universities while respecting traditions and diversity ceased to be an exclusive concern for Europeans and has become a global need.

It is important to provide the reader of this work with some definitions of Tuning. Firstly, we can say that Tuning is **a network of learning communities**. Tuning may be understood as being a network of interconnected academic and student communities that reflects on issues, engages in debate, designs instruments and compares results. They are experts that have been brought together around a discipline within a spirit of mutual trust. They work in international and intercultural groups and are totally respectful of independence on an institutional, national and regional level, exchanging knowledge and experiences. They develop a common language to problems in higher education to be understood and take part in designing a set of tools that are useful for their work, and which have been devised and produced by other academics. They are able to take part in a platform for reflection and action about higher education - a platform made up of hundreds of communities

from different countries. They are responsible for developing reference points for disciplines that represent a system for designing top quality qualifications which are shared by many. They are open to the possibility of creating networks with many regions of the world within their own field and feel that they are responsible for this task.

Tuning is built on each person that forms part of that community and shares ideas, initiatives and doubts. It is global because it has pursued an approach based on worldwide standards while at the same time remaining both local and regional, respecting the specific features and demands of each context. The recent publication: *Communities of Learning: Networks and the Shaping of Intellectual Identity in Europe, 1100-1500* (Crossley Encanto, 2011) takes all the new ideas into consideration which are developed within a community context, whether of an academic, social or religious nature or simply as a network of friends. The challenge facing Tuning communities is to gain an impact on the development of higher education in its regions. Secondly, Tuning is a **methodology** with well-designed steps and a dynamic outlook that enables different contexts to be adapted. The methodology has a clear aim: to build qualifications which are compatible, comparable, are relevant to society and with top levels of both quality and excellence, while preserving the valuable diversity deriving from the traditions of each country involved. These requirements demand a collaborative methodology based on consensus which is developed by experts from different fields who are representatives of their disciplines, and who have the ability to understand local, national and regional situations.

This methodology has been developed around **three core themes**: the first is the **qualification profile**, the second is the **syllabus** and the third refers to the **trajectories of those who learn**.

The qualification profile enjoys a key position in Tuning. After a lengthy period of reflection and debate within Tuning projects in different regions (Latin America, Africa, Russia), the qualifications profile may be defined as being a combination of forces revolving around four core points:

- The region's needs (from local issues to the international context).
- The meta-profile of the area.

- The taking into consideration of future trends in the profession and society.

- The specific mission of the university.

The question of **social relevance** is essential for the design of profiles. Without doubt, any analysis of the relationship existing between university and society lies at the heart of the matter of relevance in higher education. Tuning's aim is to identify and meet the needs of the production sector, the economy, society as a whole and the needs of each student within a particular area of study – measured by specific social and cultural contexts. With a view to achieving a balance between these different needs, goals and aspirations, Tuning has consulted leading people, key local thinkers and experts from industry, both learned and civil society and working parties that include all those interested. An initial period of this phase of the methodology is linked to general competences. Each thematic area involves the preparation of a list of general competences deemed relevant from the standpoint of the region concerned. This task ends when the group has widely discussed and reached consensus about a selection of specific competences, and the task is also performed with specific competences. Once the means of consultation has been agreed and the process completed, the final stage in this practical exercise involving the search for social relevance refers to an analysis of results. This is done jointly by the group, and special care is taken not to lose any contributions from the different cultural perceptions that might illustrate understanding of the specific reality.

Once lists of the general and specific agreed, consulted and analysed competences had been obtained, a new phase got underway over these last two years that is related to the **development of meta-profiles for the area** under consideration. For Tuning methodology, meta-profiles represent the structures of the areas and combinations of competences (general and specific) that lend identity to the disciplinary area concerned. Meta-profiles are mental constructions that categorise competences in recognisable components and illustrate their inter-relations.

Furthermore, thinking about education means becoming involved in the present, while above all also looking towards the future – thinking about social needs, and anticipating political, economic and cultural

changes. This means also taking into account and trying to foresee the challenges that those future professionals will have to face and the impact that certain profiles of qualifications is likely to have, as designing profiles is basically an exercise that involves looking to the future. Within the present context, designing degree courses takes time in order for them to be planned and developed and their approval obtained. Students need years to achieve results and mature in terms of their learning. Then, once they have finished their degree, they will need to serve, be prepared to act, innovate and transform future societies in which they will find new challenges. Qualification profiles will in turn need to look more to the future than the present. For this reason, it is important to take an element into consideration that should always be taken into account, which are future trends both in terms of the specific field and society in general. This is a sign of quality in design. Tuning Latin America embarked on a methodology so as to incorporate an **analysis of future trends into the design of profiles**. The first step therefore involved the search for a methodology to devise future scenarios following an analysis of the most relevant studies in education by focusing on the changing role of higher educational establishments and trends in educational policies. A methodology was chosen based on in-depth interviews with a dual focus: on the one hand, there were questions that led to the construction of future scenarios on a general society level, their changes and impact. This part needed to serve as a basis for the second part, which dealt specifically with the features of the area in itself, their transformation in general terms in addition to any possible changes in the degree courses themselves that might have tended to disappear, re-emerge or be transformed. The final part sought to anticipate the possible impact on competences based on present coordinates and the driving forces behind change.

There is a final element that has to be taken into account when constructing the profiles, which is linked to the **relationship with the university where the qualification is taught**. The mark and mission of the university must be reflected in the profile of the qualification that is being designed.

The second core theme of the methodology is linked to **syllabuses**, and this is where two very important Tuning components come into play: on the one hand, students' work volume, which has been reflected in an agreement to establish the Latin American Reference Credit (CLAR), and all studies are based on this and, on the other, the intense

reflection process into how to learn, teach and assess competences. Both aspects have been covered in Tuning Latin America.

Lastly, an important area is opened up for future reflection about the **trajectories of those who learn** – a system that proposes focusing on the student leads one to consider how to position oneself from that standpoint so as to be able to interpret and improve the reality in which we find ourselves.

Finally, Tuning is a **project** and as such came into existence with a set of objectives and results and within a particular context. It arose from the needs of the Europe of 1999, and as a result of the challenge laid down by the 1999 Bologna Declaration. Since 2003, Tuning has become a project that goes beyond European borders, in so doing embarking on intense work in Latin America. Two very specific problems faced by the university as a global entity were pinpointed: on the one hand, the need to modernise, reformulate and make syllabuses more flexible in the light of new trends, society's requirements and changing results in a vertiginous world and, on the other, which is linked closely to the first problem, the importance of transcending limits imposed by staff in terms of learning, by providing training that would enable what has been learnt to be recognised beyond institutional local, national and regional borders. The Tuning Latin America project thus emerged which, in its first phase (2004-2007), sought to engage in a debate whose goal was to identify and exchange information and improve collaboration between higher educational establishments, with a view to developing the quality, effectiveness and transparency of qualifications and syllabuses.

This new phase of **Tuning Latin America (2011-2013)** started life on already-fertile terrain – the fruits of the previous phase and in view of the current demand on the part of Latin American universities and governments to facilitate the continuation of the process that had already been embarked on. The aim of the new Tuning phase in the region was to help build a Higher Education Area in Latin America. This challenge takes the form of four very specific central working themes: a deeper understanding of agreements involving **designing meta-profiles and profiles in the 15 thematic areas** included in the project (Administration, Agronomy, Architecture, Law, Education, Nursing, Physics, Geology, History, Information Technology, Civil Engineering, Mathematics, Medicine, Psychology and Chemistry); contributing to **reflections on future scenarios for new professions**; promoting the

joint construction of **methodological strategies in order to develop and assess the training of competences**; and designing **a system of academic reference credits (CLAR-Latin American Reference Credit)** to facilitate recognition of studies in Latin America as a region that can be articulated with systems from other regions.

The Tuning door to the world was Latin America, although this internationalisation of the process wouldn't have gone far if it hadn't been for a group of prestigious academics (230 representatives of Latin American universities), who not only believed in the project, but also used their time and creativity to make it possible from north to south and west to east across the extensive, diverse continent that is Latin America. This was a group of experts in different thematic areas that would go on to study in depth and gain weight in terms of their scope and educational force, and in their commitment to a joint task that history had placed in their hands. Their ideas, experiences and determination paved the way and enabled the results which are embodied in this publication to be achieved.

Yet the Tuning Latin America project was also designed, coordinated and administered by Latin Americans from the region itself, via the committed work carried out by Maida Marty Maleta, Margarethe Macke and Paulina Sierra. This also established a type of *modus operandi*, conduct, appropriation of the idea and of deep respect for how this was going to take shape in the region. When other regions decided to join Tuning, there would henceforth be a local team that would be responsible for considering what to emphasize - specific features, the new elements that would need to be created to meet needs which, even though many of them might have common characteristics within a globalised world, involve dimensions specific to the region, are worthy of major respect and are, in many cases, of major scope and importance.

There is another pillar on this path which should be mentioned: the coordinators of the thematic areas (César Esquetini Cáceres-Coordinator of the Area of Administration; Jovita Antonieta Miranda Barrios-Coordinator of the Area of Agronomy; Samuel Ricardo Vélez González-Coordinator of the Area of Architecture; Loussia Musse Felix-Coordinator of the Area of Law; Ana María Montaño López-Coordinator of the Area of Education; Luz Angélica Muñoz González-Coordinator of the Area of Nursing; Armando Fernández Guillermet-Coordinator of the Area of Physics; Iván Soto-Coordinator of the

Area of Geology; Darío Campos Rodríguez-Coordinator of the Area of History; José Lino Contreras Véliz-Coordinator of the Area of Information Technology; Alba Maritza Guerrero Spínola-Coordinator of the Area of Civil Engineering; María José Arroyo Paniagua-Coordinator of the Area of Mathematics; Christel Hanne-Coordinator of the Area of Medicine; Diego Efrén Rodríguez Cárdenas-Coordinator of the Area of Psychology; and Gustavo Pedraza Aboytes-Coordinator of the Area of Chemistry). These academics, chosen according to the thematic groups to which they belonged, were the driving forces behind the building of bridges and strengthening of links between the project's Management Committee of which they formed a part and their thematic groups which they always held in high regard, respected and felt proud to represent. Likewise, they enabled there to be valuable articulation between the different areas, showing great ability to admire and listen to the specific elements attached to each discipline in order to incorporate, take on board, learn and develop each contribution – the bridges between the dream and the reality. Because they had to carve new paths in many cases to make the ideas possible, design new approaches in the actual language of the area and the considerations proposed, and to ensure that the group would think about them from the standpoint of the specific nature of each discipline. Following group construction, the process always requires a solid framework based on generosity and rigour. In this respect, the coordinators were able to ensure that the project would achieve specific successful results.

Apart from the contribution made by the 15 thematic areas, Tuning Latin America has also been accompanied by a further two transversal groups: the Social Innovation group (coordinated by Aurelio Villa) and the 18 National Tuning Centres. The former created new dimensions that enabled debates to be enriched and an area for future reflection on thematic areas to be opened up. Without doubt, this new area of work will give rise to innovative perspectives to enable those involved to continue thinking about top quality higher education that is connected to the social needs of any given context.

The second transversal group about which one should recognise the major role played comprises the National Tuning Centres – an area of representatives from the highest authorities of university policies from each of the 18 countries in the region. These centres accompanied the project right from the outset, supported and opened up the reality of their national contexts to the needs or possibilities developed by Tuning, understood them, engaged in dialogue with others, disseminated them

and constituted reference points when seeking genuine anchors and possible goals. The National Centres have been a contribution from Latin America to the Tuning project, insofar as they have contextualised debates by assuming and adapting the results to local times and needs.

We find ourselves coming to the end of a phase of intense work. The results envisaged over the course of the project have succeeded all expectations. The fruits of this effort and commitment take the form of the reflections on the area of Geology that will be provided below. This process comes to an end in view of the challenge faced in continuing to make our educational structures more dynamic, encouraging mobility and meeting points within Latin America, while at the same time building the bridges required with other regions on the planet.

This is the challenge facing Tuning in Latin America.

July 2013

Pablo Beneitone, Julia González and *Robert Wagenaar*

1

Map of the Area of Geology

Firstly, a map of the *Geology* degree Programme at undergraduate level in Latin America was put together taking into account how programmes are constructed in different countries on the Continent (see Annex I). A recent update in 2012 shows us that Geology is taught in around 99 faculties or academic departments and that it has historically been attached to either Exact and Natural Sciences or otherwise Engineering units.

Most of the schools are State-run. 10 countries were taken into consideration for South America with 70 State schools and 11 private ones, where the following qualifications are awarded: *Geologist, BSc in Geology, Geological Engineer, BSc in Geological Engineering and BSc in Science (Geology mention).* These degree Programmes have a theoretical duration of between 4 and 6 years (average: 5).

A further 5 countries were also identified in Central America where 19 schools offer the following qualifications: *Geologist, Geological Engineer, Engineer in Geoscience, BSc in Geology and BSc in Geological Engineering.* These cover a period of between 8 and 11 semesters. It should be mentioned that a degree Programme in Geology is also currently in an advanced state of creation in Honduras.

Equivalence in terms of qualifications is identified in most of the participant countries, except for Colombia and Venezuela where BSc Programmes in Geology and Geological Engineering are not similar. Additionally, intermediate level qualifications also exist in some countries in the region as follows: *Baccalaureate* and *Technician in Geology,* of 4 and 3 years' duration respectively.

The resulting professional geologist will have completed appropriate training which enables them to understand and analyse emerging situations (fundamentally in terms of environmental, energy and raw material-related problems, among others) and to provide solutions in accordance with sustainability needs in society and the environment. Generally speaking, the graduate professional works and performs tasks in public and private companies and institutions that are involved in the exploration, exploitation and management of mineral, water and energy resources, in addition to analysing geological risks, environmental studies and civil projects. They also work in academia and/or research in educational establishments and science and technology institutions.

As a result of the analysis carried out (see Annex 1), the undergraduate degree programme has a theoretical duration of 5 years or 10 semesters, except for Chile (6 years) and Uruguay and Paraguay (4 years). The curricular structure is very similar in all these countries, and comprises three or four stages of general and geological training (basic, vocational and applied). General training includes Physics, Mathematics, Chemistry, Computer Science, Humanities and Languages. Basic-vocational training covers practical subjects common to the area which are developed in classrooms, laboratories and field work. Applied training involves a range of subjects linked to the exploration, exploitation and management of mineral, water and energy resources, the analysis of geological risks, and environmental and legal-economic studies. It is generally the norm to develop and pass an end-of-degree work or dissertation as a final requirement in order to obtain the qualification (typically taking from 6 to 8 months).

As an example, in Argentina, faculties offering Geology are grouped together into the Association of Faculties with Geology Degree Programmes of the Republic of Argentina (A.F.A.G.) comprising 16 schools. These academic units have put together a Document of Standards applied to Degree Programmes in Geology in the country. This includes curricular content, professional activities and direct risks attached to the professions themselves (in accordance with which the Ministry of Education issued Ministerial Resolution 1412/08, whereby Geology is included among those professions regulated by the State, the exercising of which affects the public interest). As for curricular content, a minimum workload was determined for the BSc in Geology —BSc in Geological Science— Geologist (equivalent qualifications)

amounting to 3,200 hours. The structure of the curricula establishes the following thematic cores which are grouped together as follows:

Thematic area	Characterisation
General Basic	General training: objectives on a conceptual level.
Basic Geological	Basic for Geology.
Applied Geological	Vocational training.
Complementary	Complementary training in social, environment, legal and economic aspects.

The above outline is, generally speaking, replicated in the other Latin American schools analysed. It also coincided with the structure of the curriculum determined by the Geology Area Group attached to the Tuning Latin America Project, and this ultimately proved to be a basic component in helping to define the specific competences.

The Geology Group also determined the fact that other cognate degree Programmes exist, such as: *Geophysics* (Argentina, Brazil, Peru, Venezuela); *Geochemistry* (Argentina, Venezuela); *Oil Engineering* (Argentina, Brazil, Colombia, Ecuador, Mexico, Peru, Venezuela); *Palaeontology* (Argentina) and *Mining Engineering* (Argentina, Brazil, Chile, Colombia, Cuba, Ecuador, Mexico, Peru, Venezuela).

2

Generic and specific competences

In its in initial phase, the project defined a set of 27 generic competences, following which 18 specific ones were then discussed and established. A survey was conducted in order to gauge the relevance and importance of these in the opinion of academics, students, graduates and employers related to the area. In total, 1,246 responses were received and analysed from the surveys conducted (277 academics; 2020 employers; 347 students and 420 graduates), which shows the interest in terms of their commitment to participating. This was considered to be a sufficient sample to ensure generalisation of the results obtained. They received a high rating from these respondents.

The survey focused mainly on analysing the degree of importance and attainment that the above-mentioned groups gave to the 18 specific competences which had been deemed valid by the group of universities taking part in the project.

The competences that obtained the highest level of attainment and were given the greatest degree of importance can be considered as central to programmes in Geology, while the specific competences that obtained the lowest level of attainment are those that are starting to be developed in undergraduate studies but remain focused on professional development.

By way of a summary, it can be concluded that all the competences were rated with values of over 3.3 on a scale in which 3 is *To a considerable extent* and 4 is *To a large extent*. This means that the competences selected have been deemed relevant and important by the four groups of people interviewed.

The correlation matrix showed values of > 0.7, which means a high degree of compatibility among the criteria used by the four groups, this being greater among Employers and Graduates (> 0.9), and slightly lower in the case of Students and Academics or Students and Graduates or Academics and Graduates (values between 0.8 and 0.9). The lowest values referred to Students and Employers-Academics and Employers, whereby it would be important to take strategies into consideration so as to bring about greater reconciliation between the *academia-industry/socio-productive milieu,* which would boost employability for students.

It is worth drawing attention to the fact that this was the first time this type of exercise had been carried out on Geology degree Programmes in Latin America. It turns out that the consultation regarding specific competences took on great relevance insofar as it coincided with a pause for reflection in higher education about academic-vocational training processes, both among participant countries and globally.

Advances were subsequently made via an exercise involving the construction of teaching and learning strategies for a specific competences (V10. *Preparing and interpreting maps and geological sections),* which produced interesting results, and a preliminary approximation devoted to finding out about the different levels of student work so as to establish their workload in the different universities.

As a result of this first phase, we have been left in no doubt that the *Tuning methodology* placed the importance of competences in modernisation processes and curricular reform on centre stage.

Likewise, the agreements reached in terms of areas of knowledge about the set of specific competences were reconsidered by several universities in order to embark on processes involving reforms in these educational establishments. Currently, some universities are in the process of modifying their curricula and facing the challenge of considering the competences agreed as reference points in designing programmes and constructing graduate profiles.

However, the extent of progress in processes involving curricular reform varies from country to country. This situation will require a joint construction process that enables a fully conceived competence-

based qualification to be implemented. This process, already underway, constitutes a challenge for the present and immediate future.

For all the aforementioned reasons, it is of the utmost importance to raise the awareness of individuals who are involved in universities and bodies responsible for education policy to progress towards a change in paradigm: «*from knowledge-based training to another based on competences*» and student-centred.

Institutions will need to make positive advances in this sense via internal debates and proposals for reforms and the designing of competence-based profiles. The possibility of reaching well-defined agreements will provide the chance to specify this new approach and enable those involved to consider what the new emerging professions will be that will be linked to each sector while, at the same time, profiling the competences required for such new contexts.

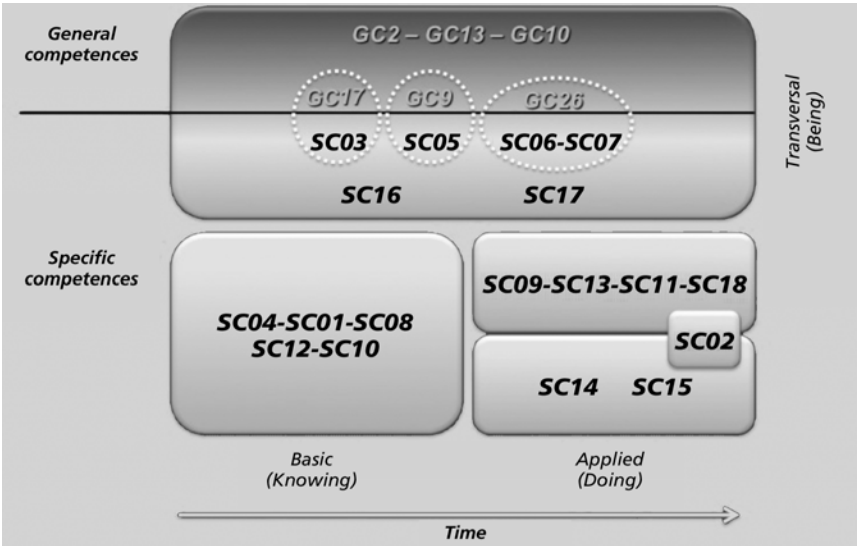
3

Meta-profile

The working party for the Area of Geology has constructed a meta-profile by taking into consideration a set of generic (GC) and specific (SC) competences as agreed and validated by students, academics, employers and graduates of Geology degree Programmes in Latin America. These competences were grouped together into domains by considering their complexity and levels of attainment required in order to form a harmonious structure. The meta-profile forms part of the analysis carried out by the working party for the area within the framework of the Tuning Project.

3.1. Outline of the meta-profile

The meta-profile can be represented in the following way:



3.2. Description of the meta-profile

Generic competences

The meta-profile seeks to lend coherence to the development of these competences as part of a continuous learning process, as is the case with Geology degree Programmes. 17 generic competences out of a total number of 27 were selected based on the experience gained in educating geologists and geological engineers, and these were concentrated into 6 groups:

- GC2 *Ability to apply knowledge in practice:* this competence includes elements from the following competence:

  — Knowledge about the area of study and profession.

- GC13 *Ability to act in new situations.*

- GC10 *Ability to learn and keep constantly up-to-date.*

- GC17 *Capacity for teamwork:* this competence includes elements from the following competences:

  — Capacity for decision-making.

  — Interpersonal skills.

  — Ability to motivate and steer towards common objectives.

- GC9 *Research capacity:* this competence includes elements from the following competences:

  — Capacity for abstraction, analysis and synthesis.

  — The skills required to search for, process and analyse information from different sources.

  — Ability to identify, consider and deal with problems.

  — Ability to formulate and manage projects.

- GC26 *Ethical commitment:* this competence includes elements from the following competences:

— Commitment to conservation of the environment.

— Commitment to their socio-cultural milieu.

— Commitment to quality.

These six groups of generic competences are developed through the entire programme to different levels of depth, and are associated with the development of «knowing how to be» as they are needed in order to achieve objectives, carry out different types of work, deal with problems and deal with situations. Another quality attached to these competences is that they are of an integrating nature, combining skills and attitudes, enabling the specific competences to be best developed. As a result of the aforementioned, these competences are grouped together within the transversal domain.

Specific competences

18 specific competences were defined in the first phase of the project which graduates need to have on completion of their studies. These competences can be grouped together into two domains – one basic and one of a more applied nature.

A. Basic competences

These competences are associated with «Knowing» and include initial knowledge and skills that geology students need to develop in the first years of their degree Programme. They are:

- SC 4. Ability to observe and understand the milieu.
- SC 1. Applying classification systems for geological materials.
- SC 8. Describing and analysing relations between elements that are present in rocks and in their internal and external structures in order to interpret the evolution and sequence of geological events.
- SC 12. Perceiving and understanding the time-space dimensions of geological processes and their effects on the planet.
- SC 10. Preparing and interpreting maps and geological sections.

B. Applied competences

These competences are associated with «Doing» and are developed in the final years of the degree Programme, for which purpose it is necessary to first develop «Basic Competences». This domain can be subdivided in two parts, each of which is linked to two areas of specialisation within Geology.

- Economic geology:
  - SC 9. Carrying out geological surveys in order to search for, exploit, conserve and manage water and energy resources.
  - SC 13. Planning, putting into practice, managing and financially overseeing projects and services that focus on the knowledge, exploitation and use of non-renewable natural resources.
  - SC 11. Assessing and rating geological resources and alterations caused in them.
  - SC 18. Locating drilling for research and exploitation, and geologically controlling this.
  - SC 2. Advising about the use of natural resources in formulating policies, standards, plans and programmes for developmental purposes.
- Geological risks:
  - SC 14. Setting out the requirements for territorial planning and the forecasting, prevention and mitigation of geological risks, and natural and man-made disasters.
  - SC 15. Carrying out and assessing technological and/or geotechnical surveys of geological materials.
  - SC 2. Advising about the use of natural resources in formulating policies, standards, plans and development programmes.

There is also a set of specific competences which are not necessarily exclusive to the basic or applied domain and are present throughout the entire programme, and which can also be included in the transversal domain. These are:

- SC 3. Ability to interact interdisciplinary and multidisciplinary areas.

- SC 16. Rigour in terms of selecting samples, data collection and its treatment and interpretation.

- SC 5. Development of teaching and research methods in Geology aimed at improving professional performance and disseminating knowledge.

- SC 6. Development of work that in keeping with care and conservation of the environmental and social milieu.

- SC 7. Development of professional activity within a framework of responsibility, legality, safety and sustainability.

- SC 17. Ability to collect, process and interpret data from a range of sources using qualitative and quantitative techniques, in order to construct geological models.

Three sub-groups can be observed when combining specific and generic competences into a single domain:

The first sub-group covers elements of teamwork and groups together the competence (SC3) *Ability to interact in interdisciplinary and multidisciplinary areas* and the competence (GC17) *Capacity for teamwork*.

The second sub-group includes capacities associated with research development that need to be acquired by the graduate. These competences are (SC 5) *Development of teaching and research methods in Geology aimed at improving professional performance and disseminating knowledge* and the competence (GC9) *Research capacity*.

The third sub-group addresses the ethical attitude that needs to be adopted by a graduate in their professional performance. This sub-group comprises three competences: (SC 6) *Development of work that is in keeping with care and conservation of the environmental and social milieu,* (SC 7) *Development of professional activity within a framework of responsibility, legality, safety and sustainability* and (GC26) *Ethical commitment*.

Taking this structure into consideration, the meta-profile for the Geologist can be described as follows:

> «The Latin American geologist should BE a professional who is able to apply their knowledge in practice, act in all situations, learn and keep constantly up-to-date, work in teams and interact in interdisciplinary and multidisciplinary areas, develop teaching and research methods aimed at improving their professional performance and disseminating geological knowledge with a high degree of ethical commitment, tending towards care and conservation of the environmental and social milieu, and carrying out their professional activity within a framework of responsibility, legality, safety and sustainability.
>
> Furthermore and in view of the nature of their work, they need to be rigorous in selecting samples, taking, treating and interpreting data, and able to collect, process and interpret it via a range of sources using qualitative and quantitative techniques, in order to ultimately construct geological models.
>
> The Latin American geologist needs to KNOW how to observe and understand their milieu, classify geological materials, prepare and interpret maps and geological sections, describe and analyse relations between elements that are present in rocks and in their internal and external structures in order to interpret the evolution and sequence of geological events, and perceive and understand the time-space dimensions of geological processes and their effects on the planet.
>
> The Latin American geologist needs to know how to CARRY OUT geological studies in order to search for, exploit, conserve and manage water and energy resources, locate drilling for research and exploitation and geologically control this, plan, put into practice, manage and financially oversee projects and services that focus on the knowledge, exploitation and use of non-renewable natural resources, and assess and rate geological resources and alterations caused in them.
>
> Likewise they should know how to carry out and assess geological and/or geotechnical surveys of geological materials,

set out the requirements for territorial planning and the forecasting, prevention and mitigation of geological risks, and natural and man-made disasters, and advise about the use of natural resources in formulating policies, standards, plans and development programmes».

3.3. Methodology applied

The working party for the Area of Geology attached to the Tuning Project drew up this meta-profile proposal, which takes into consideration the selection of 6 generic competences grouped together into six categories arranged in a sequence in three domains defined according to their complexity and attainment of learning results.

The specific competences were grouped together into two domains – one basic and the other applied. The basic domain covers competences developed in the first two years of training while the applied competences were subdivided into two areas of specialisation: economic geology and geological risks.

This meta-profile was disseminated and validated via a process of analysis and comparison.

3.4. Comparison

The meta-profile proposal was disseminated via diverse media, after putting together a working document involving a presentation with the aim of achieving consensus about different opinions with regard to their relevance. The following results were obtained:

- In Colombia it was submitted before the Professional Geologists' Association of Colombia, which brings together all Geology degree Programmes in the country. The proposal was widely accepted.
- In Brazil it was translated into Portuguese and forwarded to experts in education and geology.
- In Venezuela it was presented at the 4th Graduate and Student Technical Conference at the Earth Science at Universidad de Oriente.

- In Argentina, in the south of the country, the document was sent to Heads of Department and Academics from 7 universities (UBA, UNLP, La Pampa, del Sur (Bahía Blanca), Río Negro, Comahue and San Juan Bosco de Comodoro Rivadavia). In the centre-north of the country, the meta-profile was sent to 8 universities, presented at the Geology Students' Congress, the Management Committee of the San Juan Professional Geologists' Association and professionals from different enterprises.

- In Honduras it was presented to professionals from similar areas and to the Director of the Earth Science Institute. However, there is no Geology curriculum at undergraduate level and it is hoped that the results obtained from the Tuning Project will be used as a reference point in order to create a competence-based programme. Generally speaking, interviewees are of the opinion that the meta-profile to be applied in Honduras will need to emphasize technical aspects which are specific to the discipline and place less emphasis on political and multidisciplinary skills.

- In Peru it was sent to universities that offer degree Programmes in Geology and also presented at a meeting of the Peruvian National Tuning Centre.

- In Chile it was sent to 4 universities that offer degree Programmes in Geology – both to their directors and academics. It was also analysed by the Methodological and Technological Innovation Centre at Universidad Católica del Norte, with the conclusion being drawn that the meta-profile is to a large extent in line with the methodology used in designing degree Programmes, and this translates into major progress in defining the graduate profile.

We can conclude by stating that the meta-profile for the Latin American geologist proposed by the Tuning Project is to a large extent in line with the geologist profiles already described by participant universities in their programmes.

4

Measuring the student workload and Latin American Credit Reference (CLAR)

Student workload is the time required by the student to attain the learning results required in order to develop the competences. In order to estimate student workload, surveys were conducted among students and academics corresponding to the 6th semester of degree Programmes offered by universities taking part in the project.

The results showed a workload equivalent to 743 hours as perceived by academics and 646 hours according to students for a period of one semester comprising 16 or 17 weeks, depending on the country. Weekly workload was estimated as being 40 hours (according to academics) and 47 (according to students).

In the case of Geology, workload is concentrated in student face-to-face activities such as reading texts and field work. 52% of academics interviewed think they plan non-face-to-face hours but do not contrast these with students. However, students think that academics do not plan their hours and do not compare their planning.

The analysis of the information obtained was used as a basis for awarding a reference value in the form of an academic credit.

On a general plenary level, all participants in the Project agreed as to the establishment of a transferable academic credit system known as the Latin American Reference Credit (*CLAR*), which was devised as «*a*

unitary value for estimating workload, measured in hours required by students in order to attain learning results and pass a subject or teaching period».

This credit represents a reference value that will favour transfer among students from different educational establishments, lend greater flexibility to the higher education system and contribute towards recognition of a graduate's capacities when entering the job market. The *CLAR* is and will remain respectful towards local, regional and national independence by recognising the diversity and singular nature of different systems. It should be made compatible by the governments of those countries that are interested in implementing it by disseminating it and ensuring that it is compatible with national systems, offering qualitative and quantitative perspectives to facilitate such implementation.

This system considers annual full-time student workload to be equivalent to 60 credits, whereby a 5-year or 10-semester syllabus —common in the discipline— would be equivalent to 300 credits (for 4 years = 240 and 6 years = 360 credits, these being minimum and maximum lengths of degree Programmes in the subject). To summarise, it is hoped that the *CLAR* will help to «focus attention on student intervention and on the quality of relevance of the competences they need to develop for suitable job placement in society».

The relevance of the Project in both phases was successfully tested on a regional level, given that it is specifically mentioned in inter-governmental spheres of activity and also in higher education as being a crucial experience in the integration and convergence process. By way of a complement to the above, thematic networks resulting from this lend weight to this context, as they not only function efficiently from the project standpoint but also on a group level, as a harmonious, positive area is being established in the specific case of our discipline that has already led to the first extra-Tuning meeting at the Universidad del Norte de Chile (Antofagasta, 2012), which strengthened academic and human relations among participants.

5

Teaching-learning strategies in Geology

Below are described the teaching-learning strategies for two selected competences – one generic and one specific.

- *Generic competence:* Ability to identify, consider and deal with problems.
- *Learning results:*

  1. Identifying a problem.
  2. Analysing a problem.
  3. Formulating and justifying the solution to the problem.

- *Teaching-learning strategies:*

  1. Identifying and analysing a problem in order to find solution alternatives:

     a) Reading a problem and understanding the variables present.

     b) Identifying the causes of the problem.

     c) Compiling the information required to deal with the problem.

d) Designing different hypotheses in order to deal with the problem.

e) Choosing the most appropriate solution.

2. Using the experience and criteria to analyse the causes of a problem and put together solutions or explanations:

a) Dividing the problem into smaller parts.

b) Selecting sources of information required to deal with a problem.

c) Designing effective solutions to the problem.

d) Selecting a criterion in order to choose a likely solution.

3. Proposing and constructing solutions to problems in diverse spheres of activity:

a) Identifying problems in advance.

b) Analysing problems and causes via a global approach.

c) Recalling solutions to previous problems and applying them to new situations.

- *Specific competence:* 10: Preparing and interpreting maps and geological sections.

- *Learning results:*

1. Knowing what a map is and the elements contained in it.

2. Reading and interpreting topographic and basic geological maps.

3. Identifying mappable topographic and geological elements on land.

4. Recording data in order to represent topographic and geological elements.

5. Preparing maps and geological sections.

- *Teaching-learning strategies:*

  1. Knowing what a map is and the elements contained in it:

     a) Reading, explaining and discussing bibliography about basic cartography.

     b) Carrying out practical exercises on projections, scales, reference systems, symbols and legends, among others.

  2. Reading and interpreting topographic and basic geological maps:

     a) Reading, explaining and discussing basic bibliography about topographic and geological cartography.

     b) Carrying out practical exercises involving reading topographic maps.

     c) Carrying out practical exercises on geological maps.

  3. Identifying mappable topographic and geological elements on land:

     a) Reading, explaining and discussing bibliography about elements.

     b) Carrying out orientation exercises in the field.

     c) Recognition, orientation and localisation exercises on mappable elements.

  4. Recording data in order to represent topographic and geological elements.

     a) Applying measuring techniques in order to represent topographic and geological elements.

     b) Exercises involving spatial representation of elements on the map.

  5. Preparing maps and geological sections:

     a) Exercises involving preparation of preliminary maps.

b) Corroborating information from the preliminary map in the field.

c) Exercises involving construction of maps and geological sections.

Based on the competences and their corresponding learning results, an analysis was then carried out on the levels of development achieved by these competences and the learning strategies needed to achieve the ones selected on specific Programmes.

- Competence: Ability to identify, consider and deal with problems.

- *Programme:* Geotectonics:

  — *Learning results:*

  1. Identifying and analysing a problem in order to find solution alternatives.

  2. Using the experience and criterion to analyse the causes of a problem and put together solutions or explanations.

  — *Level of competence development:*

  — *Learning strategies:* Average:

  1. Reading a problem and understanding the variables present.

  2. Identifying the causes of the problem.

  3. Compiling the information required to deal with the problem.

  4. Designing different hypotheses in order to deal with the problem.

  5. Designing effective solutions to the problem.

  — *Assessment strategies:* Learning results are assessed in written examinations in which problems about movements of tectonic plates are posed.

- *Competence:* Ability to identify, consider and deal with problems.
- *Programme:* Geophysics

  — *Learning results:*

  1. Identifying and analysing a problem in order to find solution alternatives.
  2. Using the experience and criterion to analyse the causes of a problem and put together solutions or explanations.
  3. Proposing and constructing solutions to problems in diverse spheres of activity.

  — *Level of competence development:* Average.

  — *Learning strategies:*

  1. Reading a problem and understanding the variables present.
  2. Compiling the information required to deal with the problem.
  3. Designing different hypotheses in order to deal with the problem.
  4. Choosing the most appropriate solution.
  5. Dividing the problem into smaller parts.
  6. Selecting sources of information required to deal with a problem.
  7. Designing effective solutions to the problem.
  8. Selecting a criterion in order to choose a likely solution.
  9. Identifying problems in advance.

  — *Assessment strategies:* Learning results are assessed in written examinations in which problems about physical properties in rocks are posed.

- *Competence:* Ability to identify, consider and deal with problems.
- *Programme:* Report Project:

  — *Learning results:*

    1. Using the experience and criterion to analyse the causes of a problem and put together solutions or explanations.

    2. Proposing and constructing solutions to problems in diverse spheres of activity.

  — *Level of competence development.*

  — *Learning strategies:* High:

    i) Dividing the problem into smaller parts.

    ii) Selecting sources of information required to deal with a problem.

    iii) Designing effective solutions to the problem.

    iv) Selecting a criterion in order to choose a likely solution.

    v) Identifying problems in advance.

    vi) Analysing problems and causes via a global approach.

  — *Assessment strategies:* Learning results are assessed via preparation of a thesis project that incorporates a problem to be researched and is based on the qualification report.

- *Competence:* Preparing and interpreting maps and geological sections.
- *Programme:* General Geology:

  — *Learning results:*

    1. Knowing what a map is and the elements contained in it.

    2. Reading and interpreting basic topographic and geological maps.

— *Level of competence development:*

— *Learning strategies:* Low:

i) Reading, explaining and discussing bibliography about basic cartography.

ii) Carrying out practical exercises on projections, scales, reference systems, symbols and legends, among others.

iii) Reading, explaining and discussing basic bibliography about topographic and geological cartography.

iv) Carrying out practical exercises involving reading topographic maps.

v) Carrying out practical exercises on geological maps.

— *Assessment strategies:* Learning results are assessed via a practical examination using a map on which a geological section must be prepared.

- *Competence:* Preparing and interpreting maps and geological sections.

- *Programme:* Topography:

— *Learning results:*

1. Reading and interpreting topographic and basic geological maps.

2. Identifying mappable topographic and geological elements on land.

— *Level of competence development:*

— *Learning strategies:* Average:

i. Reading, explaining and discussing basic bibliography about topographic and geological cartography.

ii. Carrying out practical exercises involving reading topographic maps.

iii. Carrying out orientation exercises in the field.

— *Assessment strategies:* Learning results are assessed in practical work involving a topographic survey.

- *Competence:* Preparing and interpreting maps and geological sections.

- *Programme:* Photogeology:

  — *Learning results:*

  1. Identifying mappable topographic and geological elements on land.

  2. Recording data in order to represent topographic and geological elements.

  3. Preparing maps and geological sections.

  — *Level of competence development.*

  — *Learning strategies:* Average:

  i) Reading, explaining and discussing bibliography about elements.

  ii) Carrying out orientation exercises in the field.

  iii) Recognition, orientation and localisation exercises on mappable elements.

  iv) Exercises involving spatial representation of elements on the map.

  v) Exercises involving preparation of preliminary maps.

  vi) Corroborating information from the preliminary map in the field.

— *Assessment strategies:* Learning results are assessed via practical work involving a preliminary geological survey.

- *Competence:* Preparing and interpreting maps and geological sections.

- *Programme:* Field Geology:

  — *Learning results:*

    1. Preparing maps and geological sections.

  — *Level of competence development.*

  — *Learning strategies:* High:

    i) Exercises involving preparation of preliminary maps.

    ii) Corroborating information from the preliminary map in the field.

    iii) Exercises involving construction of maps and geological sections.

  — *Assessment strategies:* Learning results are assessed via work involving a geological survey on land, accompanied by a report or extended legend and oral presentation.

6

Future scenarios

As a result of the Third General Meeting held in Santiago, Chile, it was deemed appropriate to highlight future scenarios with regard to new professions and emerging competences, through conducting interviews with different specialists in the discipline. The aim of these interviews was to gather the views of well-known, highly-regarded individuals in each of the participant countries about future scenarios for the profession. It proved possible to tentatively group together the responses into: Company Geologists (managerial posts), Academics and Civil Servants.

The responses were analysed both individually and collectively in order to put together a «*proposal for analysis with a view to anticipating new emerging professions in society and the new competences required to do so*».

Below is a summary of the work carried out, whereby it can be stated that the profession will in the future need to face the following issues.

- A greater number of new conflicts that will go beyond the socio-economic and political framework. Conflicts will emerge that will be based on natural resources (especially those related to the value of food and energy), essentially in terms of their sustainability. These conflicts will be linked to the exploitation of natural resources, care for the environmental and the redistribution of wealth deriving from them.

- These scenarios will result in communities that play a greater role in decision-making and governments that exercise greater control over

the production of resources – a new forging of international ways of thinking and the relationship with societies.

- Professionals will be required to interact to a greater extent with communication sciences, education and the area of sociology, given that suitable knowledge about and handling of community culture will be needed - professionals who know how to work alongside other professionals and who also know how to pay attention to social needs and issues.

- Professionals will be required who are integrated into global society to the detriment of the current scientific professional who is finding it difficult to communicate with 21st century society – professionals with great capacity for dialogue and bargaining skills.

- There will be greater demand for professionals who specialise in energy issues (both conventional and non-conventional) and environmental geology, i.e. to optimise the relationship existing between human habitat and geological factors (soil, rocks, hydrography, topography and interaction between these and climate) which are present in different environments.

- Transdisciplinary outlooks while at the same time specific to each given problem.

- Joint activity involving business, State and community, with suitable sizing of the «value» of natural resources.

- Private investment needs to be maintained, albeit with a State that sets out clear parameters regarding results, irrespective of whether these may be positive or negative.

Lastly, members of the Area of Geology attached to the Tuning LA Project (2011-2013) hope that this contribution will help to lend support to for the working system being developed, and that results will be discussed and agreed upon with other academic units that have not been able to take part in the Project – because this process will enable there to be greater and more suitable articulation of the Geology degree Programme and strengthen integration within a *Network of Undergraduate Geology Degree Programmes in Latin America.*

On a group level, we wish to think the Project managers for their invitation to take part in it and also for the chance they have given us to internalise these experiences. This facilitated the development of new work and activities which will most likely be used and improved on by those who wish to apply this university experience methodology. We would also like to thank all the Project members for their passion and commitment to work and, in particular, to friends of the Geology group for their patience and willingness to seek consensus.

7

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Annex 1

Distribution of Geology Schools in Latin America

Below is provided a summary of the number of universities that offer the Geology degree Programme among the 15 Latin American countries involved.

In South America, these schools are located in Argentina, Bolivia, Brazil, Chile, Colombia, Ecuador, Paraguay, Peru, Uruguay and Venezuela, amounting to 81 Geology schools in total of which only 10 are privately run (Table 1), and which account for an approximate population of 367.5 million inhabitants (2012).

Table 1
Distribution of State-run and privately-run universities among the 10 South American countries in which the Geology degree Programme is offered

Countries	State-run universities	Privately-run universities	Inhabitants 2012
Argentina	16	0	40.0
Bolivia	3	0	10.3
Brazil	24	2	180.0
Chile	4	7	16.2
Colombia	3	0	45.3
Ecuador	4	2	12.2
Paraguay	1	0	6.7
Peru	10	0	26.2
Uruguay	1	0	3.5
Venezuela	4	0	27.1
South America	**70**	**11**	**367.5**

In Central America, the Geology degree Programme is offered in 5 countries - Costa Rica, Cuba, Guatemala, Panama and Mexico - for approximately 146.9 million inhabitants in total (2012), all of them State-run (Table 2).

Table 2
Distribution of State-run and privately-run universities among the 5 Central American countries in which the Geology degree Programme is offered

Countries	State-run universities	Privately-run universities	Inhabitants 2012
Costa Rica	1	0	4.7
Cuba	2	0	11.4
Guatemala	1	0	14.8
Panama	2	0	3.6
Mexico	13	0	112.4
Central America	**19**	**0**	**146.9**

Figure 1
Percentage distribution of the number of universities where the Geology degree Programme is offered in South America Qualifications awarded: Geologist, BSc in Geology, Geological Engineer, BSc in Geological Engineering, and BSc in Science (Geology).
Duration: 4 to 6 years

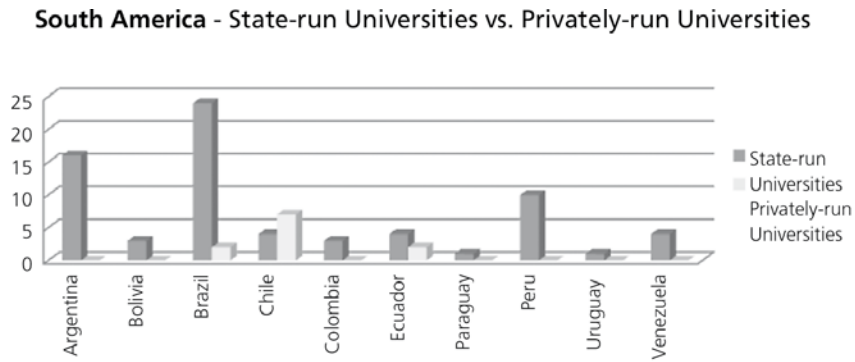

Figure 2
Ratio of number of State-run universities to privately-run universities in 10 South American countries, with 74 schools, of which 5 are privately-run and the remainder State-run

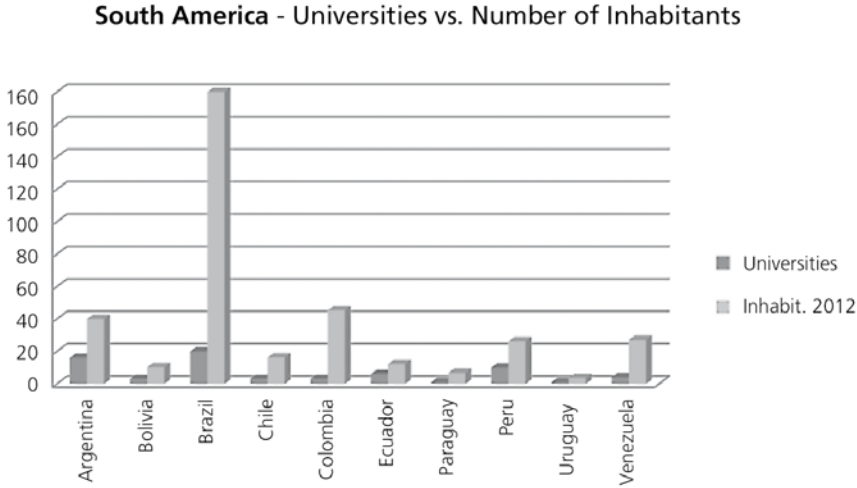

Figure 3
Ratio of number of universities per number of inhabitants per South American country: 74 universities in total for an approximate population of 370 million inhabitants

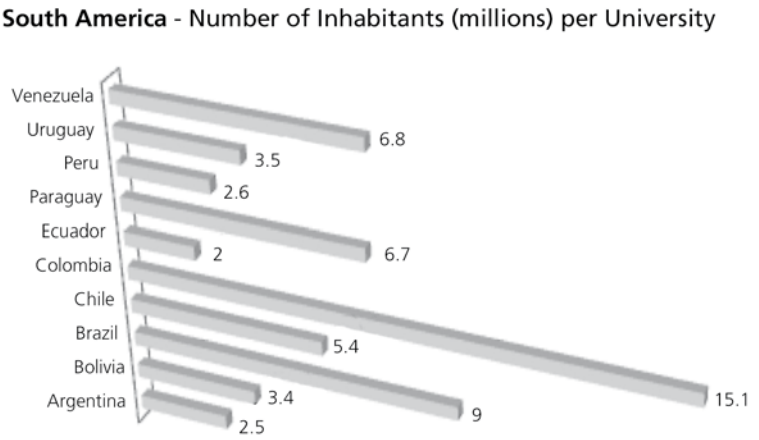

Figure 4
Ratio of number of inhabitants of the different South American countries for a population of 370 million inhabitants

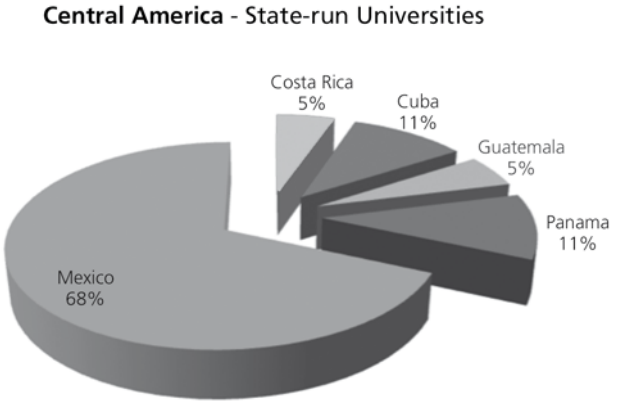

Figure 5
Percentage distribution of the number of universities where the Geology degree Programme is offered in Central America,
in 15 countries-18 schools Qualifications awarded: Geologist, Geological Engineer, Engineer in Geoscience, BSc in Geology,
and BSc in Geological Engineering.
Duration: from 8 to 11 semesters
Intermediate qualifications: Baccalaureate and Technician
in Geology Duration: 4 - 3 years

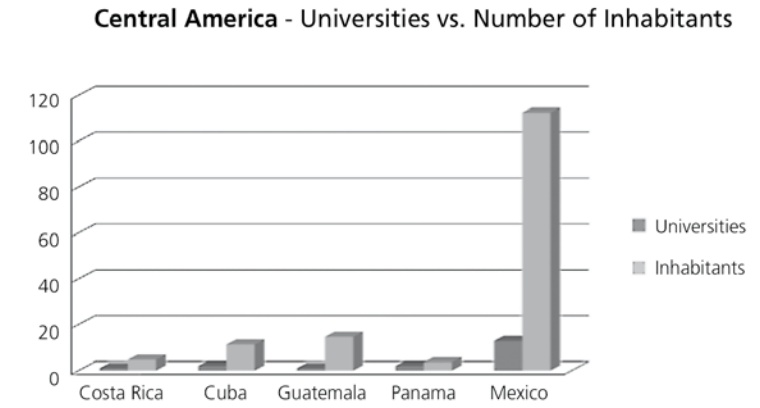

Figure 6
Ratio of the number of universities per number of inhabitants
for the 5 Central American countries
in which the Geology degree Programme is offered
Approximate total: 150 million inhabitants

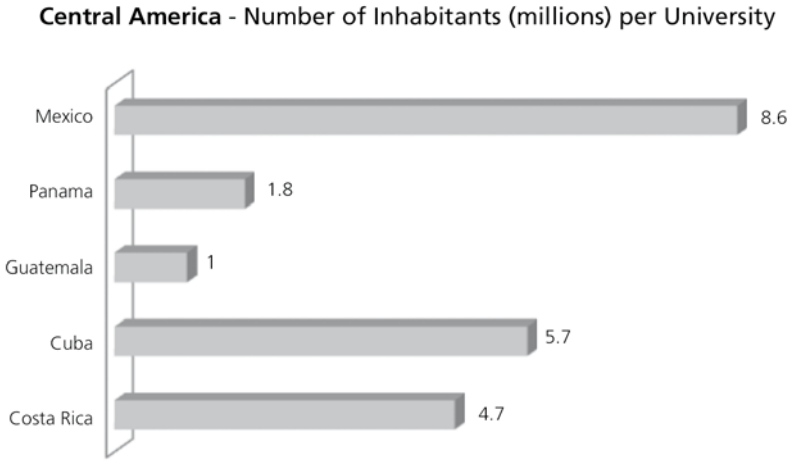

Figure 7

Deusto
University of Deusto

university of groningen

Co-financed by European Comission