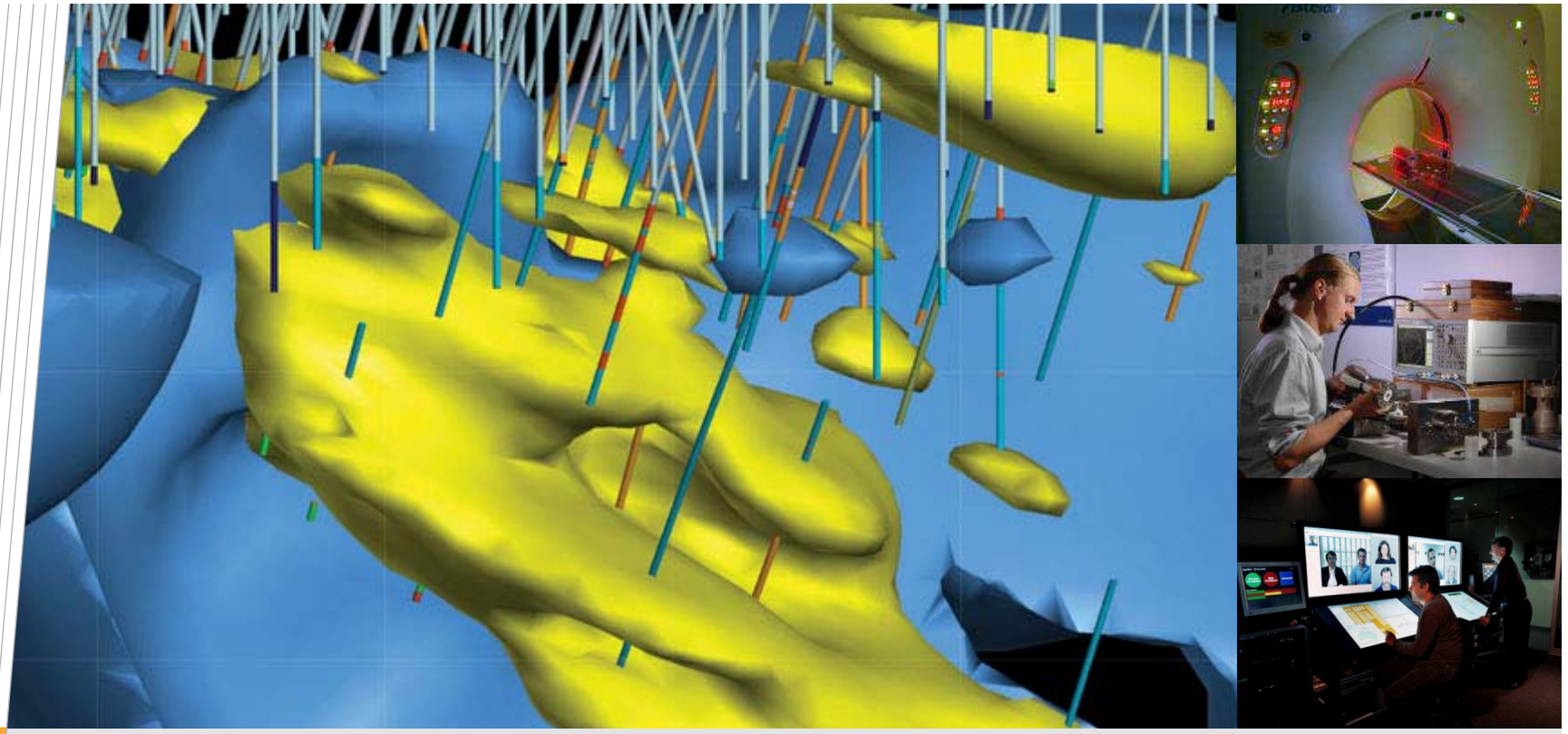


Inquiry into greenfields mineral exploration and project development in Victoria:
an R&D perspective

Jonathan Law
Director
Minerals Down Under National Research Flagship

National Research FLAGSHIPS
Minerals Down Under

CSIRO

www.csiro.au

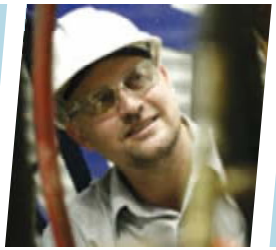
National Research Flagships

Climate Adaptation

Future Manufacturing

Sustainable Agriculture

Energy Transformed



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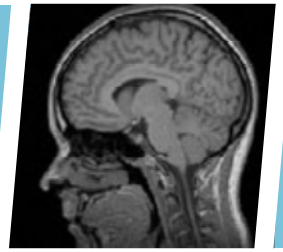
Water for a Healthy Country

Food Futures



Preventative Health

Wealth from Oceans

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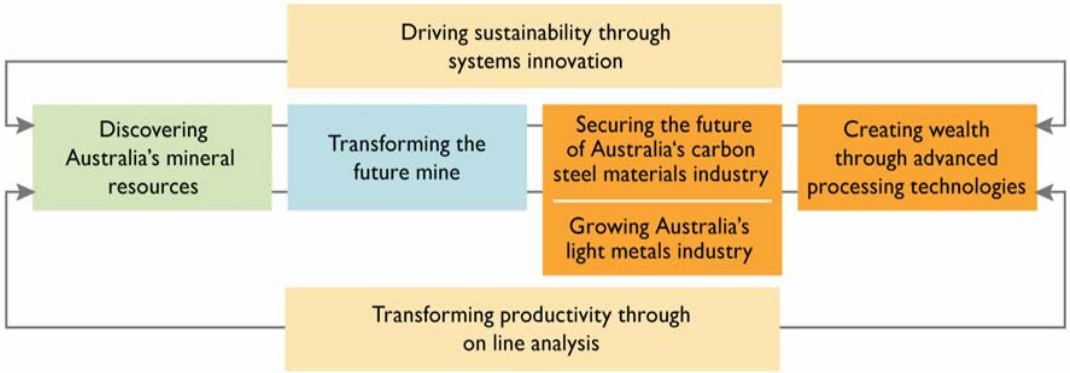
Minerals Down Under is a partnership

Assisting the minerals industry to exploit new resources with an *in situ* value of $1 trillion by 2030.
More than doubling the size of the associated services and technology sector by 2015.



Earth Science and Resource Engineering
- Computational Geoscience
- Mineral & Environmental Sensing
- Mining Automation
- Mining Geoscience
- Mining Systems
- Ore Systems Science
- Petroleum Engineering
- Petroleum Geoscience
- Regolith Geoscience

ICT Centre
- Autonomous Systems
- Networking Technologies
- Wireless technologies

Land and Water
- Environmental Chemistry & Ecotoxicology
- Urban & Industrial Water

Process Science and Engineering
- Fluids Process Modelling
- High-Temperature Processing
- Hydrometallurgy
- Materials Characterisation
- Mineral Processing & Agglomeration
- On-Line Analysis and Control
- Process Engineering

Materials Science and Engineering
- Fluid Dynamics
- Materials Performance

Mathematics, Informatics and Statistics
- Computational Mathematics
- Modelling & Inference

Ecosystem Sciences
- Social & Economic Science
- Terrestrial Biodiversity & Ecology

285 staff
$84 M/a budget
(incl. co-investment from partners)

Integrates CSIROs domain expertise for minerals

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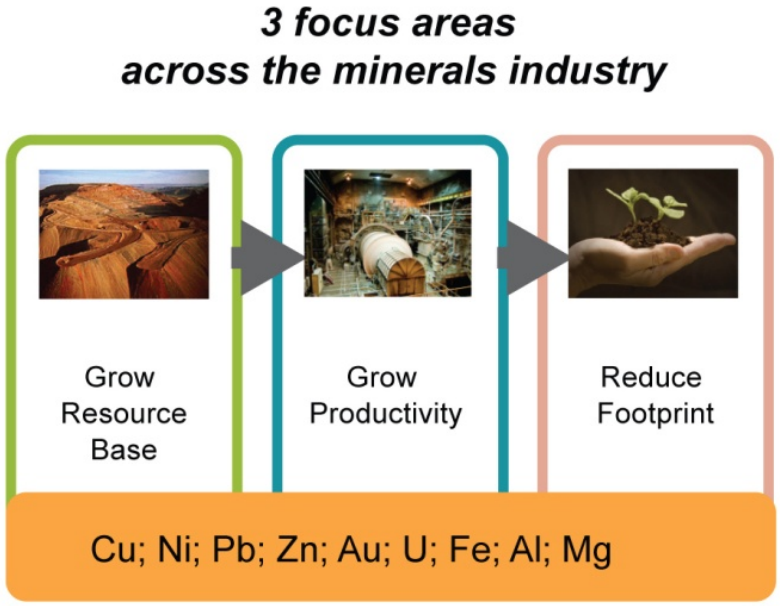
Some facts about Minerals Down Under

- Focus on minerals (including uranium)
  - Excludes C-energy, geothermal and sequestration
- Long term national benefit
- A national partnership with international links:
  - industry; government and academia
- Triple bottom line approach
  - Critical to business; critical to policy



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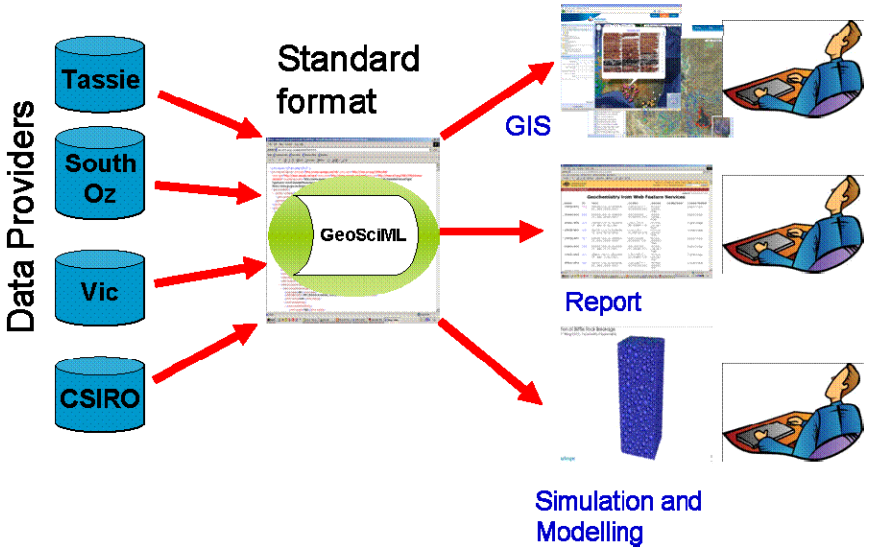
Our exploration research

- Development of National Data Infrastructure and Data Integration
- New Detection Tools for Exploration
- Mineral Systems Research
- Education, technology transfer and collaboration



Delivered with AuScope

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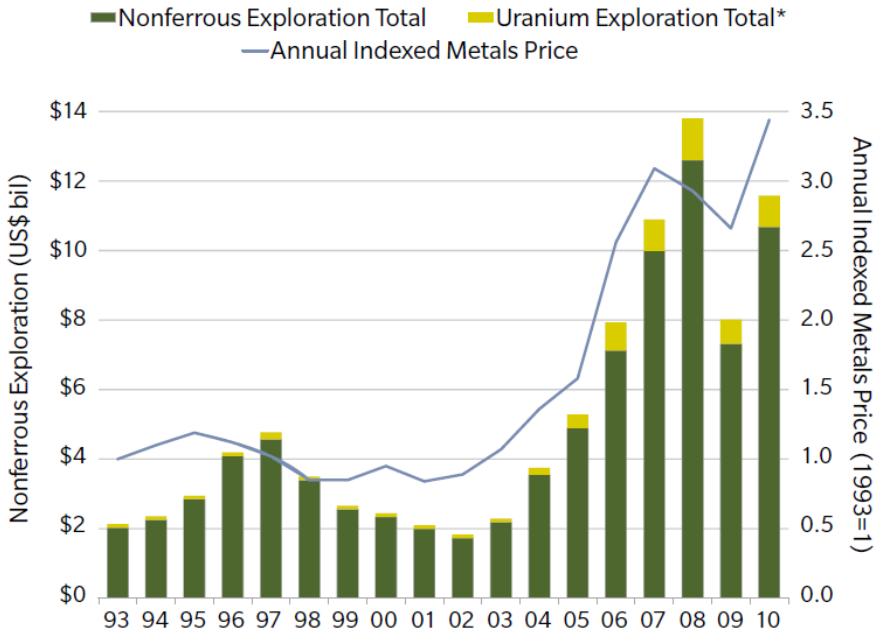
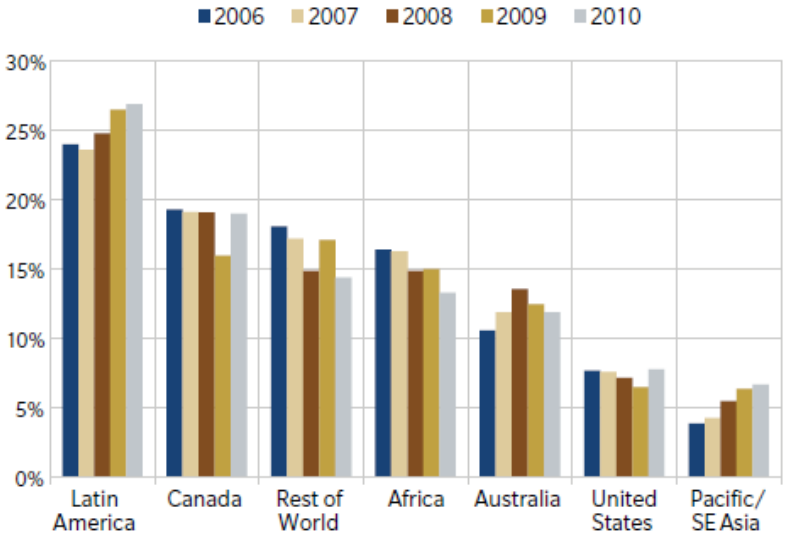
A global issue

- Declining discovery rates
- Declining greenfields share of exploration
  - 2000: ~50 % of global exploration
  - 2010: ~33 % of global exploration
- In 2011 MEG expect:
  - 50% of global exploration on gold
  - Nonferrous exploration budgets will exceed US$17 billion
  - An increase of about 50% from the 2010 total
  - A new all time high
  - Changing attitudes to risk
- Competitive investment climate





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A) Victorian mineral endowment / prospectivity

National Challenges for Australian Exploration

ISSUE	STATUS
• Perception of prospectivity	• Mature and challenging
• Transported cover	• >60% of continent “hidden”
• Depth	• 70% Au <50m (1950-2009)
• Declining greenfields	• 50% in 1999; 33% in 2010
• Global success rate	• Global performance slipping

Risk …. Declining exploration investment and production

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National Challenges for Australia: Opportunity

ISSUE	POTENTIAL OPPORTUNITY
• Perception of prospectivity	• Opportunity for investment $
• Transported cover	• New search space – g/field
• Depth	• New search space – g & b/field
• Declining greenfields	• New mining districts
• Competitive success rate	• Revival of interest – new $

International competition is as strong as commercial competition

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Non technical challenges to greenfield exploration

- Perception is everything
  - Positive success stories
  - ‘elephant’ country
- Consolidated land packages
  - “option on the haystack”
- Public understanding of exploration risk-reward
  - Exploration success rates
  - Need certainty to proceed; but low probability of development!

Resource discovery partnership

National surveys / GA

Explorers

Innovation & education

Exploration: a knowledge business

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Playing to our strengths

- Commodity mix
  - Antimony #1 global supply risk
  - Australian control:
    - Lithium (5.5 risk index)
    - Zirconium (4.5)
    - Aluminium (3.5)
    - Titanium (2.5)
- State Survey: knowledge bank
  - Global reputation
- Scientific infrastructure
  - Universities
  - CSIRO and MDU
  - Synchrotron…

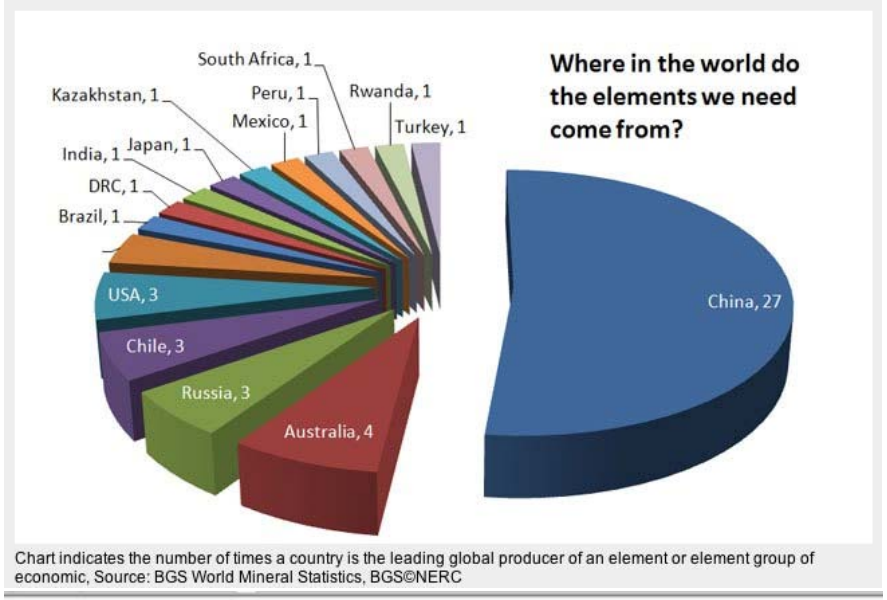

Chart indicates the number of times a country is the leading global producer of an element or element group of economic, Source: BGS World Mineral Statistics, BGS©NERC

British Geological Survey

Risk list 2011 — Current supply risk index for chemical elements or element groups which are of economic value

Element or element group	Symbol	Relative supply risk index	Leading producer
antimony	Sb	8.5	China
platinum group elements	PGE	8.5	South Africa
mercury	Hg	8.5	China
tungsten	W	8.5	China
rare earth elements	REE	8.0	China
niobium	Nb	8.0	Brazil
strontium	Sr	7.5	China
bismuth	Bi	7.0	China
thorium	Th	7.0	India
bromine	Br	7.0	USA
carbon (graphite)	C	7.0	China

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Broader industry challenges

- Increased volatility; growing demand
- Declining grade; greater complexity
- Competing land use
- Skills shortage
- Water and energy
- Emissions and waste
- Automation
- Safety
- Regional sustainability
- Public opinion and the ‘two-speed’ economy

- All an opportunity to lead!

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E) Success and failure of projects in Victoria's mining development pipeline

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Geology versus investment strategies

- Global trend to large low-grade deposits
  - High capital costs
  - Resource certainty critical
    - Nuggetty gold in many Victorian gold deposits
    - Depth and cost of drill-out for complex vein geometries
    - High profile failures
- Victorian urbanisation reflects historical gold production centres
  - Leads to land use tension

F) Approaches in other jurisdictions to foster increased investment in Greenfields exploration

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Focus on the unique potential of Victoria

- Important State initiatives
  - Rediscover Victoria (including drilling co-investment)
  - Gold undercover (ended 1999)
- Endowment is fixed but unknown
  - “Exploration technology packages”
  - Tools + data + knowledge focussed on specific terrane
- Design state strategy to build on key strengths
  - Geological differentiation
  - Human capital
  - Socio-political infrastructure
  - Natural partnerships (state; industry; innovation)

G) Roles of government

Open for business in minerals

- Use it or loose it
  - Hard to rebuild
- Geological survey
  - Strong track record
  - Precompetitive ‘data to knowledge’
  - The engine room to attract investment
- Invest for success
  - Exploration incentive schemes very successful in Australia
- Innovation links – some examples
  - Airborne mapping with PIRSA
  - Groundwater surveys with GSWA
  - Uranium minerals system studies with various state surveys

H) Opportunities to increase the net benefits from Victoria's mineral resources

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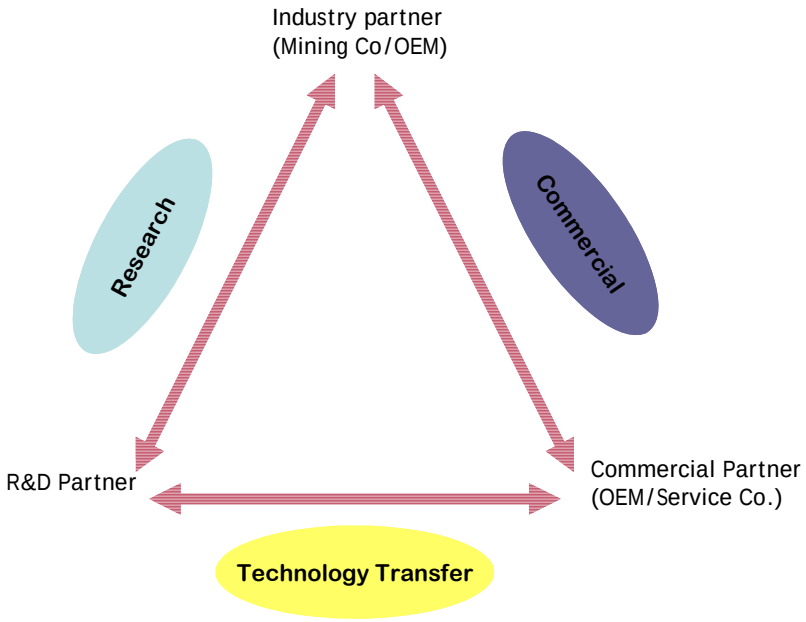
Sustainability is key

- Broad distribution of benefits
  - A sustainable vision
  - We should understand our states geology:
    - Minerals and energy resources
    - Geo-sequestration and geothermal resources
    - Geo-hazards
  - Integrate mining with the broader economy

How does Victoria fit?



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