GEOLOGY-IMPROVING INPUTS AND OUTPUTS

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Introduction

This poster has been written as part of our cooperation under the EFG Mentoring programme. The aim of this programme is to support students or non-experienced geologists (Antonio) by more experienced geoscientists (Christian) in order to facilitate their entrance in the labour market, as well as to help them to expand their informal networks at an international level.

The lack of education in geology has evolved into a loss of geological knowledge by society, and to make it worse, an awareness of its important role on daily life. This is the main cause of different social and economical disasters associated to natural phenomena such as volcanism or landslides, which could have been avoided if society were more aware about the pivotal role of geosciences facing them. Here we expose some of those problems and possible ways of solution.

Scientific combinations

Combining geological knowledge with other disciplines of science such as Medicine, Biology... is a good way of applying our expertise to enhance mutually beneficial solutions.

Medical Geology is the science that deals with the relationship between natural geological features and living organisms (of course including humans) health. Since rocks contain the majority of natural elements that are essential to living entities, weathering processes give the soil in which plants grow up, the water we drink has traveled throughout different types of rocks that influence on its composition and volcanic eruptions distribute many harmful elements for life such as arsenic or mercury. A direct link between geology and human health is obvious. The awareness of this link and the willing of solving health problems caused or aggravated by different geological aspects, are the prioritary goals of medical geology. To reach them, bringing together geologists, medicine professionals and general public is crucial. Working together will also help in the improvement of human health conditions in ways that without Geology could not have been considered or difficult to have found.

Horizon 2020 is the European Research and Innovation programme in which EU has invested over 80 billion euros between 2014-2020. The main goal of this project is to transfer more discoveries from laboratories to the market, to bring closer research and innovation (specially on industrial leadership, social challenges and science) and to produce a scientific world class so that private and public sectors can work together and innovate. In geosciences, it is specially centered on Raw materials, but there are other projects that applicate geosciences in their research, a good example is INoVA (Geochemical Controls on the **I**ce **N**ucleating Efficiency of **V**olcanic **A**sh)

The aim of **INoVA** is to understand the potential impact of volcanic ash products from explosive eruptions on climate. Volcanic ash can act as ice nucleating particles, nevertheless, this relationship is still not well known. The aim of this project is to determine this relationship combining volcanology, geochemistry and atmospheric science that will allow to understand how different types of volcanic activity affect on climate

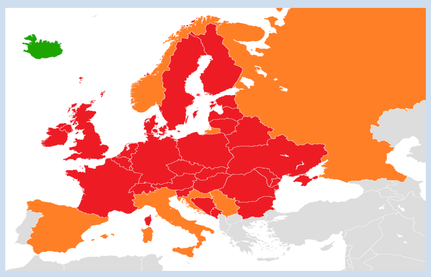
More information

As this topic is very complex, we invite you to scan this code that links to our article where we explain this poster in detail (including references used).

Problems

Education

In Spain, since the 90's different educational policies have been progressively "killing" geology inside scientific teaching, specially in schools and highschools. Teaching this scientific discipline depends on the educational center policies and teacher's determination. Teacher's determination is also a consequence of educational policies. The disappearance of sciences module in the general Teaching diploma makes that the new teacher has no background in sciences, including Geology, resulting in no determination to teach them. Apart from teachers, students are also responsible for this disappearance, as they do not see Geology worth the risk.



Por lo anterior, el **INSIVUMEH** recomienda:
A la SE-CONRED: Tomar las precauciones ya que existe la posibilidad de que desciendan lahares fuertes en todas las barrancas principales y otros canales cercanos a estas. No se recomienda permanecer dentro o en las cercanías de las barrancas.
A LA DIRECCIÓN GENERAL DE CAMINOS Y COVIAL: Tomar las precauciones ya que los pasos vehiculares son afectados en las cercanías de las barrancas principales y en las rutas por donde descienden lahares.

Figure 1. Left side, closed air space during EyjafjallajÃűkull (Iceland) 2010 eruption (Author: DeltaFalcon, Wikipedia for public use). Right side, recommendations given according to Fuego activity on 13 October 2018 (INSIVUMEH)

Natural disasters

Geophysical events such as volcanic eruptions or landslides already existed before human appearance. The concept of natural disaster appeared simultaneously to human evolution and socioeconomic system. The impact of these phenomena depends of two main factors: Geological setting and historical development. Developing countries because of their location (sectors often affected by these phenomena) and their poor development of their socioeconomic systems are the most affected. Asian and South American countries are the most concerned. The socioeconomic impact of natural disasters highlights the importance of geology, specially geomorphology, in seeking their prevention. Considering also economical factors will allow to apply prevention effectively.

"Quantum Geology"

Geology has to evolve as Physics did from Newton to Einstein. **Plate tectonics** represents the major step of evolution in our science. Looking at the concept of **Scientific revolution** defined by Thomas Kuhn (1962, 1970) provides some keys of how Geology could evolve. Kuhn proposed that science evolves through a series of discontinuous stages in which old hypotheses (paradigms) are replaced by new ones due to a crisis caused by several features (anomalies) that cannot been explained by the old hypothesis. The acceptance of the new hypothesis is made by faith. In Figure 2 we represent the history of Geology throughout these stages.

<table>
<tr><td>Catastrophism vs Lyell's Principles (New Hypothesis)</td><td>Acceptance of Lyell's Principles (Fixist)</td><td></td><td colspan="2">Discovery of radioactivity and isostasy</td><td>Continental Drift (First Attempt)</td><td colspan="2">Plate Tectonics and acceptance</td></tr>
<tr><td></td><td>Normal Science (Stratigraphy, Palaeontology)</td><td>Anomalies in Tectonics</td><td colspan="3">Crisis</td><td>Scientific Revolution</td><td>Normal Science</td></tr>
<tr><td>1830's</td><td>1850's</td><td>1870's</td><td>1890's</td><td>1920's</td><td>1960's</td><td>1970's</td><td>Today</td></tr>
</table>

Figure 2 Evolution of Geology through the Kuhnian stages of science evolution

However, some philosophers (Imre Lakatos/Karl Popper), did not agree with him. They claimed that the acceptance of a new hypothesis was made by logical conclusions as a result of a continuous methodology of study and revision of some elements (auxiliary hypotheses) of the paradigm. The degenerating elements were replaced by new ones. Differences between these ideas are due to a temporal scale. If we study the evolution of science in detail (year scale) we find Lakatos/Popper interpretation, but bigger scales (centuries) show the stages defined by Kuhn. However, Kuhn was wrong in the fact that the acceptance was made by faith.

In geology, some aspects like D" Layer (Core Mantle Boundary) mechanisms or astenosphere behavior can be considered as anomalies/auxiliary hypotheses that are still not well established. Certainly, these facts, with the help of other scientific disciplines, will drive us to a better understanding of our planet, towards **"Quantum Geology"**

Conclusion

Educational policies have been getting worse throughout the years leading to a lack of awareness by society of the key role of geosciences, resulting in ineffective prevention measures for different types of hazards (volcanism, landslides) that are fatal to our socioeconomic systems. A greater presence of geoprofessionals is the key tool in dealing with these problems, but to do so effectively we have to continue researching (finding anomalies/replacing auxiliary hypothesis) so that we can understand better our planet. The combination with other sciences shows both the crucial role of geosciences and a powerful tool dealing with these challenges.