

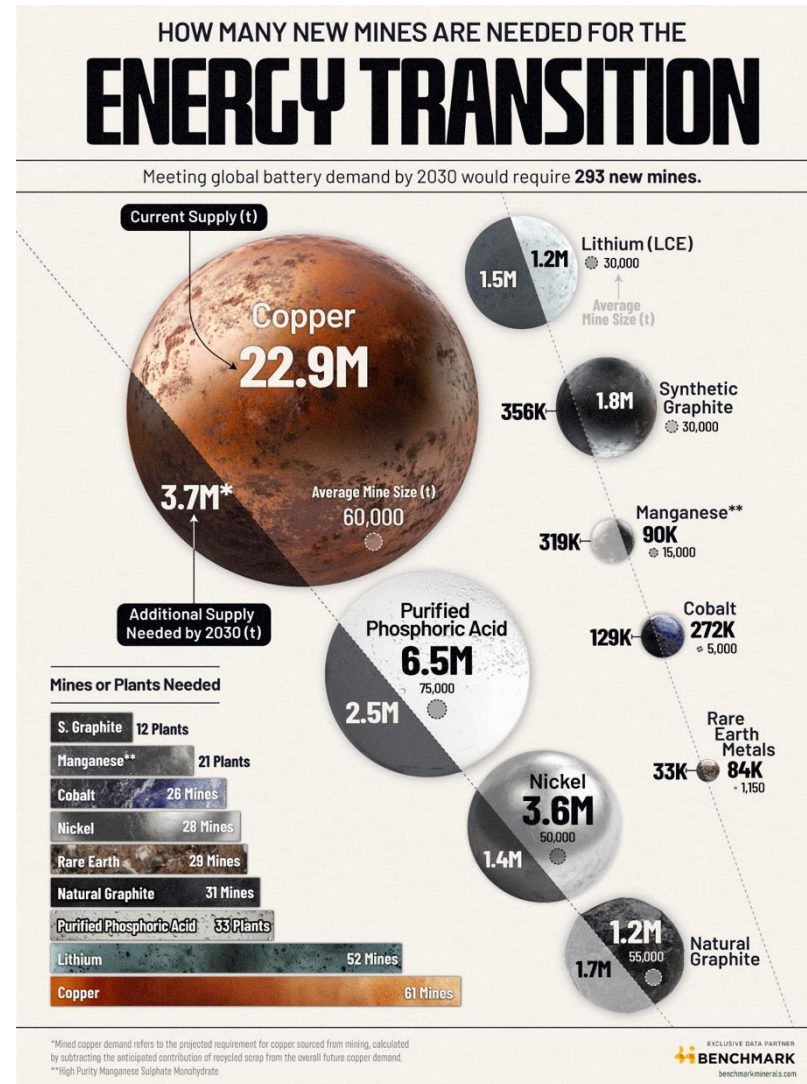
Quantum + AI: seeing, deciding and acting across the critical materials supply chain

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for
Dr Cathy Foley
Australia's Former Chief Scientist
President
Academy of Technological Sciences and Engineering (ATSE)

4 September 2026

The materials challenge is now a knowledge challenge

293
new mines by
2030

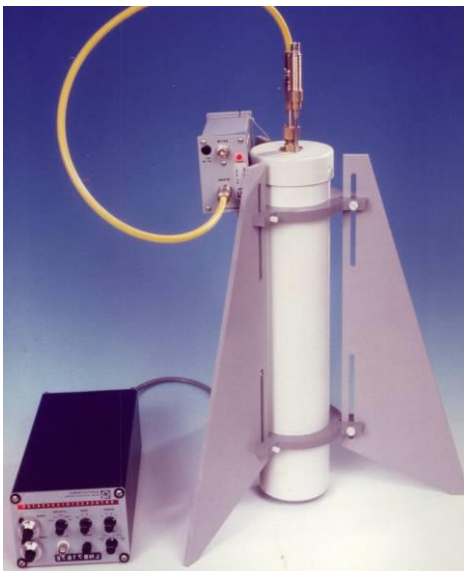


- What is in the ore body?
- How to move less rock?
- How to use less energy and water?
- How to process only what is worth processing?
- Provenance, environmental footprint and circular pathway?

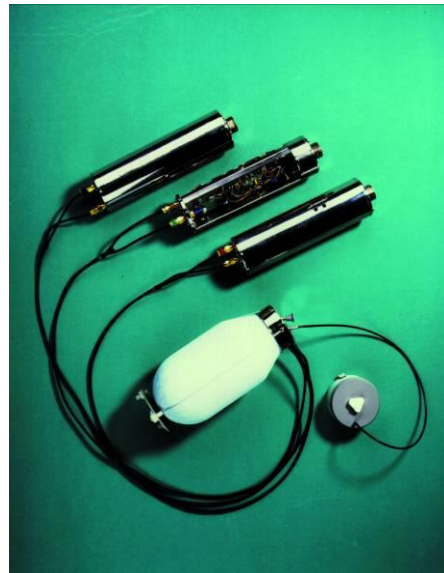


A personal example: quantum in mining is not science fiction

1992-1993
First HTS Ground-
based TEM system
BHPB



1994-1997
“Airborne System”
BHPB



1999-2001
Prototype unit
Falconbridge/Crone

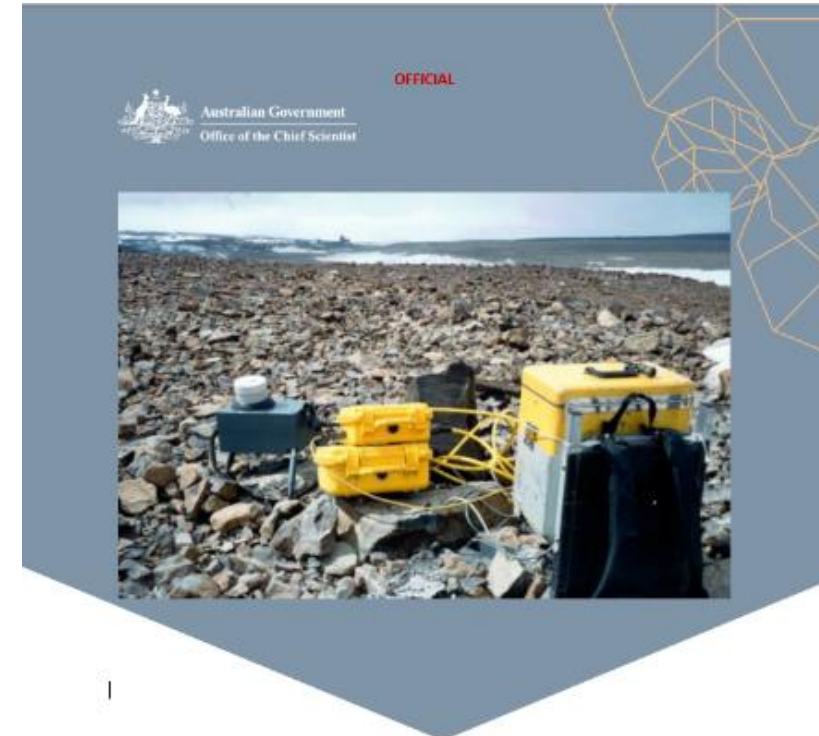


2002-2004
LANDTEM™
Outer-Rim Exploration Services



The Quantum Meets Resources lesson

- Subsurface imaging
- Positioning and navigation
- Geochemistry and ore characterisation
- Logistics and optimisation
- Modelling



Quantum Meets Resources

Outcomes report

chiefscientist.gov.au

In partnership with:



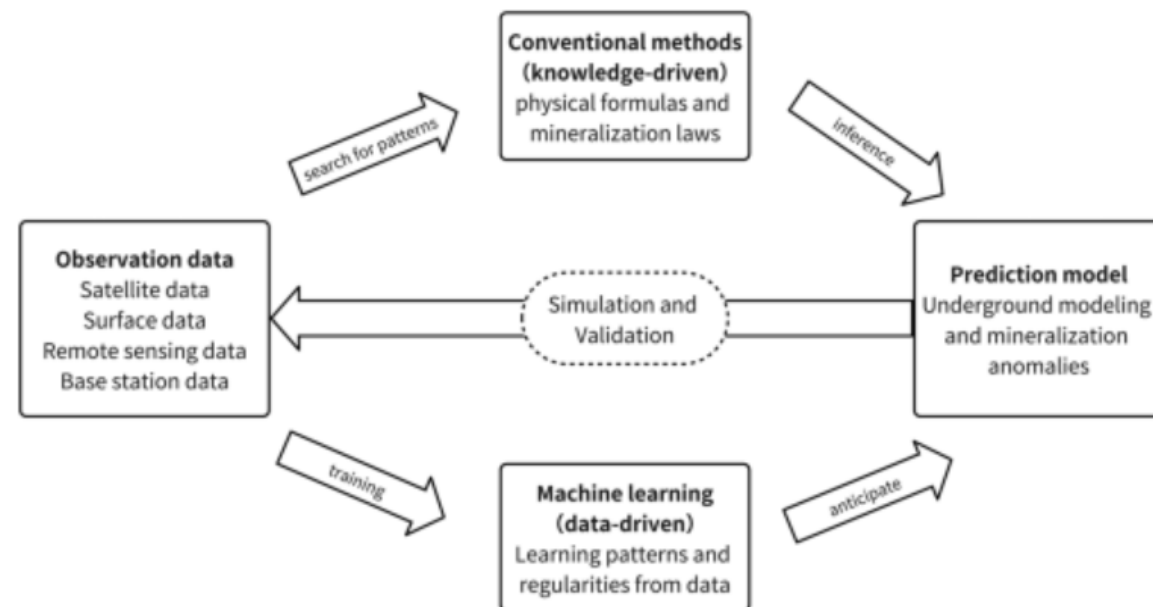
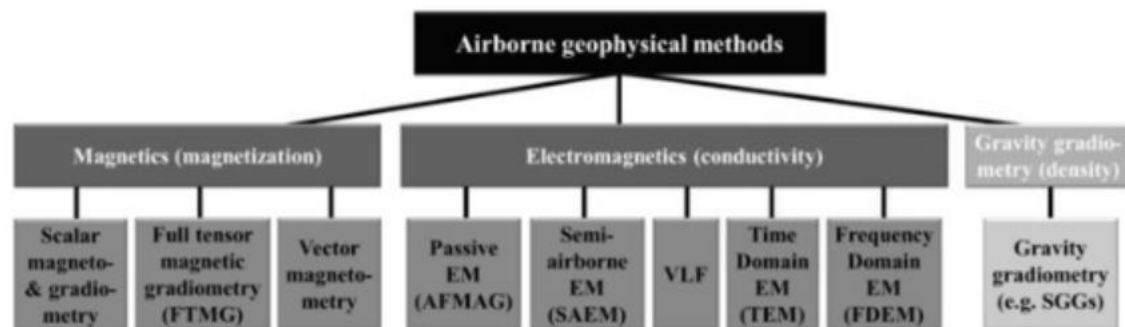
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The AI + quantum stack

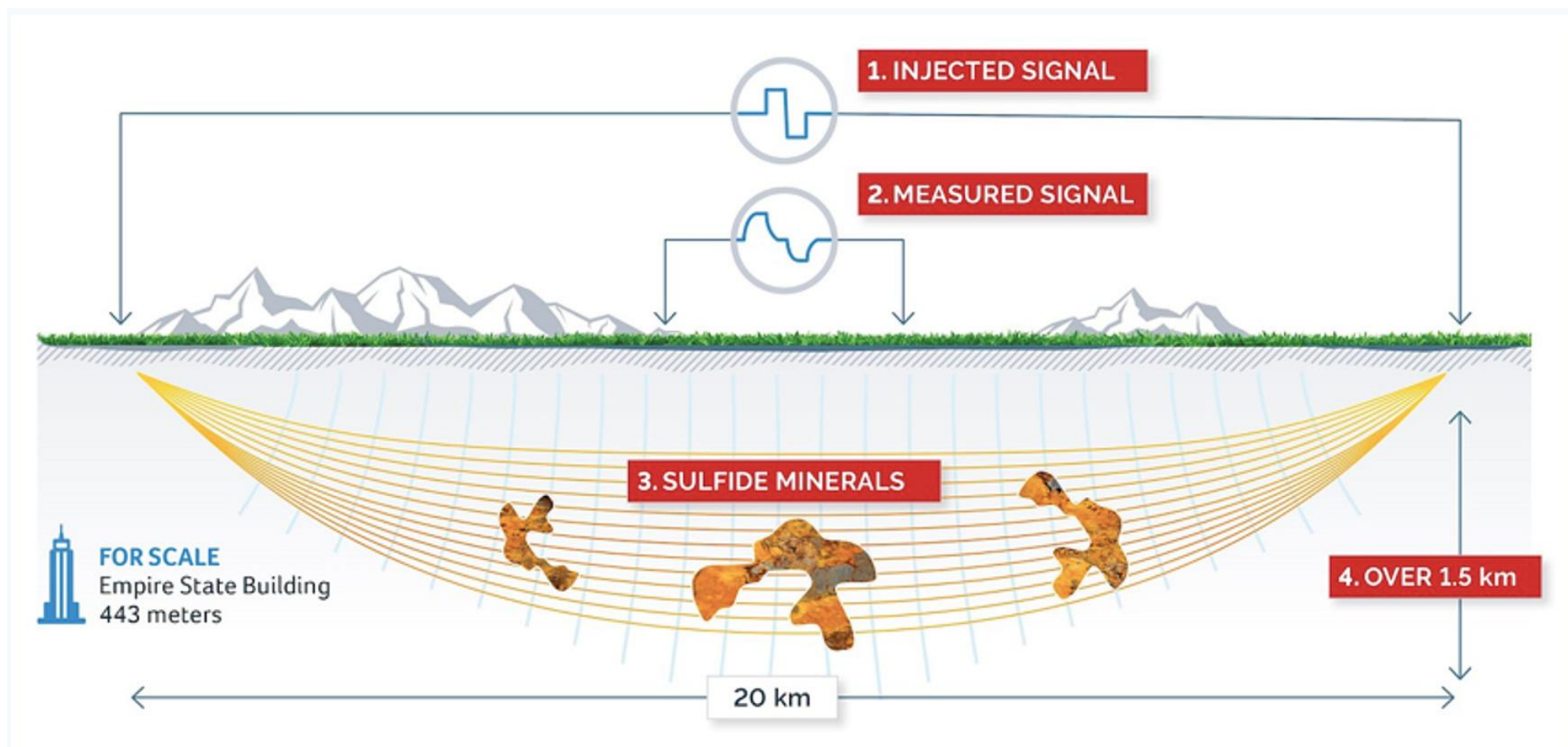
Measurement

AI and machine learning

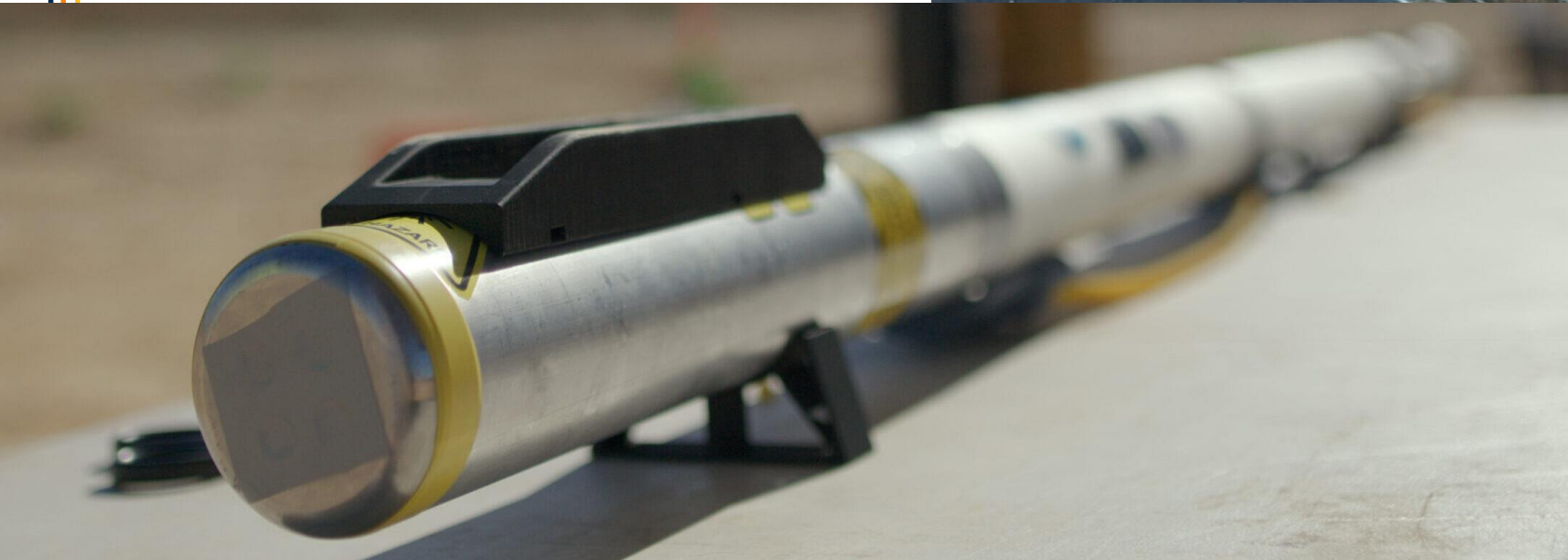
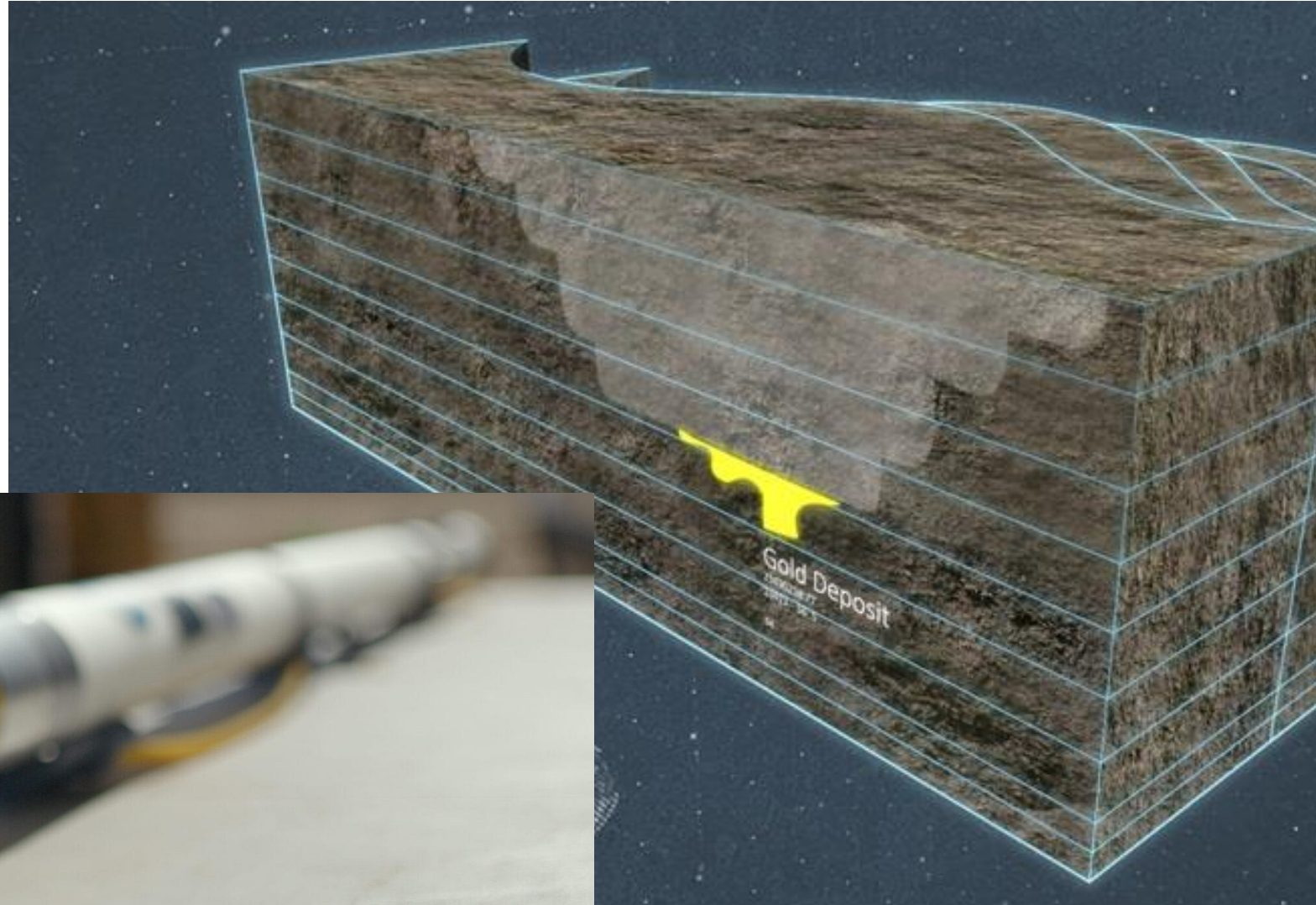
Action



Exploration:
mineral exploration needs to detect minerals
using tools that from “drill to define” to “drill to
verify”



Downhole sensing and real-time decision-making



KPIs: where quantum + AI creates volume and cost value

VOLUME

- Fewer holes/metre drilled per validated target
- Fewer tonnes moved and sent to comminution
- 5.5% throughput uplift in drill-and-blast optimisation example
- More data per drill hole through downhole and real-time sensing

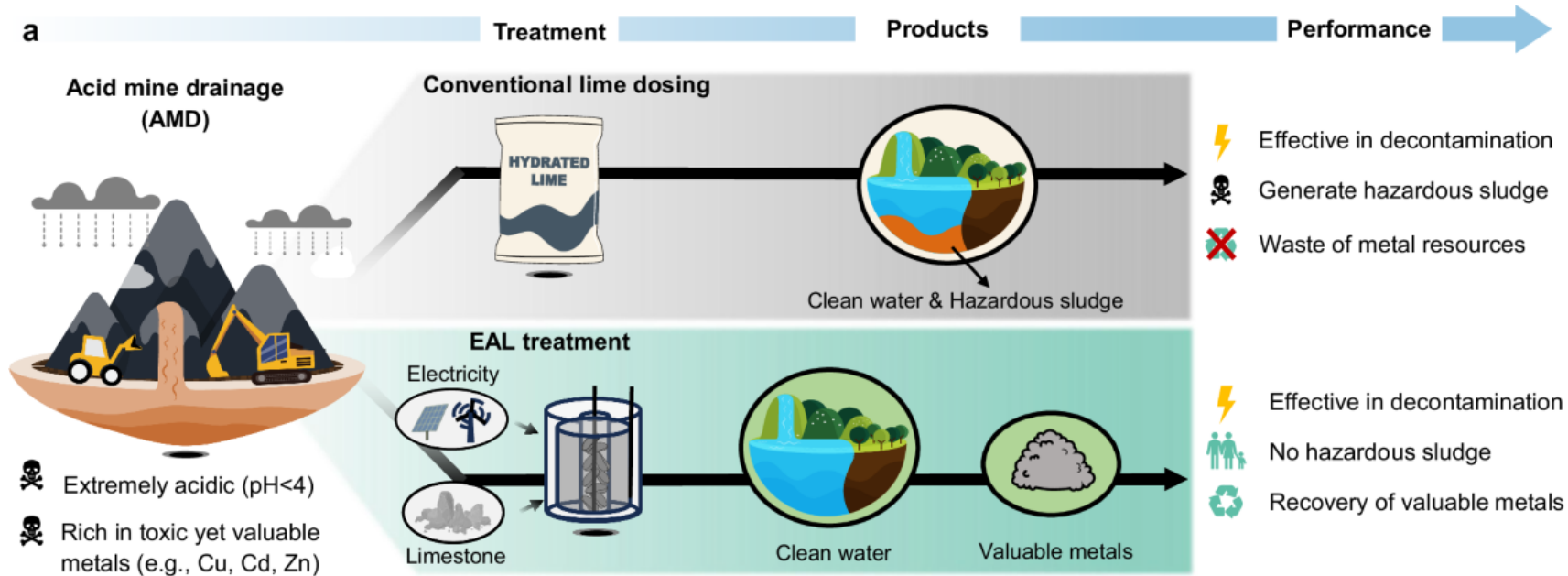
Sources: Quantum Meets Resources summary; CSIRO LANDTEM case study; Deloitte/PETRA example; CEEC/Metso comminution figures; MarketsandMarkets and other market forecasts

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COST

- >\$450M annual benefit reported from optimising one WA iron-ore drill-and-blast operation
- Quantum sensors reported to reduce exploration costs by nearly one third
- Comminution consumes ~3–4% of global electricity and can exceed half of mine energy use
- Quantum sensors market signal: ~\$260–300M in 2022/23, growing ~14–17% CAGR in published forecasts

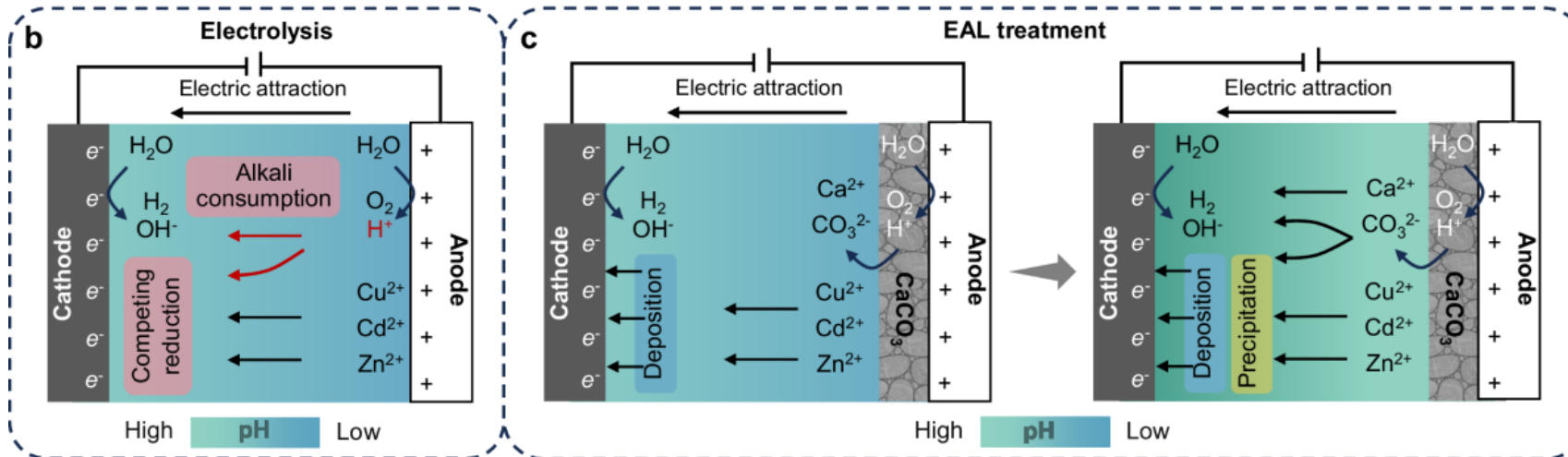
Processing: characterise early, move less rock



Energy KPI

Comminutions:

- 3-4% of global electricity
- >50% of mine energy use



Mine operations: navigation, autonomy and safety



Quantum computing: the hard problems behind the decisions

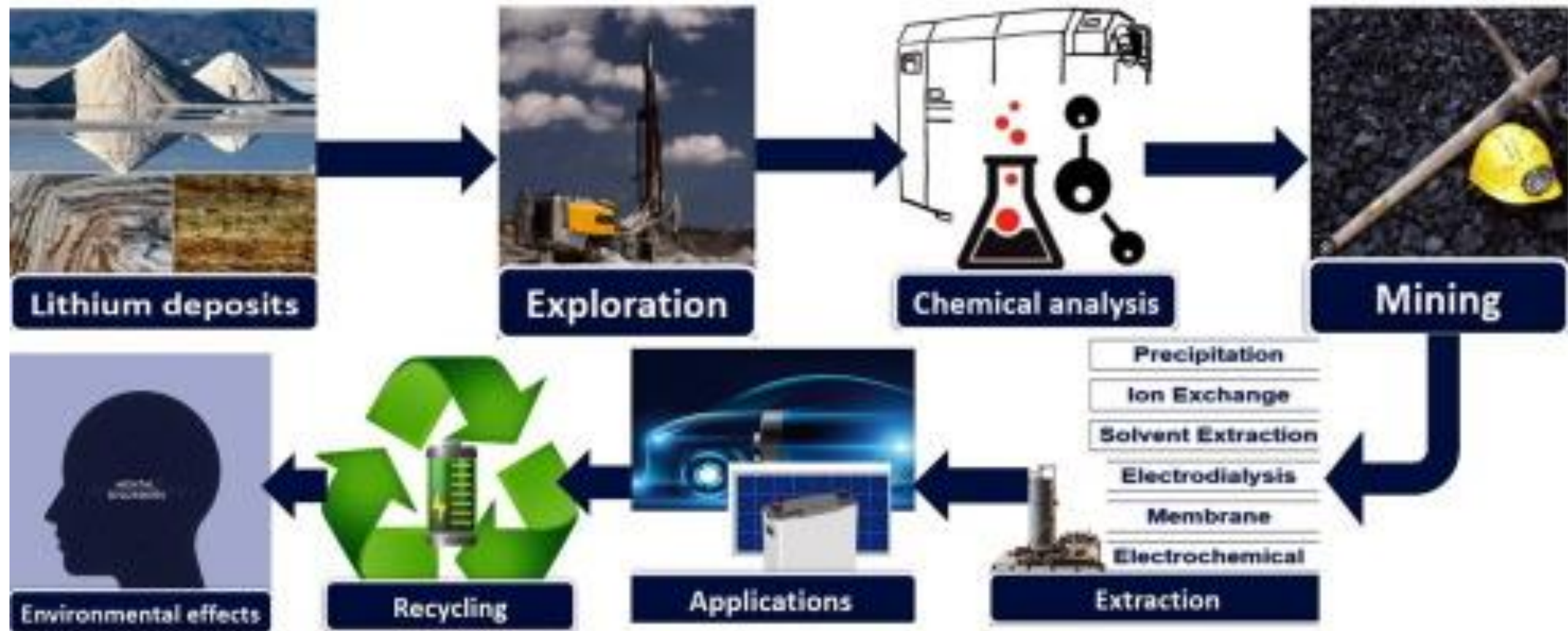
- Where are the hard optimisation and modelling bottlenecks where even a small improvement creates large value?
 - Inverse Problem
 - Optimisation

Cost KPI

>\$450M p.a. benefit from one optimisation example



Traceability, circularity and responsible innovation



Closing: the competitive edge is in combining capabilities

- The edge is not AI alone or quantum alone
- From combining four things:
 - deep domain expertise in geology and mining
 - advanced sensing
 - AI and machine learning
 - New computational approaches, including quantum
- Shift the KPIs: more data → better decisions

Thank you