GEOETHICS: ETHICAL, SOCIAL AND CULTURAL VALUES IN GEOSCIENCES RESEARCH AND PRACTICE

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Volume: *Geoscience for the Public Good and Global Development*

Keywords: Geoethics, Society, Geosciences, Planet Earth.

Abstract

Geosciences have evident repercussions on society. Geoscientists possess knowledge and skills to investigate, manage and intervene on the geosphere, implying ethical obligations. The adoption of ethical principles is essential if geoscientists want to best serve the public good. Their ethical responsibility requires a more active role in interacting with society. Geoethics represents a new way of thinking about and practicing geosciences, focusing on issues related to the relationship of the geoscientist with him/herself, with his/her colleagues, and with society in the broadest sense.

Introduction

The ethical responsibility of geoscientists requires a more active role in interacting with society, by giving people valuable contexts that inform the need for sustainable development, and perspectives that reveal essential and delicate balances of natural systems that impact humanity.

Geoethics consists of research and reflection on those values upon which to base appropriate behaviour and practices where human activities intersect the geosphere (IAPG, 2012; Peppoloni and Di Capua, 2015) and should become an essential point of reference in geoscientists' curricula (Mogk and Geissman, 2014). Acting in this direction implies awareness by the geological community of its ethical commitments and the necessity to train new generations of geoscientists that in the future will be able to transfer to society not only practical aspects of geological knowledge but also a new way to understand our planet.

Geoscientists come from different social, cultural and economic contexts and have different skills and experiences in their careers. So, firstly, we need to pose this question: can we identify common values to share among this international and heterogeneous community to better research in and practice of geosciences?

Geoscientist's actions

We can identify three levels that we should consider in analyzing the geoscientist's actions. First, the relationship of the geoscientist with him/herself: he/she faces geoethical implications in his/her work and dilemmas even in the way to act. It implies questions, problems, and reflections for his/her own conscience to manage, within the perspective of his/her individual responsibility.

Second, the relationship of the geoscientist with his/her colleagues (Mayer, 2015; Peppoloni et al., 2015): respecting different ideas and views to avoid plagiarism and research misconduct; being transparent and honest in providing data to colleagues, sharing information (Montreal Statement, 2013; Singapore Statement, 2010), and conducting peer/public review (Allington and Fernandez Fuentes, 2014); and pursuing a multidisciplinary approach as the way to solve complex issues collaboratively.

Finally, the relationship of the geoscientist with society in its broadest sense, according to his/her own social responsibility: engaging in science communication and education, considering how best to present the scientific uncertainty of results; better defining a geoscientist's responsibilities while interacting with politicians and mass media, as well as his/her role in decision-making processes; taking action to develop and to foster a more sustainable use of energies and natural resources in order to leave new generations a more manageable future (GSL, 2014; Lambert and McFadden, 2013; Peppoloni and Di Capua, 2015).

These three levels give a framework in which geoscientists can work and make decisions following reference values. Geoethics is the discipline that studies these values and tries to develop in the scientific community a new way of thinking about its responsibility to help society have a sustainable future.

The values of Geoethics

The foundations of Geoethics are traced back to three main elements: the importance of geological culture as an essential part of the geoscientist's background, the concept of responsibility (individual and social), and the definition of an ethical criterion on which to guide behaviour and practices in geosciences (Peppoloni and Di Capua, 2012). These pillars are rooted in a set of values that, for simplicity, we can divide into three groups that partially overlap: ethical values, cultural values and social values.

Ethical values

These set of values concerns the individual and social sphere of a geoscientist, giving a deep sense to his/her work. They comprise:

- respect for the scientific method, based on the primacy of observations of natural phenomena with respect to models, assuring clearness in separating scientific results from their interpretations;
- professionalism and competence, which implies a documented scientific and technical expertise in order to guarantee the trustworthiness of studies;
- training and life-long learning, to better assure updated knowledge;
- sharing knowledge at all levels as a valuable activity, which implies communicating science and popularizing results, while taking into account probabilities and uncertainties;
- verifying sources of information and data;
- assuring a peer-review process to technical and scientific publications;
- working with a spirit of collaboration and reciprocity, which involves understanding and respect for different ideas, hypotheses and theories;
- knowledge of the systems and the dynamics of Nature through observation;
- respect for natural systems and dynamics when designing interventions on the environment;
- protection and enhancement of geodiversity for sustainable development of communities;
- promotion of sustainability in order to assure energies and natural resources for future generations.

Principles of Research Integrity, as expressed in the Singapore Statement (2010), the Hippocratic-like oath published in the form of a "Geoethical Promise" (Matteucci et al., 2014), deontological codes of conduct for scientific and professional associations and societies (TGGGP, 2013) provide effective and concrete applications of the listed ethical values.

Cultural values

Geosciences have an intrinsic cultural value, as they contributed in past centuries to build the modern way of thinking and the current level of human civilization (Cervato and Frodeman, 2012; Peppoloni and Di Capua, 2012).

Geosciences are not just a collection of useful scientific and technical information and data; they represent a cultural resource, capable of influencing current and future ways of thinking about space and time, especially in Western cultures.

Geosciences have led society to deem geological landscape, geodiversity and geoheritage as important cultural values (Brocx and Semeniuk, 2007), which are able to strengthen the relationship between communities and the land they inhabit, so that the deep roots of cultural identity that are strictly connected with that land can be recognized. For this reason, geosciences have been also capable of transforming these values into socio-economic values, such that geological landscapes,

geodiversity and geoheritage are also social capitals. Taking care of and enhancing these social capitals can become a way of assuring sound socio-economic development, while preserving nature in a sustainable way and improving quality of life. Geoparks and geotourism represent not only the synthesis of scientific, cultural, educational and environmental values connected with the concept/value of geoheritage, but also an economic opportunity for a country's development.

The concept/value of geodiversity is critical for understanding the variability of natural substrates, which are essential for the development of life and its biodiversity, as well as supporting cultural and social diversity. Recognizing the value of geodiversity is also a fundamental step in enhancing the distinctiveness of an area, even with the perspective of a more effective defense against natural hazards. Discovering the value of the geological landscape helps to raise human aesthetic senses - the feeling of wonder for Nature, the sense of respect for the land that hosts our lives, and the trust in science as one of the tools we have to explain the story of its evolution.

Social values

An ethical perspective in geosciences can be helpful for considering current complex global problems, such as climate change, the search for new sources of energy and the best management of the current ones, the need for a sustainable approach to the environment, the defense against geo-hazards, and the development of a society of knowledge.

With the growth of world population, society needs more energy supplies and natural resources, leading to increased greenhouse gas emissions and unavoidable pollution and land consumption. Considering current economic systems and technological levels, climate change and natural risks can affect billions of people with disastrous consequences.

Anthropogenic activities are necessary but have a strong impact on environment (Reddy, 2013). The use of technologies produces a huge impact to the geosphere, resulting in changes in physical, chemical, biological systems, with repercussions that are not easily predictable. Land and ocean ecosystems depend on the equilibrium of the environment, which is extremely delicate.

This does not mean that we have to stop any kind of activity, but these impacts must be carefully considered by allocating adequate economic investments to study their mitigation to prepare for a more sustainable future. Geosciences are on the front lines to help society face these great challenges. Sustainability, prevention and education are social values on which to base a new vision for future years.

"Sustainability" means a prolonged use of a natural resource and low consumption of energy in a two perspectives. In the near term, it aims to develop strategies and technologies for reduced use of energies and minerals. and to encourage the percentage increase of renewable energies. In the long

term, it means building a new model of economic development for our societies that aims to give new generations the possibility of discovering and exploiting other ways to produce energy and use natural resources. A sustainable world is also economically beneficial to society as a whole.

The culture of prevention means to think in an ethical way about protecting the population against natural risks, replacing the culture of emergency. Generally, preventive and mitigating activities are not developed due to a lack of funds (even if in the long term preventing and mitigating policies are able to reduce economic and social costs of disasters), bureaucratic inefficiencies and an inadequate involvement of the population in risk communication and education. Recent scientific work shows that it is possible to defend people against risks through accurate and continuous monitoring of natural phenomena, the use of early warning systems, careful land management, suitable construction methods well-calibrated on the hazardous features of each area, and education and information campaigns to citizens. Prevention is effective when the network of roles and responsibilities of each of the "actors" involved in the risk scenario works well: citizens, technicians, scientists, local administrators, law makers, decision makers, mass media (Di Capua and Peppoloni, 2014).

Scientists do not have to alarm or reassure but should provide their knowledge to guide decision makers. Politicians are required to implement actions to protect citizens and the land, ensuring compliance with appropriate levels of security. Mass media outlets should pay more attention to the quality of the information they collect and spread, making sure that they are scientifically reliable. People, often considered a taxable entity in defending against risks, should have an active role: while citizens have the right to pretend that the government develops preventive security policies, the population has the duty to inform itself and understand the importance of investing in its own safety.

Finally, geoeducation should be central in the scholastic curriculum. Geoscientists can contribute to raising awareness about how the geosphere (our home, the dwelling place) operates and evolves, building a knowledgable society with the goal of improving the human condition and economic prosperity. Transferring knowledge, using easy language and precise tools and strategies, is an important democratic value that creates conscious and informed citizens and develops a sense of belonging and protecting between the community and the land it inhabits.

In our opinion, geoscientists who think and act ethically promote geoeducation as a fundamental social value at the base of a shared knowledge. More generally, the culture of geosciences must become a widespread and shared social knowledge that is promoted and developed within a more general process of scientific acculturation of society.

Conclusions

Geoethics is not a limit to the freedom of action but a new opportunity for geoscientists to think about the best way to act for society. It can be a framework for ensuring actions are more respectful towards the environment and other individuals.

Globalization is a fact. It is a contradiction to feel ourselves immersed in a globalized world and at the same time claim to act for our own, without taking into account the inter-relationships among us and the world in which we live. Earth sciences teach us that these relationships operate on a global scale. Since much of what we can do is in our hands, Geoethics can guide us towards a new behaviors. We need to train new generations of geoscientists, teaching Geoethics among geosciences curricula, so that they will be able to transfer to society not only the practical aspects of geosciences knowledge but also a new way of understanding our planet. Geoscientists need to base their activities on a system of shared values, which would give future generations the possibility and right to decide the best for their future.

With these aims, the IAPG – International Association for Promoting Geoethics (www.iapg.geoethics.org) – was established in 2012 to build a new awareness in the scientific community. It aims at joining forces with geoscientists all over the world through creation of an international, multidisciplinary and scientific platform for discussing ethical problems and dilemmas in Earth Sciences, strengthening the research basis for Geoethics through scientific publications (with a peer-review process) and meetings, and popularizing ethical issues in geosciences in the public arena.

Acknowledgments

We wish to thank Prof. Cindy Palinkas (University of Maryland, Center for Environmental Science, USA) for her suggestions to improve the text.

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