AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

HiSeis: see your Earth more clearly: Mr Damien Kenworthy, HiSeis Pty Ltd

Explore SA: The Gawler Challenge: The Hon. Dan van Holst Pellekaan MP, Minister for Energy and Mining, South Australia

Ensuring your downhole data is future-proofed for incorporation in machine learning algorithms: Dr Shawn Collins, Wireline Services Group

MinEx CRC: improving exploration methods through research collaboration: Dr David Giles, MinEx CRC

Using A.I. to classify lithology: navigating through the propaganda to indentify opportunities in your image data: Ms Sam Scher, Corescan

The world's best pre-competitive data: Dr Richard Blewett, Geoscience Australia

Resource stewardship for a high-tech future: Mr Michael Wright, NSW Department of Planning, Industry and Environment

HiSeis

SEE YOUR EARTH MORE CLEARLY

03/03/2020

TOP

Evolution of HiSeis

RESOURCES

Seismic

- **Fundamental** technique for O&G
- High **resolution**
- Great **depth** of penetration

Innovation & Funding$_{2006}$

- Curtin project to **solve** seismic problems
- Financial **support** from WA government

Success

- Educate the **benefits** & results
- **Success** around the world

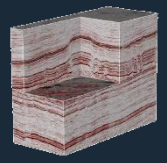
Multi-client$_{2018}$

- **Proven** model from O&G
- **Ready** to take to minerals industry

Why not minerals?

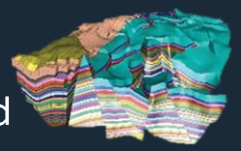
OIL & GAS:

- **Simple** geology
- Proven success



MINERALS:

- **Complex** geology
- Innovation required



HiSeis$_{2009}$

- Curtin **research** IP commercialization
- **Integrated** service: design to interpretation

Curtin University

Investment$_{2018}$

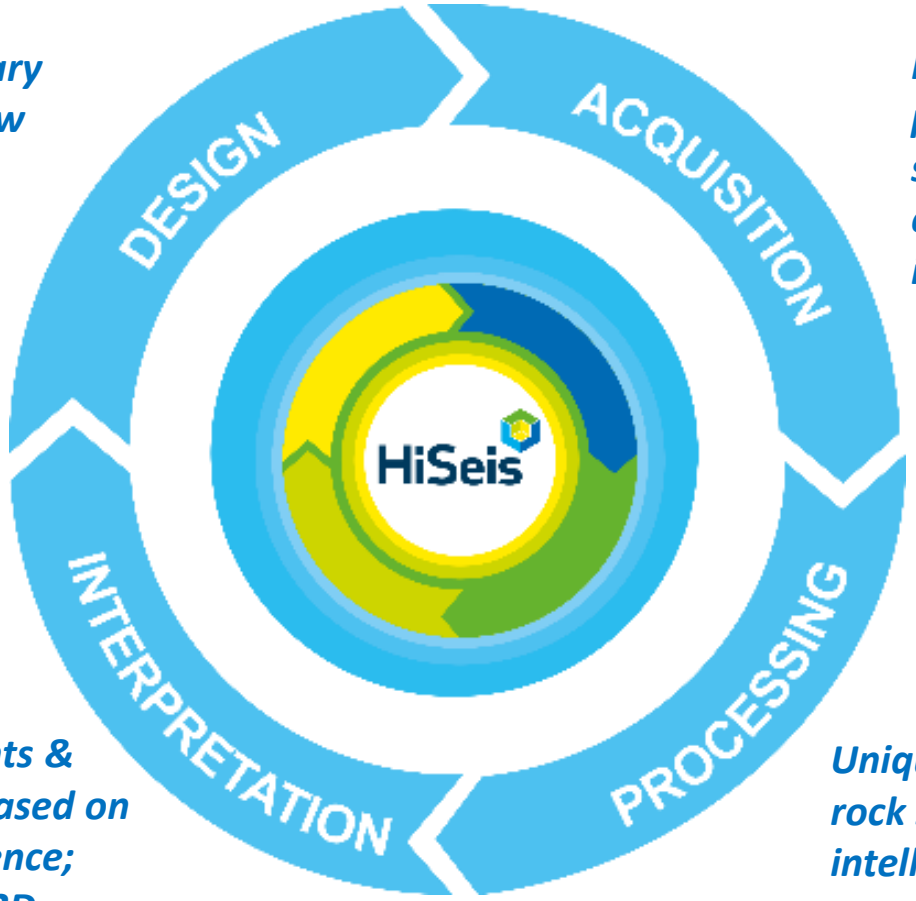
- New **investment** from the mining industry
- Curtin remains as a significant shareholder

AUSDRILL

HiSeis Business Model

Proprietary know how

Novel robust portable sources; small crews; low environmental impact



Enhancements & know how based on deep experience; proprietary 3D seismic modelling

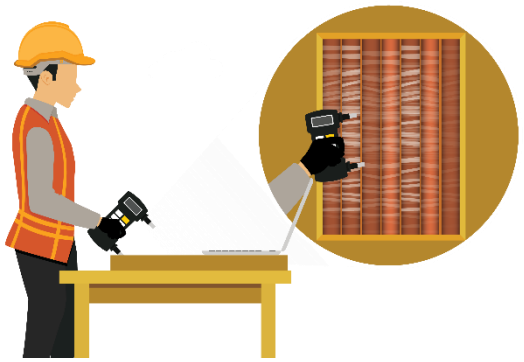
Unique algorithms; hard-rock seismic processing intellectual property from over $30m in R&D

- HiSeis is a **geology "problem solver"** not a seismic data acquisition contractor.
- Provide full turnkey solution.
- Integrated service offering & methodology that focuses on optimising all key areas of seismic surveying.
- HiSeis **Seismic De-risking Process reduces technical & commercial risk** associated with the application of modern seismic to mining problems.

HiSeis De-risks Every Seismic Program

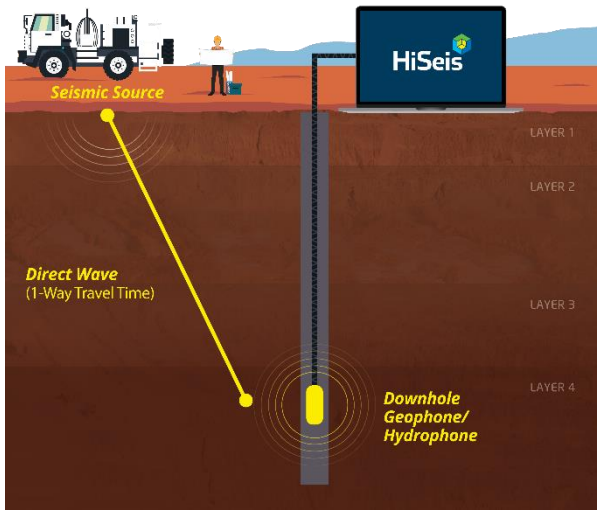
Investigate

Seismic Response - rock properties and synthetic modelling



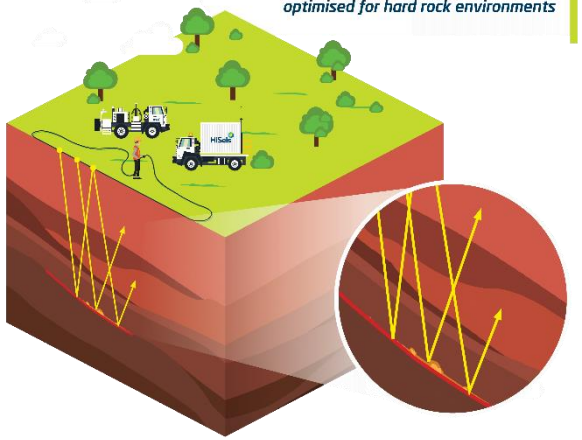
Optimise

2D & down hole seismic processing, interpretation



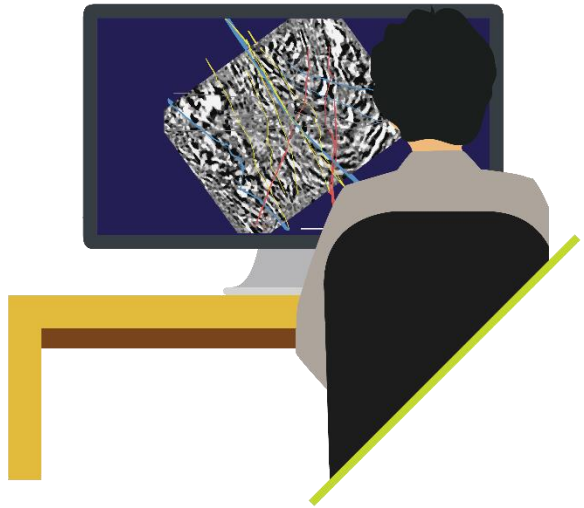
Acquisition

2D & 3D design and data acquisition optimised for hard rock environments



Visualise

Renewed geological understanding, target generation. 3D high resolution imaging and interpretation

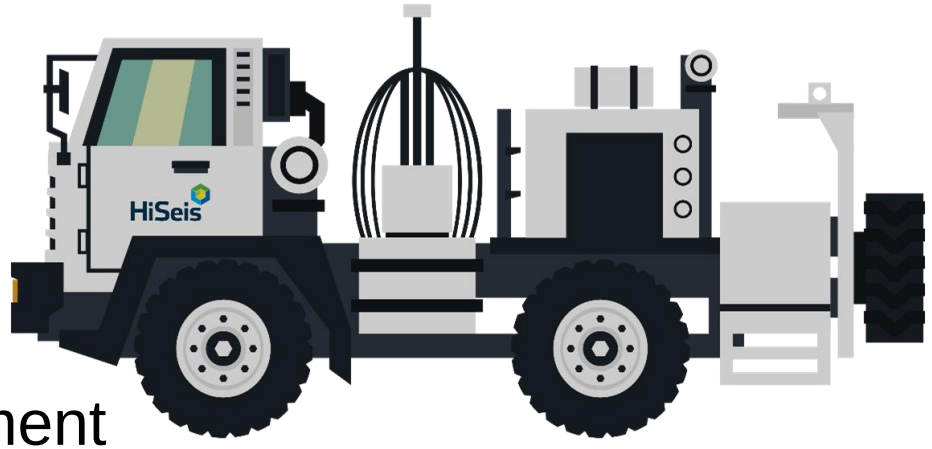


HiSeis Minerals Seismic Experience

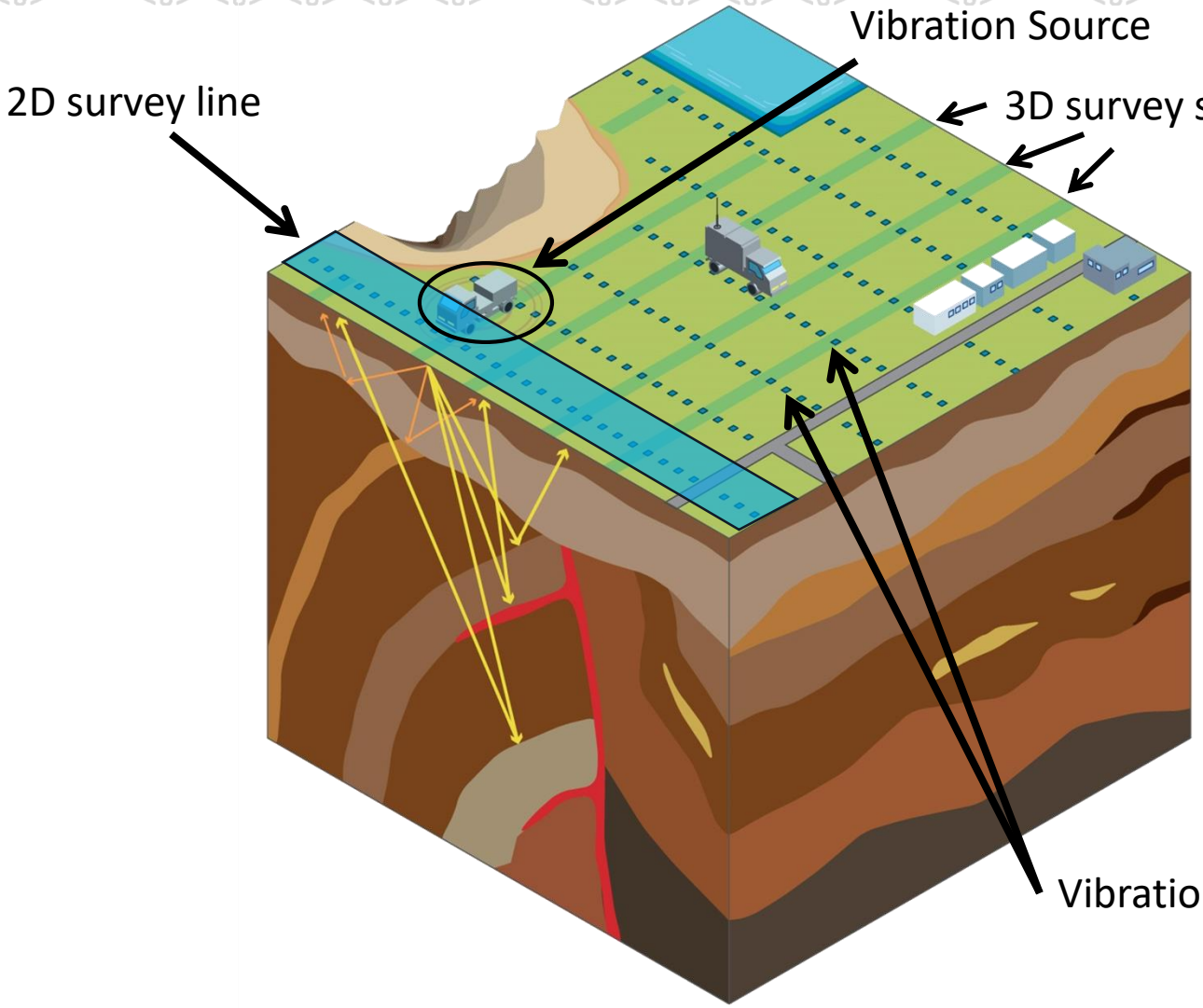
HiSeis has completed over 80 x 2D and 3D minerals seismic surveys globally… for the precious metals, industrial metals, bulk commodity & battery metal industries.

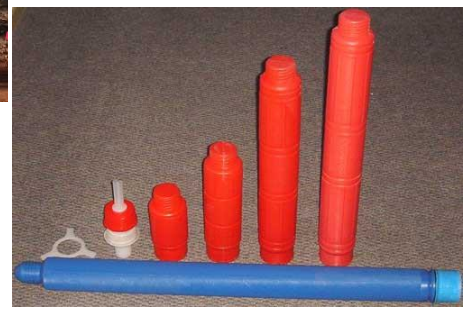
Why Seismic

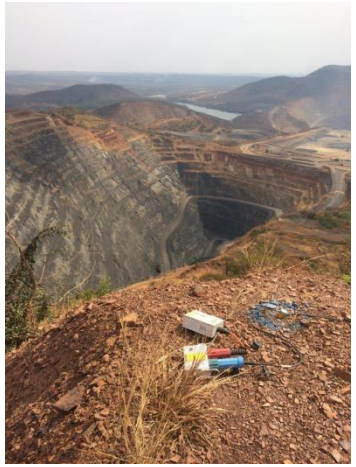
- Can investigate to large depths
- High resolution & maintains resolution at depth
- Faster screening around initial discovery
- Better conceptual understanding of geology and mineralisation:
  - Drill target generation
  - Optimise infrastructure capacity and placement
  - More cost effective brownfields exploration
  - Basement & regional architecture for greenfields
- Improved mapping of structures for mine planning and safety
- Continuous mapping of rock moduli to assist blasting and processing
- Sensitivity, resolution, depth of penetration >> gravity, magnetics, EM, IP



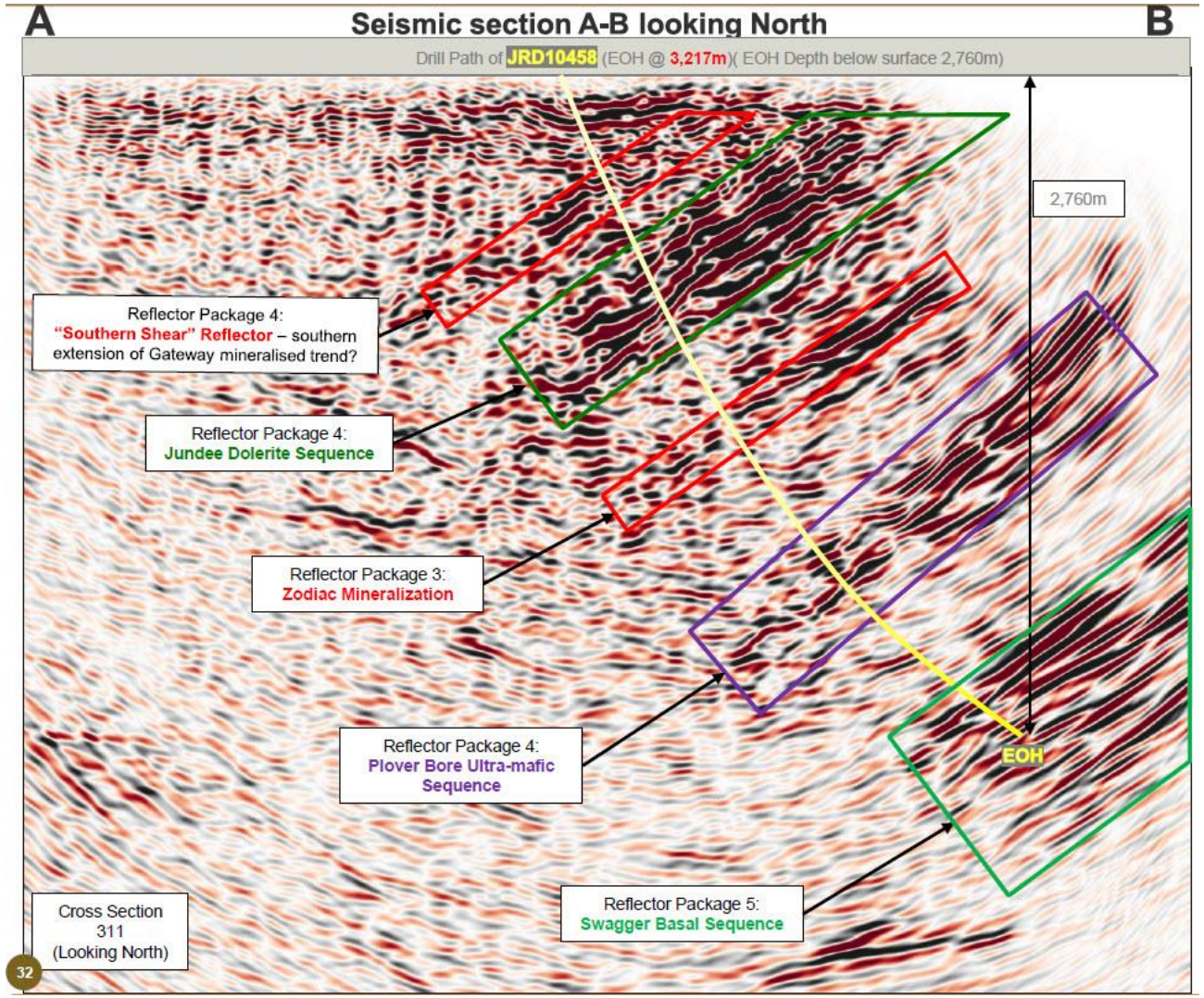
Survey Layout







Northern Star – Jundee Gold Mine, Western Australia



Northern Star announced the Zodiac discovery of a HiSeis 3D Seismic Survey in August 2017.

NSR ASX announcement
5 August 2017

Northern Star drilled one of the deepest holes in Australian gold history; this hole targeted two additional seismic reflectors below Zodiac, which has already returned grades up to 765gpt. Final drill hole length was +3,200m.

NSR ASX announcement
20 February 2018

Summary

- Resolution orders magnitude better than conventional geophysical techniques
- Potential to map structures and geologic complexity to depths > 2km
- Potential to compress timeframe and cost of discovery
- Seismic is a viable exploration tool, imaging the space between drill holes

Drill deeper with confidence, fast track discovery and grow resources!

“The information seismic surveying give us is unparalleled technically in my view, let alone providing, on a bang-for-buck cost basis, a very, very good data set for the money that you spend”

“With the first drill hole into the 3D seismic data set we made a new discovery - the very first hole - and we've now drilled eight holes into it and we haven't missed it in a single hole”

Miningnews.net 24 Aug 17, Bill Beament (Exec Chairman - Northern Star).

HiSeis

THANK YOU

hiseis.com

GAWLER CHALLENGE

JOURNEY TO DISCOVERY WITH DATA

2 MARCH – 31 JULY 2020

+ A$250,000 PRIZE POOL

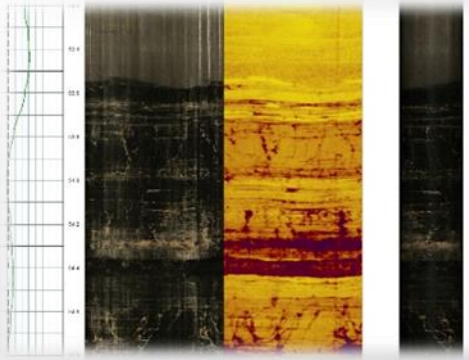
+ RECOGNITION FOR WHAT YOU FIND

+ JOIN AN EPIC GLOBAL CHALLENGE

ENTER NOW: **energymining.sa.gov.au/exploresa**

A Government of South Australia initiative in partnership with Unearthed

TOP



WIRELINE SERVICES GROUP | THE DRILLHOLE DATA EXPERTS

Ensuring your downhole data is future-proofed for incorporation into machine learning algorithms

Shawn Collins, Ph.D., P.Geo. – General Manager Canada

Phil Hawke, Ph.D. – Chief Geophysicist

March 2020

TOP

Outline

- Introduction
- What is AI
- Data for machine learning “the training set”
- Borehole data examples
- Conclusion

Who we are – Core Values & Behaviour

Our Core Values and Behaviour guide our direction and everyday actions.

Behaviours

- ✓ Respect
- ✓ Clarity
- ✓ Accountability
- ✓ Collaboration
- ✓ Courage
- ✓ Passion
- ✓ Innovation
- ✓ Fun

Core Values

What is Artificial Intelligence?

"A broad area of computer science that makes machines seem like they have human intelligence"

- Narrow AI (NAI) – Programmed to perform a single task
- Artificial General Intelligence (AGI) – Machines that exhibit human intelligence
- Artificial Superintelligence (ASI) – Machines are more capable than humans

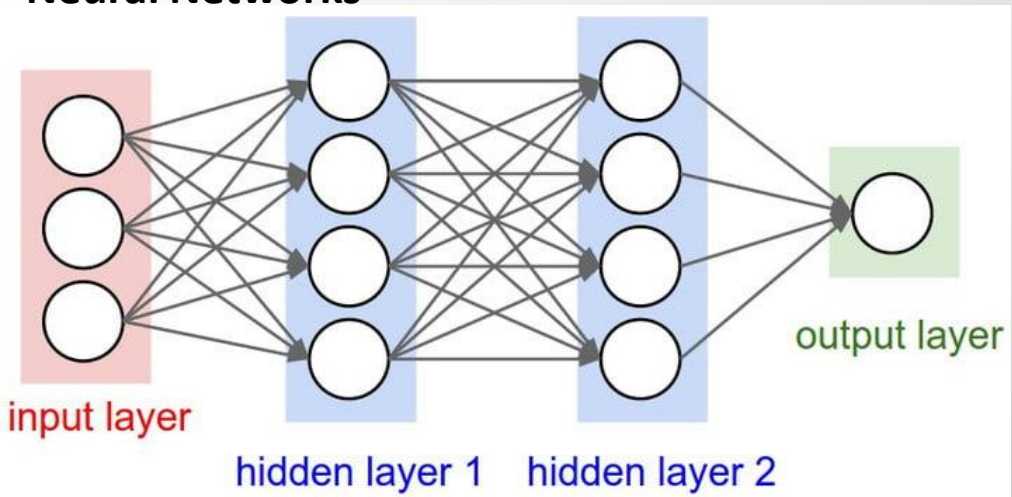
Narrow AI is where we are at currently

How do we accomplish the goal of NAI?

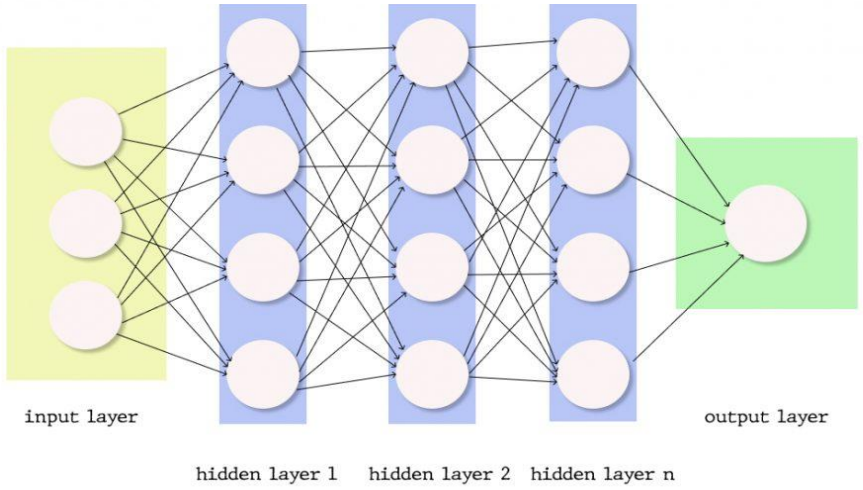
Depends on when you asked the question!

- Neural Networks
- Machine Learning
- Deep Learning

Neural Networks



Deep Learning



NAI – Accomplished with the use of Machine Learning

Things to consider for NAI –ML to be successful:

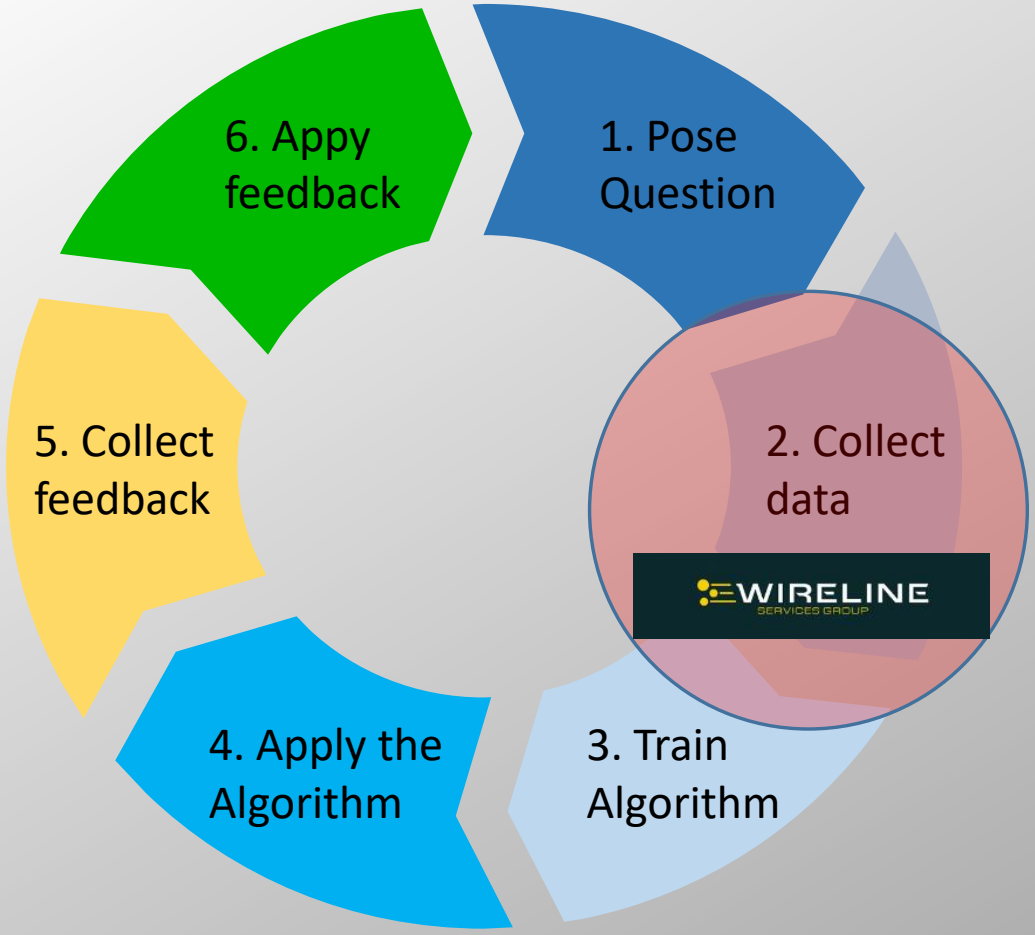
1) Is there a clear pattern in the data?
2) Is there data available to characterize this pattern?
3) Can the behaviour be described by a mathematical expression?

If those criterial are met we can apply ML in more geological terms:

Supervised Learning,

Unsupervised learning,

Semisupervised learning



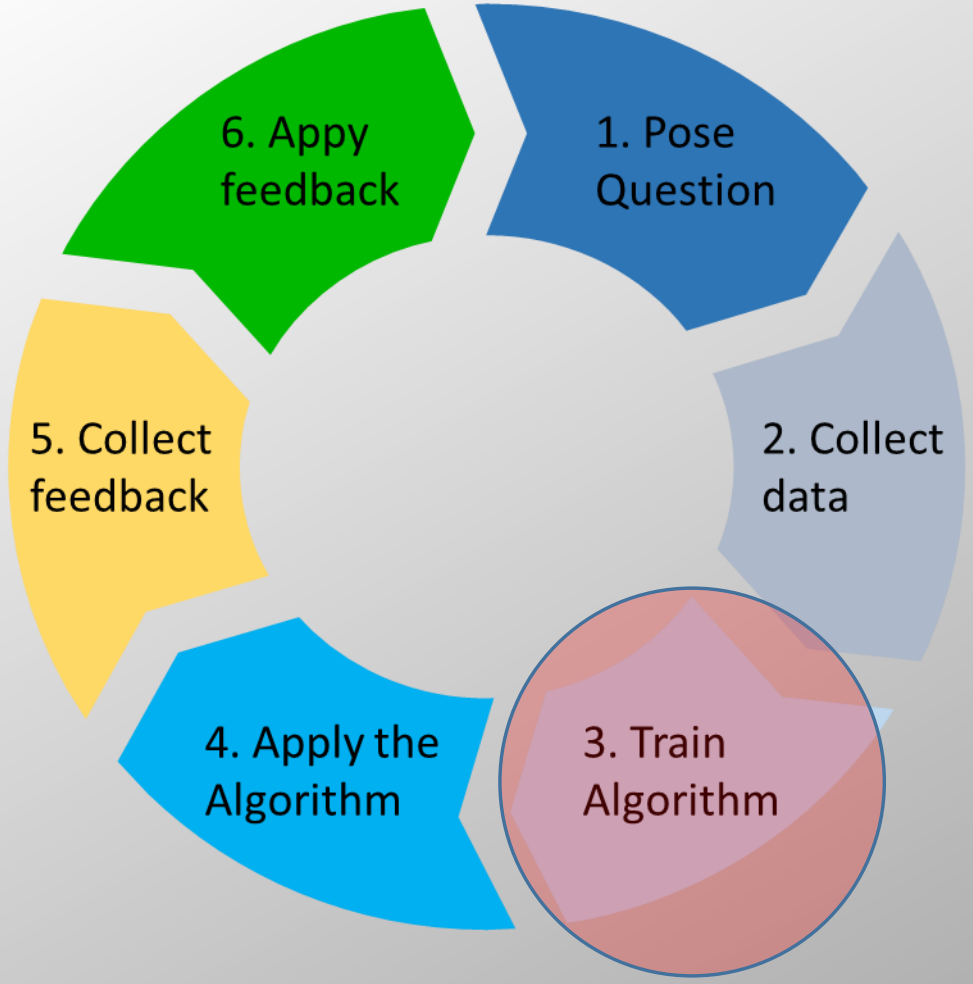
The Hunt for Your Algorithm

Start the process by asking a question. Usually this involves prior knowledge of a system that has the desired outcome. This data is known as the **Training Data.**

Training data is used to determine the algorithm used to answer the question posed in step 1.

This process is only as good as the data you use to make your training set.

Many datasets available but I am only going to illustrate my point with borehole geophysics.

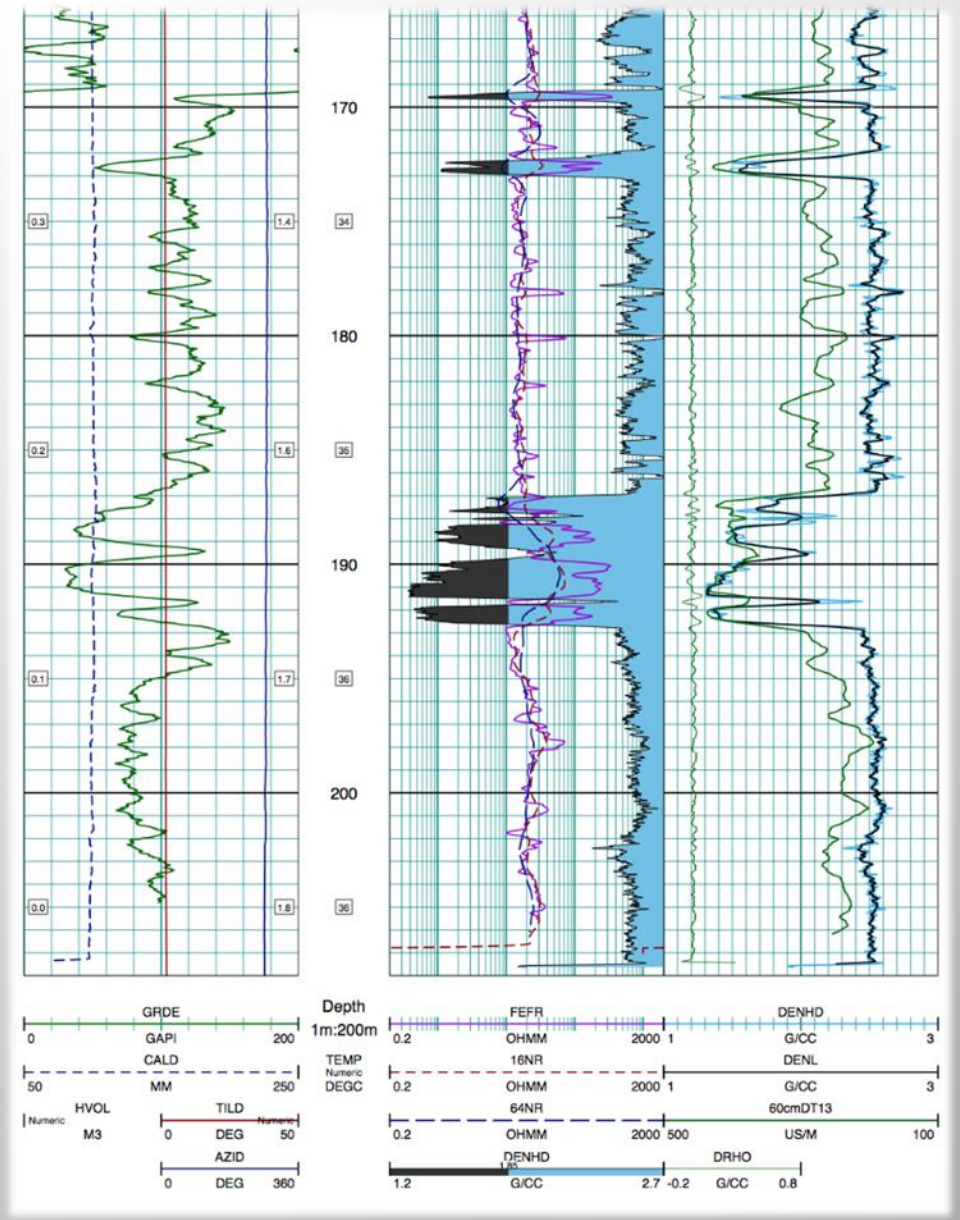


Physical Properties Logging – Ore Body Knowledge

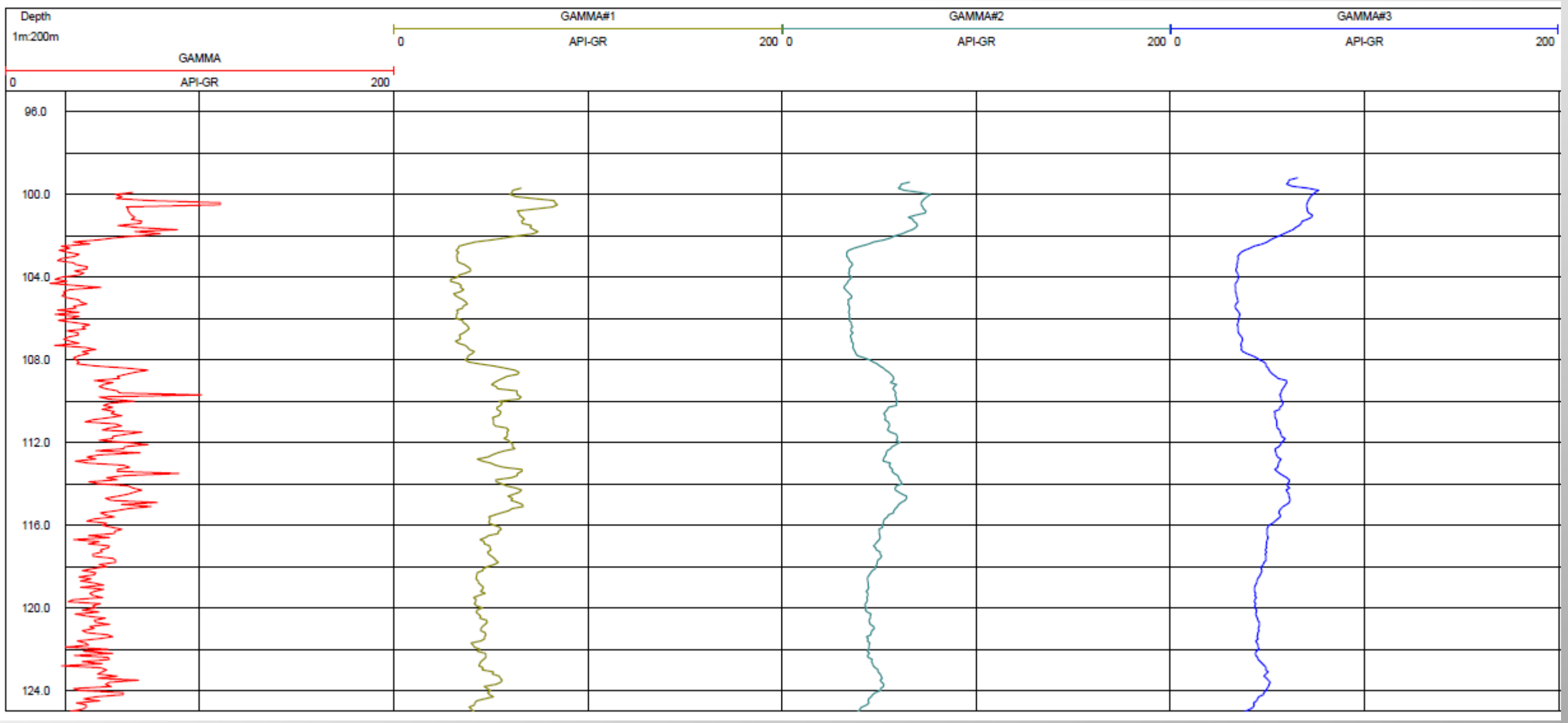
Records physical measurements of the lithology.

Characterize rock properties in increase ore body knowledge through:

- Radiometric – gross and spectral
- Resistivity and Conductivity
- Magnetic Susceptibility
- Acoustic Velocity
- Density



But which log is the correct one?

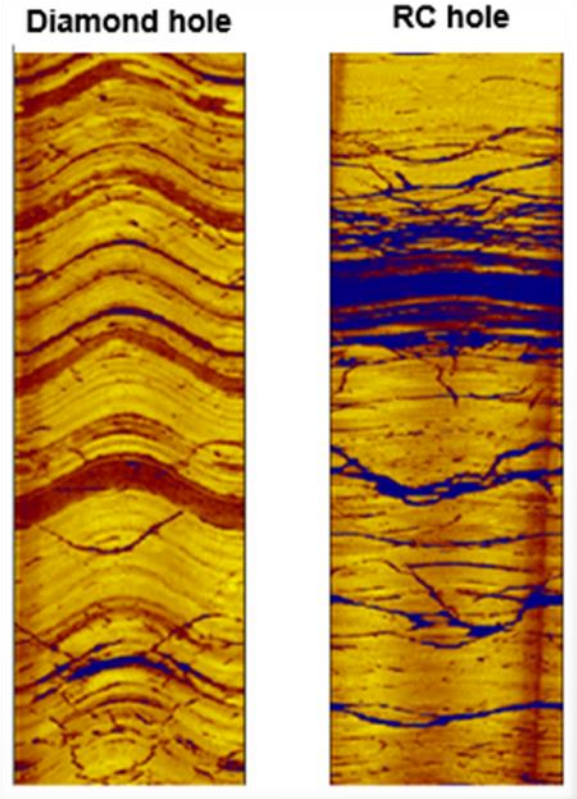


Physical Property Variables to Consider

1. Calibrations
2. Measurement Units
3. Tool specifications
4. Processing steps
5. Do you have enough data to answer the relevant questions
   - Data sparsity
   - Data corruption

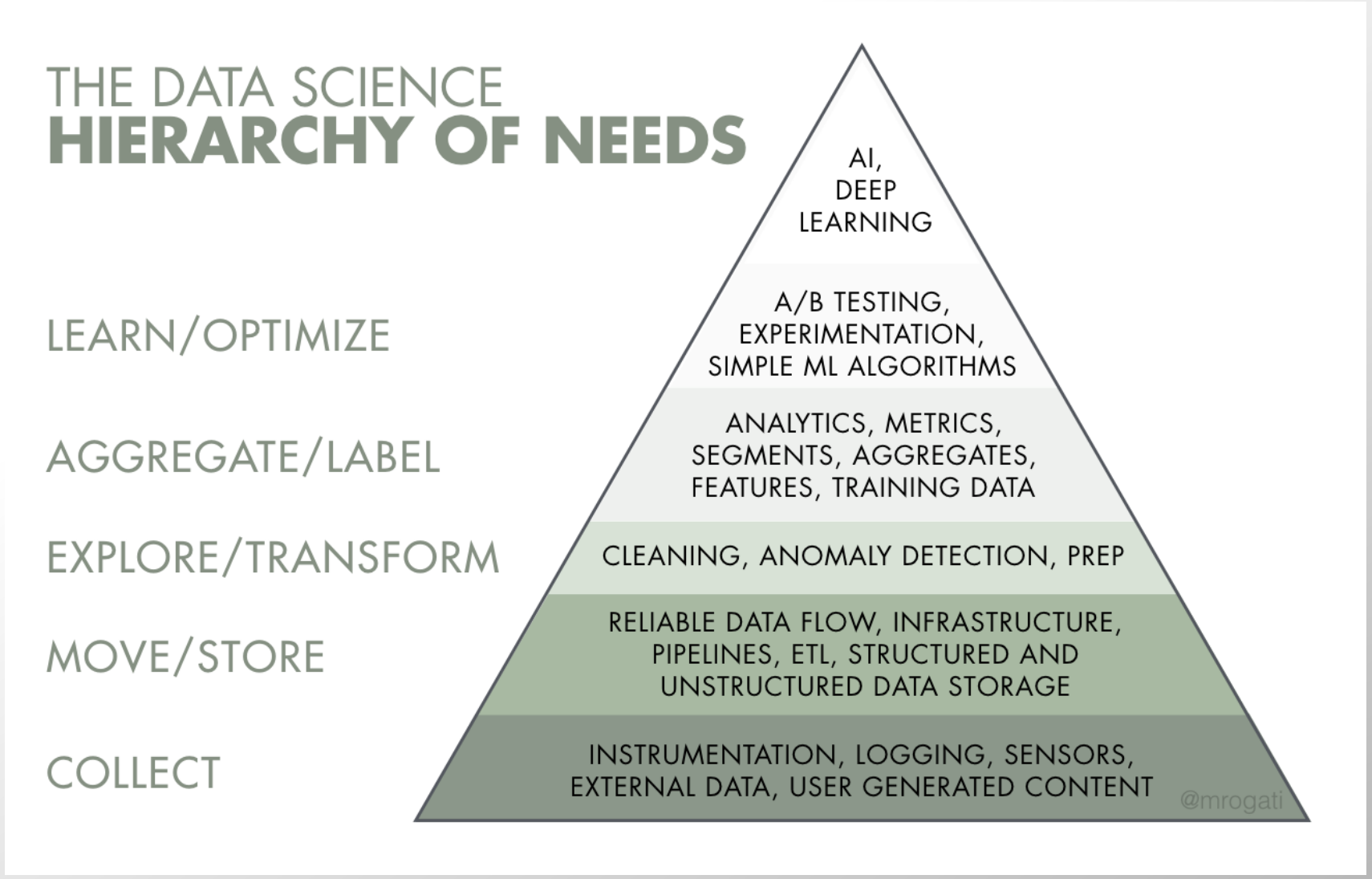
6. Era of data collection

Orientation & Identification of Structure



- Measures veins, bedding and fractures.
- Assist in geotechnical and structural analysis.
- In diamond, sonic or percussion drill holes.
- Optical and Acoustic Televiewer.

Holistic Plan for Data from Collection - AI

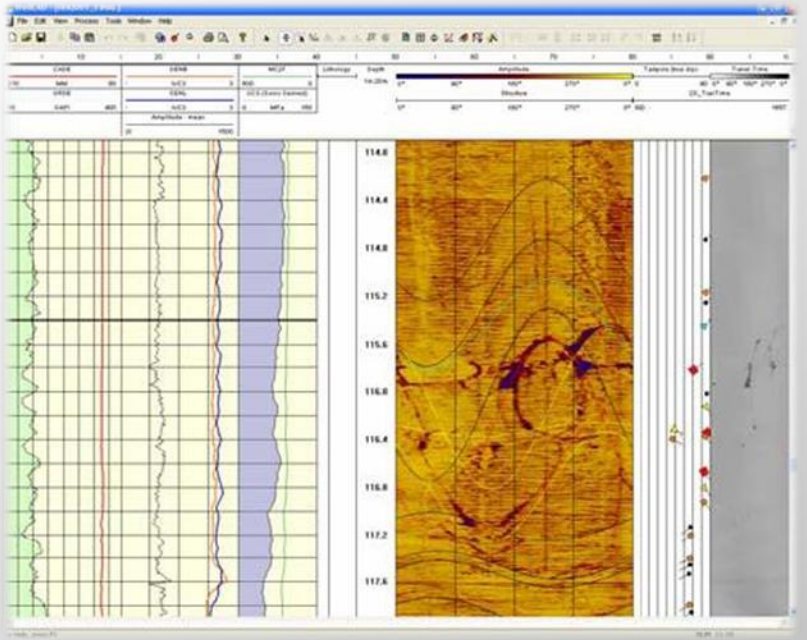


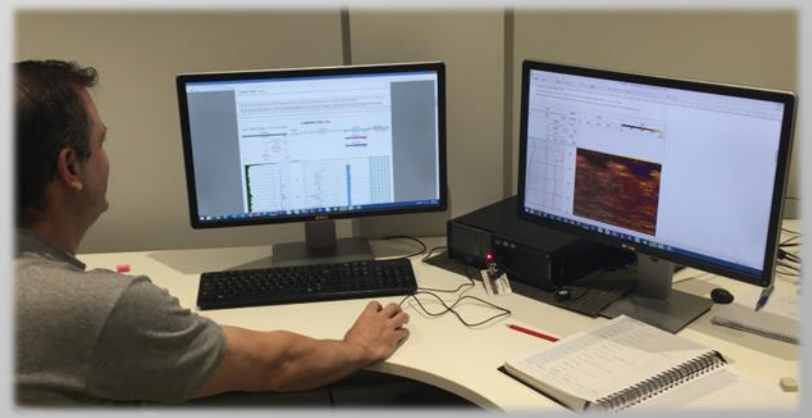
Monica Rogati, 2020

What we offer – Expertise

Our Data Processing Centre (DPC) provide:

- Quality control, processing, interpretation and integration of data.
- Monitoring of all tool calibration and performance.
- Answer products:
  - Rock property characterization
  - In-situ Dry Density equivalent
  - Moisture mapping





Conclusions

1. Wireline Services Group – Has and continues to be a world class provider of wireline logging data for incorporation into AI – machine learning algorithms.

2. As dataset gets larger and more expensive a holistic approach to data is necessary to “future-proof” your data and lower the time and expense of cleaning the data.

3. Given a properly trained dataset, the machine learning environment can be used to highlight subtle features or unknown zones and provide another avenue for target generation.

4. This entire process adds value to costly drill programs.

Questions?

Thank you!

minexcrc.com.au

Find us on LinkedIn

TOP

Majors, METS and Survey Participants (16)

MinEx CRC

AngloAmerican

BARRICK

BHP

SOUTH32

Epiroc

Geotec
Boyles Bros S.A.

HiSeis

IMDEX
REAL-TIME SUBSURFACE SOLUTIONS

AMC
DRILLING OPTIMISATION

REFLEX
INTELLIGENCE ON DEMAND

MiKAY
DRILLING
Setting the Standard

OLYMPUS
Your Vision, Our Future

SANDVIK

wassara
STRAIGHT FORWARD DRILLING

Australian Government
Geoscience Australia

Geological Survey of Western Australia

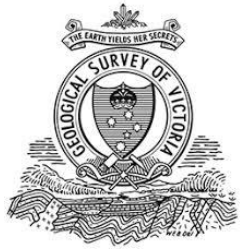
SOUTH AUSTRALIA

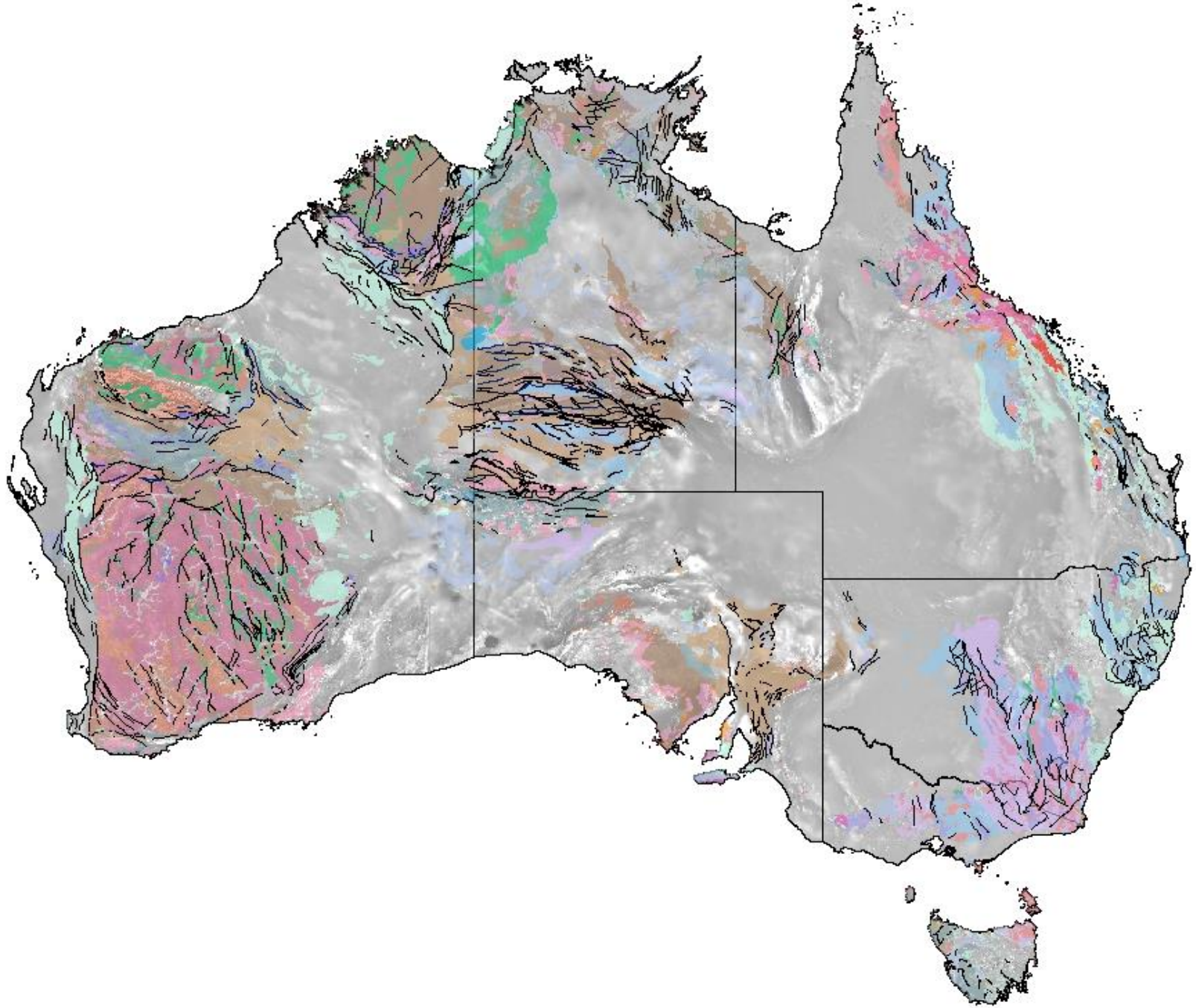
Government of South Australia
Department for Energy and Mining

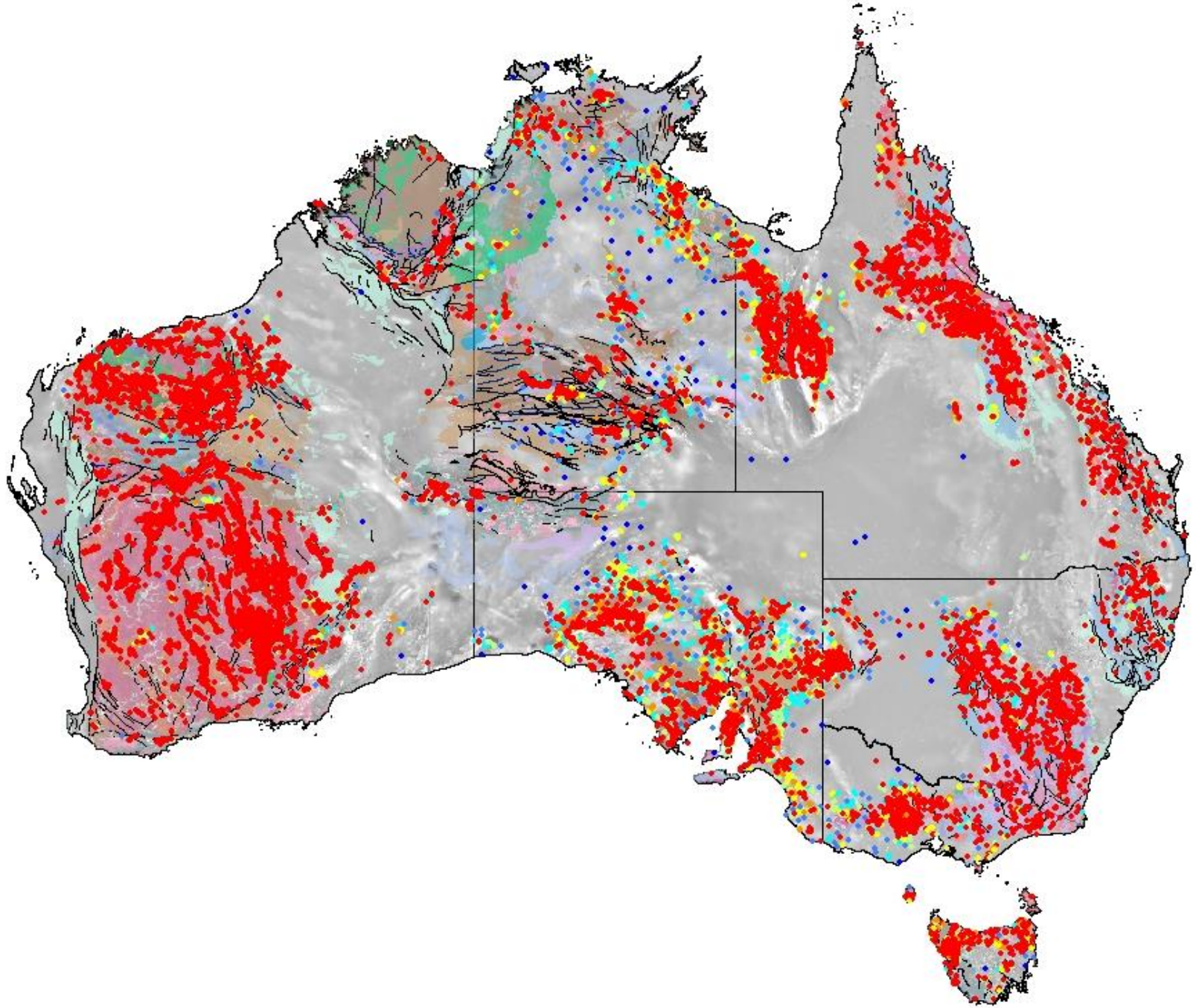
NSW GOVERNMENT

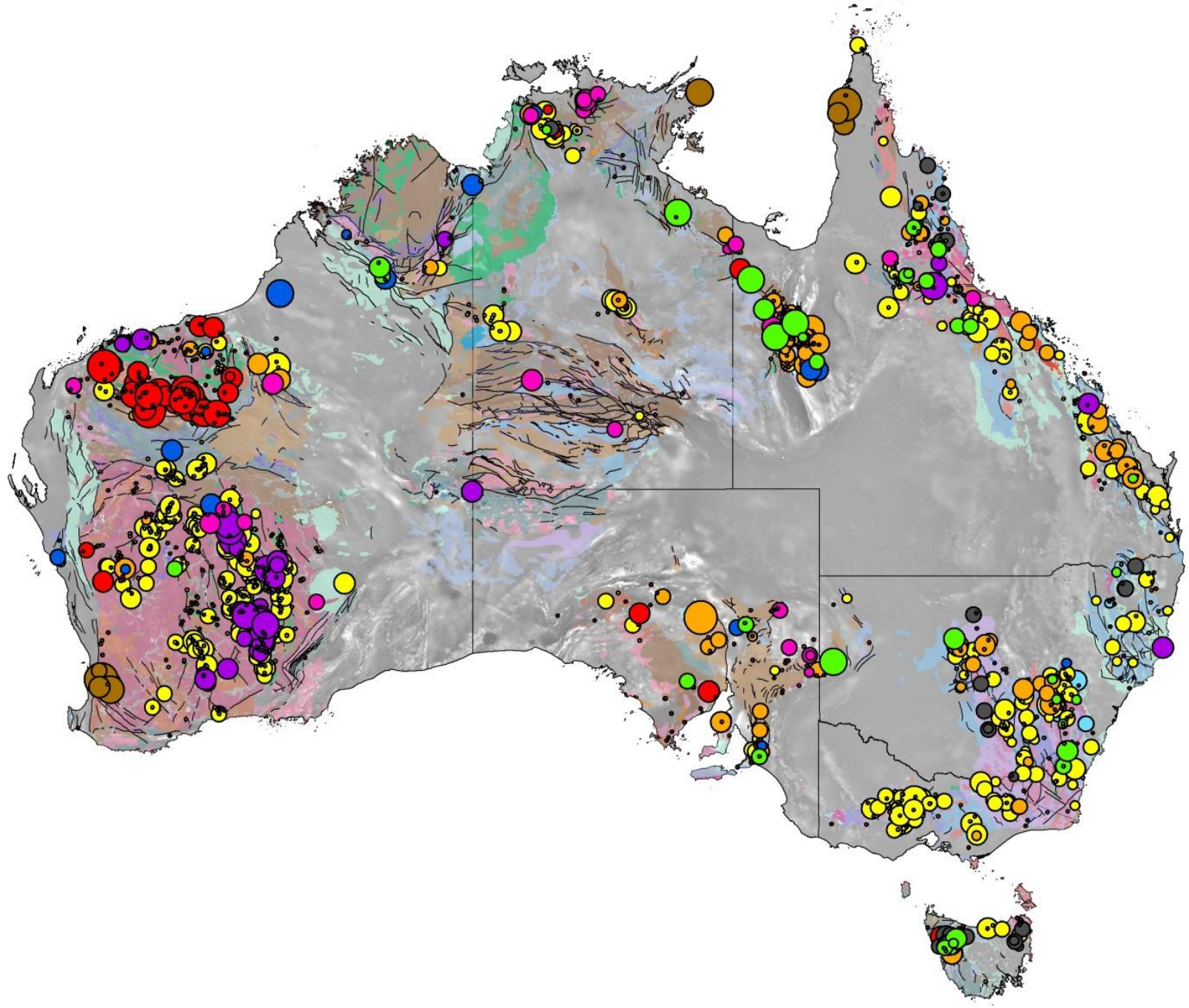
Research Participants and Affiliates (20)

MinEx CRC

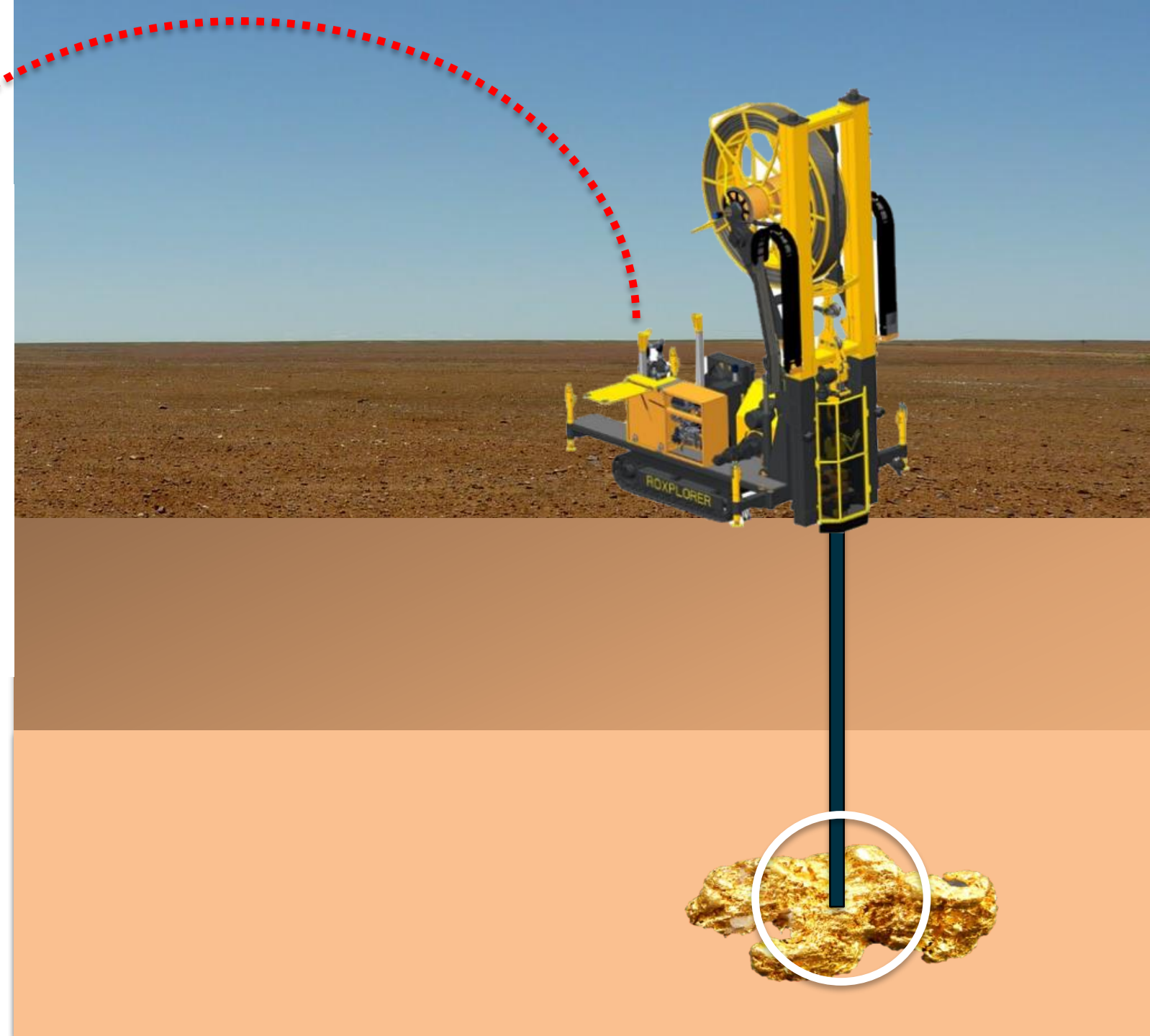








MinEx CRC



MinEx CRC

Programs and Projects

Program 1
Drilling Technologies

- Project 1 **Drilling Optimisation and Automation**
- Project 2 **Coiled tubing drilling for definition of mineral deposits**
- Project 20 **Hydraulic processing system for CT drilling**

Program 2
Data from Drilling

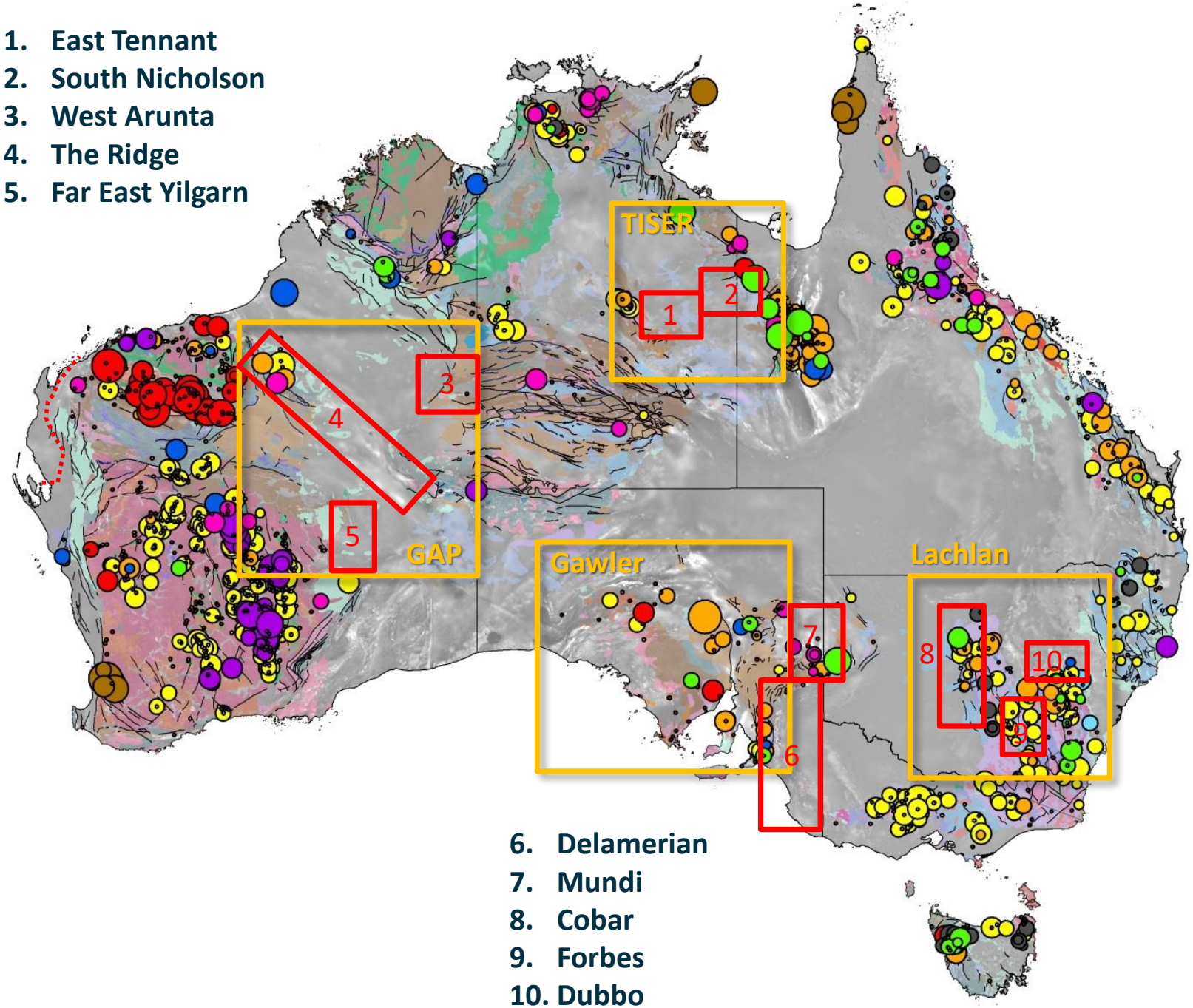
- Project 3 **Real-time downhole assay**
- Project 4 **Petrophysical logging while drilling**
- Project 5 **Seismic in the drilling workflow**
- Project 6 **Automated 3D modelling**

Program 3
National Drilling Initiative

GA | **GSSA** | **GSNSW** | **GSWA**

- Project 7 **Maximising the value of data and drilling through cover**
- Project 8 **Geological architecture and evolution**
- Project 9 **Targeting Mineral Systems in covered terranes**

1. East Tennant
2. South Nicholson
3. West Arunta
4. The Ridge
5. Far East Yilgarn



6. Delamerian
7. Mundi
8. Cobar
9. Forbes
10. Dubbo

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Using A.I. to Classify Lithology: Navigating through the Propaganda to Identify Opportunities in your Image Data

3 March 2020

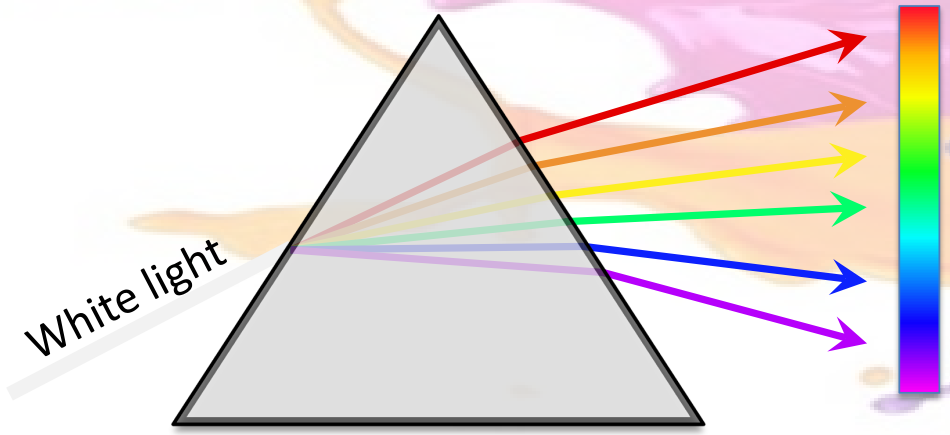
Sam Scher M.Sc., Senior Geochemist

THE IMPORTANCE OF TERMINOLOGY

Thanks to machine-learning algorithms, the robot apocalypse was short-lived.

- Artificial Intelligence (A.I.) denotes machines that can think for themselves.
- Machine Learning is a subset of A.I. that is focused on systems that learn from their environment, e.g. data.
  - It is a method of data analysis that automates analytical model building by using algorithms that iteratively learn from data to find hidden insights and structure without being explicitly programmed where and how to look.

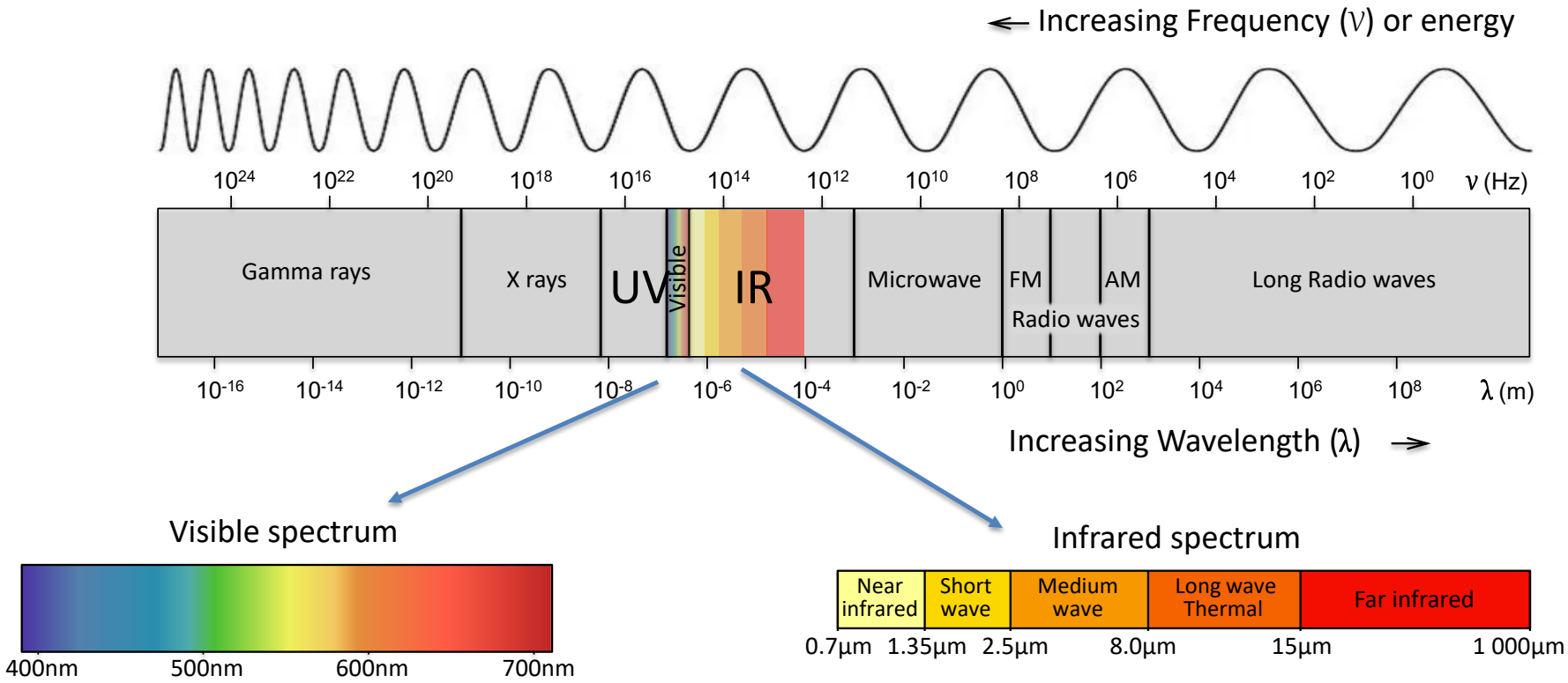
IDENTIFYING MINERALS WITH THE VISIBLE COLOR SPECTRUM



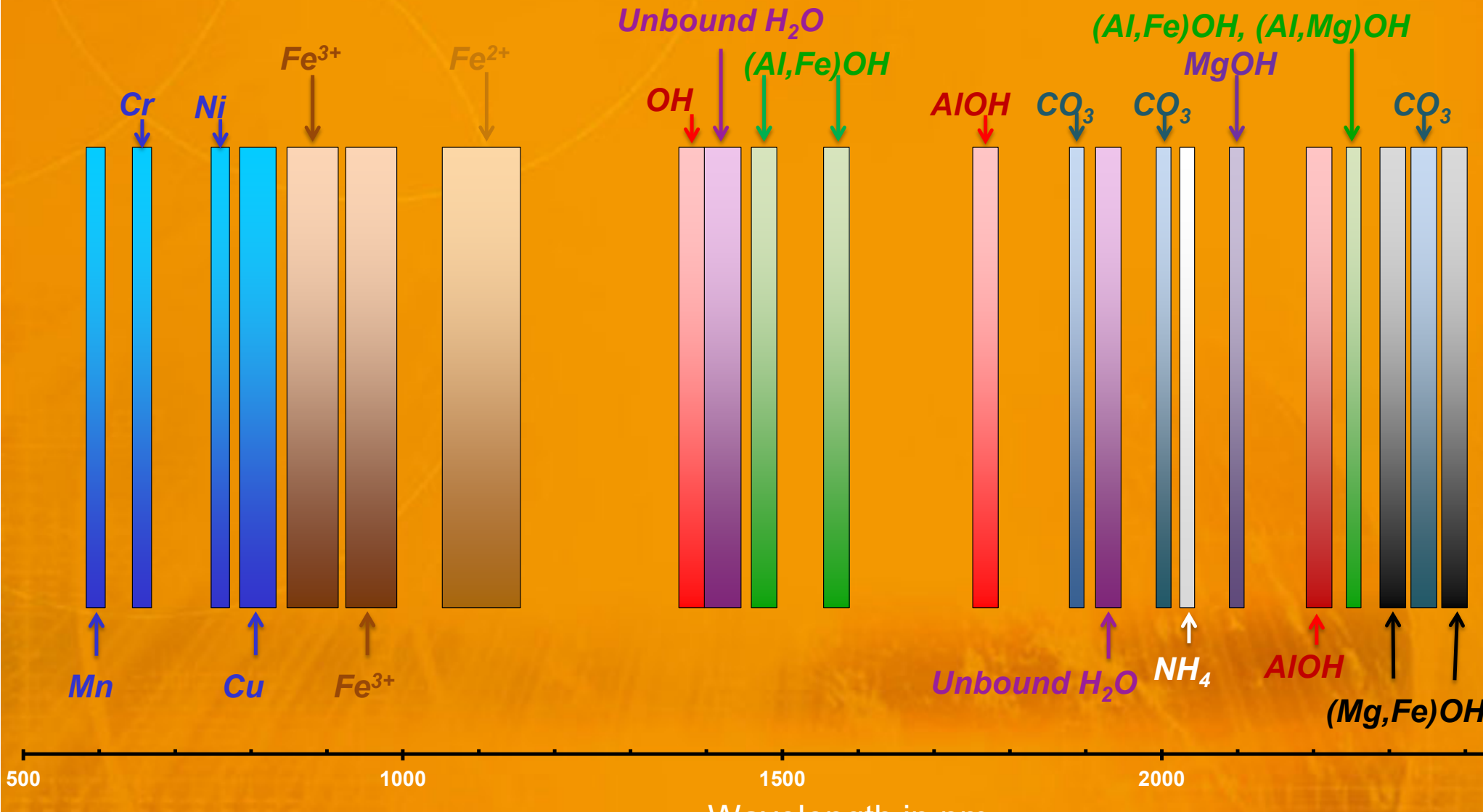
Violet:	380nm to 424nm
Blue:	424nm to 491nm
Green:	491nm to 575nm
Yellow:	575nm to 585nm
Orange:	585nm to 647nm
Red:	647nm to 760nm

How to combine valuable human interpretations with quantitative data, e.g. mineral identification…?

THE PHYSICS OF LIGHT: THE ELECTROMAGNETIC SPECTRUM



Diagnostic absorption features of minerals in the Visible-near (VNIR) to shortwave infrared (SWIR) range



OH: ~1400nm (also ~1550nm & ~1750-1850 nm in some minerals)

Water: ~1400nm & ~1900nm

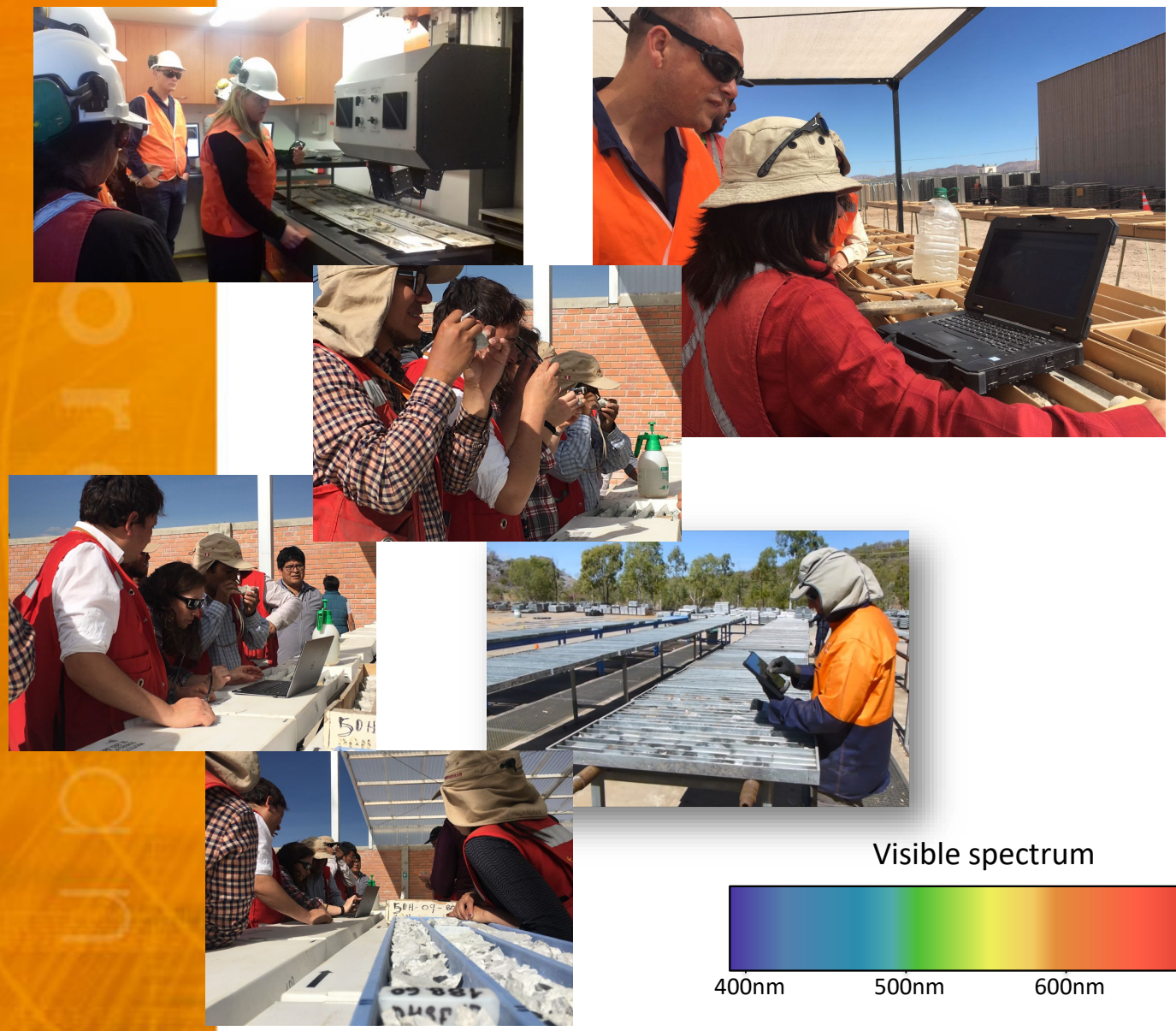
AlOH: ~2160-2228nm

FeOH: ~2230-2295nm

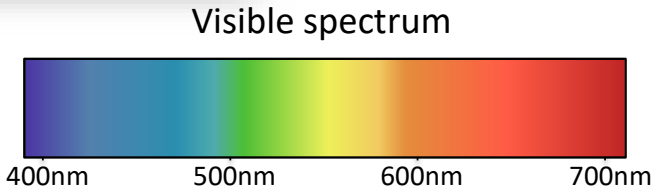
CaCO3: ~2300-2370nm

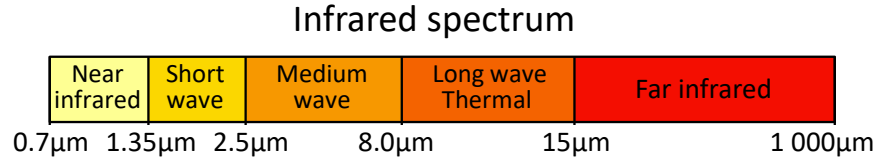
MgOH: ~2300-2370nm

ADVANTAGES OF INTEGRATING HYPERSPECTRAL CORE IMAGING IN LOGGING

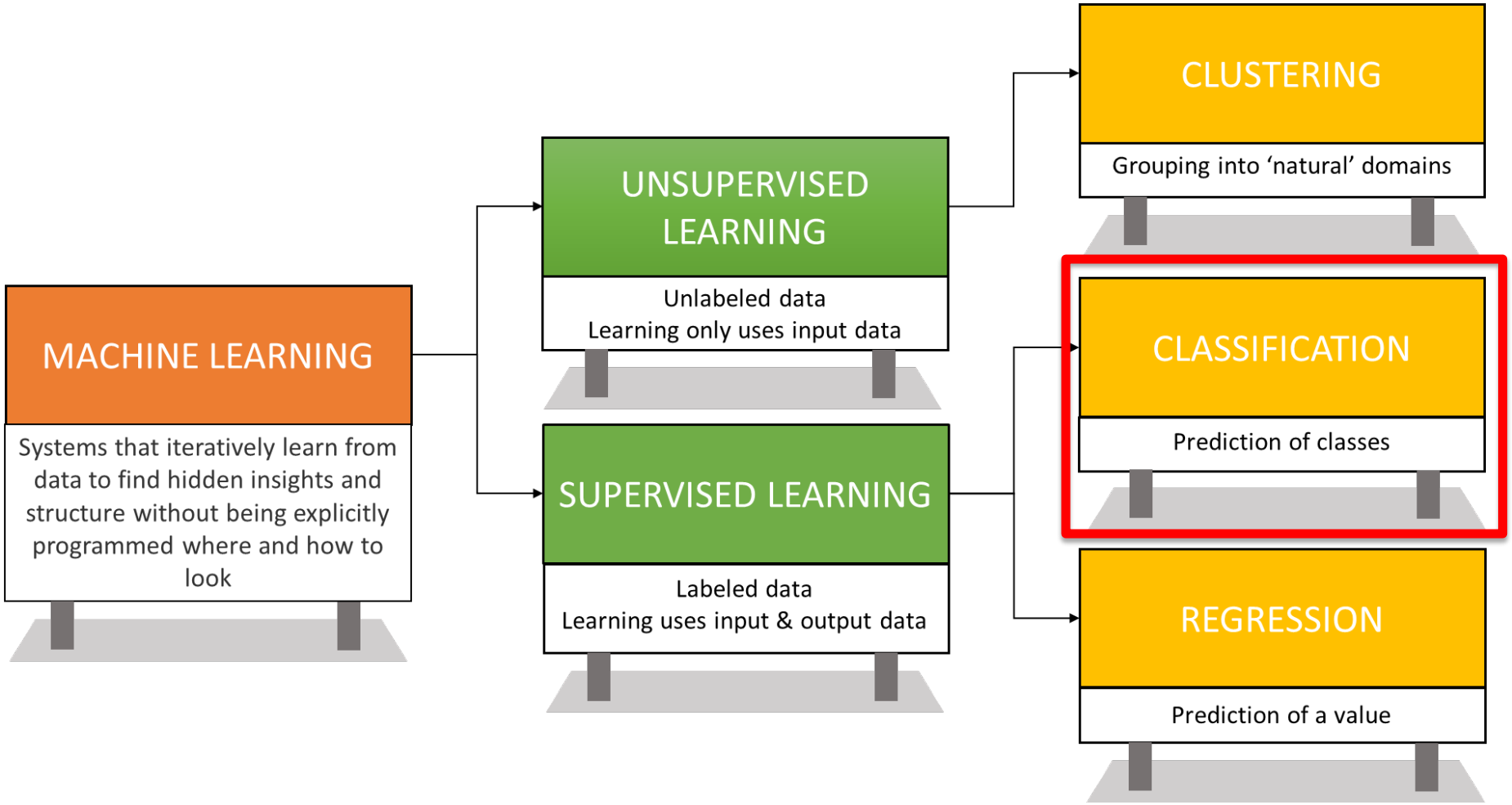


- Geologists bring knowledge, context and hard-earned wisdom
- ‘Domain experts’ are indispensable
- The synthesis of humans and consistent, precise analytical data is best-practice

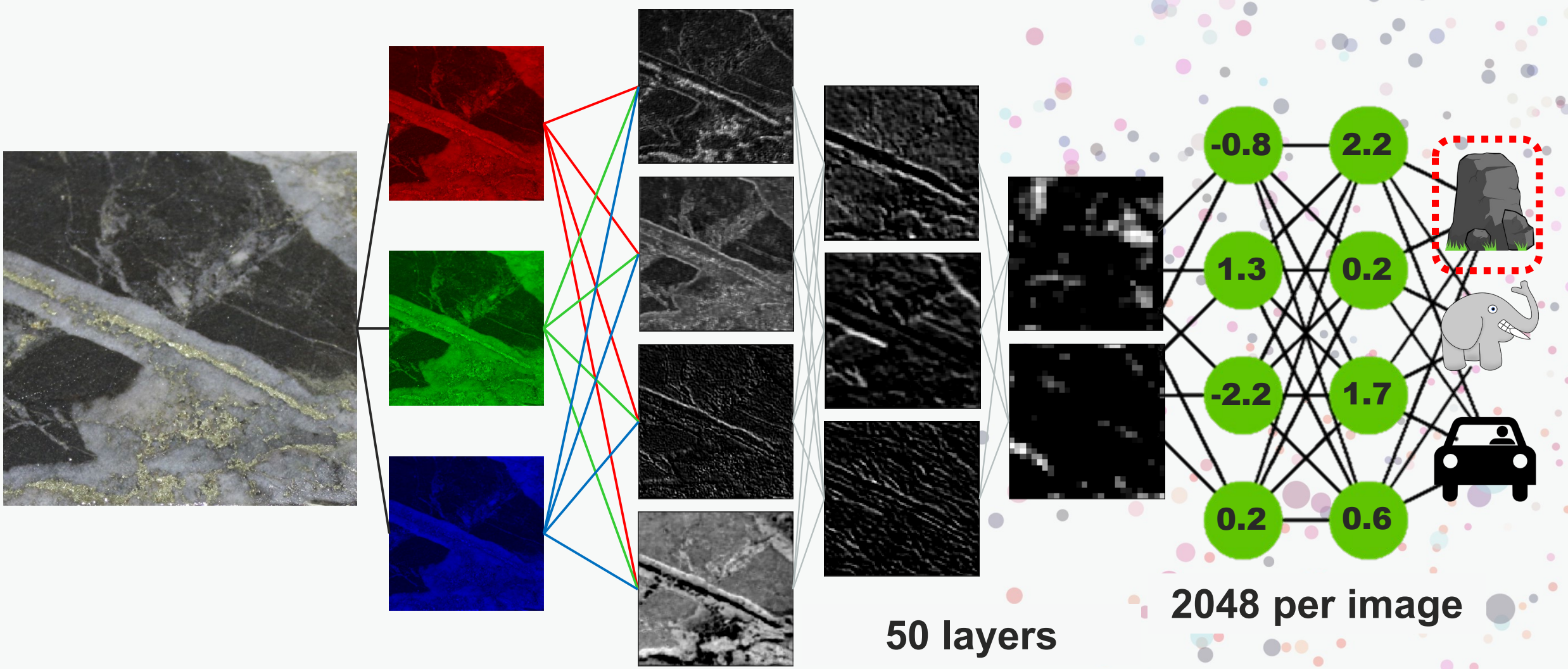




THE BASICS OF CREATING A MACHINE LEARNING MODEL TO ASSIST LOGGING



Computer vision: Convolutional Neural Networks



MAPPING LITHOLOGIES WITH RGB

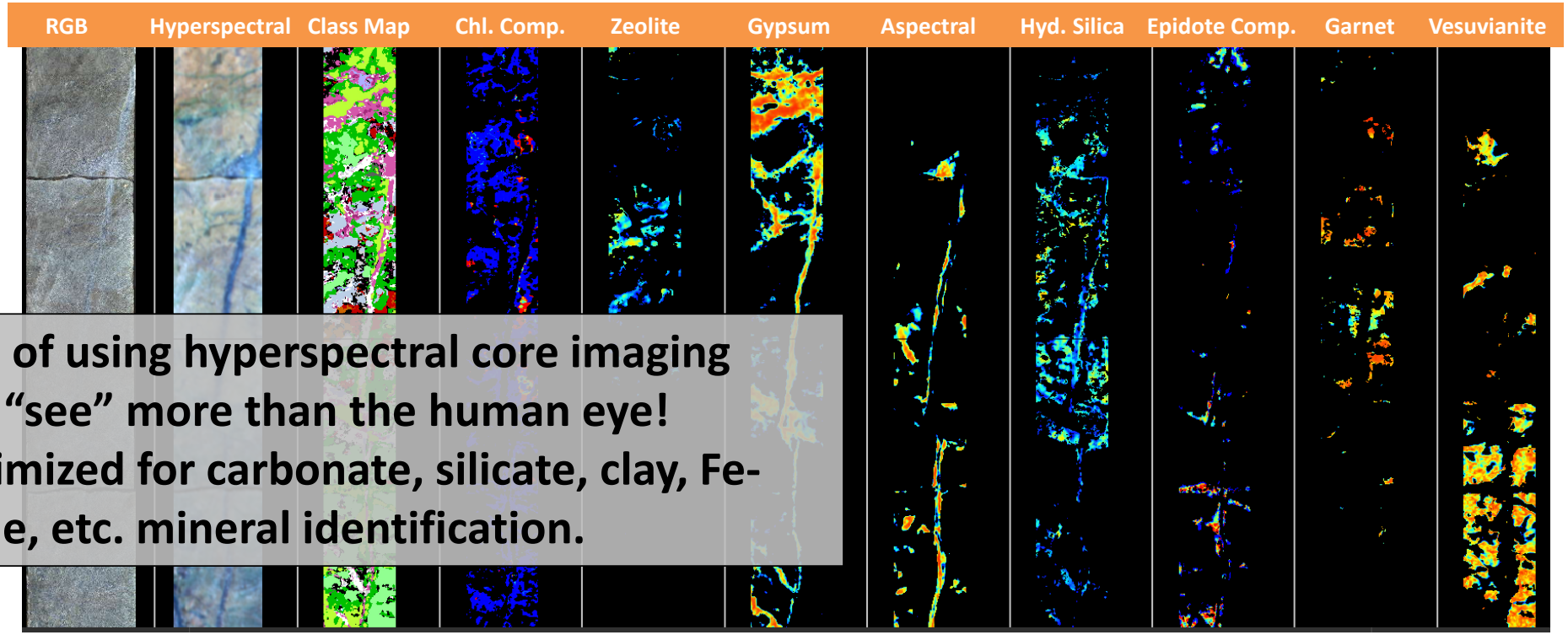
- **Limitations with ML using RGB photography**
  - Masking, problems with photography (sun/angle)
  - RGB photography can only see ~380-760nm; information is limited to what a human eye can see!
  - The machine has all the same difficulties of differentiating complex mineralogy and lithologies as humans.
- Importantly, **consistency** is improved by using ML.

A machine is only as smart as what you put into it, those who program it…and ***how the results are applied***

SOLVE GEOSOLUTIONS

IMAGE CLASSIFICATION AND CORESCAN DATA

- Most machine learning workflows require large amount of high resolution and **consistent data**.
- Corescan collects approximately 200,000 pixels of data per meter. The HCI-4 will produce 800,000 pixels per meter.
- Significantly, Corescan data provides spatial relationships between the pixels in the form of an image; therefore we know which minerals exist as a given and the position of every other mineral.



Advantages of using hyperspectral core imaging

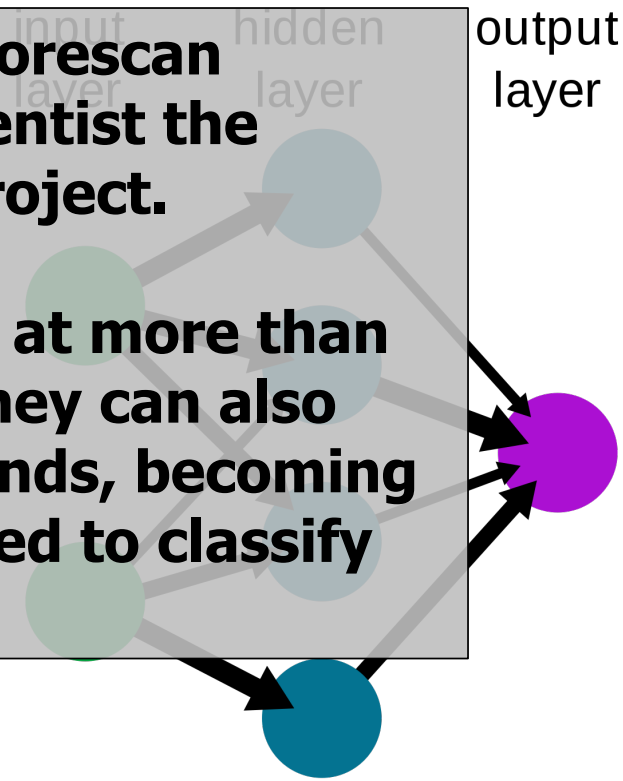
- **Can "see" more than the human eye!**
- **Optimized for carbonate, silicate, clay, Fe-oxide, etc. mineral identification.**

MAPPING LITHOLOGIES WITH CORESCAN RGB + 512 BANDS + LASER PROFILER

Project geologists in conjunction with a Corescan spectral geologist can advise the data scientist the optimal bands to use as inputs for each project.

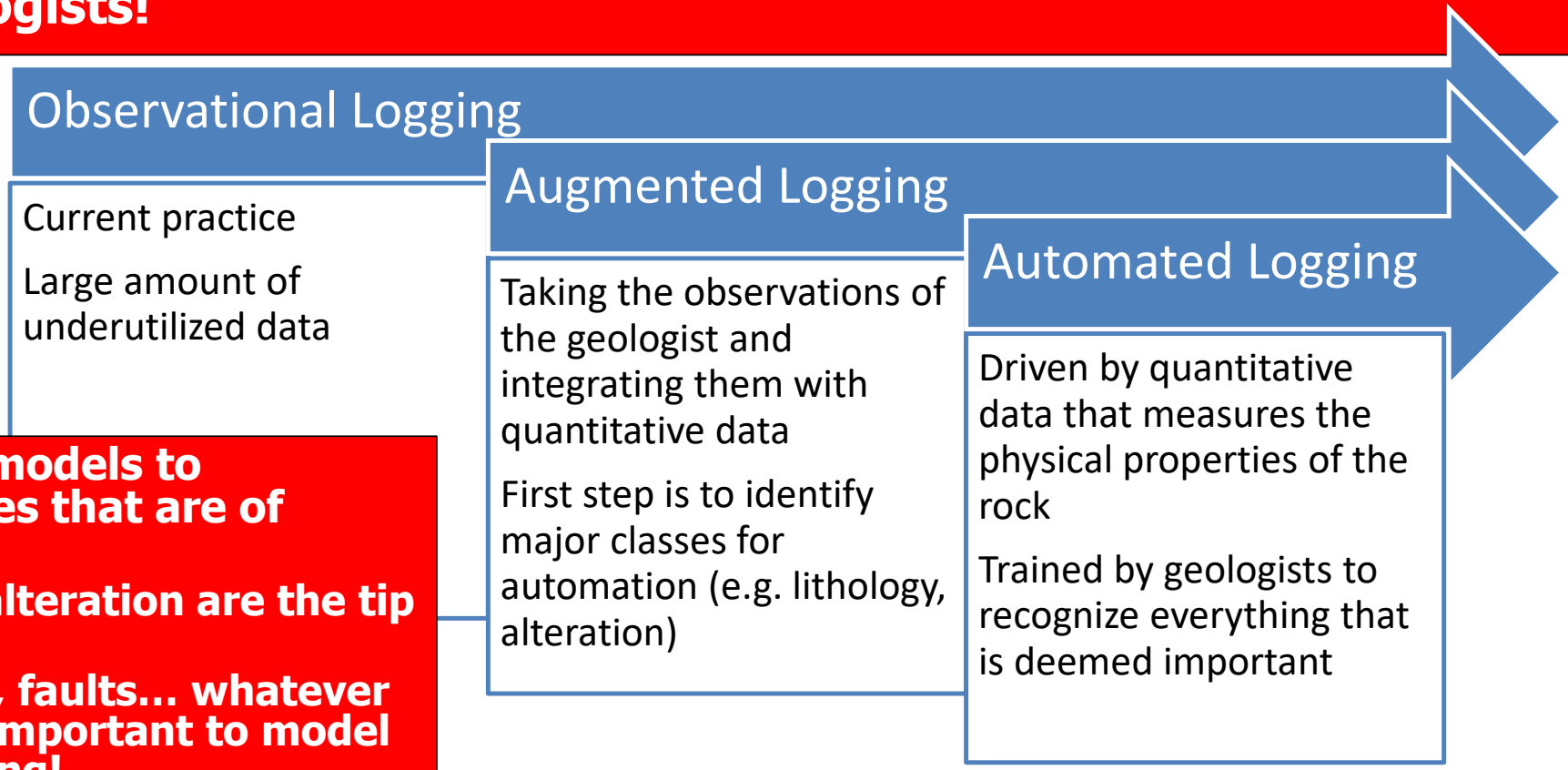
This will create neural networks that look at more than the individual Corescan bands of data… they can also look at the interactions between these bands, becoming similar to ratios and gradients that are used to classify spectra!

A simple neural network



USING IMAGE ANALYSIS TO AID IN LOGGING CORE

- **Warning:**
  - **High degree of geological knowledge required!**
  - **Will require an extreme amount of effort on the part of the staff geologists!**



- **Will need to train models to recognize all classes that are of importance:**
  - **Lithology and alteration are the tip of the iceberg!**
  - **Veins, breccias, faults… whatever you log and is important to model will need training!**
  - **Re-evaluation of what is important may be required!**

The speaker would like to acknowledge Solve Geosolutions and the Corescan team for their input in this talk.

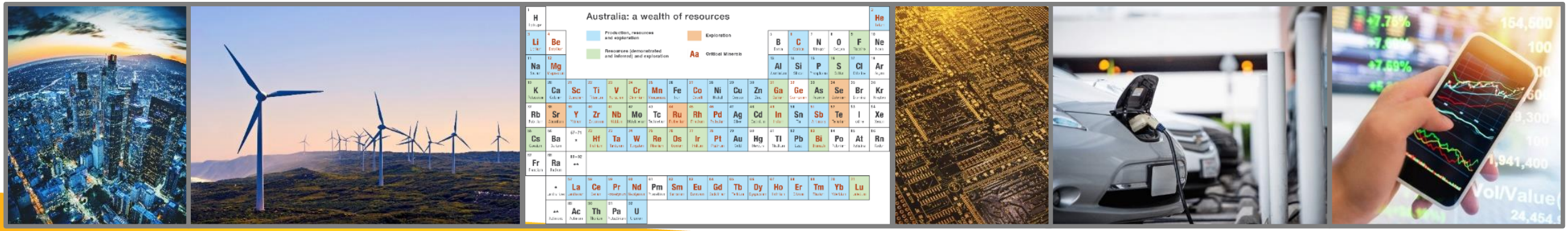
Thank you all for attending.

AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

Australia United: making the world's best pre-competitive data even better

Dr Richard Blewett (Branch Head, Mineral Systems, Geoscience Australia)
Richard.Blewett@ga.gov.au



TOP

Lowering the entry for multiple ‘personas’

Investment manager
What and where is the next big opportunity?

Exploration Geologist
Where should we drill?

Landholder
What are the resources on my land?

Indigenous
What does this mean for my community?

Govt. Policy Officer
How does Government respond to development?

Natural Resource Manager
How do we plan for development?

Academic/Geol. Surveys
Can the data help my research?

Ministerial Advisor
How can we achieve the Minister's goals?

Making useful data more usable and more used

Geoscience Australia acknowledges the traditional custodians of the country where we meet and where this work was undertaken.

We also acknowledge the support provided by individuals and communities to access the country, especially in remote and rural Australia.

NORTHERN TERRITORY GOVERNMENT

Geological Survey of Western Australia

Tasmanian Government

NSW GOVERNMENT Planning & Environment

GEOLOGICAL SURVEY OF VICTORIA

MinEx CRC

AuScope

THE UNIVERSITY of ADELAIDE

THE UNIVERSITY OF WESTERN AUSTRALIA

Australian National University

UNIVERSITY of TASMANIA

HARVARD

UNIVERSITY OF CAMBRIDGE

CSIRO

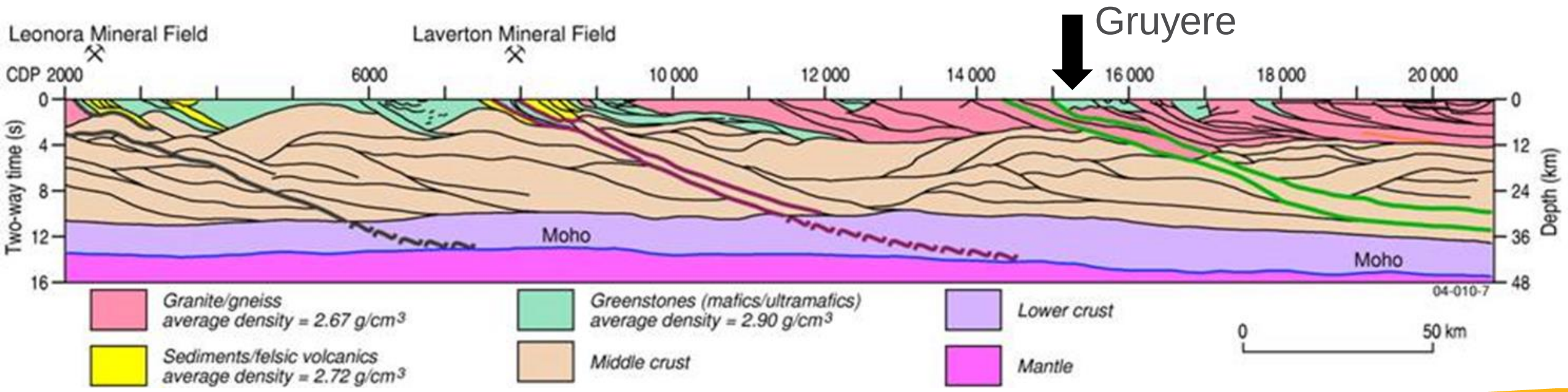
AUSTRALIA MINERALS

National Mineral Exploration Strategy

- Encourage investment
- Harness capability
- Protect the environment
- Support people and communities

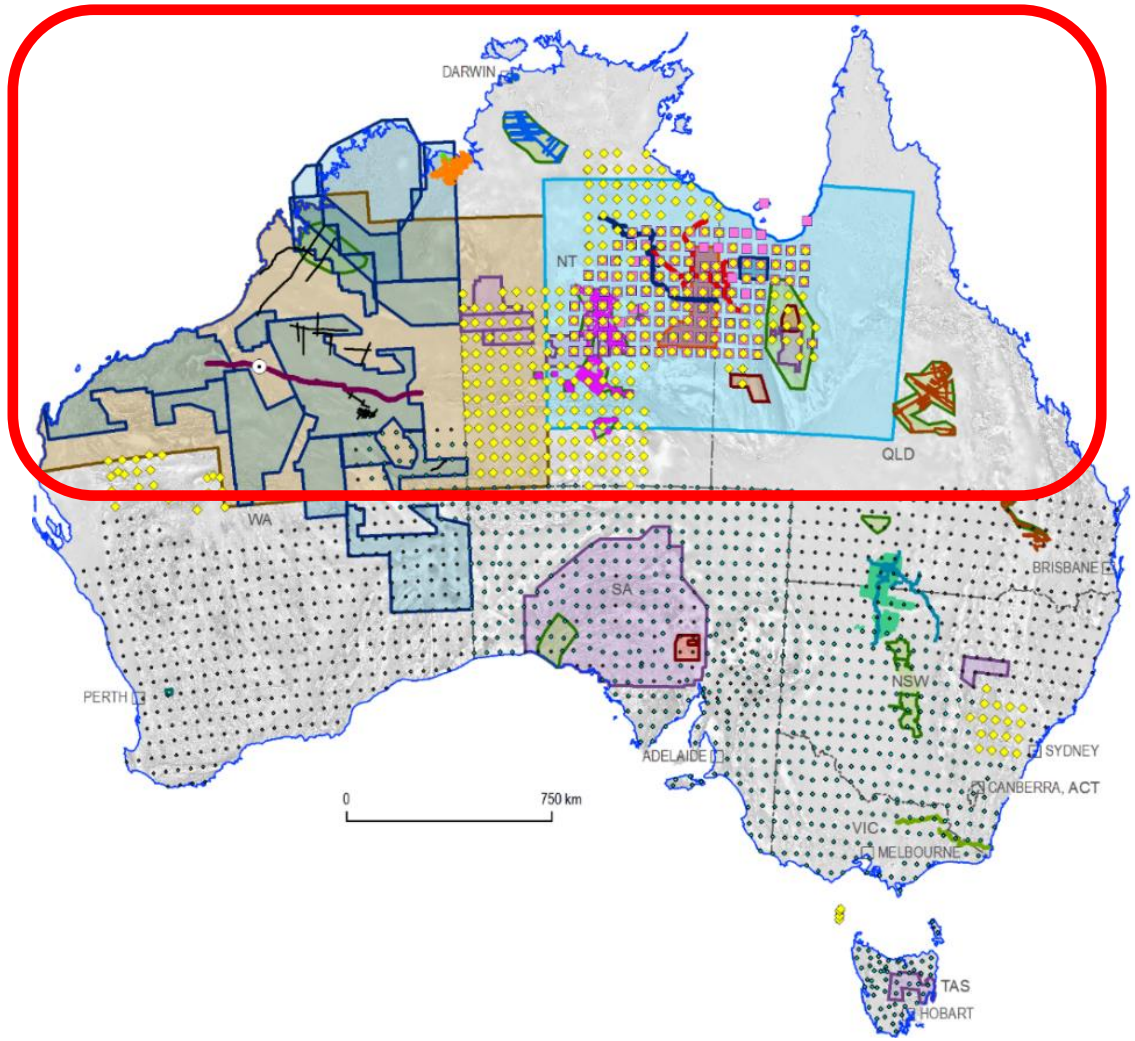
Impact of pre-competitive on discovery

- 1990s – collected airborne magnetic data, produced geological interpretations
- 2001 - collected reflection seismic data, undertook interpretation (below) which predicted this belt is prospective for new world-class gold deposits
- 2014 - Gold Road Resources discovered the Gruyere gold deposit in the Yamarna Belt, utilising GA's interpretations datasets which is a 6+ Million oz greenfields discovery.



AUSTRALIA MINERALS

Geoscience data to de-risk Exploration



***Exploring for the Future*, September 2019**

- *AusAEM 2017–2018 completed survey*
- *AusAEM 2019 current survey*
- *Gravity survey, South Nicholson Basin, released October 2017*
- *Seismic reflection survey, South Nicholson Basin, released March 2018*
- *AEM survey, Surat and Galilee basins*
- *AEM survey, East Kimberley*
- *AEM survey, Northern Stuart Corridor*
- *AEM survey, Southern Stuart Corridor*
- *Seismic reflection survey, Kidson Sub-basin*
- *Seismic reflection survey, Barkly Sub-basin*
- *Reprocessed seismic reflection survey, Canning Basin*
- *Reprocessed seismic reflection data, East Kimberley*
- *AusARRAY survey, Mount Isa to Tennant Creek*
- *EFTF AusLAMP survey, completed*
- *Stratigraphic drilling, Kidson Sub-basin*

Geophysical Acquisition Programs, current activities

- *Airborne magnetic and radiometric survey*
- *Gravity survey*
- *Airborne electromagnetic survey*
- *Magnetotelluric survey*
- *Airborne test site*
- *AEM survey, Thomson*
- *Gravity survey, Thomson*
- *Seismic reflection survey, Lachlan*
- *AusLAMP survey, completed and in progress*
- *AusLAMP survey, planned*

NOTE: The greyscale background represents aeromagnetic data (0.5 first vertical derivative of total magnetic intensity).

PP-3117-2

Australian Government
Geoscience Australia

AUSTRALIA'S NORTHERN TERRITORY

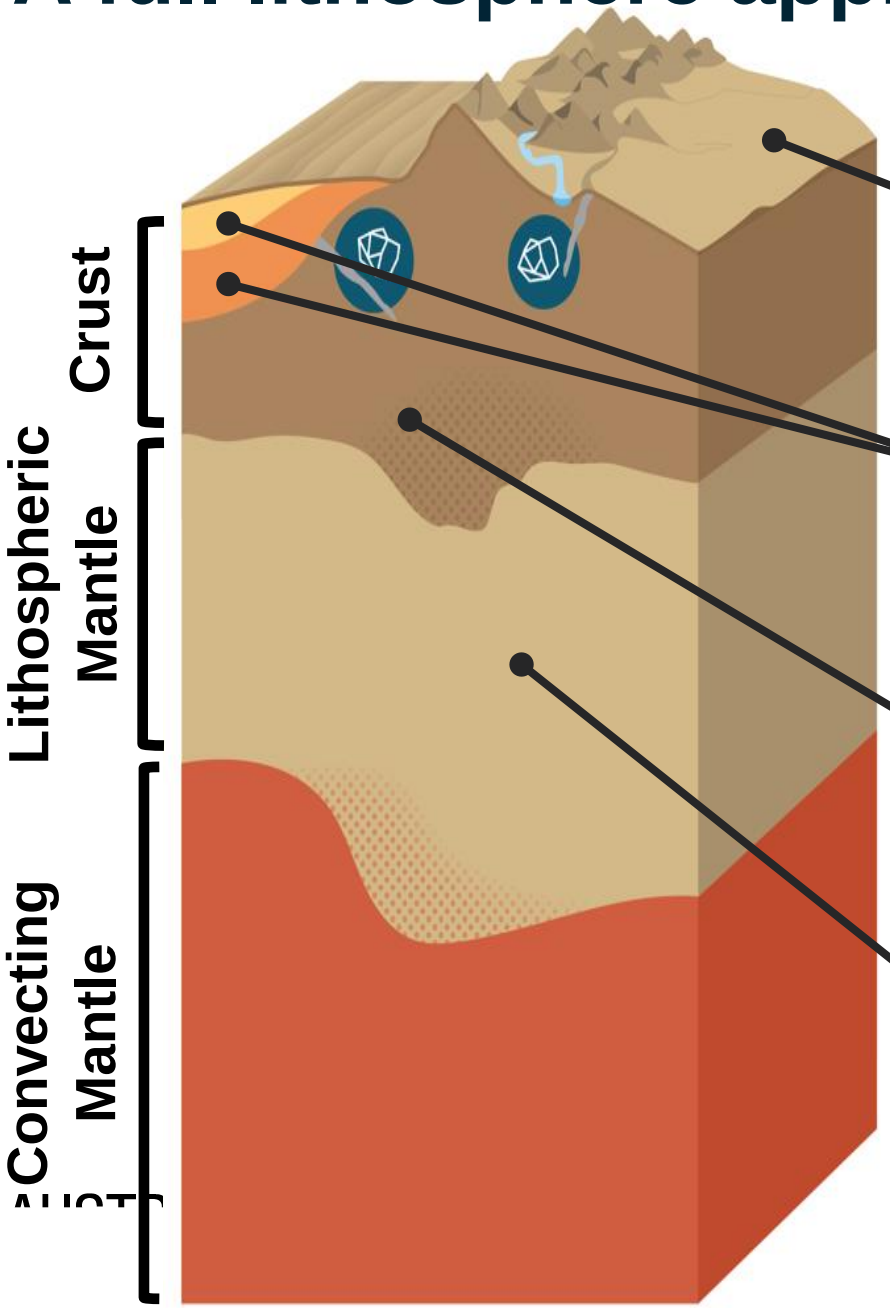
Queensland Government

NSW GOVERNMENT

GSWA 2018

Tasmanian Government

A full lithosphere approach to discovery

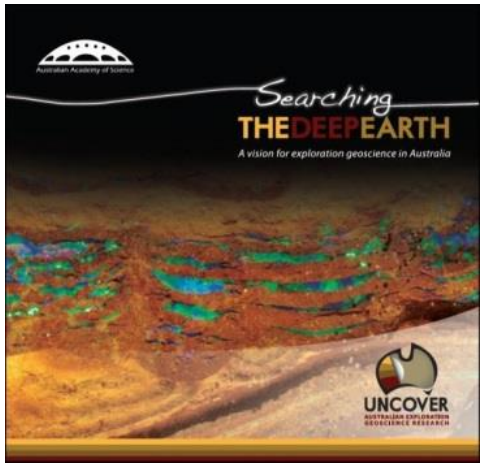


Surface

Cover / Basins

Crust

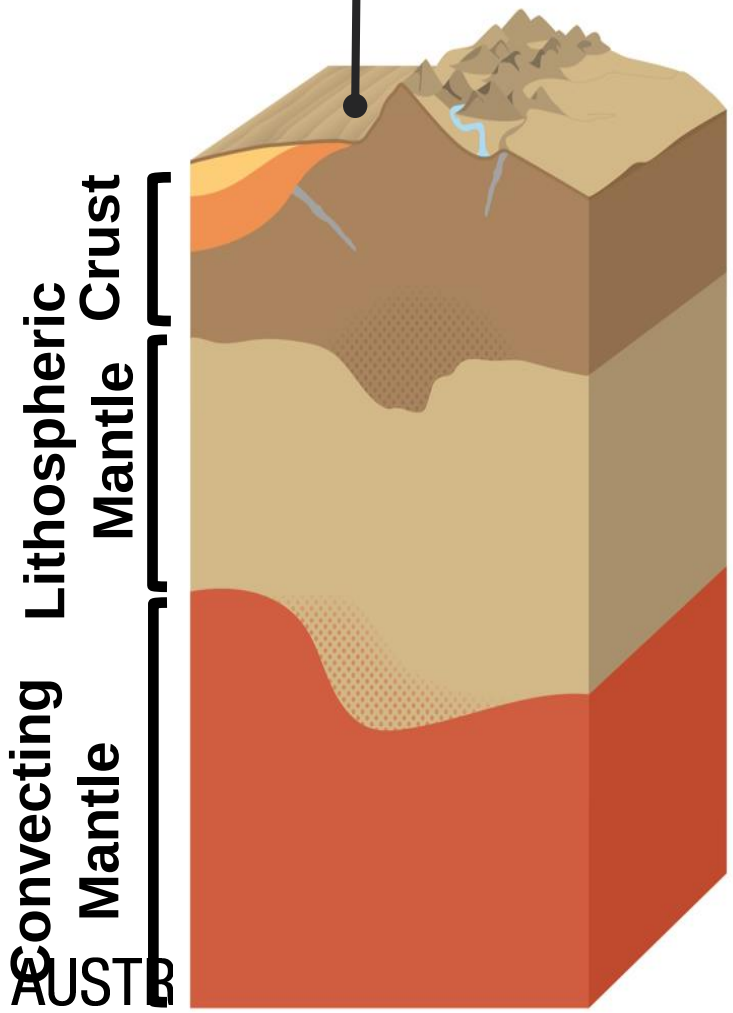
Lithospheric Mantle

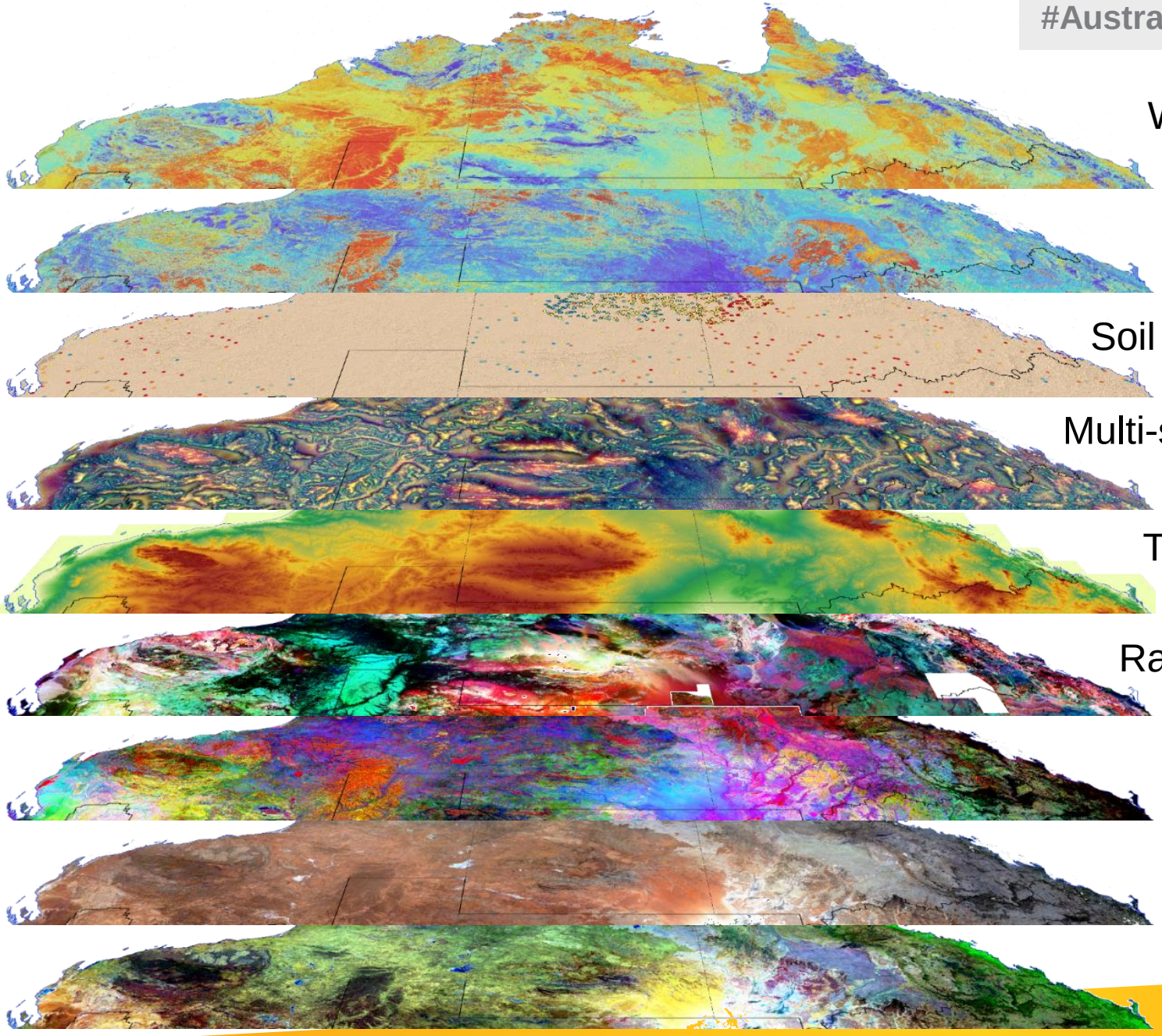


Mineral Potential

Amira Roadmap Highest & High Priorities

Surface





Predicted Weathering Intensity

Predicted Iron Oxide

Soil Geochem.

Multi-scale topo.

Topography

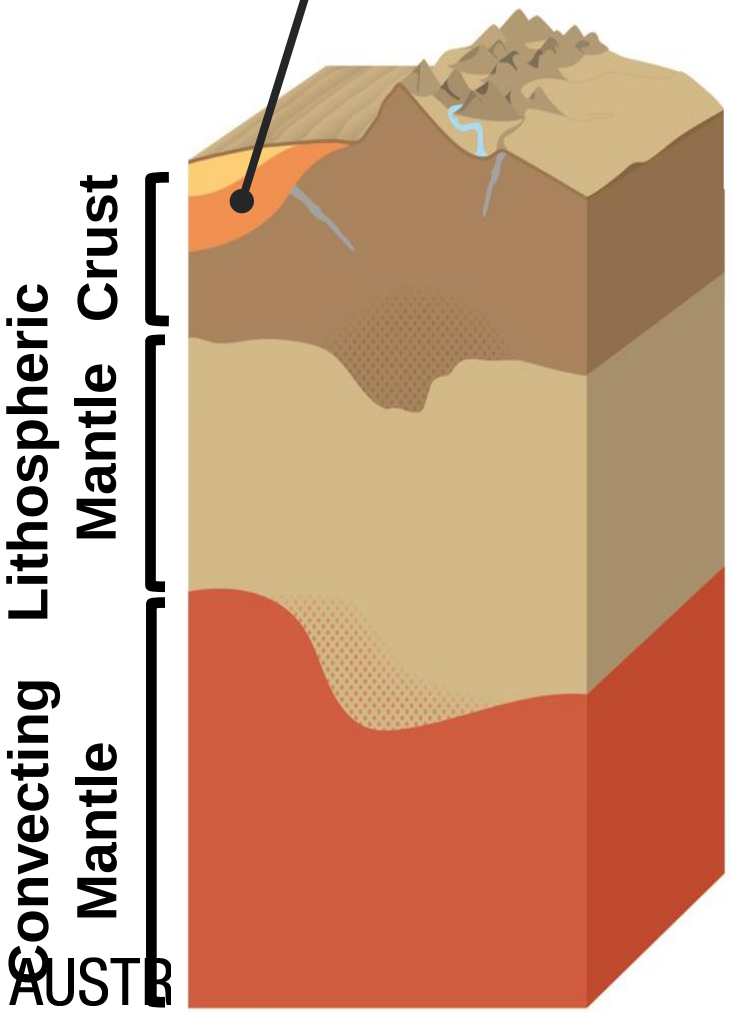
Radiometrics

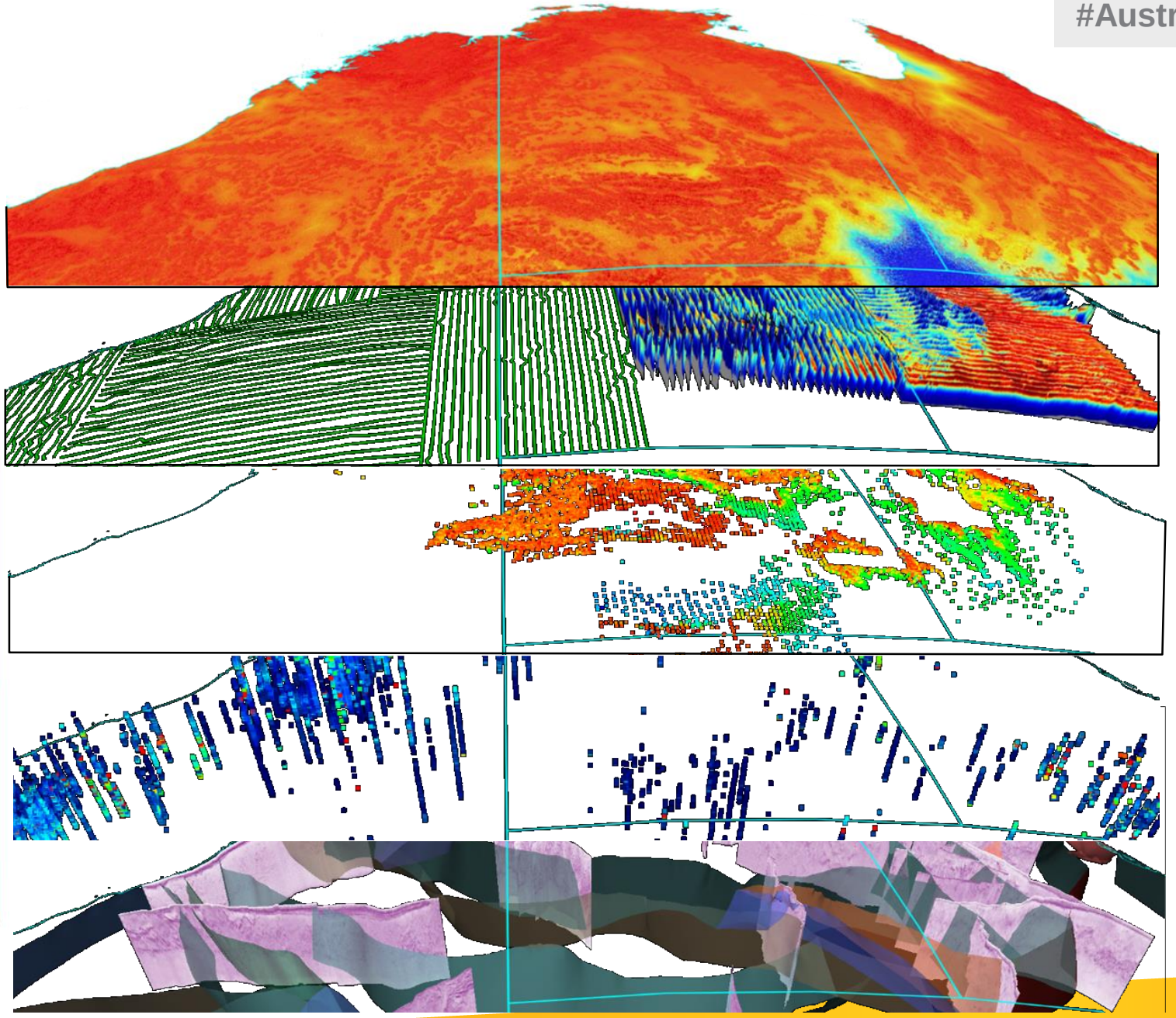
Sential2 Minerals

Landsat Barest

Landsat Greenest

Cover & Basins





Inferred basin/cover thickness

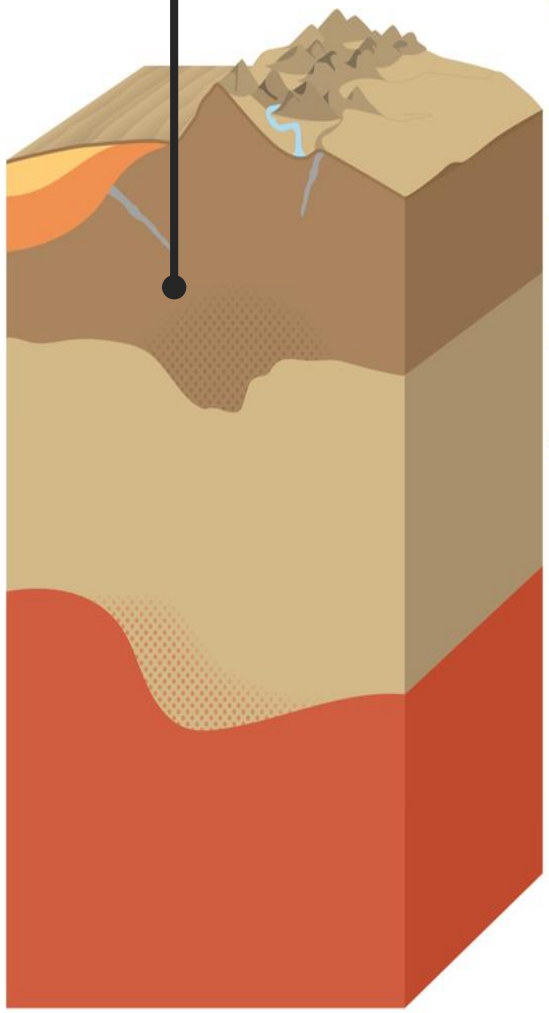
AusAEM

Depth to magnetic top

Source Rocks Atlas

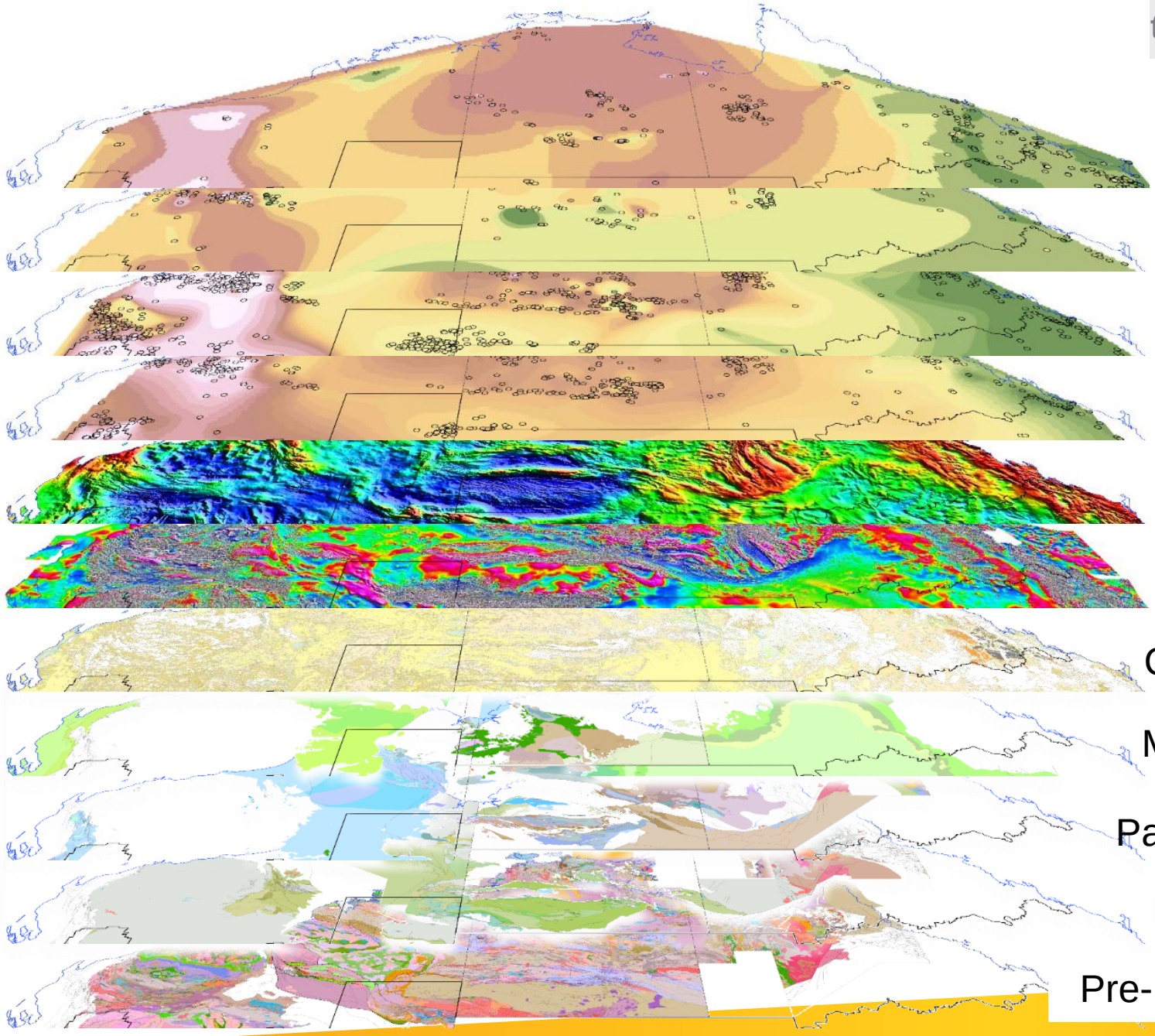
Reflection Seismic & Major Boundaries

Crust



Lithospheric Mantle
Crust
Convecting Mantle

AUSTR



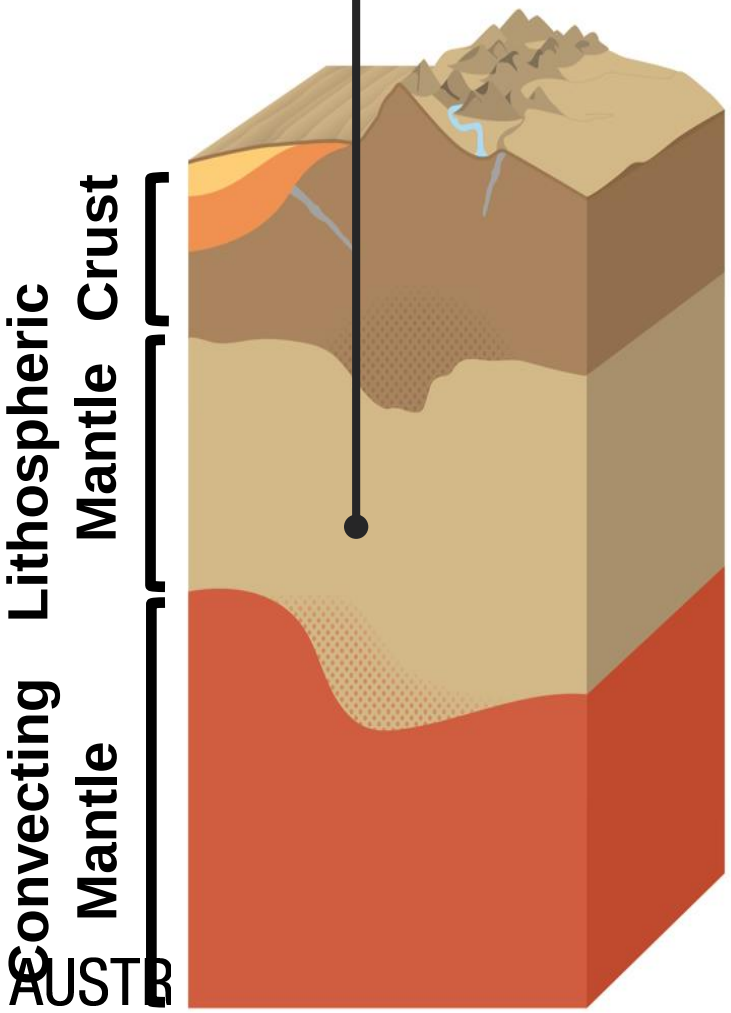
Isotopic Atlas
- Ar-Ar
- Pb-Pb
- U-Pb
- Sm-Nd

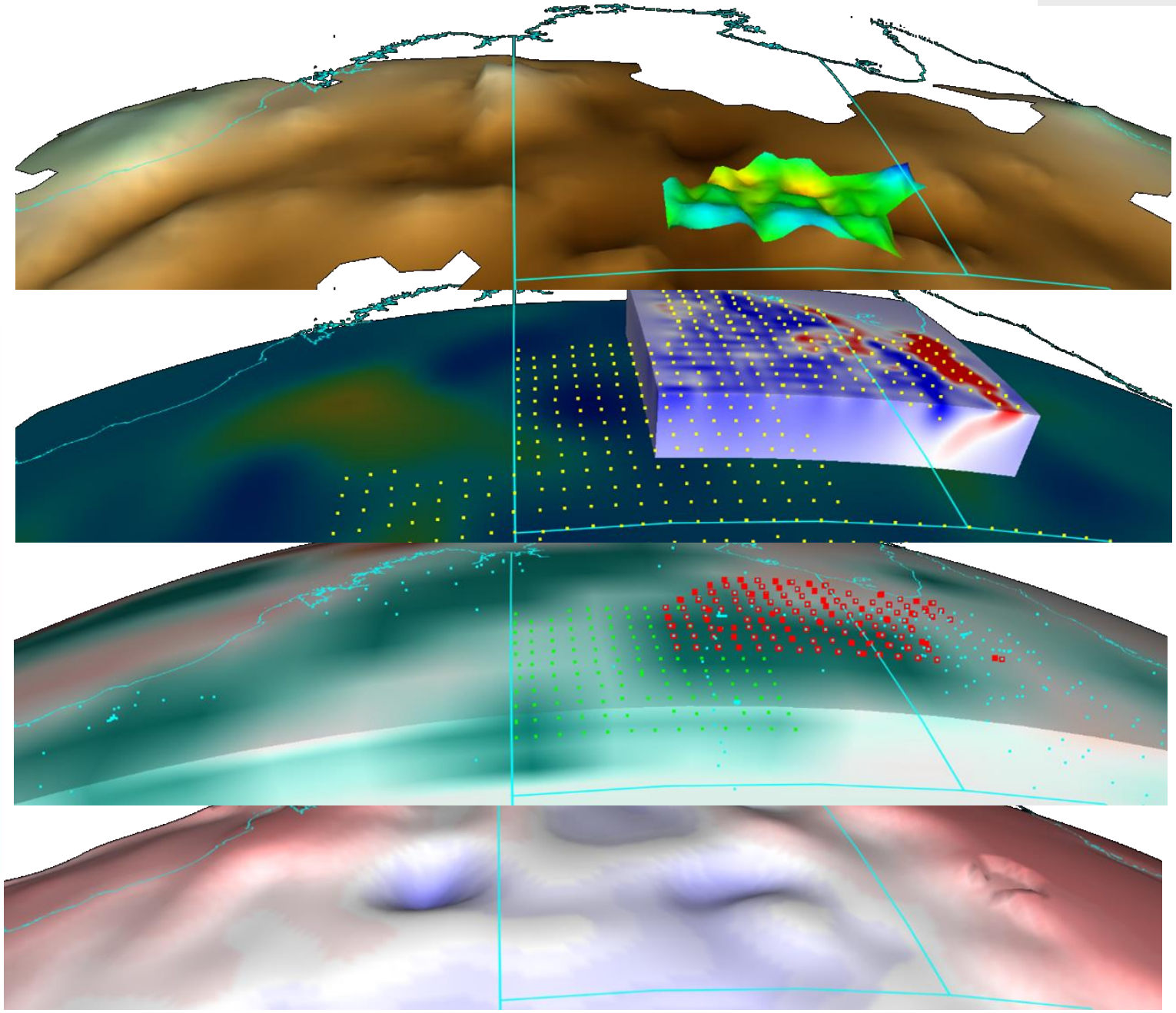
Gravity

Magnetics

Solid Geology
- Cenozoic
- Mesozoic
- Palaeozoic
- NeoProt.
- Pre-NeoProt.

Lithospheric Mantle





Moho

AusLAMP resisitivty models

AusArray velocity models

Base of Plate

Exploration Workflow using GA's portal

www.portal.ga.gov.au

1. **Project Generation Phase**
   - Mineral Potential Mapper
   - Economic Fairways

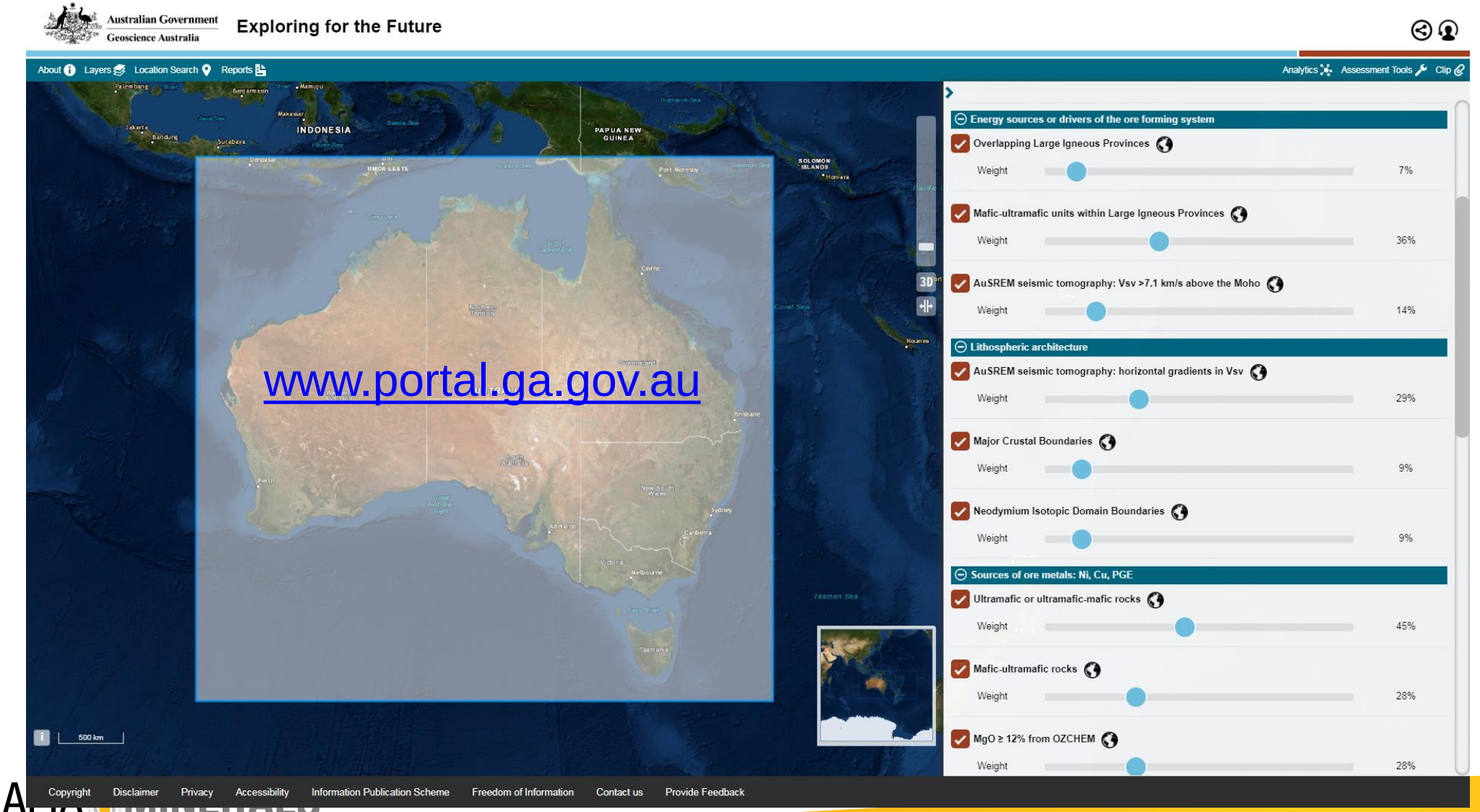
2. **Exploration Phase**
   - Data Discovery and Download
   - Analytical Tools
   - Planning a Drilling Program

3. **Feasibility Phase**
   - Route planning
   - Exposure risk and social analysis

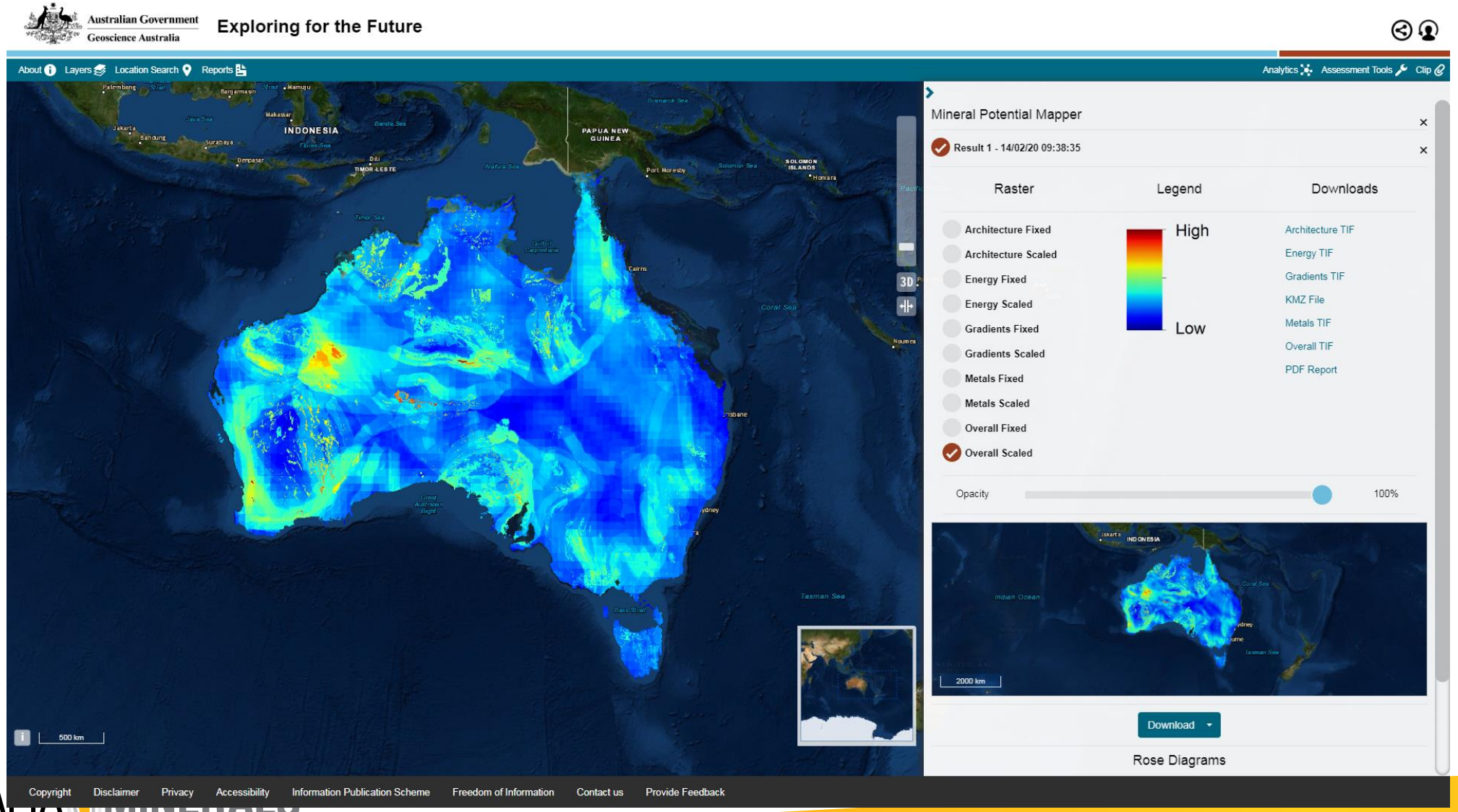
3. **Mining, Production, Mine Rehabilitation Phase**
   - Environmental monitoring

From pre-competitive data to pre-competitive decision-support

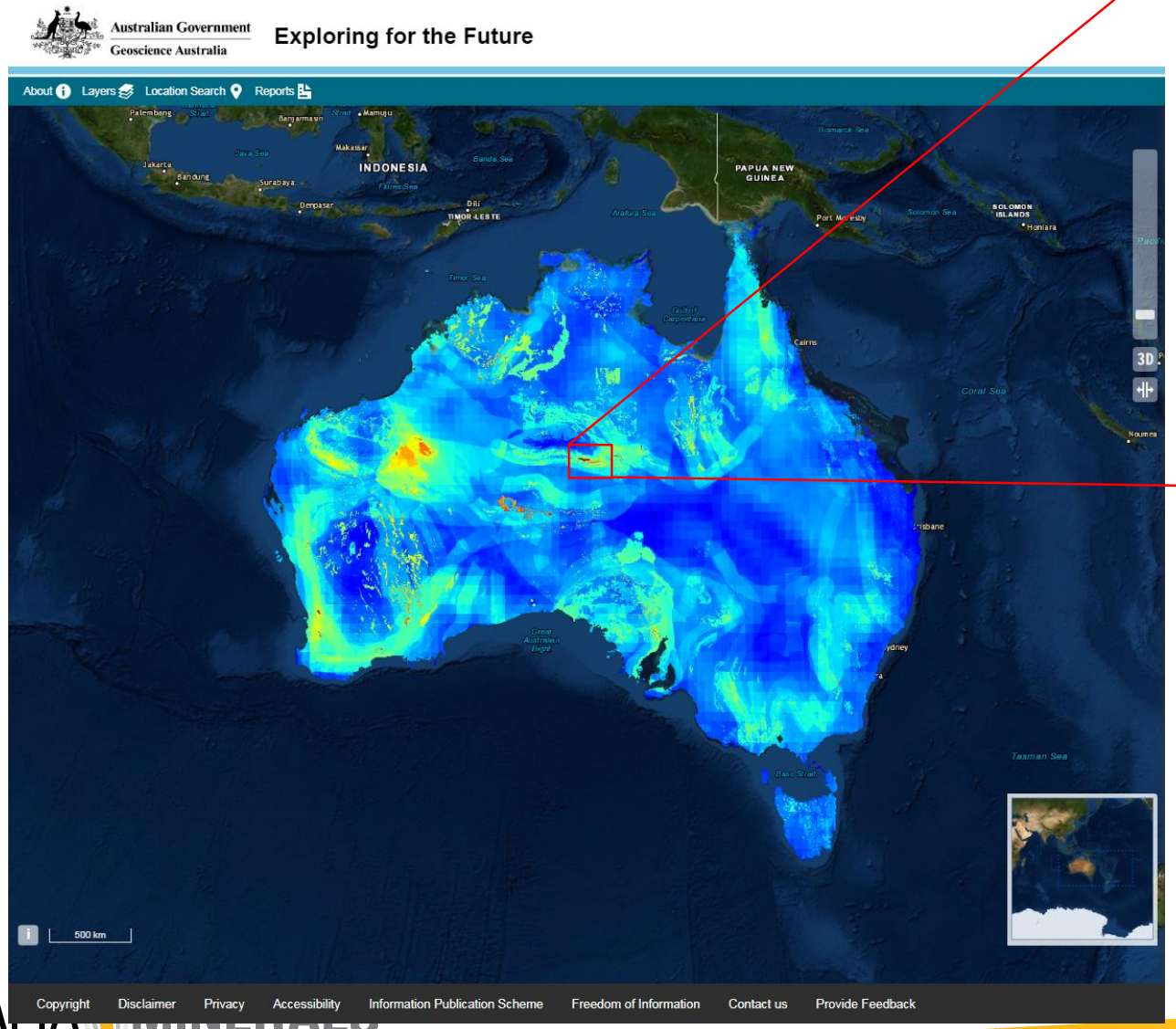
1) Project Generation: Mineral Potential Mapper Tool

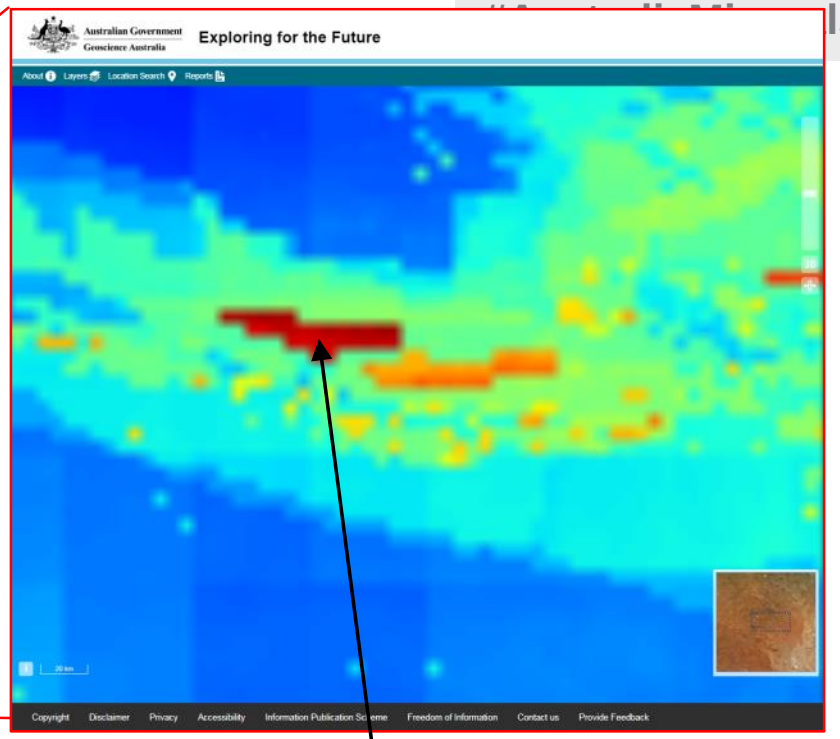


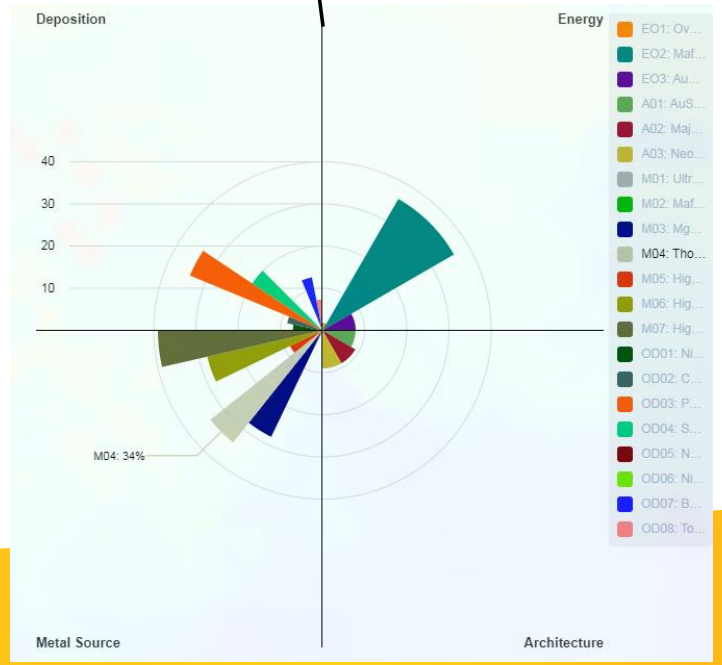
1) Project Generation: Mineral Potential Mapper Tool

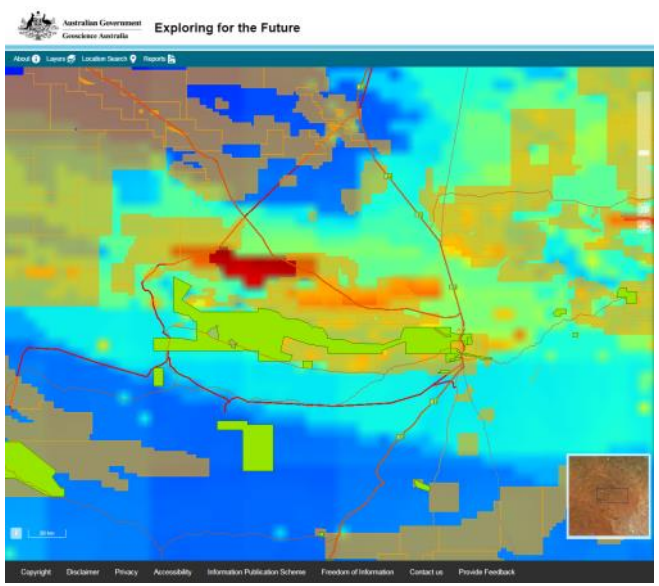


Project Generation:

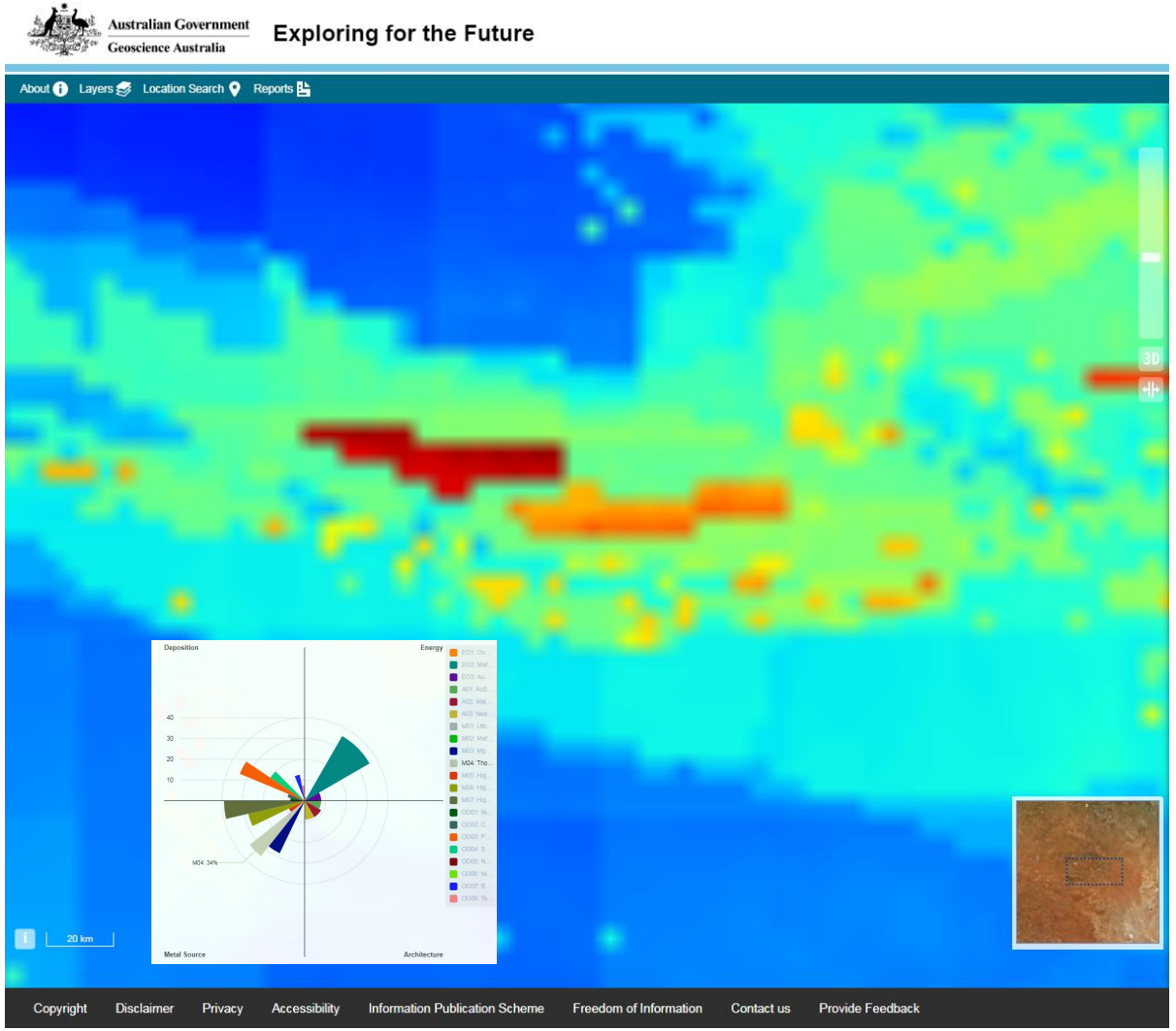


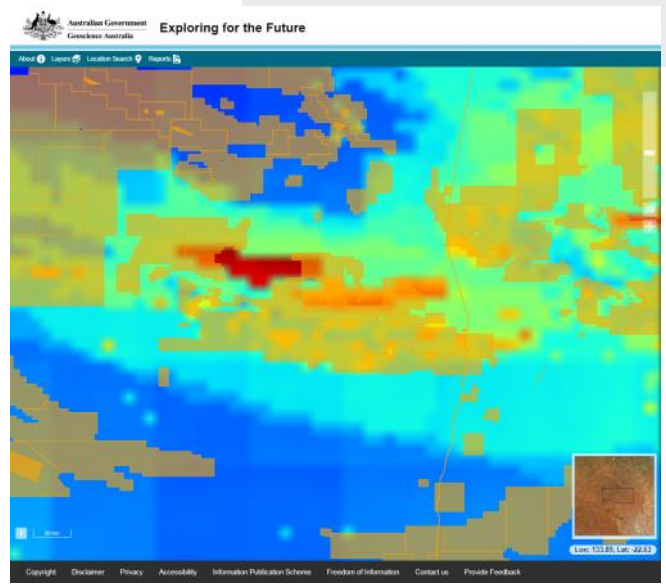




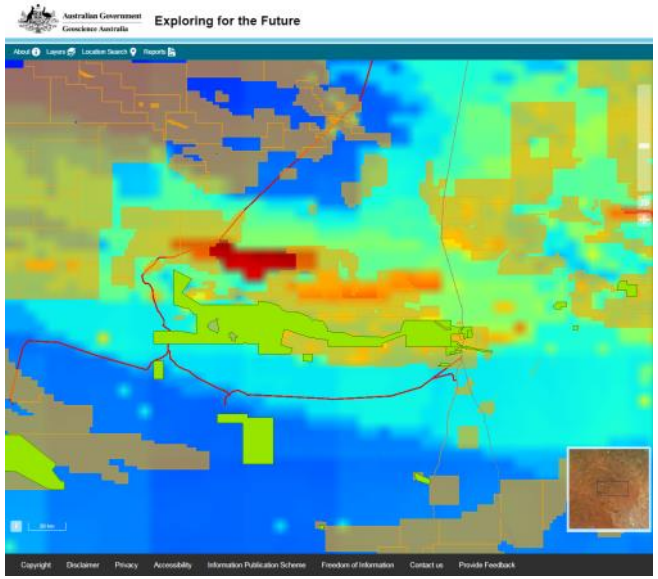


Roads

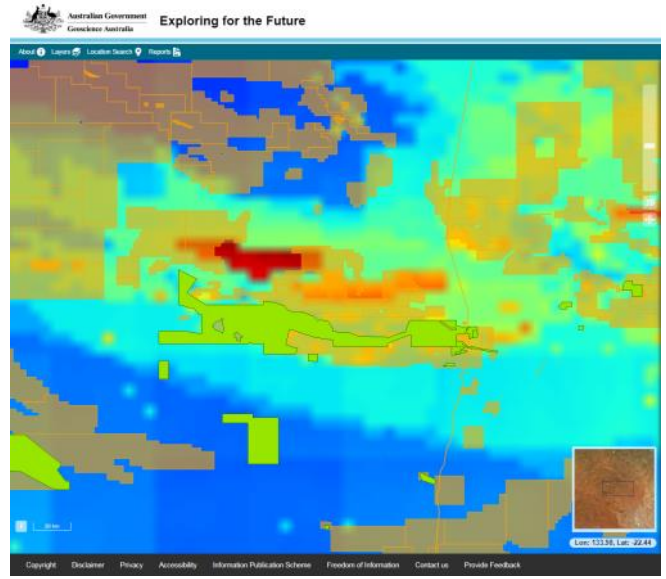




Mineral Tenements



Pipelines and Railways



National Parks

AUSTRALIA MINERALS

DISCLAIMER

- This ‘Economic Fairways Tool’ (**tool**) is presented by the Commonwealth of Australia represented by Geoscience Australia (**Geoscience Australia**) for the purpose of disseminating material free of charge for the benefit of the public. In particular, this tool makes available material relating to mineral ore deposits in northern Australia.
- However, Geoscience Australia does not guarantee and makes no assurances in relation to the accuracy, reliability, currency or completeness of any material available through this tool. Geoscience Australia accepts no legal liability whatsoever arising from, or connected to, the accuracy, reliability, currency or completeness of any material available through this tool, including the manner in which the material available through this tool is interpreted or used, or the results of such use.
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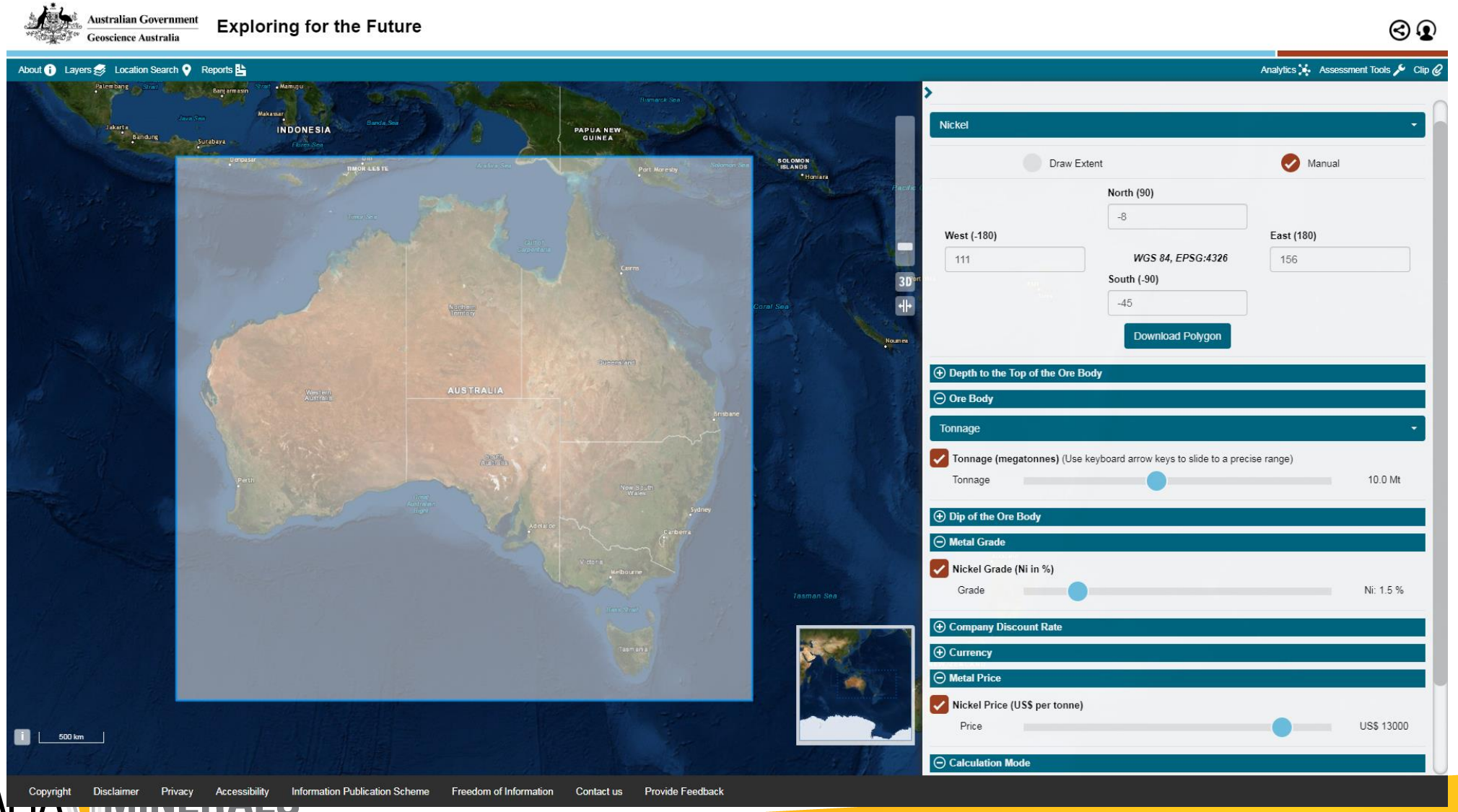
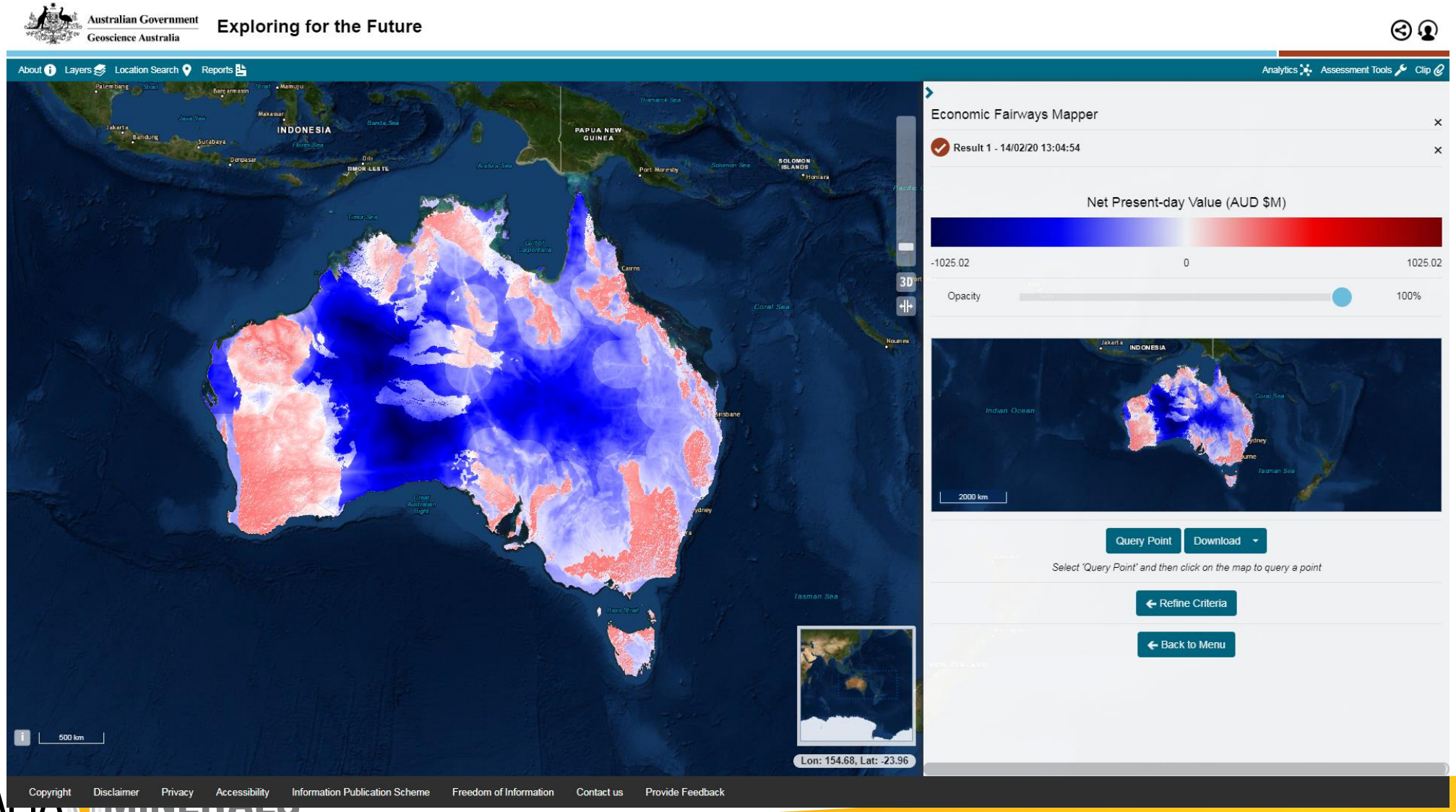
- The material available through this tool may include the views or recommendations of third parties, which do not necessarily reflect the views of Geoscience Australia.
- Users must exercise their own skill and care with respect to their use of this tool and that users carefully evaluate the accuracy, currency, completeness and relevance of the material available through this tool for their purposes.
- This tool is not a substitute for independent professional advice and users should obtain appropriate professional advice relevant to their particular circumstances before taking any action based on material available through this tool.
- In this disclaimer, except where stated otherwise: **'material'** includes, without limitation, data, algorithms, economic modelling, citations, feasibility assessments, heat maps, estimates or other indicators of cost to mine for an ore body, estimates or other indicators of potential return if an ore body is discovered, dollar values, pricing and conversion rates; and **‘material available through this tool**’ includes material available through any linked site.

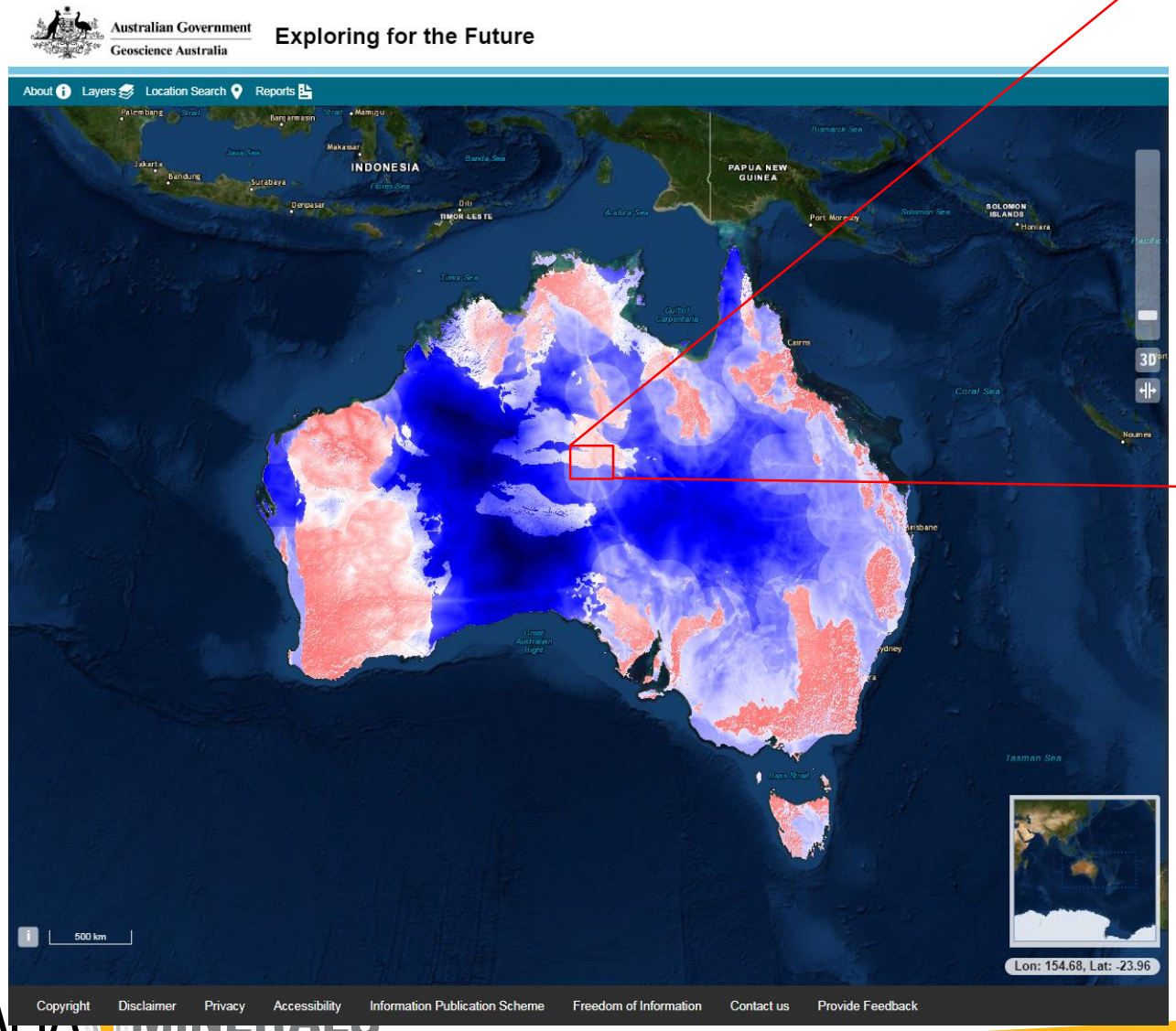
1) Project Generation: Economic Fairways Mapper

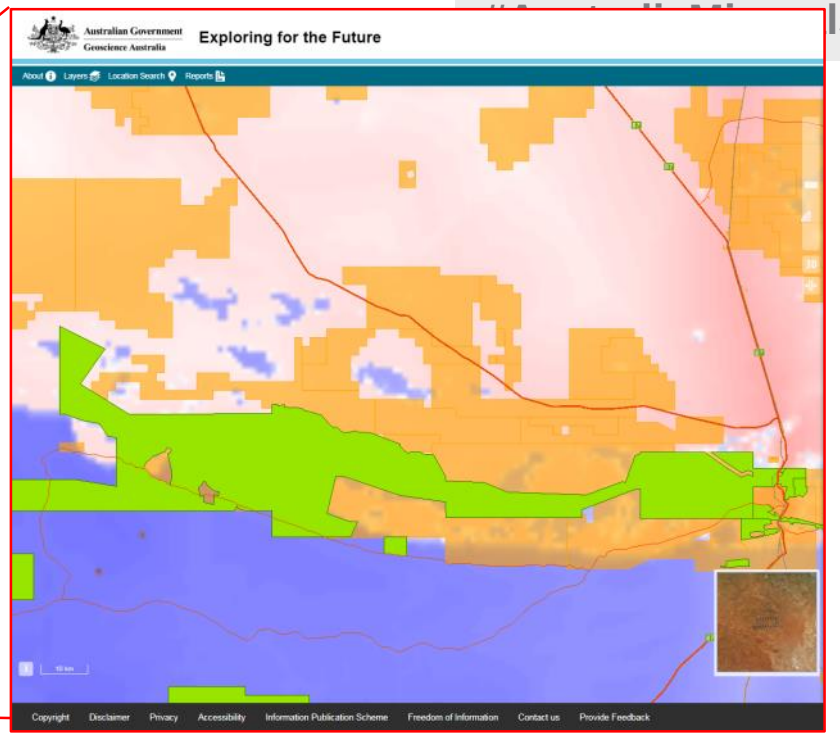


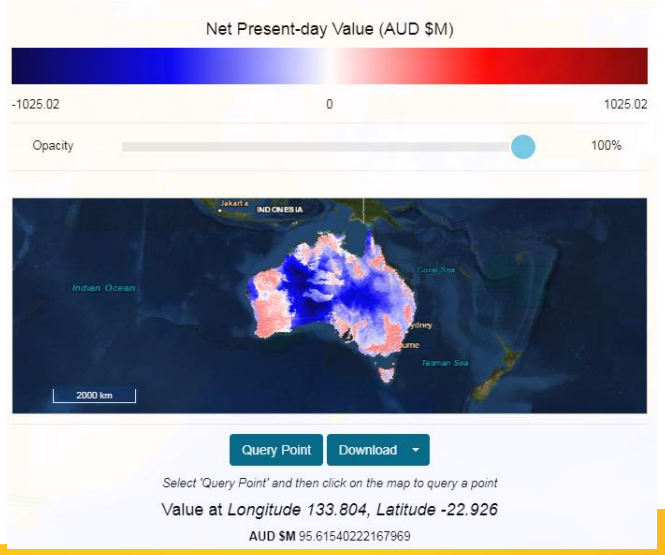
1) Project Generation: Economic Fairways Mapper



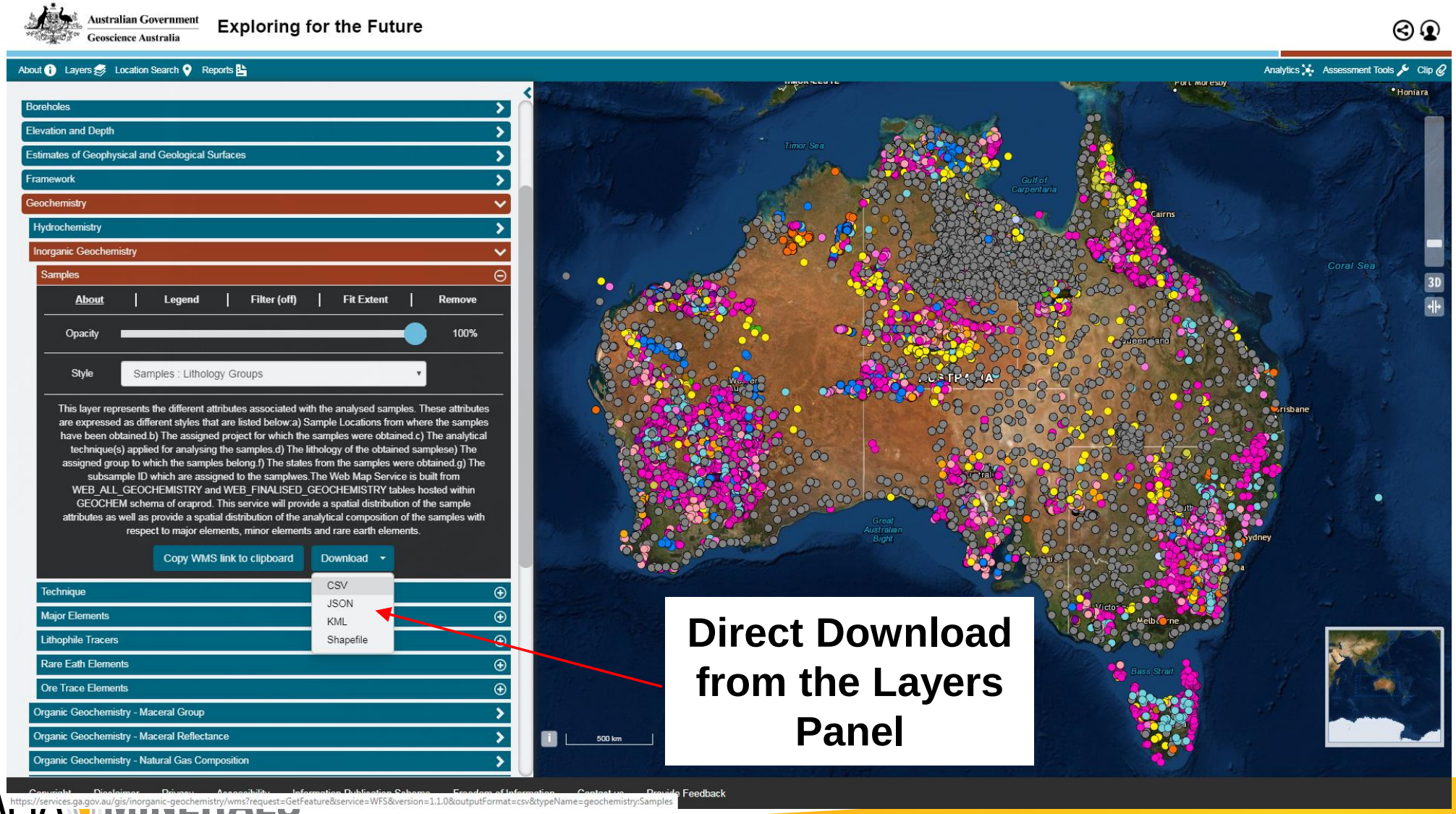
1) Project Generation:







2) Exploration: Data discovery & download



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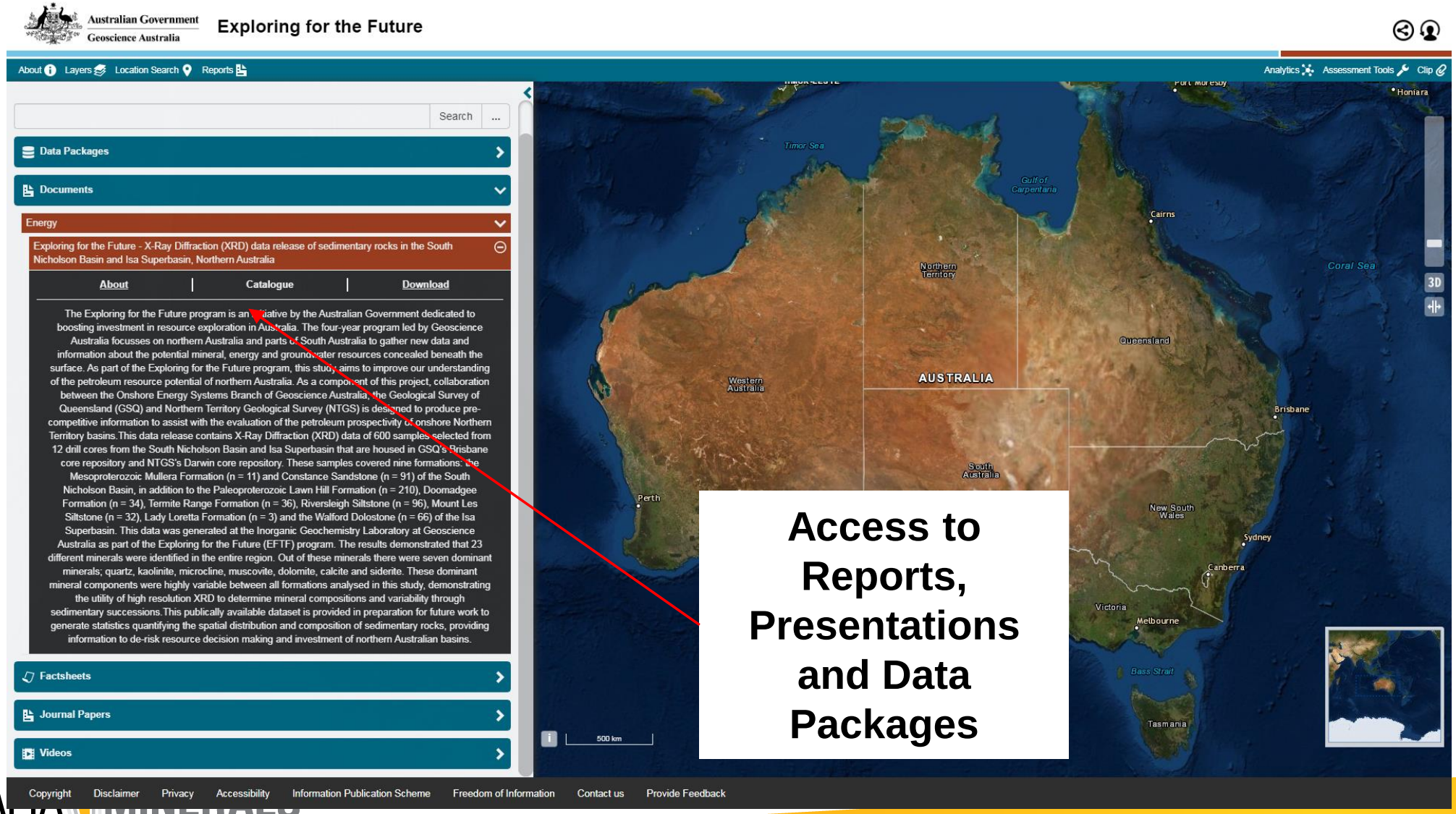
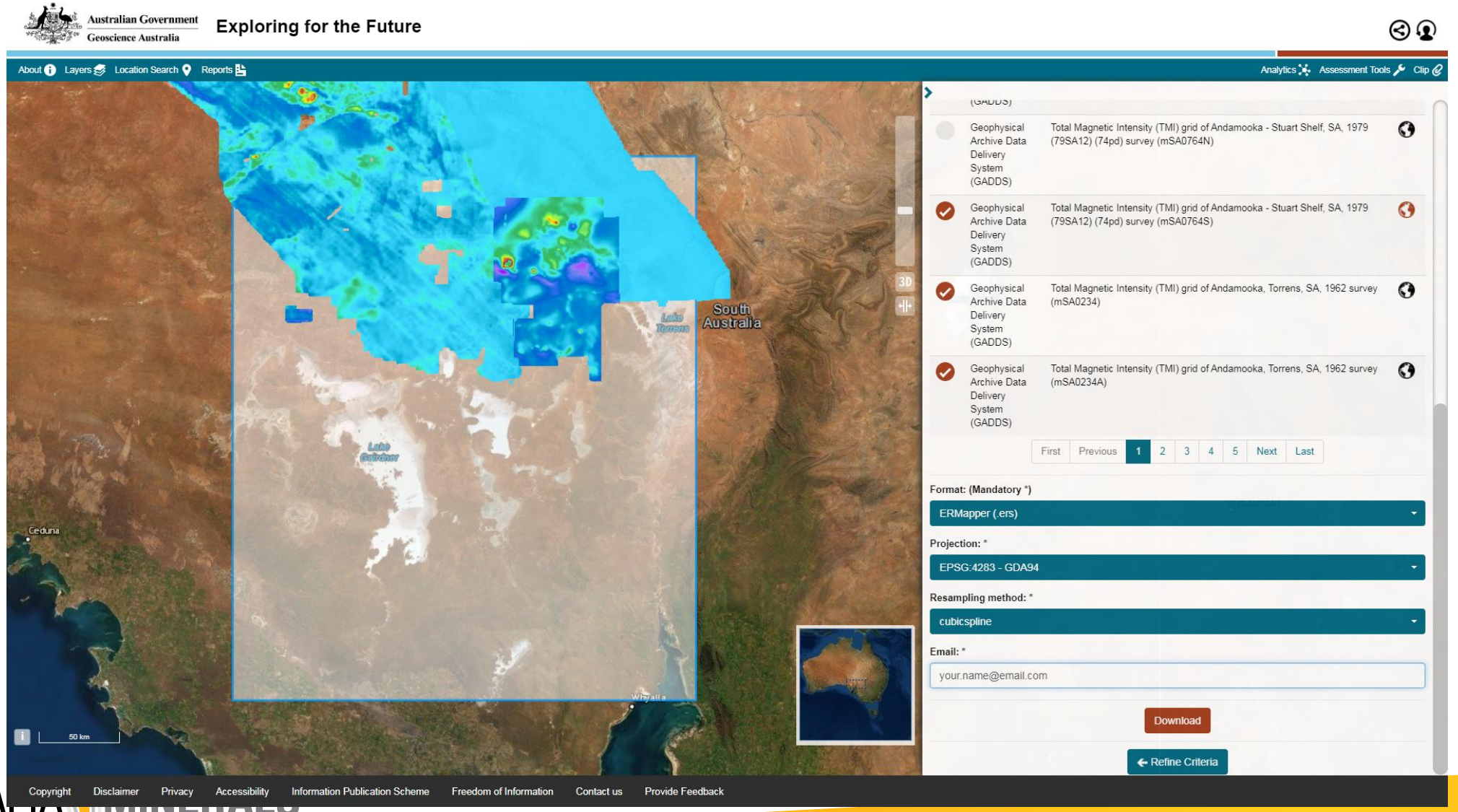
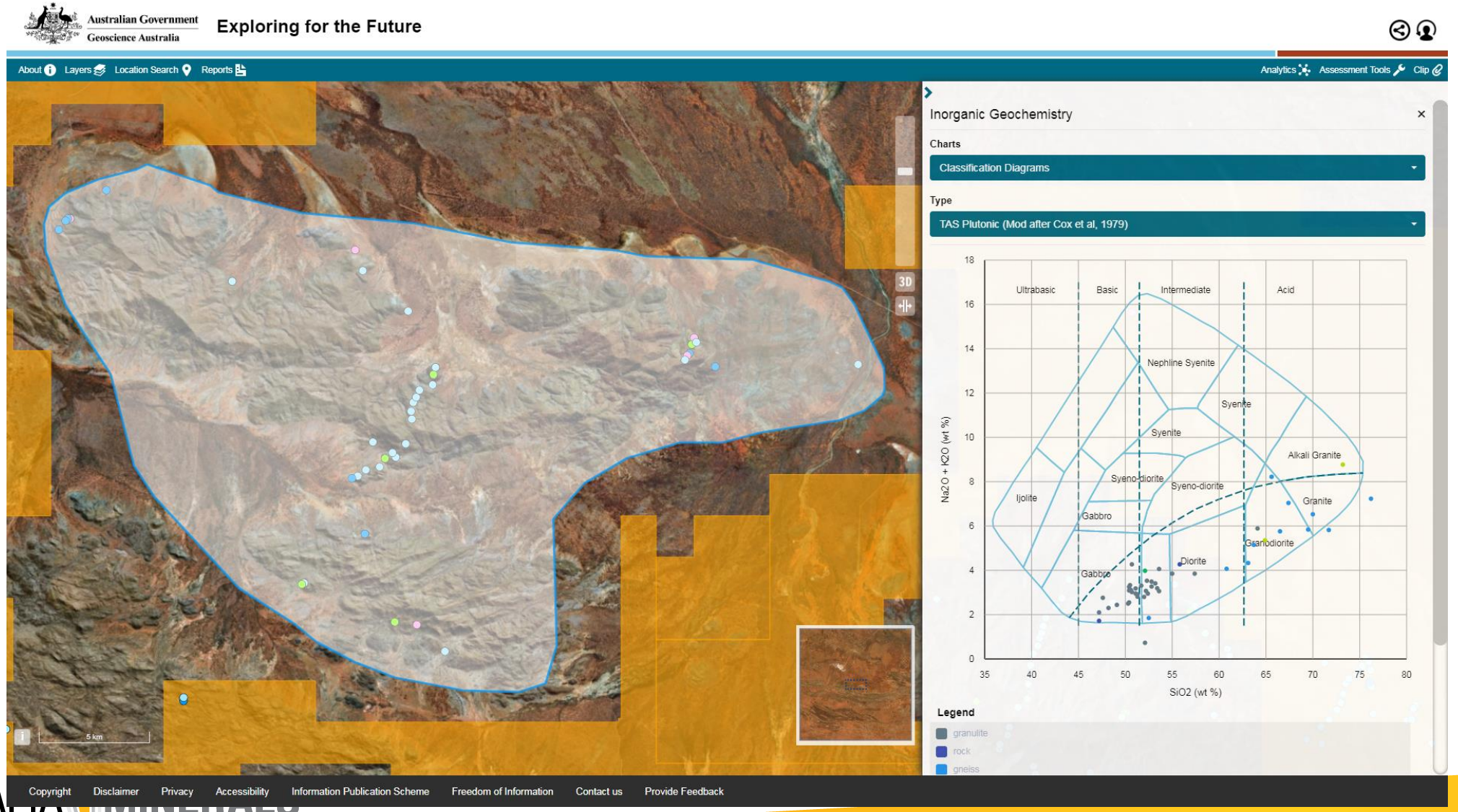


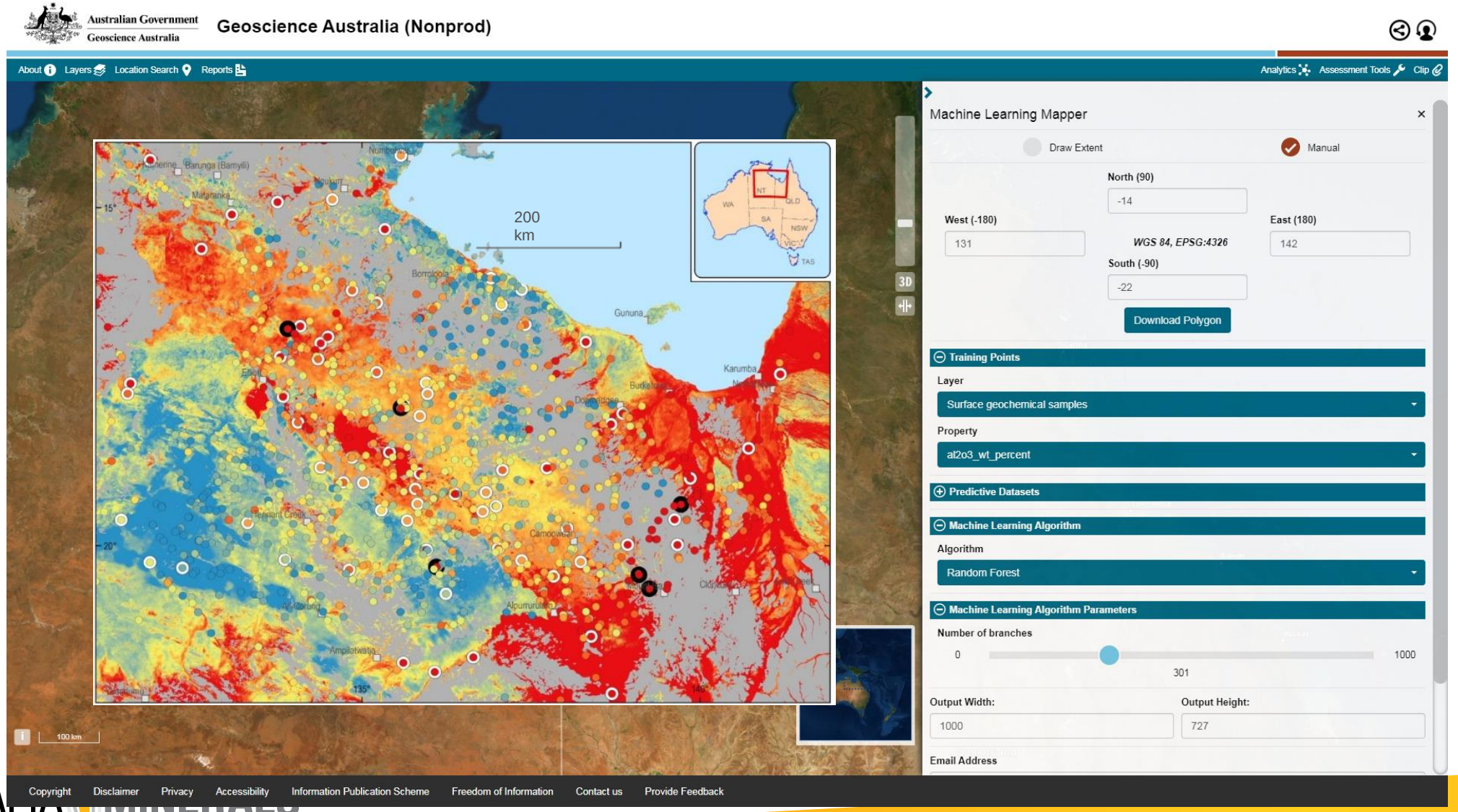
2) Exploration: Data discovery & download (Clip-Zip-Ship)



2) Exploration: Analytical Tools (Inorganic geochemistry)

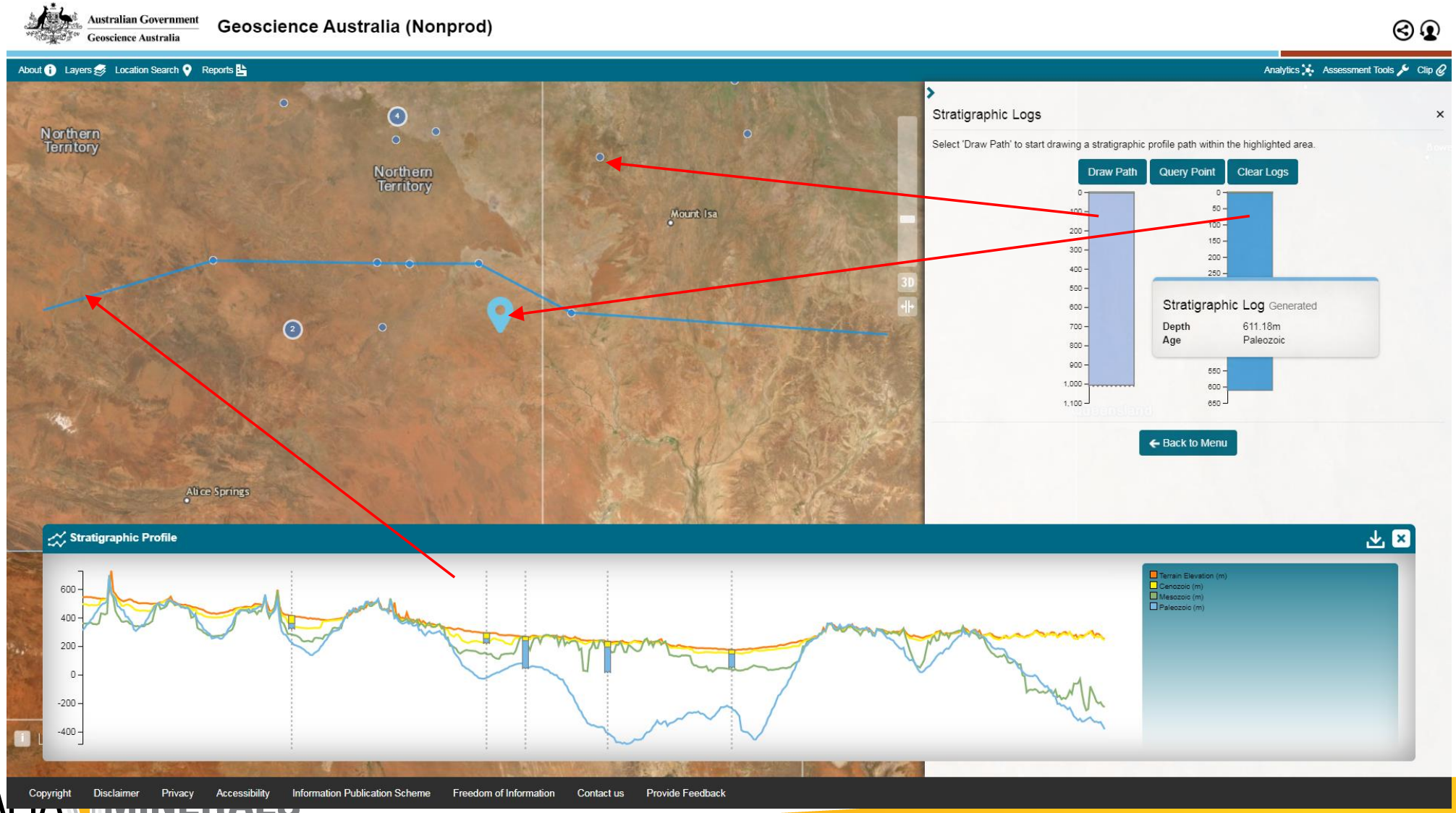


2) Exploration: Data Processing (Machine Learning)

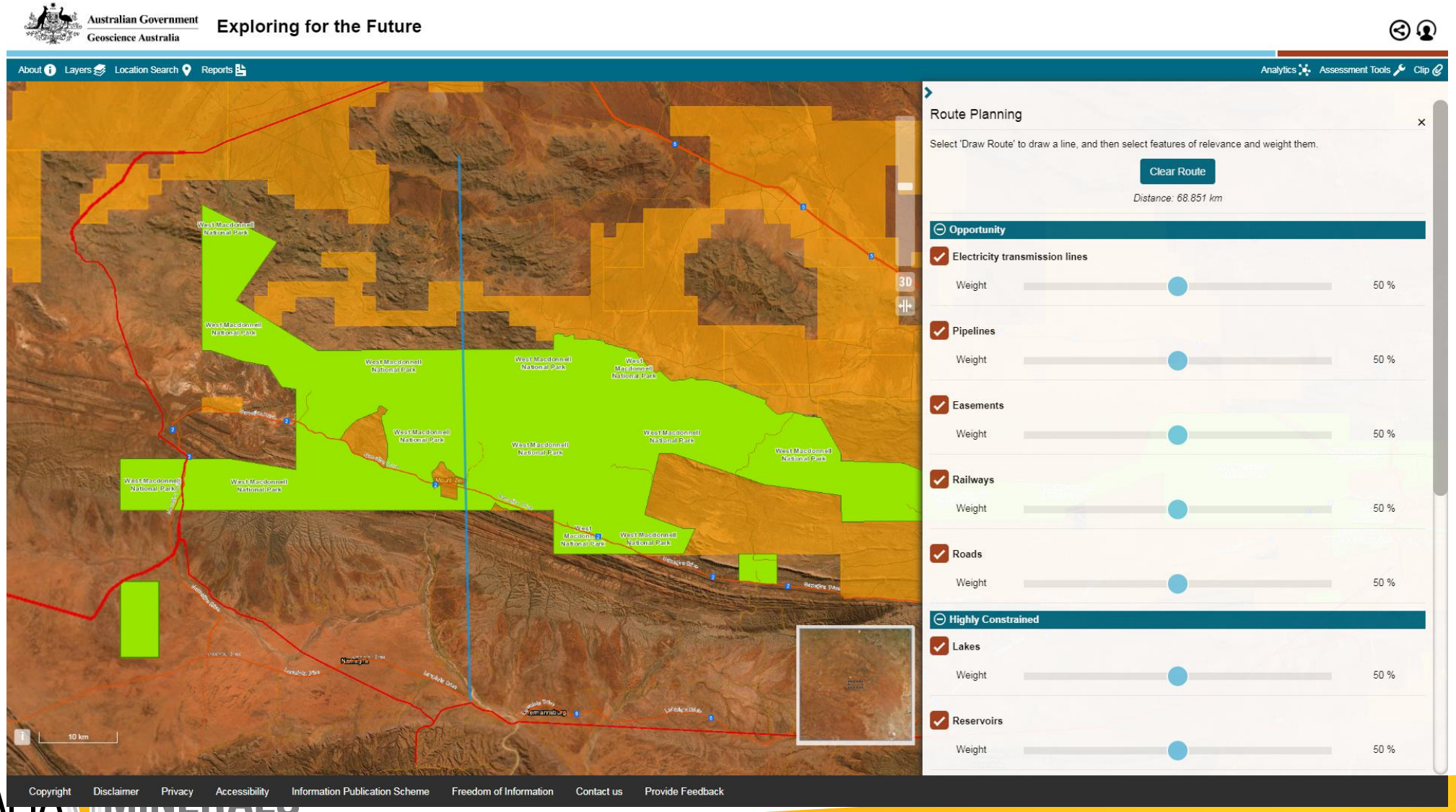


2) Exploration: Planning drill program (3D visualisation)

2) Exploration: Planning drill program (virtual bore hole)

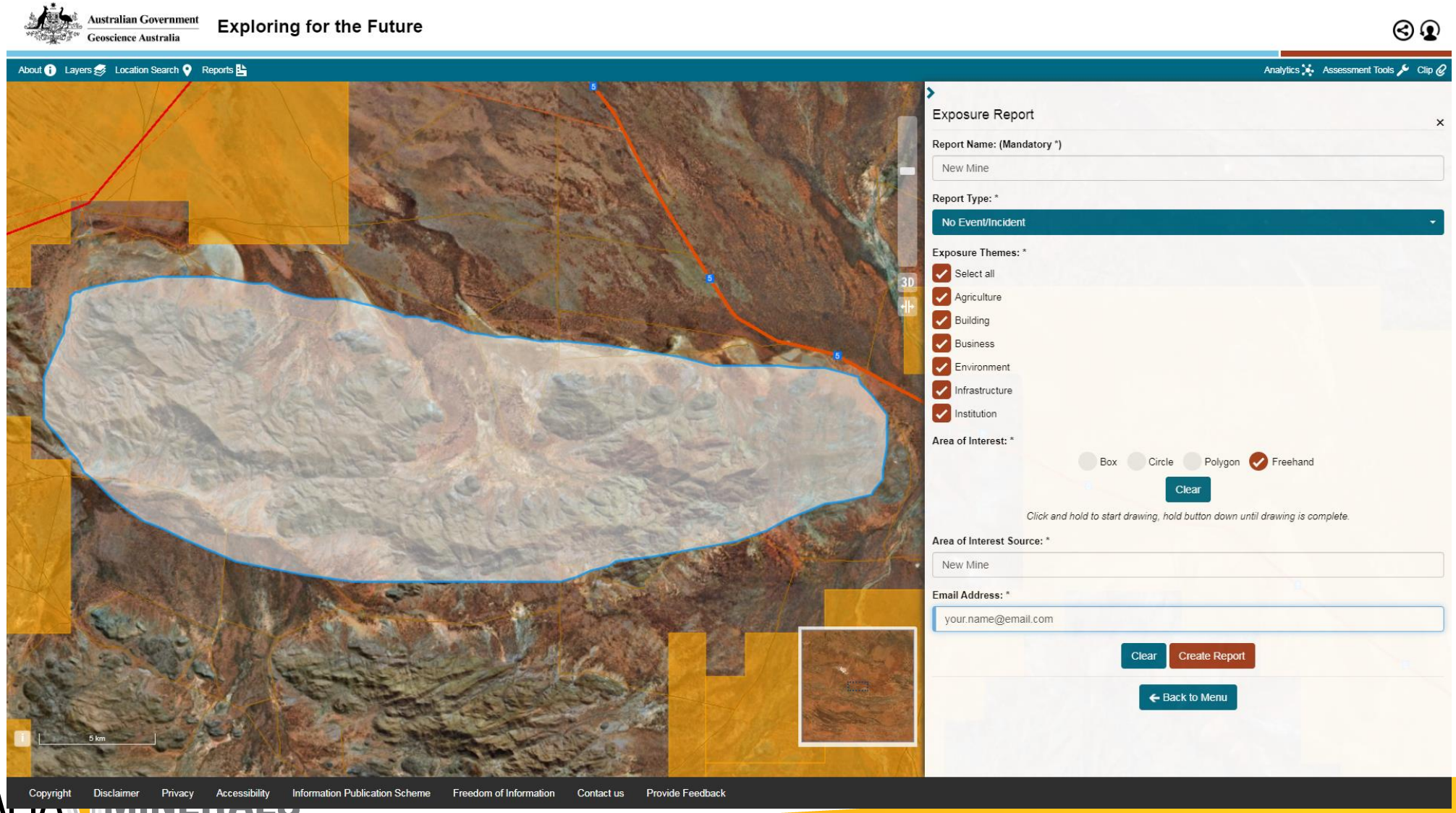


3) Feasibility: Route and infrastructure planning



3) Feasibility: Route and infrastructure planning

3) Feasibility: Exposure risk & social report



3) Feasibility: Exposure risk & social report

Geoscience Australia - Exposure Report

Event name: New Mine

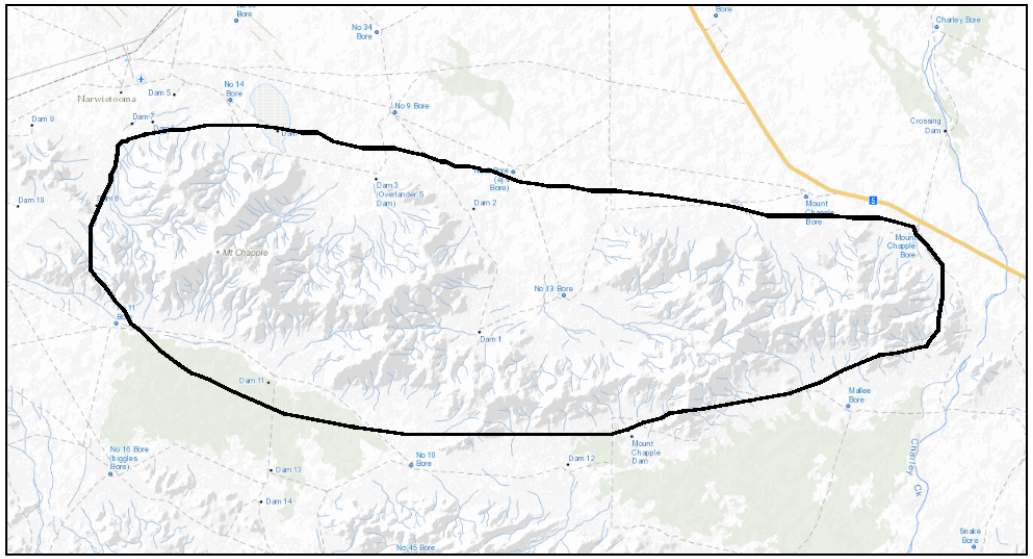
Event type: No Event/Incident

Report Date: 14-02-2020 14:17:54 (AEST)

LGAs within the event footprint: MacDonnell (R) (0.1%)

Localities within the event footprint: No localities found

Footprint data source: New Mine



Building Exposure, V10 January 2019	
Residential	**Event**
Population count	-
Dwelling count*	-
Building count	-
Pre 1980 construction count	-
Pre 1990 probable asbestos containing products**	-
Reconstruction value	$-
Contents value	$-
Commercial	
Building count	-
Reconstruction value	$-
Industrial	

Dwelling estimates where residents:		
Demographic*	**Event**	**NT(Av)**
Are all aged 65 or over	0%	8.6%
Includes persons aged 14 years and under	%	31.7%
Includes an Indigenous person	0%	22.2%
Are a single parent family	0%	9.8%
Are in need of assistance for self-care activities	0%	8.9%
Include persons not proficient in English	0%	1.2%
Do not have access to a motor vehicle	0%	13.3%
No one has completed Year 12 or higher	0%	15.4%
Moved to the region in the last 1 year	0%	17.5%
Moved to the region in the last 5 years	0%	39.8%
Top 5 employing industry*:		

Institution Exposure			
Education	**Event**	**Government Facilities**	**Event**
School - Pre/Primary	-	Federal Court	-
School - Secondary	-	Medicare Office	-
School - Tertiary	-	Centrelink Office	-
School - Other (Combined, Special)	-	Diplomatic Facility	-
Health and Welfare		Consulate Facility	-
Hospital - Public	-	Major Defence Facility	-
Hospital - Private	-	Correctional Facility	-
Nursing Home	-	Immigration Detention Facility	-
Retirement Home	-	Local Government Offices	-
Emergency Services			
Police Station	-		
Fire Station	-		
Ambulance Station	-		
SES Facility	-		
Emergency Management Facilities	-		

Infrastructure Exposure			
Utility/Energy	**Event**	**Transport**	**Event**
Power Station - Major Renewable	-	Airport - Major Areas	-
Power Station - Major Fossil Fuel	-	Airport - Major Terminals	-
Transmission - Substation	-	Airport - Landing Grounds	1
Transmission - Electricity Lines (km)	-	Road - Major (km)	-
Liquid Fuel - Refineries	-	Road - Arterial and Sub-arterial (km)	-
Liquid Fuel - Terminals	-	Railway - Station	-
Liquid Fuel - Depots	-	Railway - Tracks (km)	-
Liquid Fuel - Petrol Stations	-	Maritime - Major Port	-
Gas Pipeline (km)	-	Maritime - Ferry Terminal	-
Oil Pipeline (km)	-		
Off-shore Extraction Platform	-		
Waste Management Site	-		
Waste Water Treatment Plant	-		
Major Dam Walls	-		
Telephone Exchange	-		
Broadcasting Studios (Radio and TV)	-		

Business Exposure, ABR 2018			
Number of businesses	-	**Number of Registered Charity Organisations:**	
Accommodation and Food Services	-		
Administrative and Support Services	-	**Number of Primary Producers***	-
Agriculture, Forestry and Fishing	-	Agriculture and Fishing Support Services	-
Arts and Recreation Services	-	Aquaculture	-
Construction	-	Dairy Cattle Farming	-
Education and Training	-	Deer Farming	-
Electricity, Gas, Water and Waste Services	-	Fishing	-
Financial and Insurance Services	-	Forestry and Logging	-
Health Care and Social Services	-	Forestry Support Services	-

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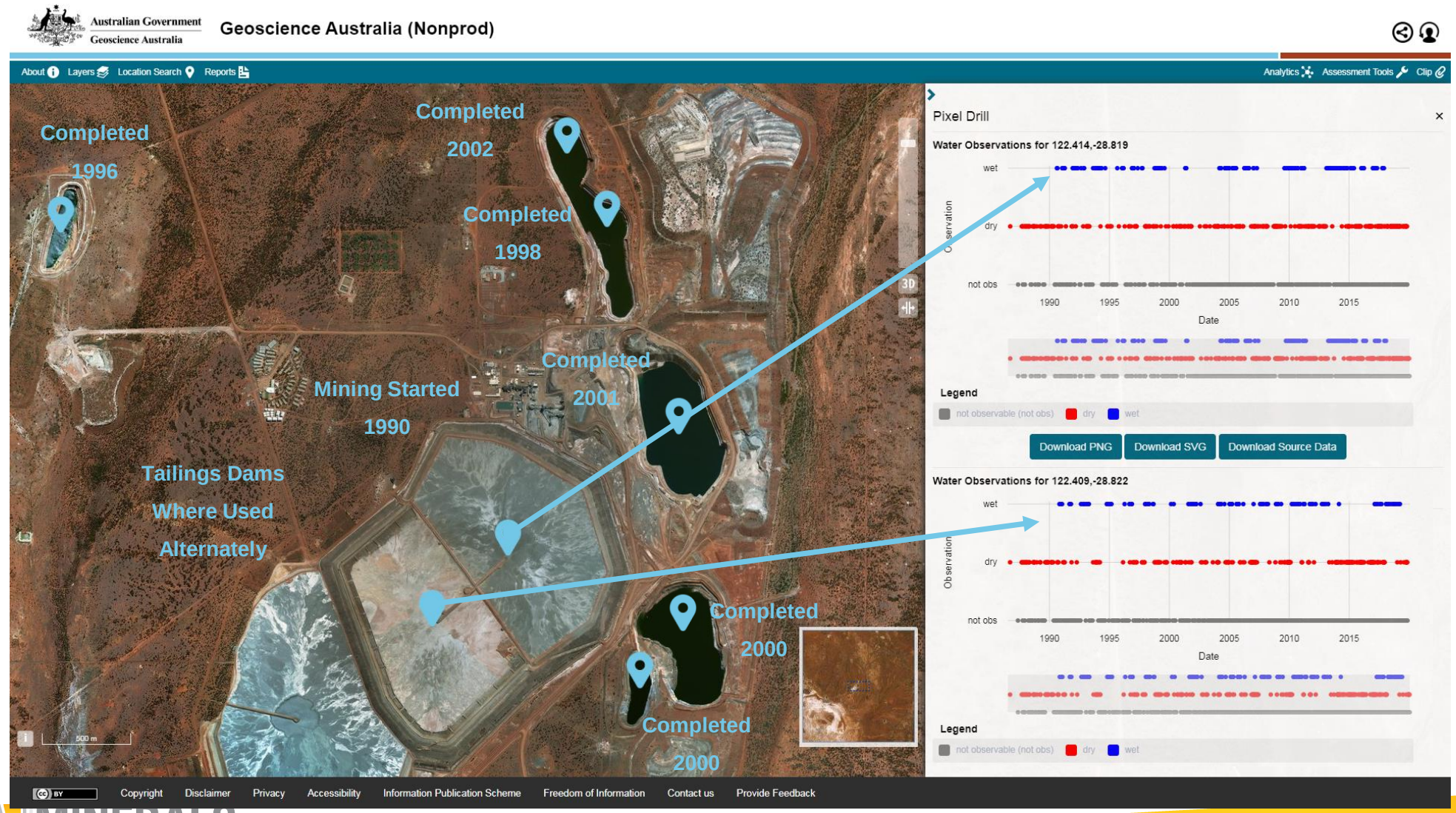
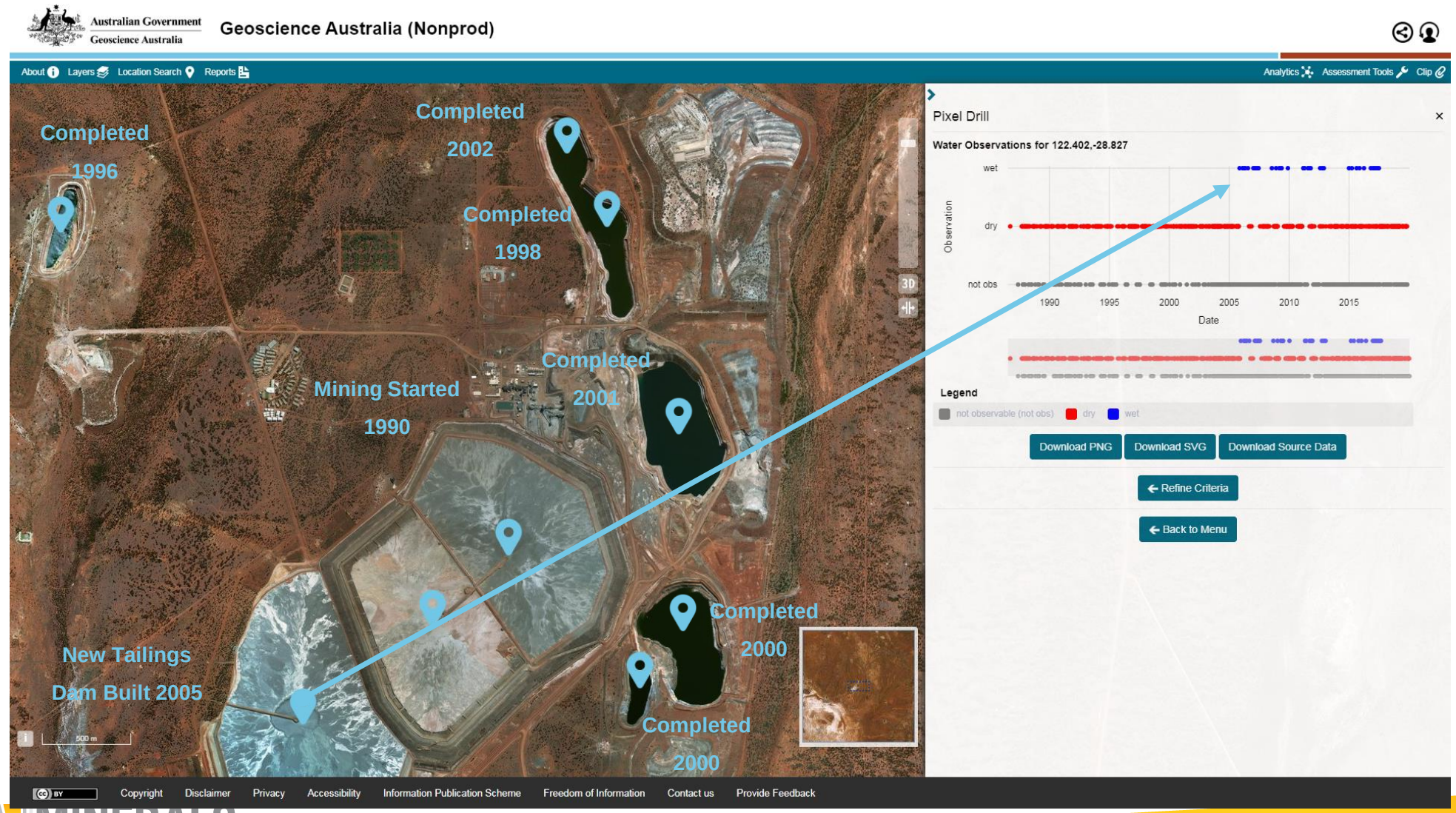
4) Mine monitoring and rehabilitation



4) Mine monitoring and rehabilitation



Take home messages

- Australia a highly favourable investment destination (Fraser Institute)
- We have the geology, the data and frameworks

- From data to decisions…… www.portal.ga.gov.au
- Economics + ESG + cultural - bottom line capability
- World-first portal that makes the world's best pre-competitive information even better

Australia Minerals

www.australiaminerals.gov.au

Thank you for your interest in Australia

Join us at the Booth (Trade Show South), or
Australia Day (Tuesday morning *206B MTCC North Building*),
for demos or just a chat

AUSTRALIA MINERALS

REALISE THE OPPORTUNITY

New South Wales Resource stewardship for a high-tech future

NSW GOVERNMENT | Planning, Industry & Environment

Acknowledgement

On behalf of the Division of Resources & Geoscience,

I acknowledge that we meet today on land that is the traditional territory of many nations including the Chippewa, the Haudenosaunee and the Wendat peoples, and is now home to many diverse First Nations, Inuit and Métis peoples.

I also acknowledge the many Aboriginal First Nations people in NSW on whose lands we live and work, and of whose lands I will be speaking today.

Agenda

- A bit about New South Wales (NSW)
- The Future of Minerals in NSW
- NSW – your next exploration destination
- Questions

NSW overview

Not only the country's most populated state, it's also **Australia's best economic performer**

Population

- Sydney — **5.1 m**
- Total NSW — **7.9 m**
- Australia — **24.7 m**

Economy

- 2.9% growth
- AAA credit rating
- 95.4% employment

Foreign investment

NSW accounted for 44% of total greenfield FDI projects into Australia from 2013–18

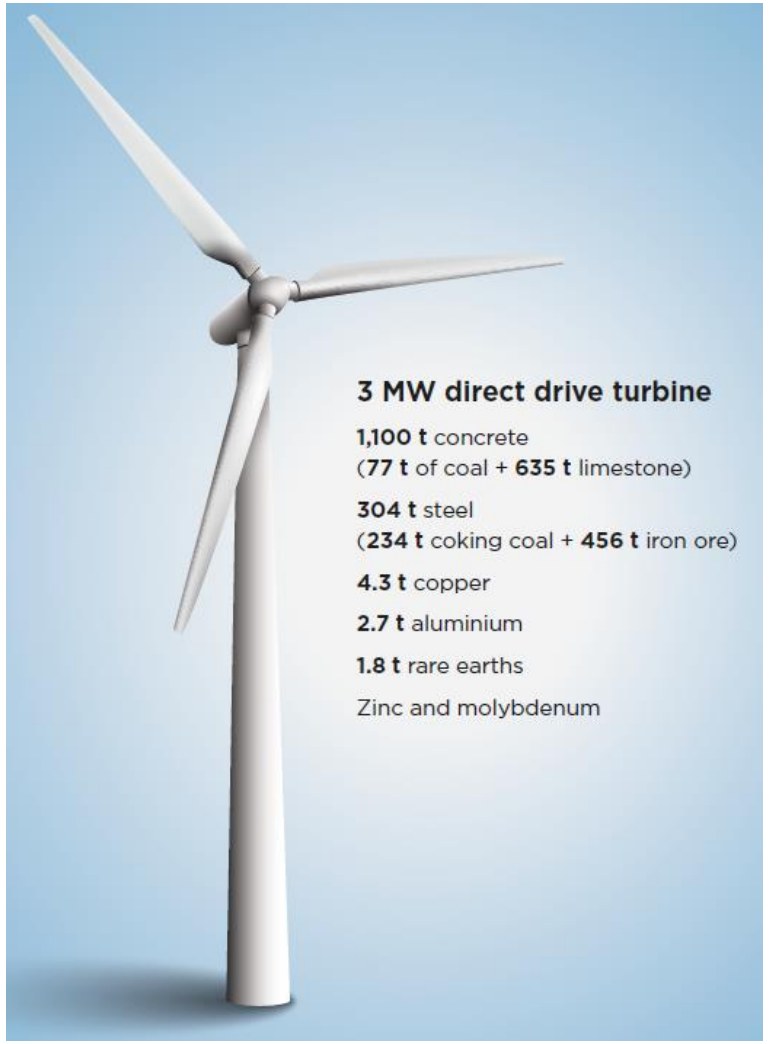
Infrastructure

A$87.2 billion government investment from 2017–2021

Future of Minerals in NSW

- Our mineral resources supporting the modern world by:
  - responsible sourcing
  - increasing exploration potential
  - opening new frontiers for traditional and critical metals

Renewable energy



Gear powered wind technologies
Al Aluminium, Cr Chromium, Cu Copper, Fe Iron, Mn Manganese, Ni Nickel, St Steel, Zn Zinc

Direct drive wind technology
Al Aluminium, Cr Chromium, Cu Copper, Fe Iron, Pb Lead, Mn Manganese, Nd Neodymium, Ni Nickel, St Steel, Zn Zinc

Crystalline silicon solar technology
Al Aluminium, Cu Copper, Fe Iron, Pb Lead, Ni Nickel, Ir Iridium, Ag Silver

Copper indium solar technology
Cu Copper, Ir Iridium

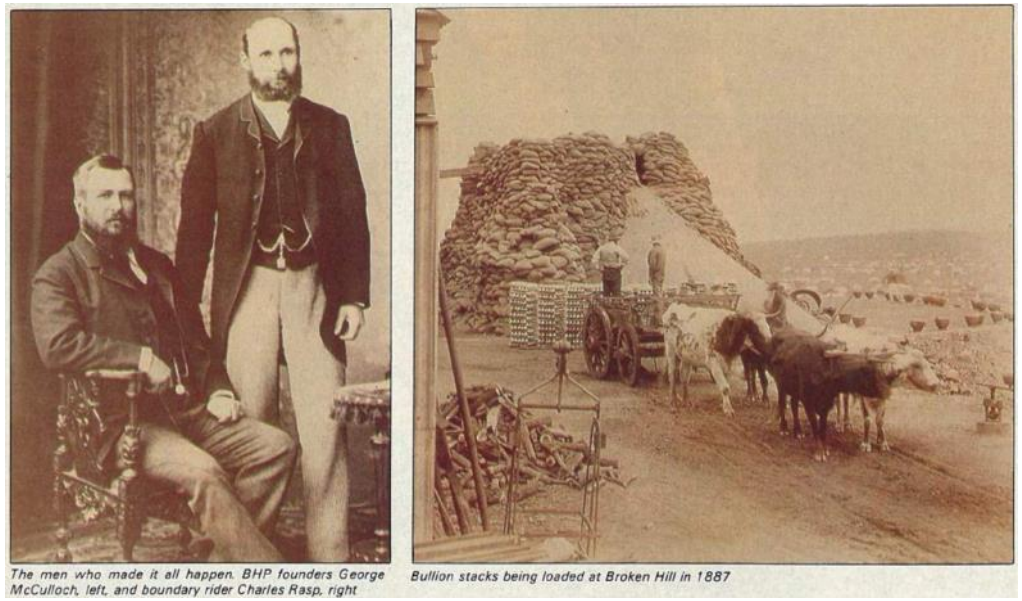
Cadmium Telluride solar technology
Cu Copper, Zn Zinc

Lead acid batteries technology
Pb Lead, St Steel

Amorphous silicon solar technology
Zn Zinc

Lithium ion batteries technology
Al Aluminium, Mn Manganese, Co Cobalt, Li Lithium, Ni Nickel

NSW's long history of mining

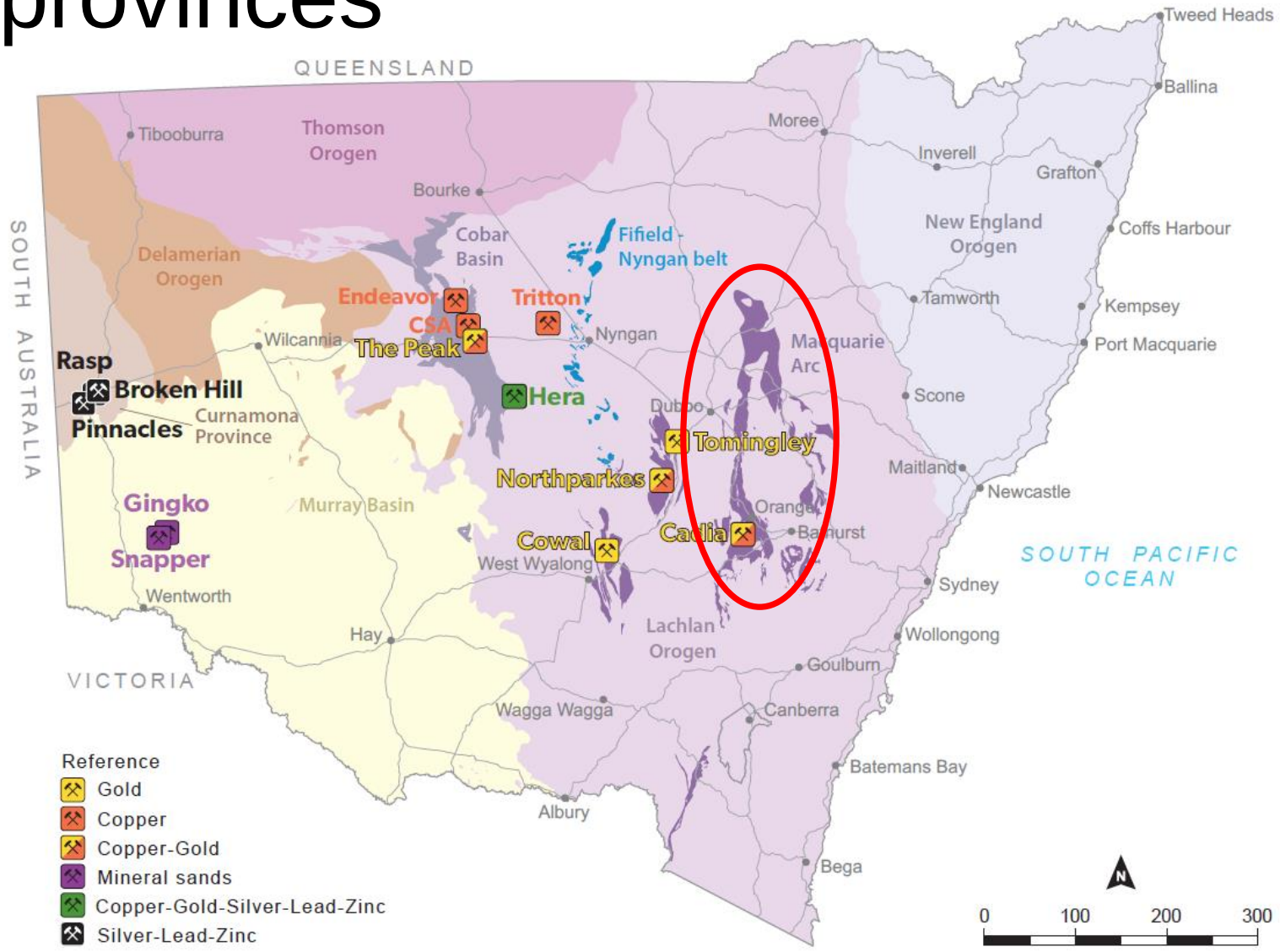


The men who made it all happen. BHP founders George McCulloch, left, and boundary rider Charles Rasp, right

Bullion stacks being loaded at Broken Hill in 1887

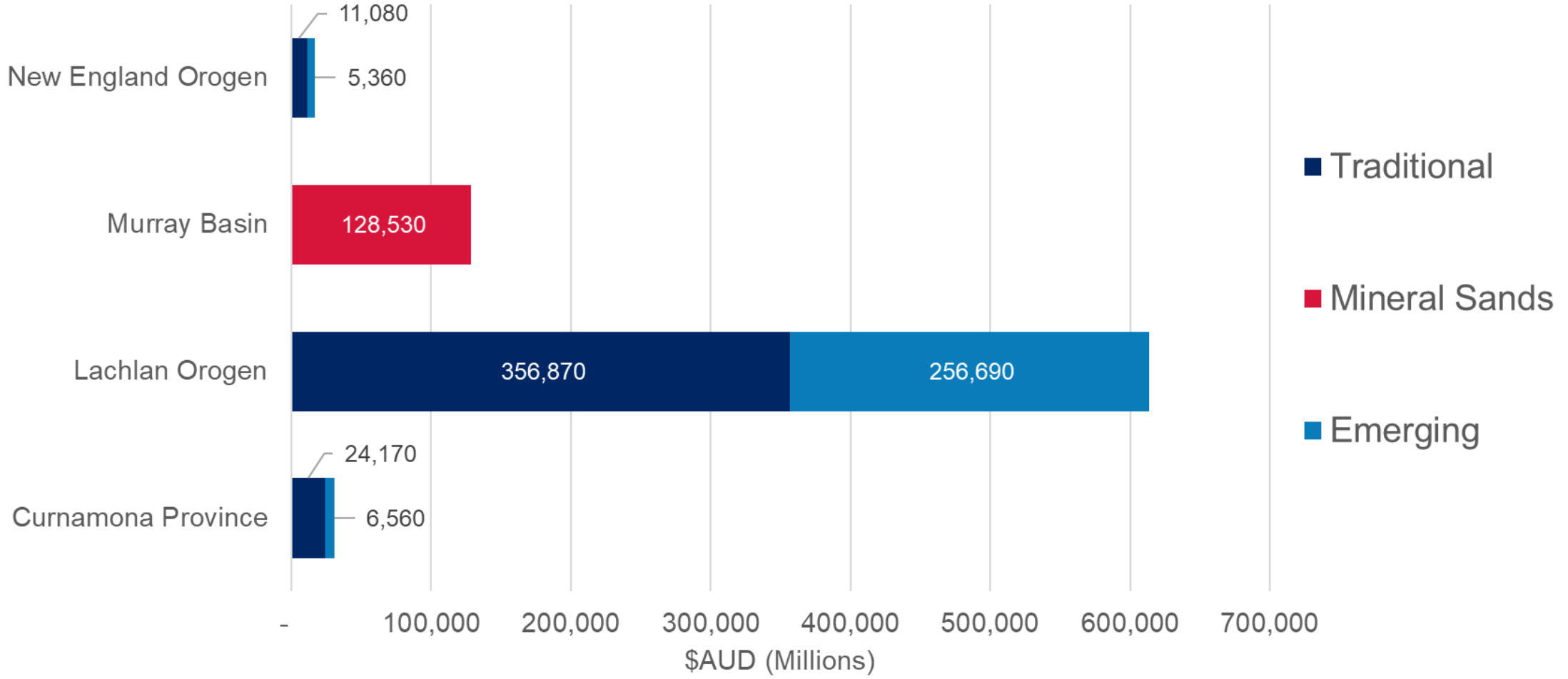
NSW's share of mineral exploration in Australia since 2010 has more than doubled from 5.3% to 11.7% in 2019

NSW mineral provinces

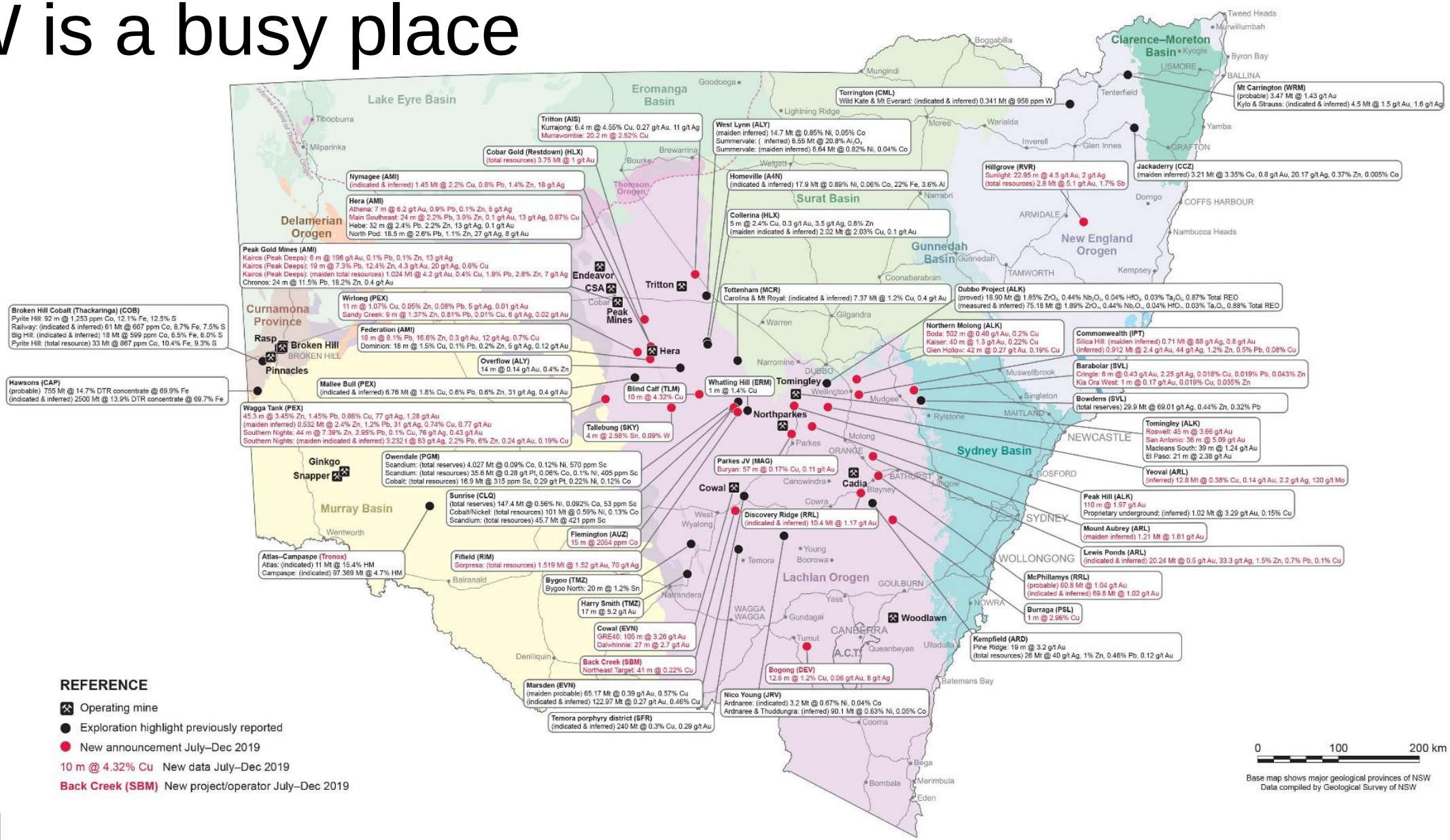


AUSTRALIA MINERALS

Value in the ground



NSW is a busy place



AUSTRALIA

Attracting explorers to NSW

Seamless Geology Project

MinView

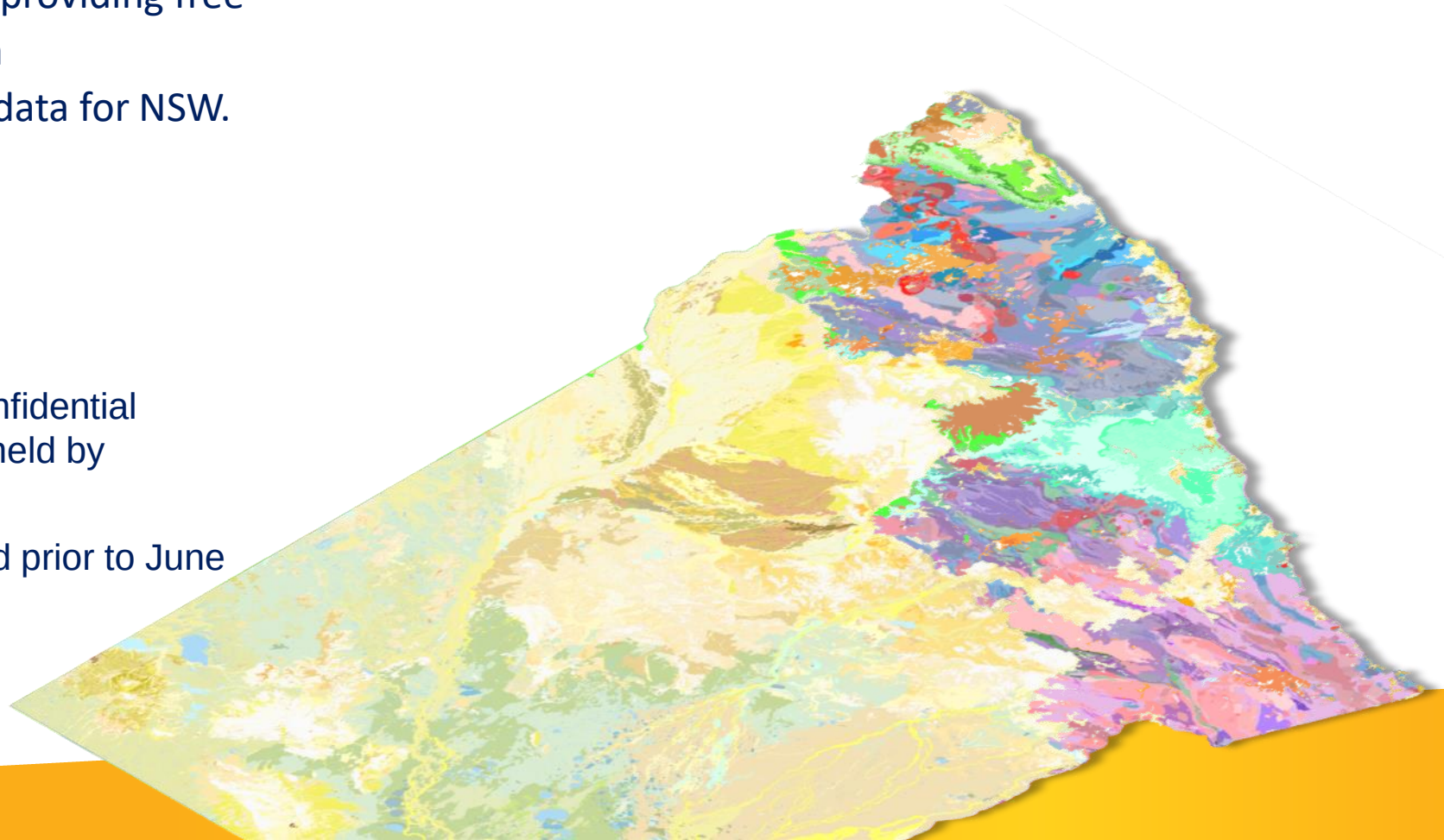
MINVIEW - web mapping application providing free access to view, search and download a comprehensive range of geoscientific data for NSW.

DiGS

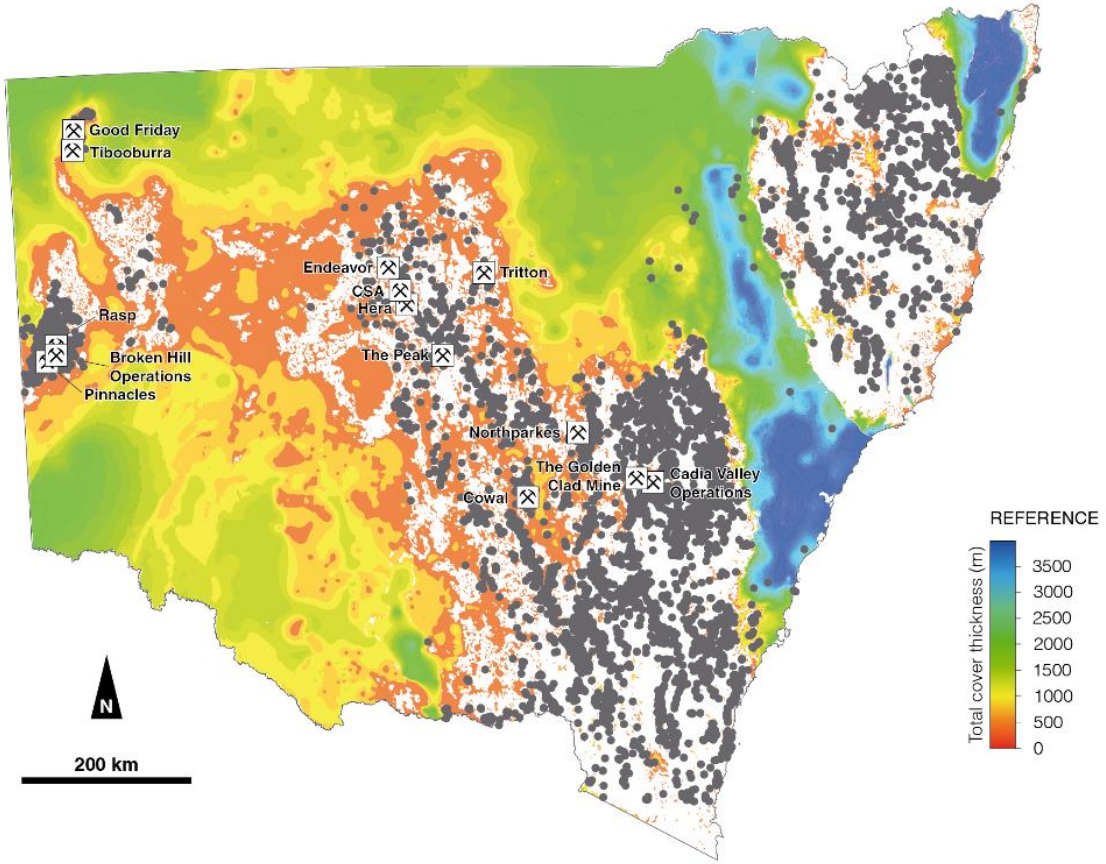
DIGS - public, online archive

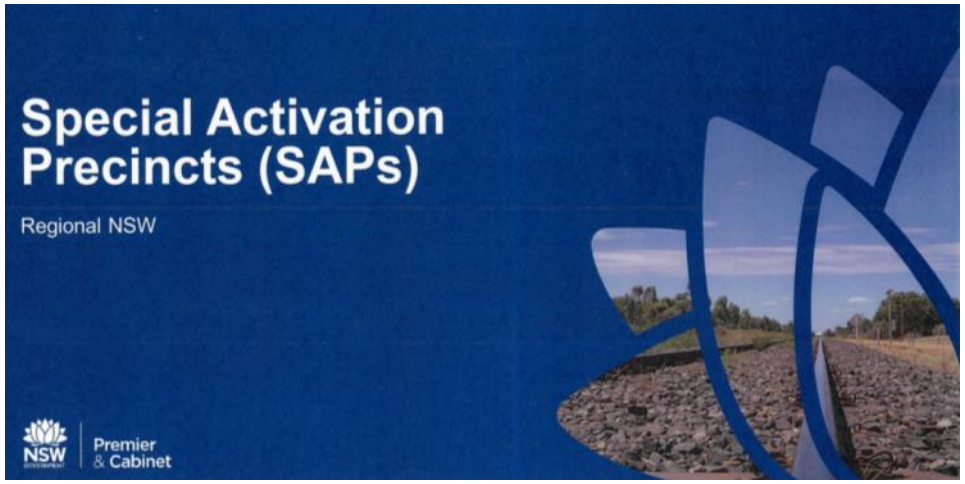
Provides access to over 140,000 non-confidential reports and other documentary material held by the NSW government.

Confidential exploration reports submitted prior to June 2016 will be made public in June 2021.



Demonstrated support for mining





Vision:

Our mineral and petroleum resources generating prosperity for the people of NSW

Michael Wright

Deputy Secretary, NSW Division of Resources and Geoscience

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