**The Role of Geosciences in Sustainable Development: Knowing the Complex Relationships in the Geology-Environment-Health system**

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**Abstract**

The Sustainable Development Goals (SDGs) provide a comprehensive roadmap for achieving global sustainability by 2030. These 17 goals demand active contributions from scientists, particularly geoscientists, who play a key role either in the exploration and management of geological resources, or in the protection and restoring the natural environment. Research demonstrates that geosciences are involved (in)directly in most of the SDGs, namely in the 7, 11, 12 and 13, highlighting their relevance in addressing today’s global challenges, as the obtaining of critical raw materials for green energy transition. Although geological resources are essential to societal development, their exploitation often comes at a significant environmental and health cost. Thus, this keynote explores the intricate relationship between geological activities, environmental impacts, and public health.

Research in many abandoned mining areas reveals metal(loid) contamination of soils, sediments and waters, which poses significant long-term risks for ecosystems. These environmental contamination scenarios are often highly complex, so the implementation of remediation processes requires in-depth knowledge of the specific conditions at each site. This aspect is often overlooked, which explains the lack of success of some of the environmental remediation measures adopted. In addition, these studies highlight the need for spatial risk assessments and environmental monitoring to integrate regional planning and health policies regarding the dangers of urban and industrial expansion into geologically sensitive zones. Although much progress has now been made in terms of legislation and environmental protection measures in many developed countries, the same is not true for many underdeveloped countries. Much of this knowledge has come from studying the environmental liabilities of past mining operations, which continue to work as natural laboratories for studying the processes of availability, mobility and toxicity of potentially toxic elements (EPTs).

However, cases of environmental or human health risks related to EPTs are not only associated with mining scenarios, but there are also several situations of trace element enrichments exclusively associated with natural geological processes. Geohealth studies contribute to identifying health problems related to the geological environment and sustainable resource management strategies tailored to each case.

Recognizing the health dimensions of geological resource use is essential for building a more equitable, resilient, and sustainable future. Integrating geohealth into policy and planning ensures that human development respects the Earth’s dynamic systems while safeguarding public health.

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