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Viewpoint

Social geology — integrating sustainability concepts into Earth sciences

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ABSTRACT

Most geologists would argue that geoscientific knowledge, experience, and guidance is critical for addressing many of society's most acute environmental challenges, yet few geologists are directly engaged in current discourses around sustainable development. That is surprising given that several attributes make modern geoscience well placed to make critical contributions to contemporary sustainability thinking. Here, we argue that if geoscientists are to make our know-how relevant to sustainability science, two aspects seem clear. Firstly, the geoscience community needs to substantially broaden its constituency, not only forging interdisciplinary links with other environmental disciplines but also drawing from the human and behavioral sciences. Secondly, the principles and practices of 'sustainability' need to be explicitly integrated into geoscience education, training and continued professional development.

1. Introduction

The study of the Earth, its history and how it works provides essential knowledge, experience, and guidance on how to meet many of society's most acute planetary challenges (UNESCO, 1998; American Geosciences Institute, 2011; The Geological Society of London, 2014). Through global socio-economic drivers of international trade, industrialization, urbanization and coastalization we are using more and more natural resources, and the way we are utilizing our resources has started to affect our ecosystem more noticeably and irreversibly than ever before. All this has the potential to impact our ability to sustain the economy, protect national security, eradicate global poverty and preserve the natural environment. Although this interface between wise management of geological resources and risks and social development has been called 'social geology' (Mata-Perelló et al., 2012), it has been argued (Mora, 2013) that '..most geologists tend not to be involved in discussions around sustainable development' (Fig. 1).

The apparent disconnect between geoscience and sustainability may be because the United Nation's (2015) Sustainable Development Goals (SDGs) do not appear, at first glance, to be overtly geological (Fig. 2). And yet, not only is geoscience important to many of the SDGs (Gill, 2016a) but underpinning the whole notion of the sustainability agenda is the broad acceptance that humans are now a dominant geological force on the planet, warranting our own bespoke epoch: the Anthropocene (e.g. Steffen et al., 2011; Waters et al., 2016) (Fig. 3). The fact that some of the cumulative impacts of our anthropogenic changes are now becoming significant enough to be able to be compared with similar events in the geological past means that, more than ever before, many of the central tenets of Earth science bear directly on humanity. In this burgeoning 'human age' the applied aspects of economic geology, petroleum geology, engineering geology, hydrogeology, geohazards and the use of the land-surface for agriculture, housing and infrastructure assume even greater importance, alongside the geological facets of climate science, land and environmental management, and disaster risk reduction. In practice, however, it would seem that most geologists have yet to grasp the wider societal interests and implications of the Anthropocene Epoch debate (see Lewis and Maslin, 2015; Ellis et al., 2016).

Making sustainability thinking more central to geology is not a new idea. Over two centuries ago, James Hutton's seminal 'Theory of the Earth' placed what he referred to as the 'physiology' of our planet at the heart of geology, with his 1788 opus opening with the remark: 'This globe of the earth is a habitable world, and on its fitness for this purpose, our sense of wisdom in its formation must depend'. Given that modern geology rests on such a foundation, it is perhaps surprising that today the geoscience community is less

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Fig. 1. How we exploit our raw materials and natural resources has significant impacts on the future health and well-being of our economy, our environment and ourselves. Although most aspects of securing a sustainable future – such as meeting Society's rising energy demands – have strong geological underpinning, geologists rarely find themselves central to sustainable development thinking.
Authors own.

fully represented in in current discourses on Earth's health and well-being in comparison with other scientific disciplines (Mora, 2013).

Our under-representation is particularly surprising given that several attributes make modern geoscience well placed to make critical contributions to contemporary sustainability issues. As 'Earth System Science', it grapples with the complex linkages between the atmosphere, hydrosphere, cryosphere, biosphere, and lithosphere, giving a unique whole-planet perspective. Those interlinkages have ensured that Earth has maintained itself as a sustainable system over billions of years, recycling the vital components for a habitable planet. Geologists, therefore, possess a valuable synoptic and temporal conceptual framework for evaluating Earth's sustained viability for life.

Even as the rise of Earth System Science has shifted the frontline of our curiosity-driven discipline toward solution-oriented science (Schlosser and Pfirman, 2012), conventional geological inquiry still remains critical. Many of the long-standing methodological limitations of Earth science – incompleteness of data, lack of experimental control, changes occurring too gradually for direct observation or measurement – pertain equally to sustainability science. And with geologists trained in a range of specialized problem-solving skills, they would seem especially well suited to the challenges of developing more sustainable environmental practices. Indeed, as Gosselin et al. (2013) contend:

> 'As a historical and interpretative science, geology can inform society about interactions in coupled human-environmental systems because our skills and proficiencies allow us to recognize the varying manifestations of phenomena at different spatial and temporal scales.'

So, how can the geoscience community increase its involvement and profile in the sustainable development arena? The

Fig. 2. The UN Sustainable Development Goals (United Nations, 2015). The apparent disconnect between geoscience and sustainability may be due to the fact that the SDGs do not appear to be overtly geological.