Addressing Mining and the environment in Africa through Innovations

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Africa is a new frontier for mining companies.

The continent’s geology hosts world-class mineral deposits.

Frost-Killian et al., 2016
Global exploration budgets by country (% share of global), 2017
(non-ferrous metals)

92 other countries and regional allocations account for 10.9%.
Innovation: What is it anyway?

Innovation:

“new ideas that add value”
Innovation: What is it anyway?

Innovation:

“is not a synonym for research and development or technology”

Innovation does not necessarily require either!
Innovation: What is it anyway?

R&D is not Innovation

**Research:** systematic investigation to solve a defined problem

**Development:** transformation of research into new products, methods or knowledge.

R&D is a possible pathway to innovation
Innovation: What is it anyway?

Technology is not innovation

Technology: tools and machines, developed via applied science and engineering, that can be used to do physical or knowledge work.

Innovation of concepts, processes, business models, interpretive methods are critical for us.
Innovation: What is it anyway?

Ontogeny of innovation

**Ideas**  
*(always the first step!)*

**investigation**  
*(could be formal R&D)*

**actualisation**  
*(could be technology)*
Innovation: What is it anyway?

Ideas are primary:

An excellent investigation and actualisation of a poor idea will not deliver value.
Innovation: What is it anyway?

Think outside the box!

... and other clichés.
Innovation: What is it anyway?

Uber

The innovation of Uber was to connect several apparently unrelated ‘boxes’.
Let’s talk about geoscience innovation and the value of integration
Geoscience Innovation

Why do we need to innovate in the geoscience?

Value = Societal impact

The mining ecosystem
Rapid advances in survey technology → collecting and analysing more data than ever before
Big Data

- Larger and more diverse data sets lead to both new challenges and opportunities as we endeavour to extract useful meaning from data.
- Integration and inversion of independent data sets
- Using machine learning and artificial intelligence

Source: Quantec Geo (2018)
High performance computing

Lengau cluster

Source: CSIR
Integrated 3D Common Earth Model

- Gravity, Magnetics, Conductivity, Acoustic Velocity, Geology, Geochemistry all in a single model and in “agreement” (or not)
- By making sure the model is coherent we can identify subtle anomalies and refine our geological models
- Machine learning – such as unsupervised clustering, supervised classification (e.g. assigning likely rock types) etc and 3-D GIS querying may provide critical insights that help us map geology
Re-mining of Old Tailings

- Most of the old tailings are economically viable for re-processing depending on the grades, costs, and metal prices;
- Advanced processing technologies are making it possible to process tailings at a lower costs and maximise the recovery;
- The resultant waste from re-processed tailings can be used to make concrete geopolymers that are usable in constructions (e.g., making pavement bricks);
  - Mortar Geopolymer can be used as covers and liners for slimes dams;
  - Mortar Geopolymer can be used as backfilling material in underground openings.

Manual hydraulic monitor on a tailings facility in South Africa (http://www.tailings.info)

Geopolymer synthesized using mine tailings at CGS
Treatment of Mine Water

Active treatments:

- Reverse-Osmosis (RO) treatment of mine water to drinking water quality;
- Engineered fibers for selective ion removal;
- Advances in membrane and ion-exchange technologies;
- Use of waste materials such as Fly Ash for treatment of mine water;
- Constructed wetlands;
- Options need to be selected to ensure net benefit to society.

Passive treatment:

- Plant design for extraction of metals from the mine water by using natural materials such as lime for neutralizing acidity in water;
- Through this process, depending on the size of the plant, the metals (precious and base metals) can be economically viable.
Next Generation Geoscience

Providing timely, fit-for-purpose geoscience to support value-based decision making.

Capture Data | Manage Data | Make Better Decisions

Capture geoscience data: How can we collect fit-for-purpose geoscience data at the right time to support:
- Better spatial understanding of value in minerals, water, environmental;
- Better strategic and tactical/operational decisions?

Manage geoscience Data: How can we develop internal and external capability to support:
- New and existing multi-discipline data streams;
- Integrated knowledge management systems; and
- Systems engineering approaches and workflows?

Make Better Decisions: How can we develop human and machine learning capabilities to support:
- Timely and optimised value-based decisions;
- Improve operational practices in planning and project execution
Next Generation Geoscience

1. The amount of data generated in two days is as much as all data generated in human history before 2003

2. The big data analytics and services industry is worth $3 billion and expected to hit $20 billion in next 5 years

3. Improved use of data could generate $3 trillion in additional value each year in 7 industries

4. Data is a resource, much like water or energy, and like any resource, data does nothing on its own. Rather, it is world-changing in how it is employed in human decision making.

Source: US Chamber of Commerce (2014)
Summary

1. Innovation starts with ideas

2. Divergent thinking is the source of the biggest breakthroughs. Connect the seemingly disconnected boxes. Uberise ourselves!!

3. Data, big data, does not necessarily mean collecting new data

4. Data integration = Common Earth Model

5. Think societal value

6. Applications of geoscience are vast and constitute the basis for developmental decision making
   a) Exploration
   b) Mining
   c) AMREC-PARC competence in quantification of resources
   d) Environmental stewardship
   e) Social impact
   f) Value addition and industrialisation
   g) Policy and legislative prerogative
   h) Development
THANK YOU

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