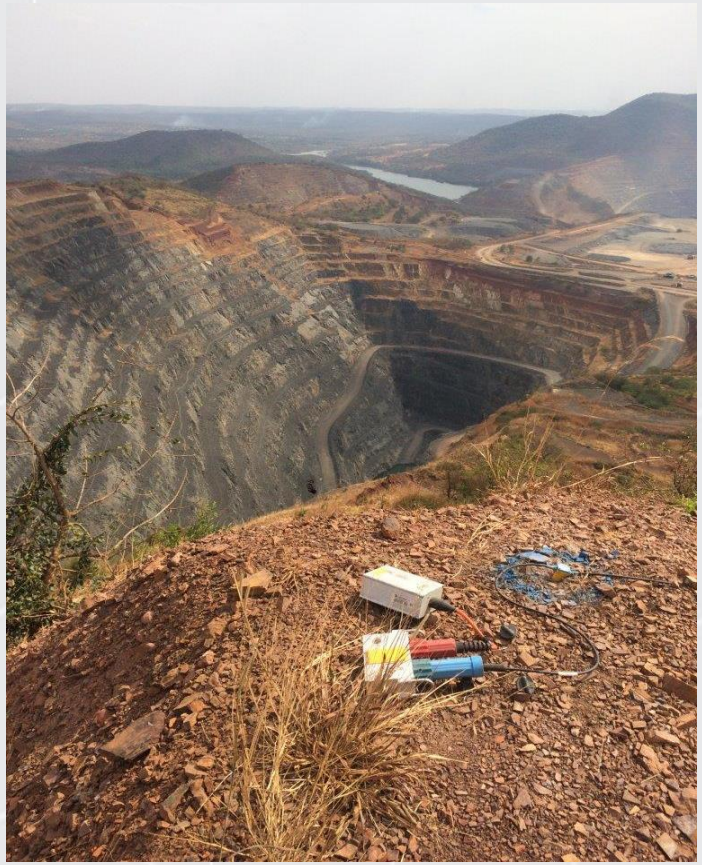
Advances in Seismic Reflection as an Exploration Tool in Hard-Rock Mining

HiSeis
www.hiseis.com



Greg Turner

QUEENSLAND resources COUNCIL

28 February 2018, Brisbane, Qld, Australia

The last 10 years…

Status 2007

- Applied research and surveys led by Curtin University
- Strategies developed to address:
  - statics
  - velocity analysis
    - Discontinuous reflectors
    - “off-the-plane” reflectors
- Recognition that interpretation begins during processing
- 2D surveys successfully mapping mineralised geology

Status 2017

- IP from Curtin University commercialised by HiSeis
- >20 minerals 3D surveys worldwide
- Better understanding of rock property variability and importance of alteration
- Regularly imaging steep dipping geology and structures
- Demonstrated ability to image below surface obstructions
- Ongoing learning and development

Minerals Seismic Worldwide

Types

Gold
- Orogenic
- Epithermal

Copper
- VMS
- Porphyry
- Orogenic

Zinc
- Sedex
- VMS

Nickel
- Komatiitic
- Layered intrusive

Iron ore
- BIF

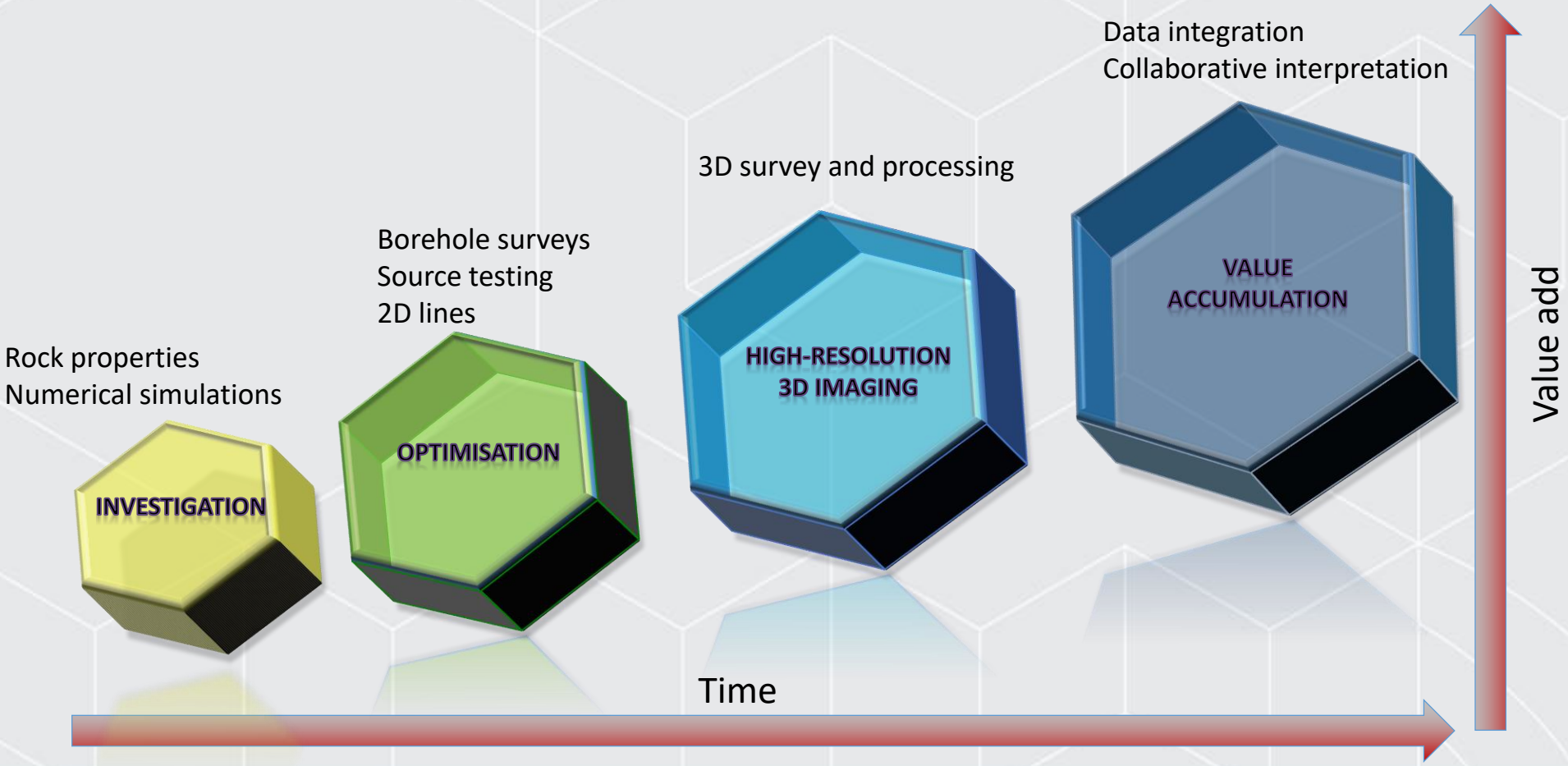
Uranium
- Unconformity

Lithium
- Pegmatite

Rutile
- Mineral sands

Note: Only HiSeis projects shown, many additional surveys have been completed particularly in South Africa

Implementation strategy for hard-rock seismic reflection

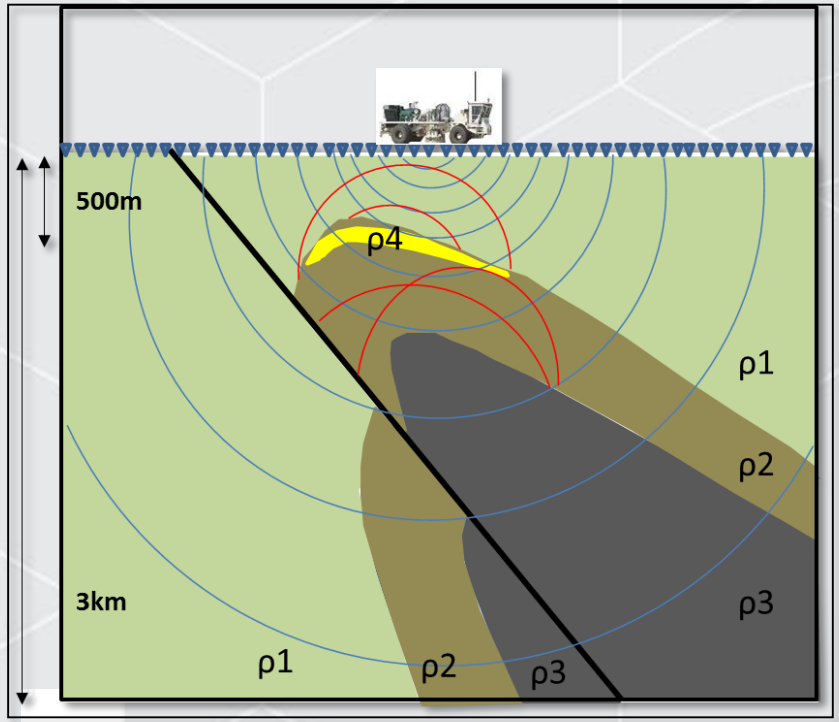


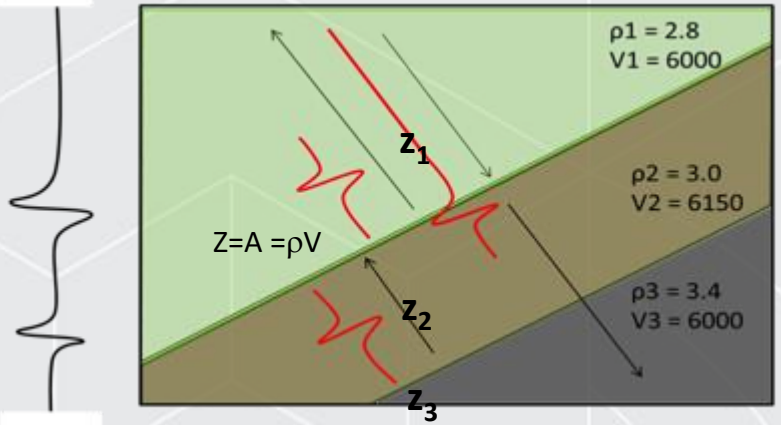
What causes reflections?

- Reflections occur at abrupt changes in acoustic impedance

- Acoustic Impedance (AI) =
  Density (ρ) * Velocity (V)

  Eg.
  - Bedding planes
  - Unconformities
  - Intrusions
  - Alteration zones
  - Faults
  - Shears
  - Large stopes
  - Massive Sulphides
  - Anywhere there is an abrupt change in AI

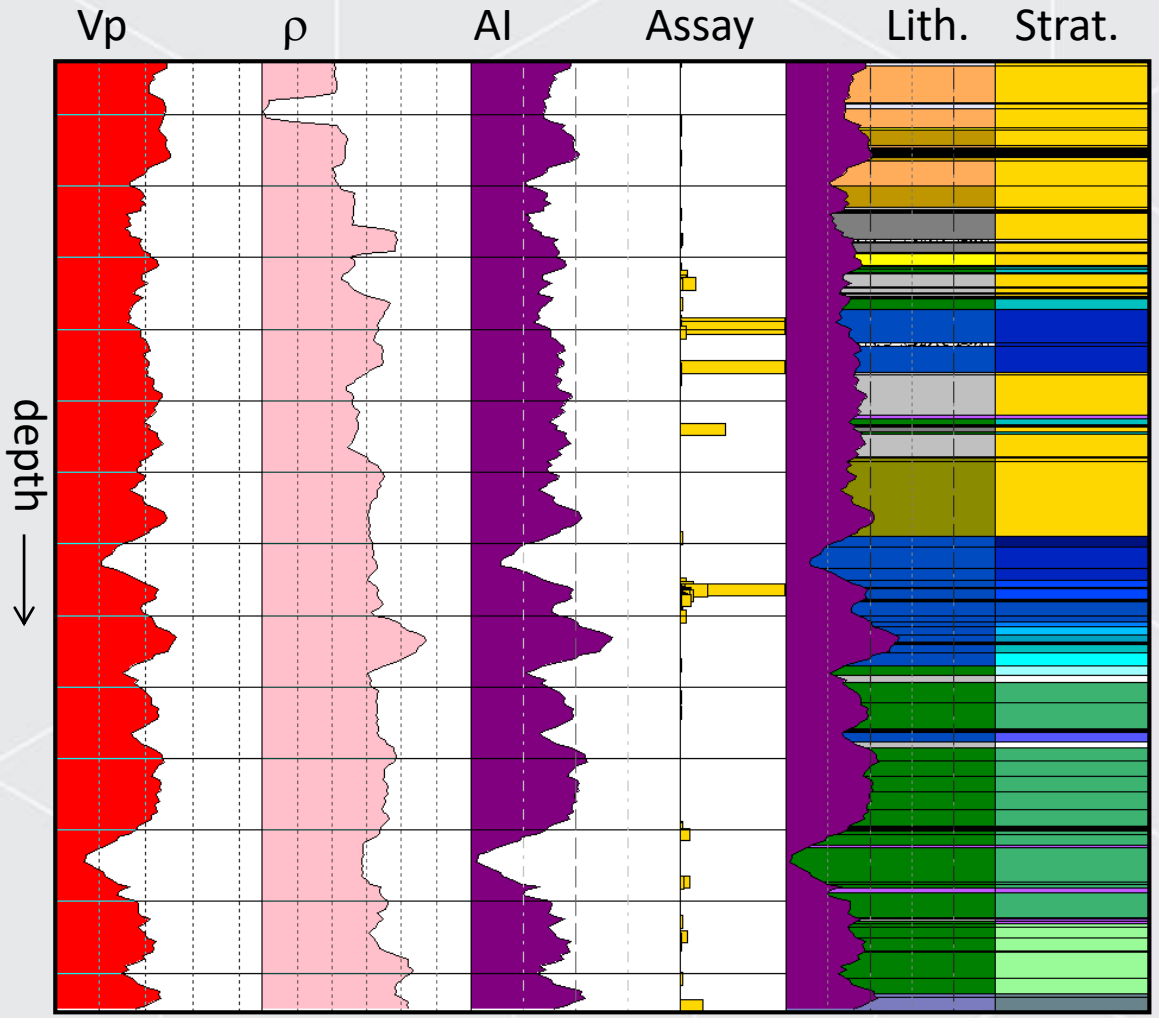




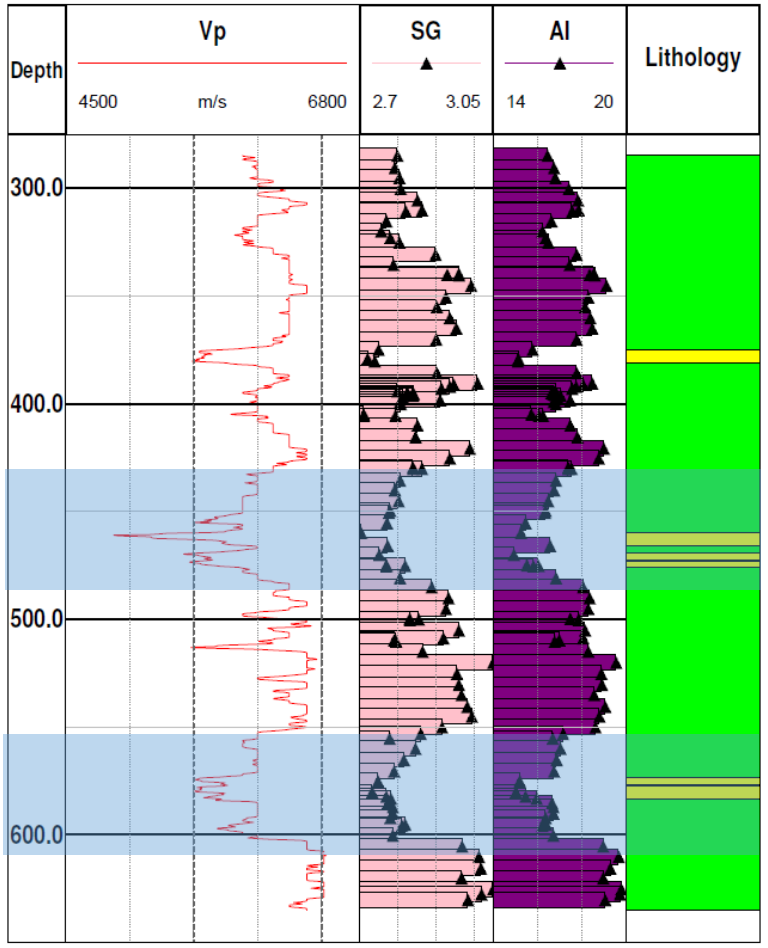
Rock property measurements

- Measure transit time through core, half core or hand specimen
- 100-200 samples per day

Correlation with other datasets



Evidence for impedance contrast associated with alteration

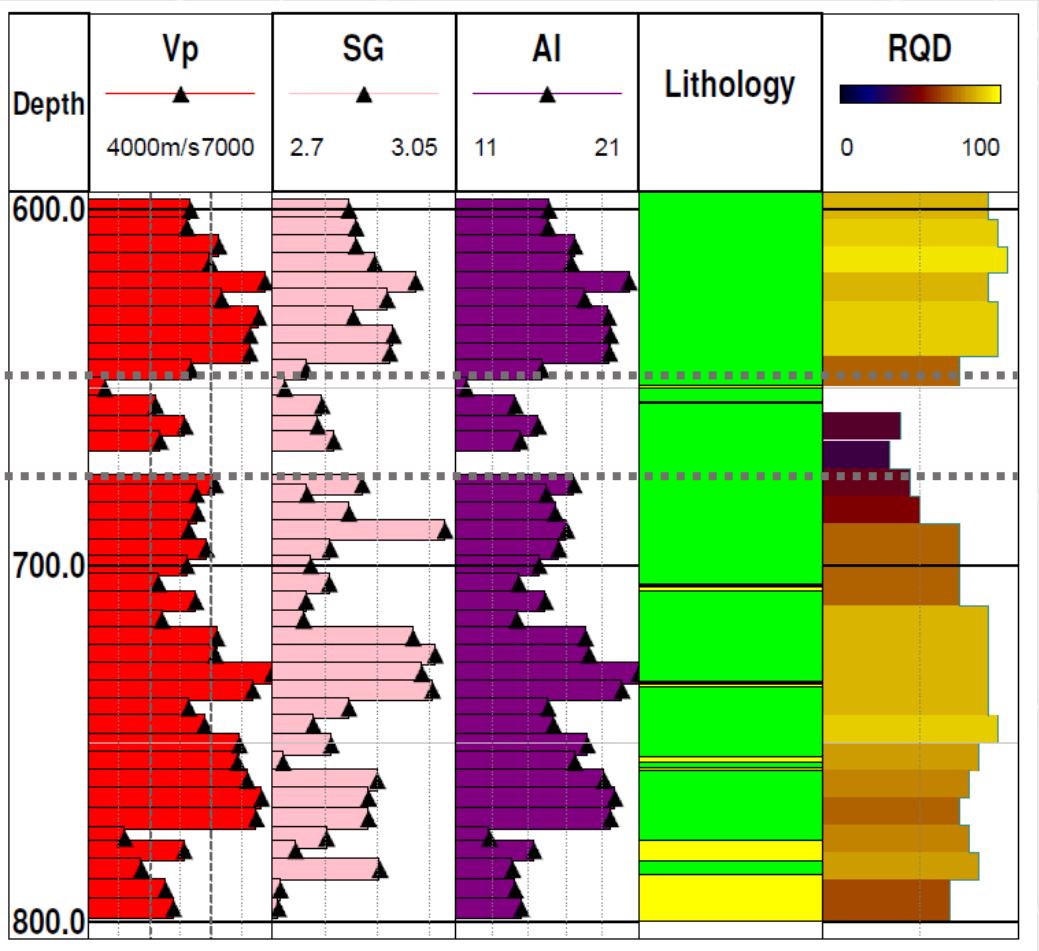


Enhanced reflectivity

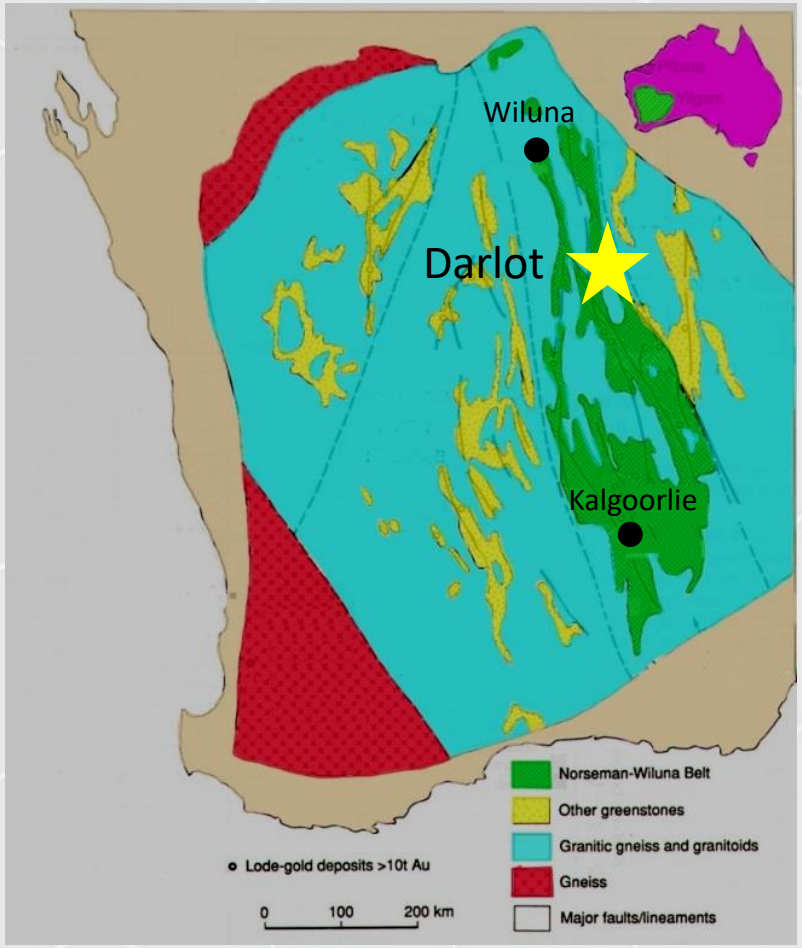
Mafics

Felsic

Evidence for impedance contrasts within fault zones

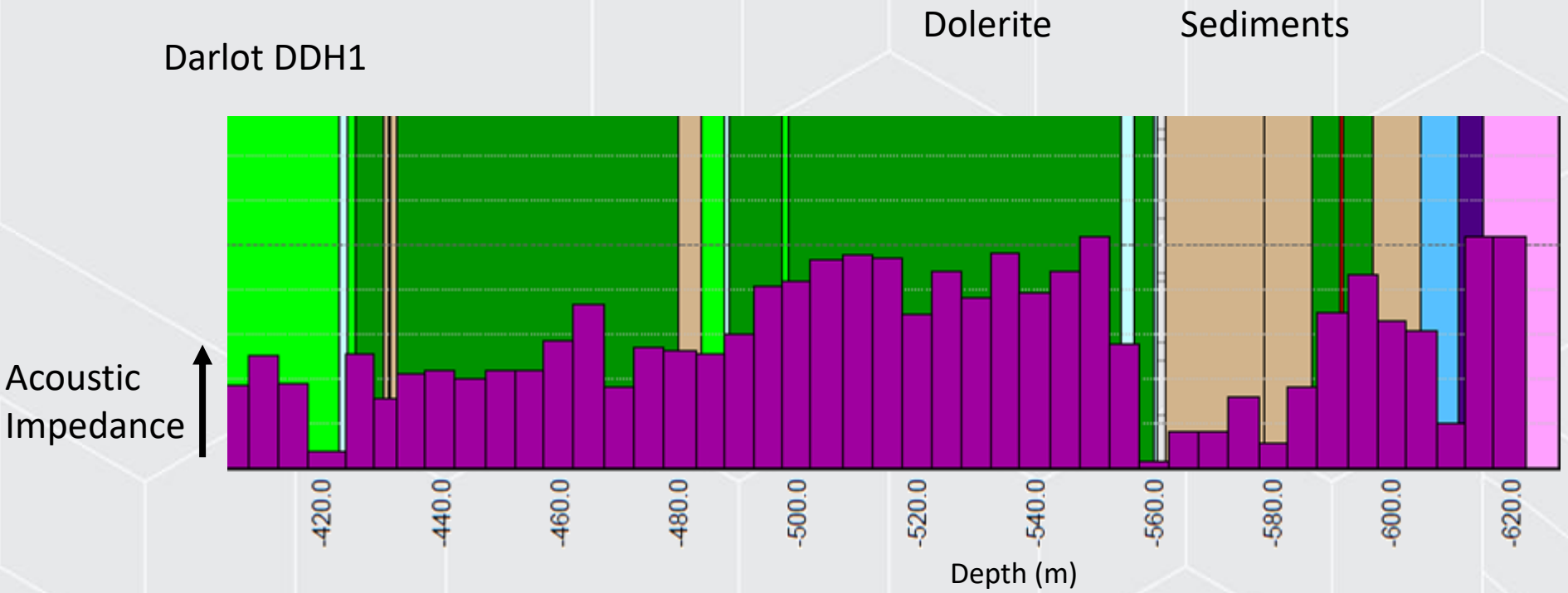


Case History 1
Exploration around a mature mine - Darlot



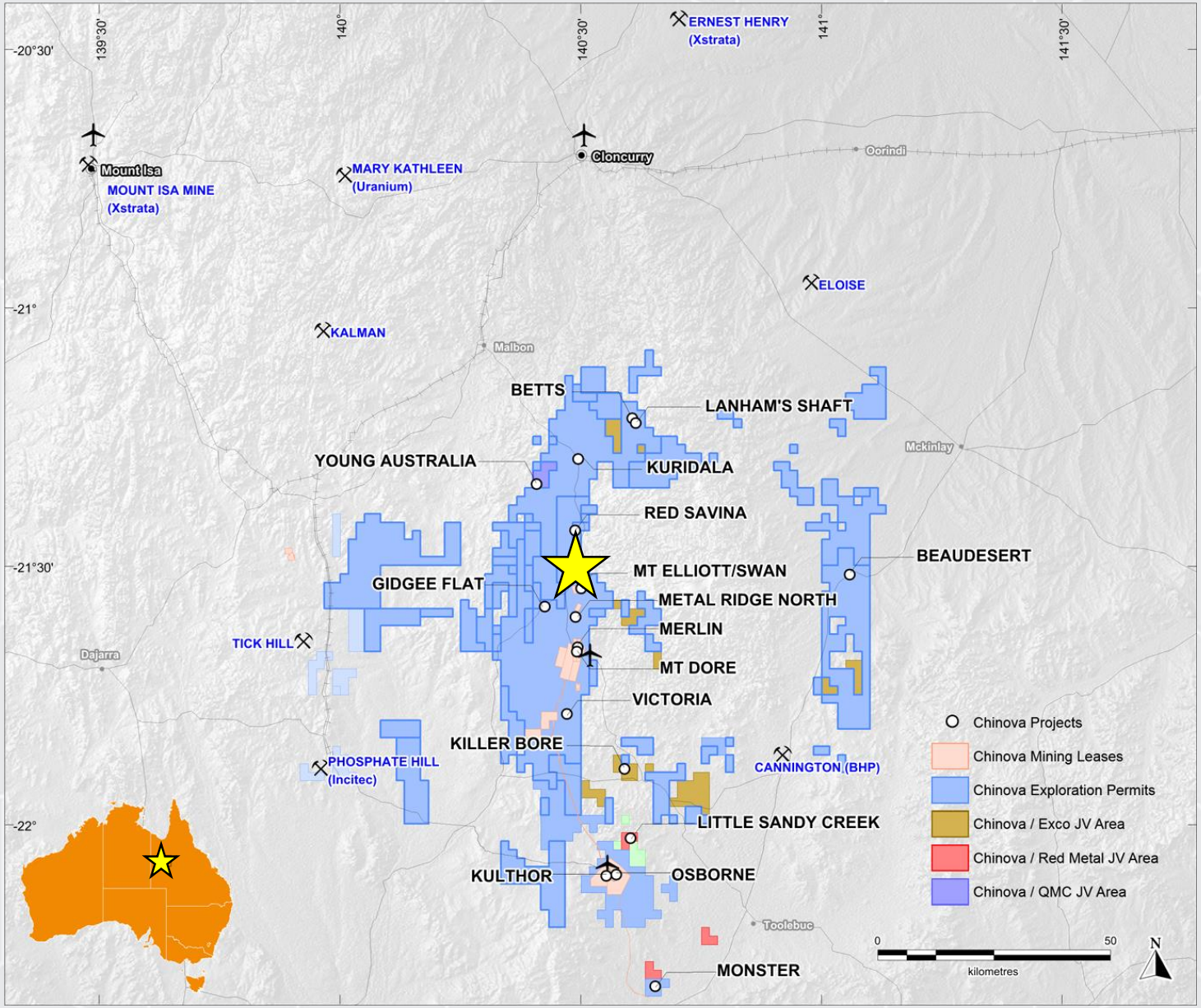
Darlot – orogenic gold

Darlot DDH1



Darlot 3D seismic stats.

Extent	5.5km x 4.5km
Depth imaged	> 3km
Volume	75km^3
Cell/Voxel size	15m x 7.5m x 4m
Number of voxels	~165 million
Cost	~ A$2.4M
Time conception to interp ready	6 months

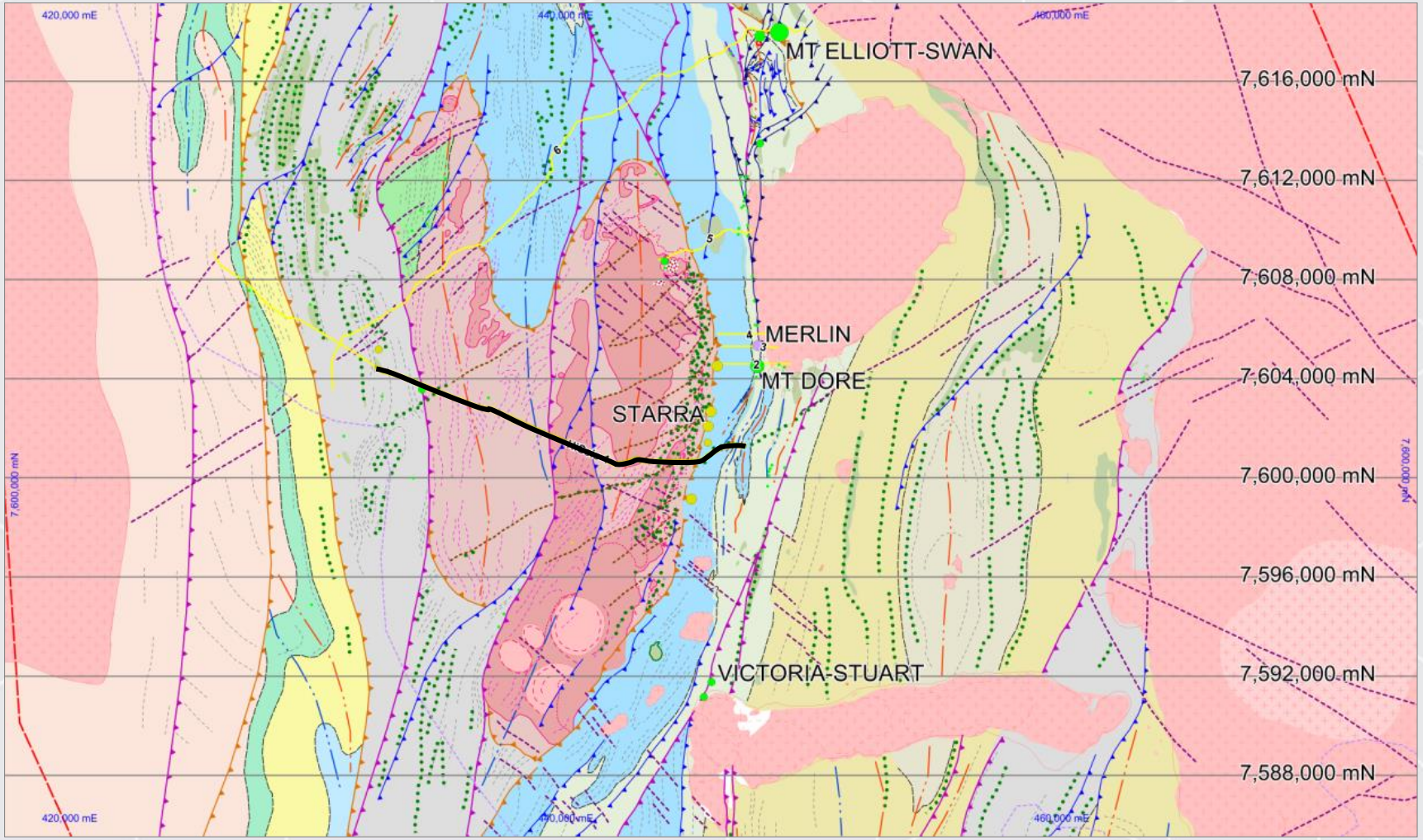


Case History 2

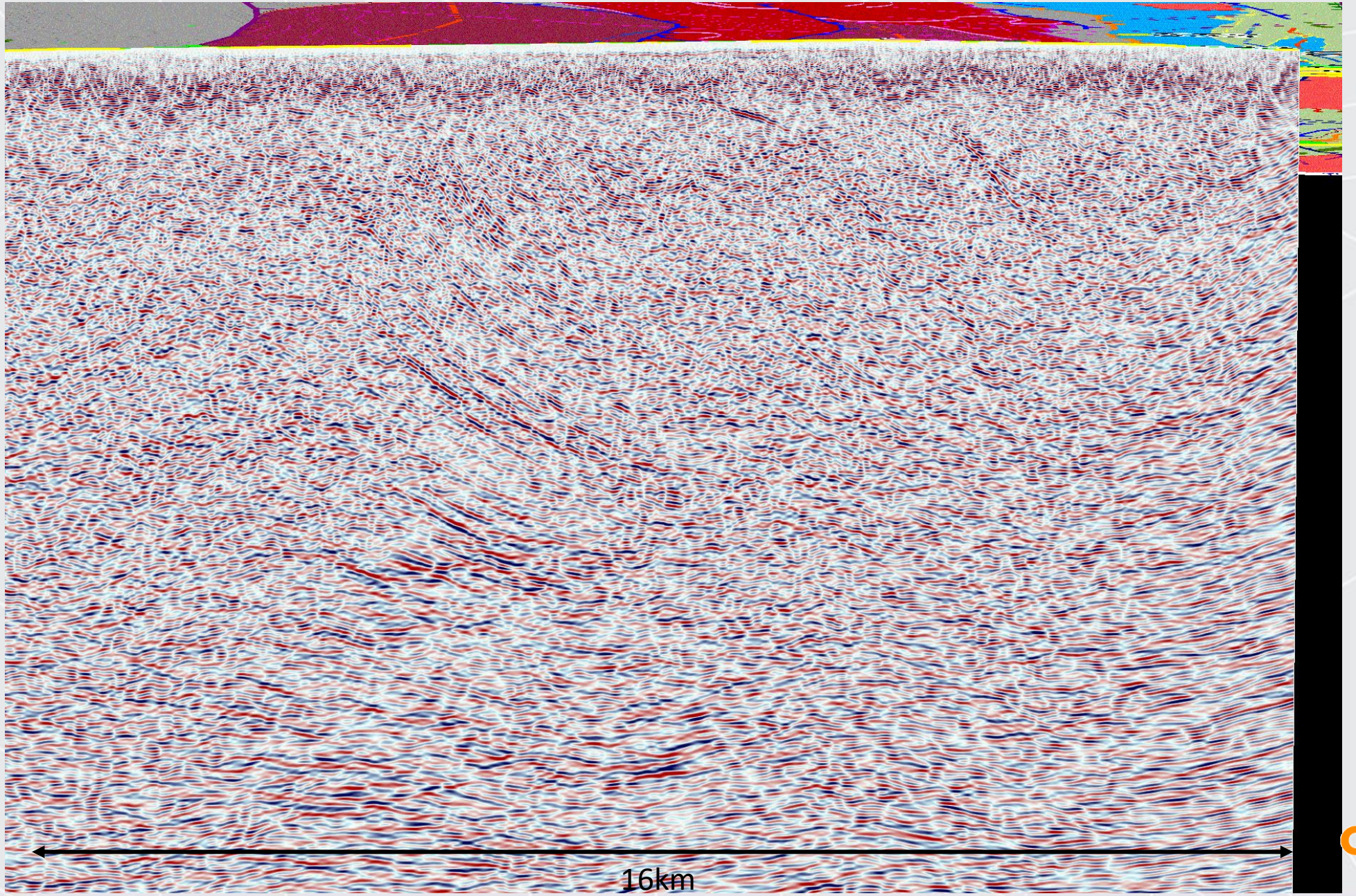
Investigating geological architecture

Mt Elliott

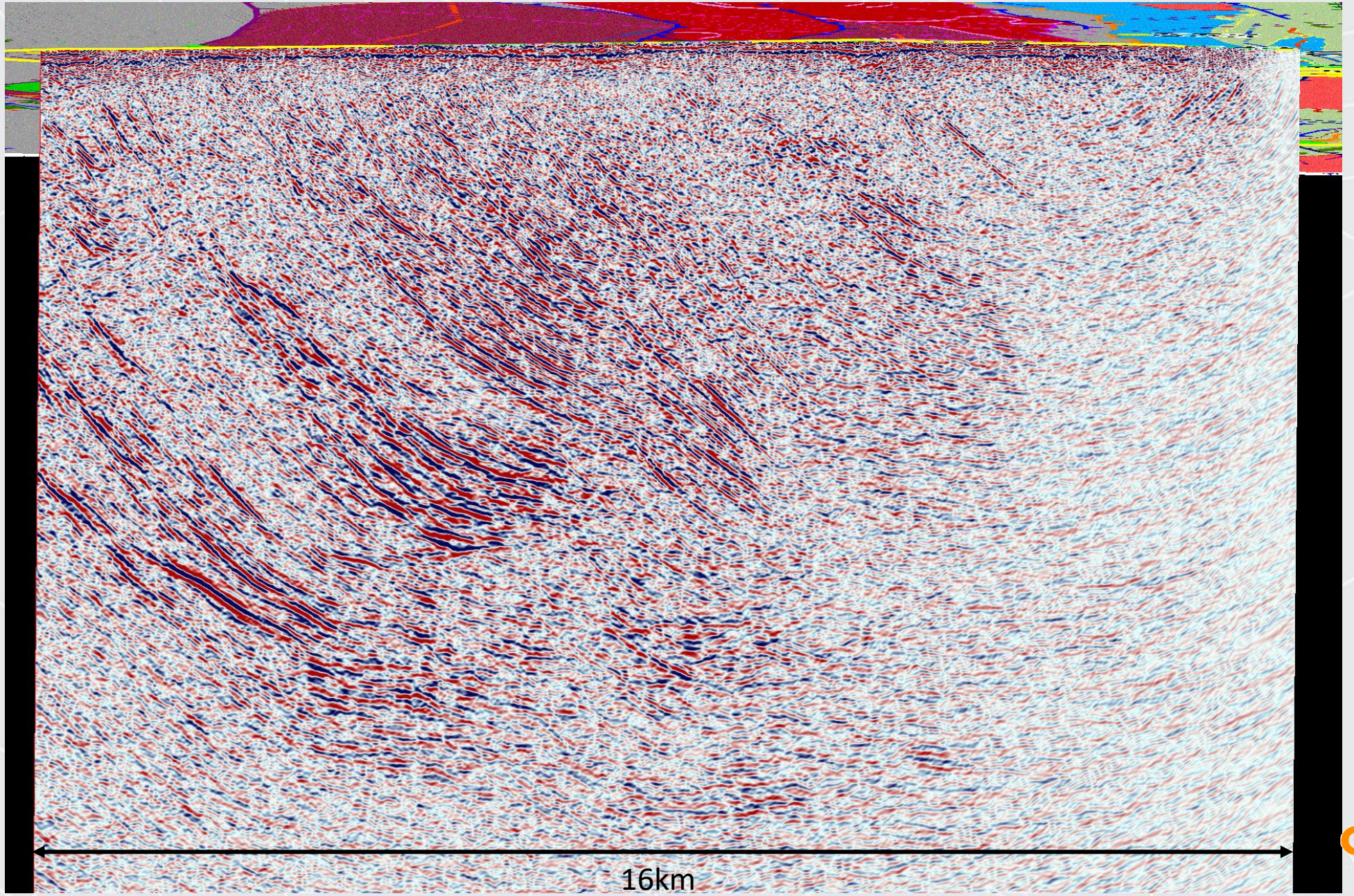
2D Seismic Reflection Surveys - adding the depth dimension



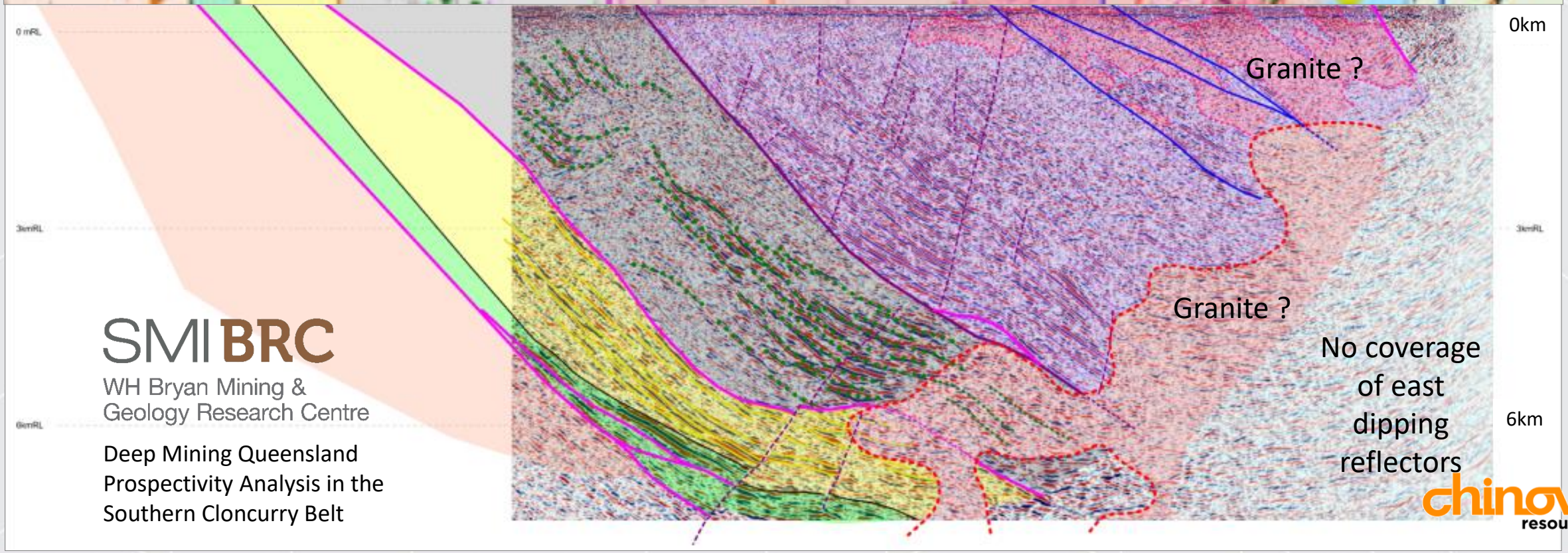
Original Processing



HiSeis Processing



Seismic interpretation

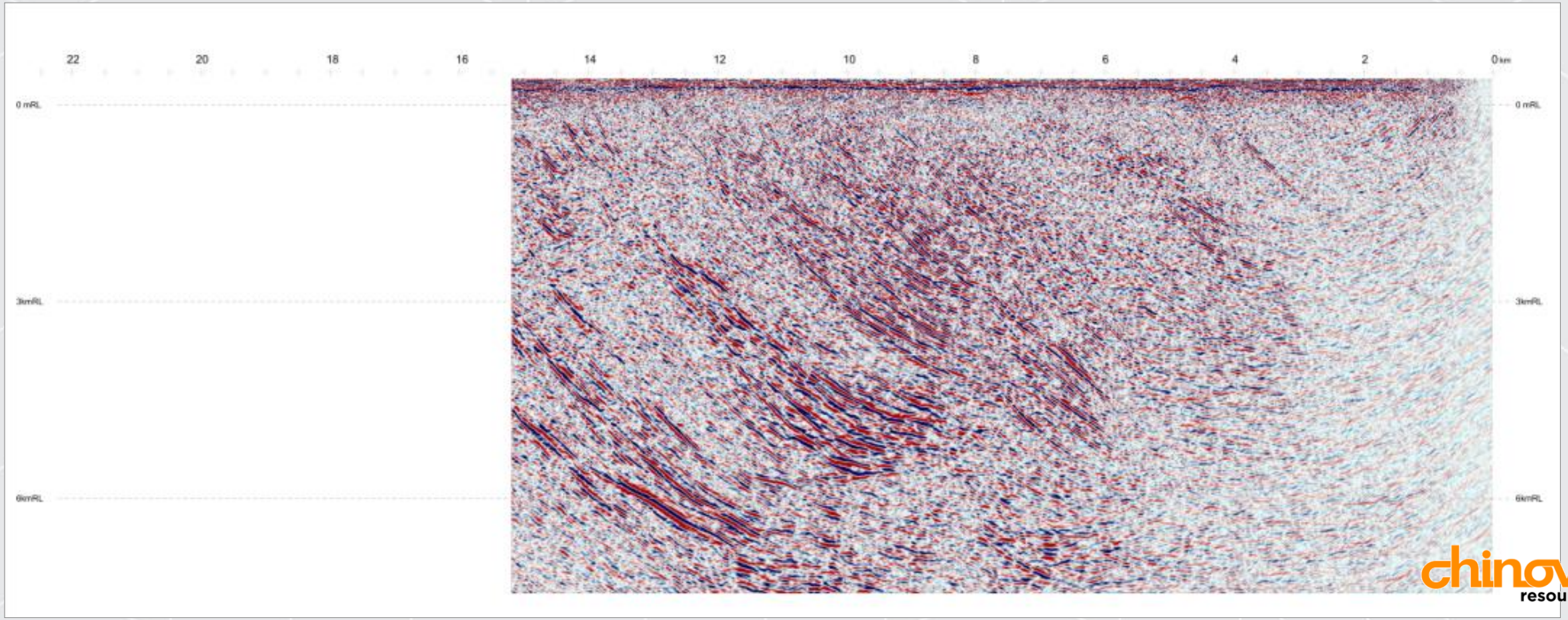


SMI BRC
WH Bryan Mining & Geology Research Centre

Deep Mining Queensland Prospectivity Analysis in the Southern Cloncurry Belt

chinova resources

Seismic without interpretation overlay



Summary

- Understanding the rock properties is key to interpretation
- Alteration is a key control on seismic rock properties
- Seismic can be effective in steep geology
- Seismic very effective at mapping structures
  - flexures
  - intersections with key units
  - intensity of alteration
  - timing
- New tool for mineral exploration especially as go deeper

The Opportunities

- Better deep targeting in areas of known endowment
- Faster screening around initial discovery
- Better conceptual understanding of geology and mineralisation
- Better mapping of structures for mine planning and mine safety

➢ Faster, more cost effective exploration

➢ Reduced geotechnical issues

➢ Better optimised infrastructure capacity and placement

Acknowledgements

SMI BRC
WH Bryan Mining & Geology Research Centre