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Editorial

Sustainability in mining, minerals and energy: new processes, pathways and human interactions for a cautiously optimistic future

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A B S T R A C T

The supply of minerals and energy is critical to global society. However, this supply is associated with social and environmental impacts, leading to concerns of generational and intergenerational equity. In light of these concerns, a call for papers for a special volume on the mining industry was issued with the view that such academic work could assist in reducing the negative impacts associated with this industry. This paper introduces the Special Volume "The sustainability agenda of the minerals and energy supply and demand network: an integrative analysis of ecological, ethical, economic, and technological dimensions". The Special Volume contains 84 articles, divided into several themes; sustainability accounting and reporting, corporate social responsibility, future mining challenges, integrative frameworks for sustainability, management aspects, mining in a developing context and new frontiers in the oil and gas industry. The Special Volume also includes two letters on contemporary issues with commentaries on these from experts in the fields, viz., community conflict and land rehabilitation. Insights obtained across these themes are summarized and recommendations are made of what is needed to build upon the findings of this Special volume. A research agenda is proposed for the future from the gaps and synergies identified. The overall contribution of this Special Volume is that it renews the debate on the sustainability challenges for the mining industry and provides transdisciplinary insights into resolving some of these challenges.

1. Introduction

The mining industry plays a crucial role in ensuring an acceptable quality of life is, or will be, available to billions of people across the globe. The demand for minerals and energy is anticipated to rise, ore quality is decreasing and costs to access it are increasing, as are community expectations of the performance of mining companies and those associated with them. In this context, addressing the sustainability agenda of the mining industry is a 21st century challenge of global significance.

The extraction of natural resources has created legacies of unacceptable long-term social and environmental impacts in many parts of the world. These impacts range from the geographic and cultural displacement of indigenous communities to contamination of water, air and land with toxic by-products of extraction and processing that have not been sufficiently well contained and/or treated. To avoid these impacts in future, business as usual must change, even taking into account the substantial efforts to improve performance made in recent decades by responsible companies and diligent regulators. It is not possible for human society and the ecosystems of this planet to meet the growing demand for minerals and energy if developing economies follow the same inefficient and destructive material and energy trajectories that the high GDP countries took to achieve their current status. This is as relevant for commodity supply impacts as the effects associated with commodity use.

Technological discoveries are needed to radically improve the minerals and energy demand and supply processes and networks, from the extraction of resources to their use and reuse. However, while this will be necessary it is not sufficient. Management systems, company decision-making, governmental policies, educational and research priorities, societal attitudes and empowerment in charting and achieving sustainable societal futures must be envisioned and implemented. Implementing this transition is at the heart of equitable, sustainable societal development.

The Call for Papers (CfPs) for this Special Volume (SV) of the Journal of Cleaner Production, (JCLP) was written very broadly to solicit inputs from the international research community on topics, data and approaches that could be used to provide insights into our evolving capability for addressing the immense challenges posed by the projected increases in demands for metals, building materials and energy. This CfPs was published in November 2012, several months after the United Nation Conference on Sustainable Development in Rio De Janiero, in June 2012 (Rio +20 conference), and thus it was released at a pivotal time in renewed global efforts towards Sustainable Development (SD).

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Mining's contribution to SD was a critical issue discussed at Rio +20. Building upon the achievements of earlier major events such as the Rio World Summit in 1992 and the World Earth Summit in Johannesburg in 2002 (Rio+10), this conference reiterated the vital role for the mining industry in SD. The International Council on Mining and Metals (ICMM) was at the forefront of these discussions. They issued the following papers at the conference on mining's contributions to SD:

- Mining's contribution to Sustainable Development
- Human rights, social development and the mining and metals industry
- The role of minerals and metals in a low carbon economy

The emphases of these papers by ICMM represented a shift in focus from analysis and mitigation of impacts to the potential of a more comprehensive analysis of the wider contributions of this sector and its products to the transition to truly sustainable societies (ICMM, 2012). Essentially, the focus was not on how mining can be sustainable but on how mining, minerals and metals can contribute to SD (ICMM, 2012, p. 4).

The Rio +20 outcome document, "The Future we Want" includes two paragraphs devoted to the role of mining. In line with the ICMM, the document acknowledged the critical importance of minerals and metals, and highlights a need for mining companies to maximize social and economic benefits, and to effectively address negative social and environmental impacts (UN, 2012, paragraph 227, P. 44). A strong regulatory and legal framework for mining accompanied by improvements in accountability and transparency was also recommended (UN, 2012 p.44).

This SV includes 82 papers and seven commentaries (on two topics) and, as such, is likely the largest published set of fully peer-reviewed work on sustainability in the resources sector. This introductory article places all the contributions into context with one another in terms of the theme they most clearly address but also taking into account the connections between papers and interpretations of threads of issues and opportunities that emerge from the collection rather than just the individual papers. Many papers are cited several times in an attempt to draw connections and lead to conclusions and research issues. Readers are encouraged to focus on the introductory lead–in sentences in each of the descriptive citation sections so that the thread of connection can be discerned. The authors recognize that this is a challenging task given the large number of papers and sections. As a result, it is expected that readers may have to "consume" this introduction in a number of sequential and iterative readings rather than as a single pass. Many SV introductions create a framework for interpretation that can be used to synthesize the overall content of the contributions. In this case, the size of the SV and breadth of the content of the papers made this task too difficult to achieve as well as introduce the individual papers. Consequentially, two of the authors undertook to write a second paper that focused solely on an interpretative overview and not on citation of the individual contributions. That paper (Moran and Kunz, 2014) follows immediately after this introduction in the SV.

The introduction to this SV contains:

- A broad overview of literature on sustainability in the mining industry;
- Brief scoping of the SV, based upon the CfPs;
- Summary of the papers accepted for this SV;
- Discussion of emerging trends, themes and issues;
- Recommendations for future research questions and challenges.

2. Literature on sustainability in the mining industry

To set the scene for this SV, the team conducted a broad literature search to evaluate the extent to which mining and minerals are incorporated into current and historical academic dialogue.

A search on "Sustainable development" within Google Scholar (16 July 2014) returned approximately 1.37 million articles. An analysis was undertaken using the Thomson Reuters ISI Web of Science and Scopus, which found 14,699 and 41,378 articles, respectively to a search on "sustainable development" that was restricted to "articles" from 1987 to 16 July 2014. When the search was refined to only include papers with "mining or mineral*", the results for Web of Science was 537 and Scopus was 3547. Scopus found a significantly greater number of papers than ISI in this domain, possibly because it covers a wider array of social science journals (Markard et al., 2012). Only four institutions appear in all search lists, i.e., the broad SD search and the refined "mining or mineral*" search, viz., the Chinese Academy of Sciences, The University of Queensland, Beijing Normal University and The University of British Columbia. The *Journal of Cleaner Production* (Scopus) was the leading journal by numbers of papers for both the general "sustainable development" search and the constrained "mining and mineral*" search.

A time series analysis of the Scopus data from 1987 to 16 July 2014 found that the literature on sustainable development is increasing (Fig. 1). The first jump in numbers of papers published, occurred in 1996 followed by a surge in 2006–2008. This trend has continued and at an increased rate (note the data for 2014 are incomplete due to the date of the search). In overall numbers, the literature specific to sustainable development in mining and minerals is small by comparison. This is notable given the importance of mining and minerals in global terms. However, the time series revealed that this is being addressed. The number of papers on topics, including "mining and mineral*" increased in the same manner as the number that addressed "sustainable development" with the jumps appearing in the same years (Fig. 2). However, "mining and mineral*" showed an increasing trend in terms of percentage of the total, with considerable scatter prior to 1996, and a much clearer upward trend recently (Fig. 3). The strong response to this SV's CfPs is consistent with increased research activity in this area.

3. Summary of SV contributions

The original CfPs (Lodhia et al., 2013) invited submissions on the following seven topics:

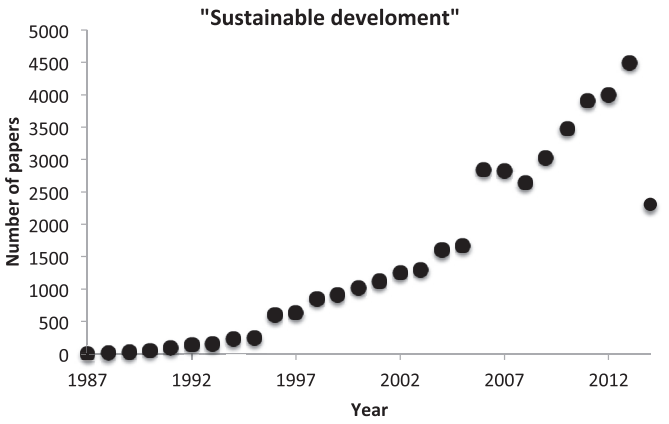

Fig. 1. Number of publications (Scopus) from a search on "Sustainable development" since 1987 (2014 incomplete year).

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