The Role of Geological Surveys in "Smart" Mineral Enterprise Development

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Ore grades are declining
Developing a mine

• Geology
  Application of new geological concepts and exploration technologies, terrain favourability and exploration maturity

• Geography
  Underlying issues that would underpin project development, such as infrastructure and markets

• Government and society
  Overall risk, favourability of mineral and environmental legislation and social acceptance

From discovery of a deposit to opening a mine can take 20 or more years mine life expectancy 80 to 120 years
Billions of £s
Key trends in resource supply

• Decrease in ore grades
  • Deeper mines increase emissions and waste production.
  • Energy and water consumption increases, driving operational costs up and increasing the environmental impact of the operation

• Increased competition with other land uses
  • Increase in community conflict
  • Increasingly, operations are delayed or prevented by problems in receiving permits and licences or social conflicts.
  • In many jurisdictions, community and legal barriers cause more than 50% of delays producing many millions of tonnes per year loss in supply
Options

• If the trends are increasing demand and difficulties in supply, how can we fill the gap?

• What is the role of recycling?
  resource efficiency?
  public education?
Recycling has a part to play but we will still need for primary production

Modelled primary (dashed black line) and secondary (dashed grey line) copper production.

The black and grey continuous lines show the historical data of primary (ICGS, 2015) and recycled copper production (1966-2010, from ICSG), respectively.

The continuous black line is the sum of the modelled primary and secondary production.

The grey area shows the results of Northey et al. (2014).
Coordination of geochemistry and geophysics data for exploration
The Epistemic Divide

• The primacy of price as a trigger for innovation and supply
• Resource extraction impacts and their salience in leading to supply constraints
• Recycling stocks and efficiency based on product design
• Using historical precedent as a predictor of the future
Tilton et al. and the CSM establishment

a. Slowly rising slope due to gradual increase in costs.

b. Discontinuity in slope due to jump in costs.

c. Sharply rising slope due to rapid increase in costs.
So again, let’s restate the problem!

- Demand for all raw materials has risen dramatically
- Substitution, recycling and usage efficiency improvements will not be enough on their own
- Projections for energy technology, urbanisation and economic growth will dramatically increase demand for all raw materials
- The more obvious deposits have been discovered and lower grade deposits are being worked from increasing depths
- The rate of new discovery is not keeping pace with exhaustion of deposits
- **Need to forestall unpredictable and unforeseen shortfalls due to market failures in price signalling and new global goals!**
Sustainable Development Goals
Sustainable development goals

Goal 8. Promote sustained, inclusive and sustainable economic growth, full and productive employment and decent work for all

8.4 improve progressively through 2030 global resource efficiency in consumption and production, and endeavour to decouple economic growth from environmental degradation...

Goal 12. Ensure sustainable consumption and production patterns

12.2 by 2030 achieve sustainable management and efficient use of natural resource
What are our recommendations?

• Develop international guidelines for planetary mineral consumption
• Raise awareness of the impacts of mineral consumption from source to product. Individuals and nations need to be accountable for their resource use
• Support industry investment and research into new mineral exploration and extraction technologies
• Develop global best practice for responsible mineral resource development
How do we make this happen?

• Work with others
  • Use International Council for Science and similar bodies to encourage dialogue across academic disciplines
  • Involve other groups - UNEP/IRP, ICMM, World Bank, European Union, African Union and so on
  • Advise legislators, policy advisers and opinion formers

With a view to developing a new Social Contract for mining
Recommendation 1

• *Reach consensus on international targets for global mineral production*: As with the targets for emissions reductions in COP 21, standards should be set to assure that mining is conducted with maximum efficiency and minimal negative impact on the environment and society.
Recommendation 2

- **Monitor impacts of mineral production and consumption**: Establish a system for tracking mineral use along the entire value chain, from source to end-of-life, perhaps based on the “fingerprinting” developed by the German Geological Survey for tantalum.
Recommendation 3

• *Support investment and research into new mineral exploration and extraction technologies*: Private-public cooperation is needed to develop new techniques for mineral exploration in new locations, from deep in the crust to the bottom of the ocean, drawing on lessons from programs such as Australia's UNCOVER
Recommendation 4

- *Harmonise global best practices for responsible mineral resource development:* Mineral deposits are irregularly distributed and their locations are fixed by geology. Thus, the value of these mineral resources must be assessed in the context of other land uses.
Recommendation 5

• *Develop maps and inventories showing the availability of recyclable metals:* These maps would show the locations and status of stocks of in-use metals available for future use and recycling, just as geoscience agencies map the locations of primary ores.
Governance mechanisms

• Intergovernmental Forum on Mining, Minerals Metals and Sustainable Development
• UNEP International Resources Panel – Governance Working group can provide knowledge base
• United Nations Environmental Assembly could be a consensus forum to develop an international agreement on minerals
Questions for Discussion

• Effectiveness of PPP models and how geological surveys can be most effective? Learning from JOGMEC and KIGAM?

• Is IUGS and efforts like RFG adequate or do we need some international agreement for coordinating mineral supply research and planning?


• What can be the role of universities and training programs in this regard?