A GRAND CHALLENGE: Sustainable Natural Resources Development on a Small Planet
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Mining and Sustainable Development

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“Themes inherent in this meeting will include:

A) A life cycle analysis of proposed mineral resource recovery actions (including non-fuel minerals, coal, and uranium).
B) Recognition that this Grand Challenge is by nature cross disciplinary (engineers and scientists in full communication) and coupled.
C) A range of perspectives, from conservation and preservation through development and sustainability.”
Sustainable Development (SD)

“Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs.”


Four Essential Aspects of Sustainability Science*

- **Normative.** SD has as its foundation normative ethical as well as practical aspects. SD is about improving the quality of life for people while respecting and living within the limits of the ecosystem
- **Dynamic.** SD is a process with moving targets
- **Relevance.** Evolving contributions of sustainability science is essential to support societal SD
- **Rigor.** SD research must be integrated in traditional disciplines as well as integrated with multi, inter and transdisciplinary research programs

Sustainability vs. Sustainable Development

• Sustainability as used in ‘environmental sustainability’, ‘economic sustainability’, ‘social and cultural sustainability’ is a one-dimensional concept
• Sustainable development is multi-dimensional as it integrates, it strives to sustain or even enhance all the dimensions


Mining and Sustainable Development

• This does not refer to sustainability of the industry, a company or a mine; clearly an oxymoron if used in that fashion
• It is a culture that addresses in very clear and practical terms how mining can contribute to sustainable development
• It is a concept of needs, an idea of limitations, a future oriented paradigm, and a process of change
The goal of sustainability with respect to minerals is to maintain the stream of benefits that minerals provide in such a manner that the net contribution of the resource is positive over the life cycle of mine or field, and product.

Thus the challenge to the mining industry is to be sustainable material service providers to society while contributing to sustainable development at all scales.
**Terminology Issues**

“an arbitrariness of the different definitions and conceptions of SD”*

- Sustainable forests
- Sustainable construction
- Sustainable mining
- Sustainable comminution engineer

**The contributions that mining makes to sustainable development (SD) or to sustainability**


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**A key outcome was development of a consensus definition/approach of sustainability when applied to engineering problems**

- **Economic:** The engineered system is affordable
- **Environmental:** The external environment is not degraded by the system
- **Functional:** The system meets users’ needs—including functionality, health and safety—over its life cycle
- **Physical:** The system endures the forces associated with its use and accidental, willful, and natural hazards over its intended service life
- **Political:** The creation and existence of the system is consistent with public policies
- **Social:** The system is and continues to be acceptable to those affected by its existence
Realities of Earth Resource Technology and SD

• Historic perspective:
  – Sodium nitrate, or Chile saltpeter, mined in Northern Chile until the Haber Process was developed
    • Large land areas of disturbance remain
• Not so recent history:
  – Widespread application of heap leaching technology for gold/silver and copper recovery since the early 1980’s
    • Some long-term impacts were not well understood at the time of implementation
• Present issue:
  – Hydraulic fracturing in shale formations
    • Extensive environmental and social impacts
    • Currently banned in Quebec, New York, New Jersey and two cities: Pittsburgh and Buffalo
    • Moratorium in France
Concluding Proposal

• Problem Statement: New technologies, especially when disruptive (step changing) typically only address one or two of the SD elements (e.g. economic advantage or environmental protection)

• Need: develop an integrative multi-disciplinary process for the evaluation of new technologies during their development to address whether their implementation will result in an overall positive or negative contribution to SD

Some Potential Questions

• What are the risks and benefits and how are they distributed intra- and inter-generationally?
• What are the short and long-term environmental impacts and are they irreversible?
• What are the health and safety impacts for workers and communities?
• Are the economic benefits societal or only corporate?
• How are trade offs among social, economic and environmental impacts and benefits going to be decided?
• Is the present regulatory framework (environmental and otherwise) adequate to address this technology?
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