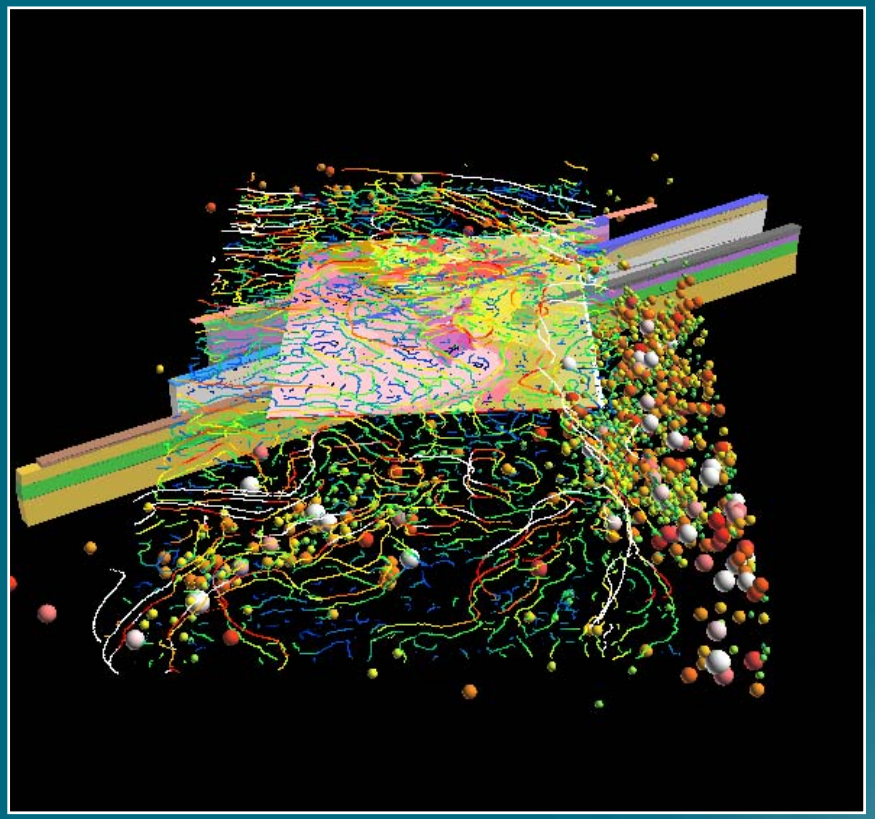
This presentation contains notes. Double-click on a slide's note icon to view its comments.

Crustal architecture, source rocks, and fluid pathways in the central Olympic Cu-Au province



Nick Direen

Patrick Lyons, Elizabeth Jagodzinski, Peter Milligan, Roger Skirrow

MINERALS & ENERGY RESOURCES
Government of South Australia

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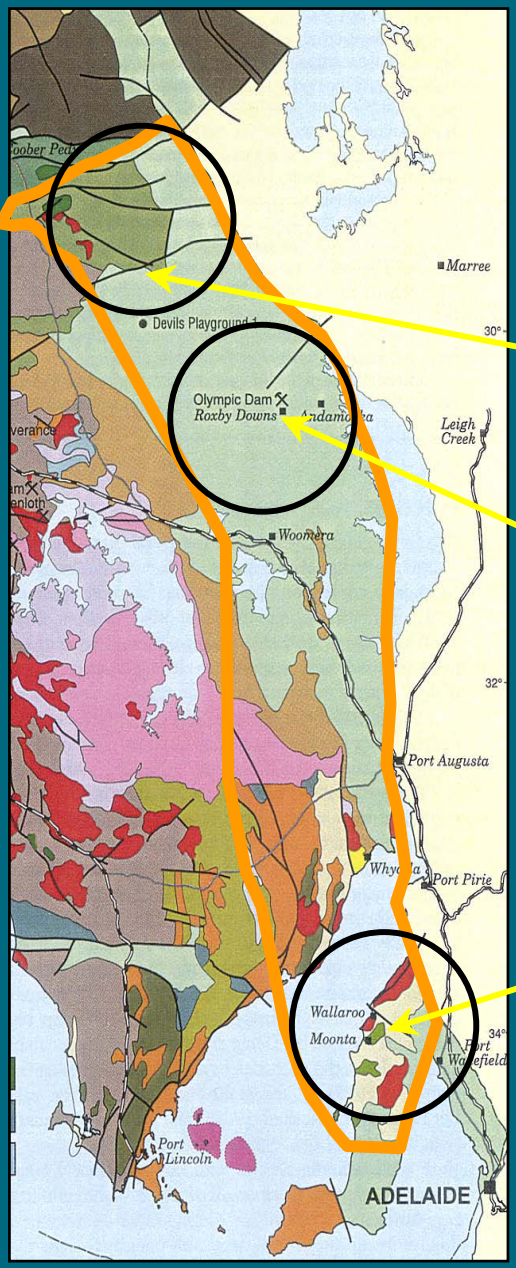

1615-1500 Ma

Olympic Cu-Au Province

Prominent Hill

Olympic Dam

Moonta-Wallaroo

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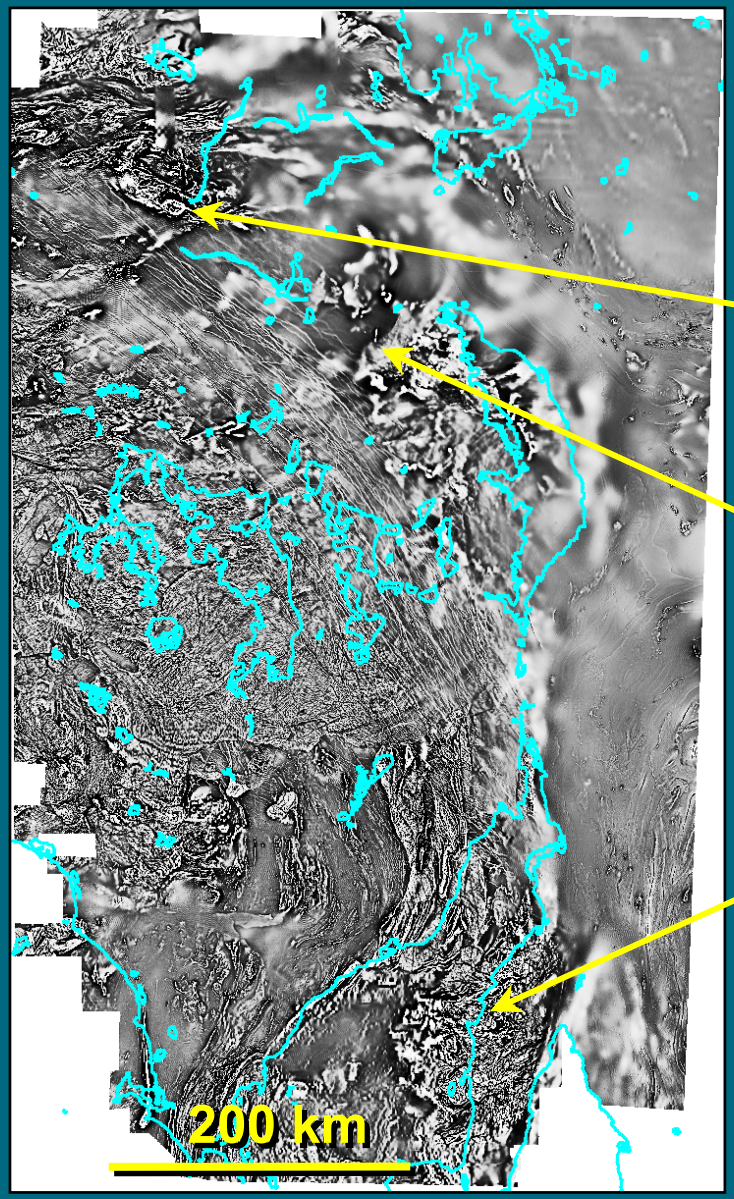
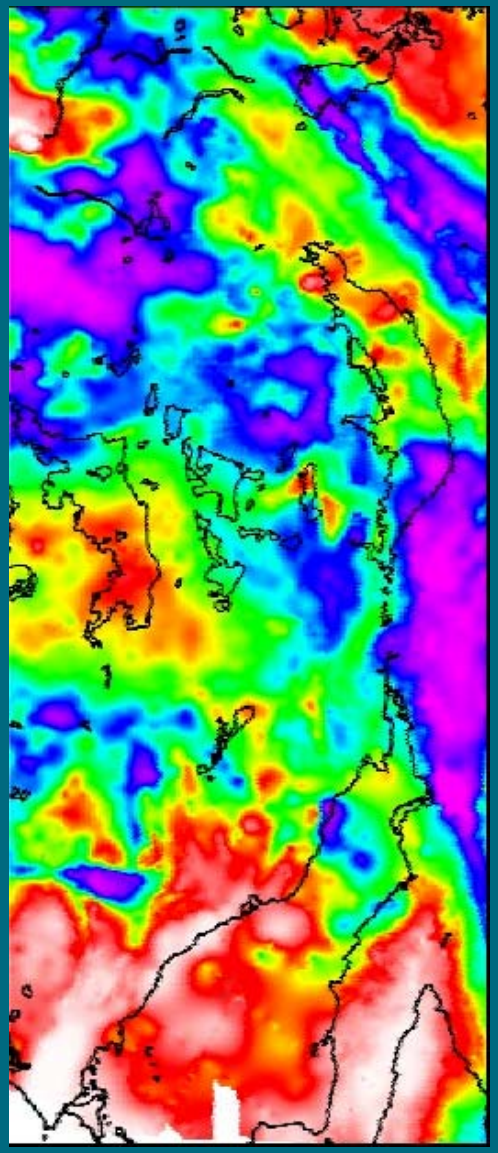
Under cover in the magnetoscape

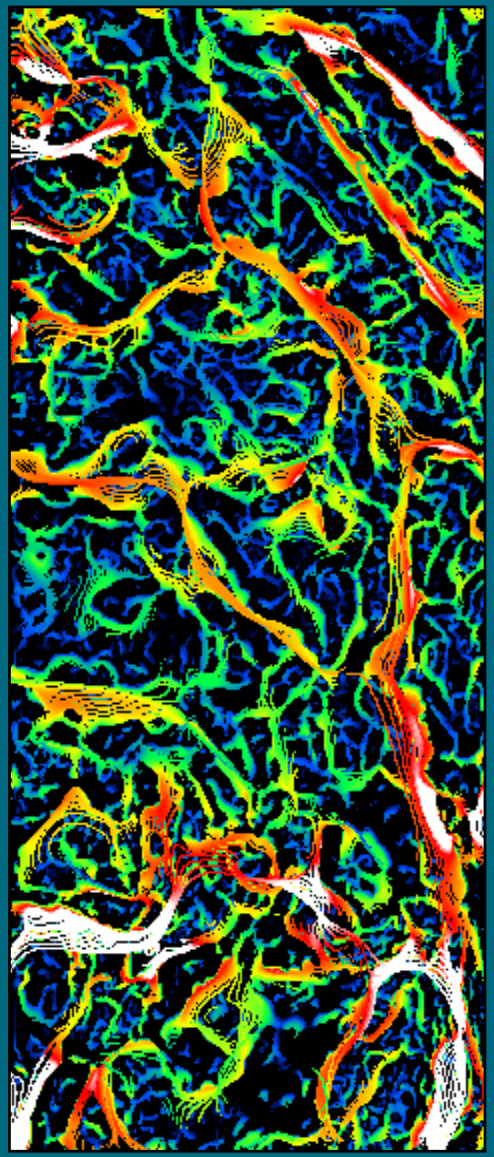


New stitch of residual total magnetic intensity data, 1VD rtp

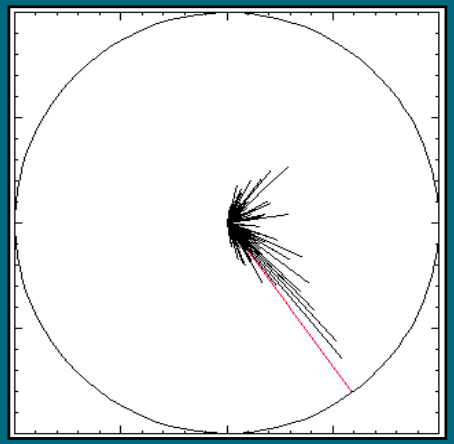
OCGP Gravity



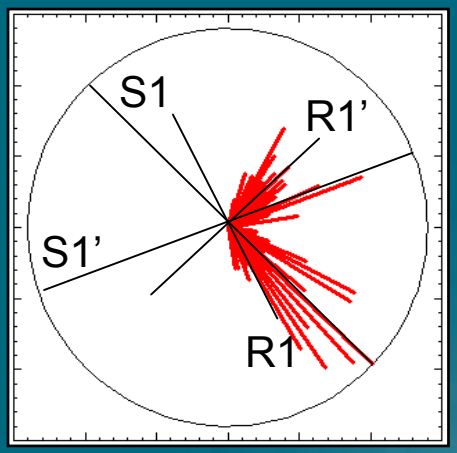
Gravity Worms



Structure

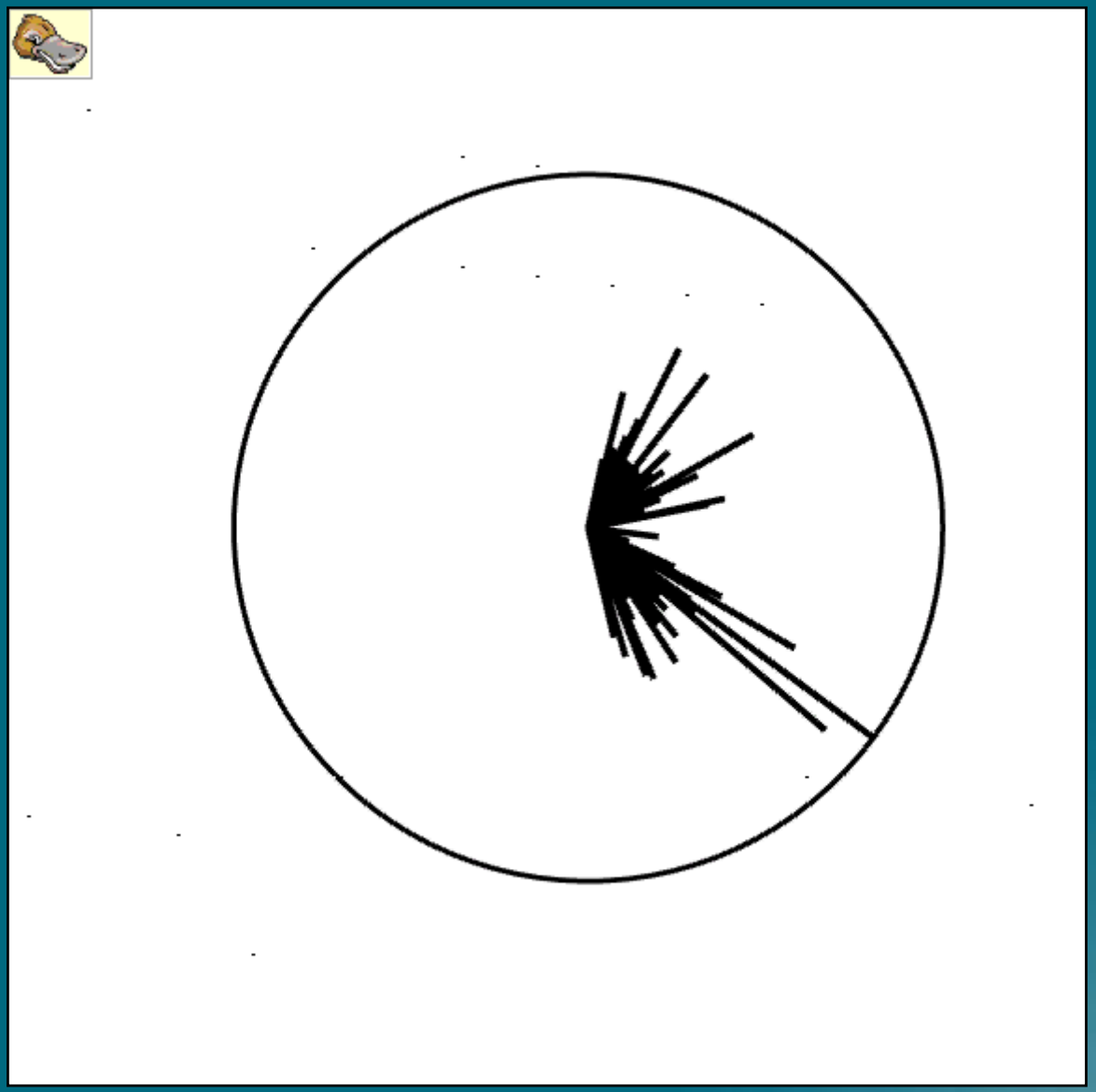


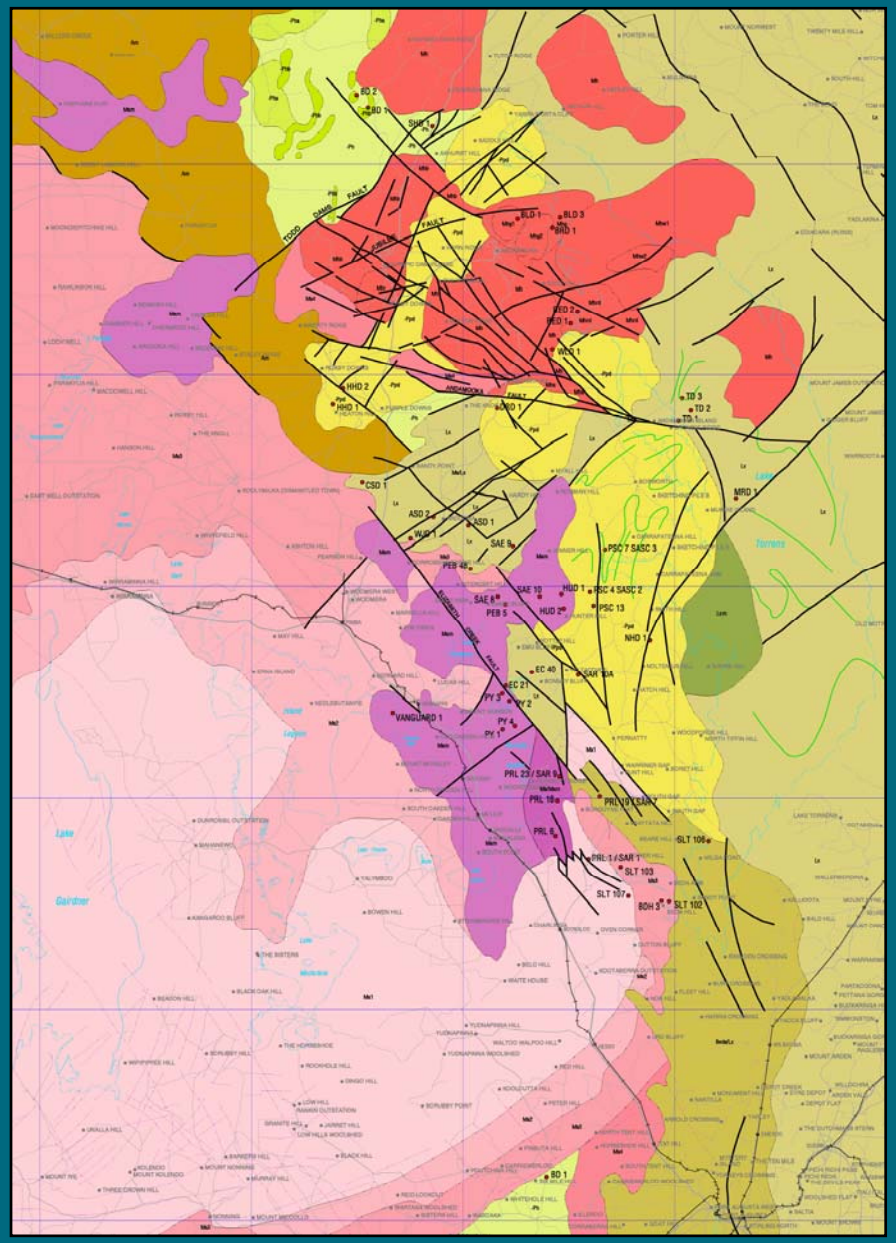
Edge length and azimuth



Edge azimuth histogram

Worm directions, 500 m to 41 km UC

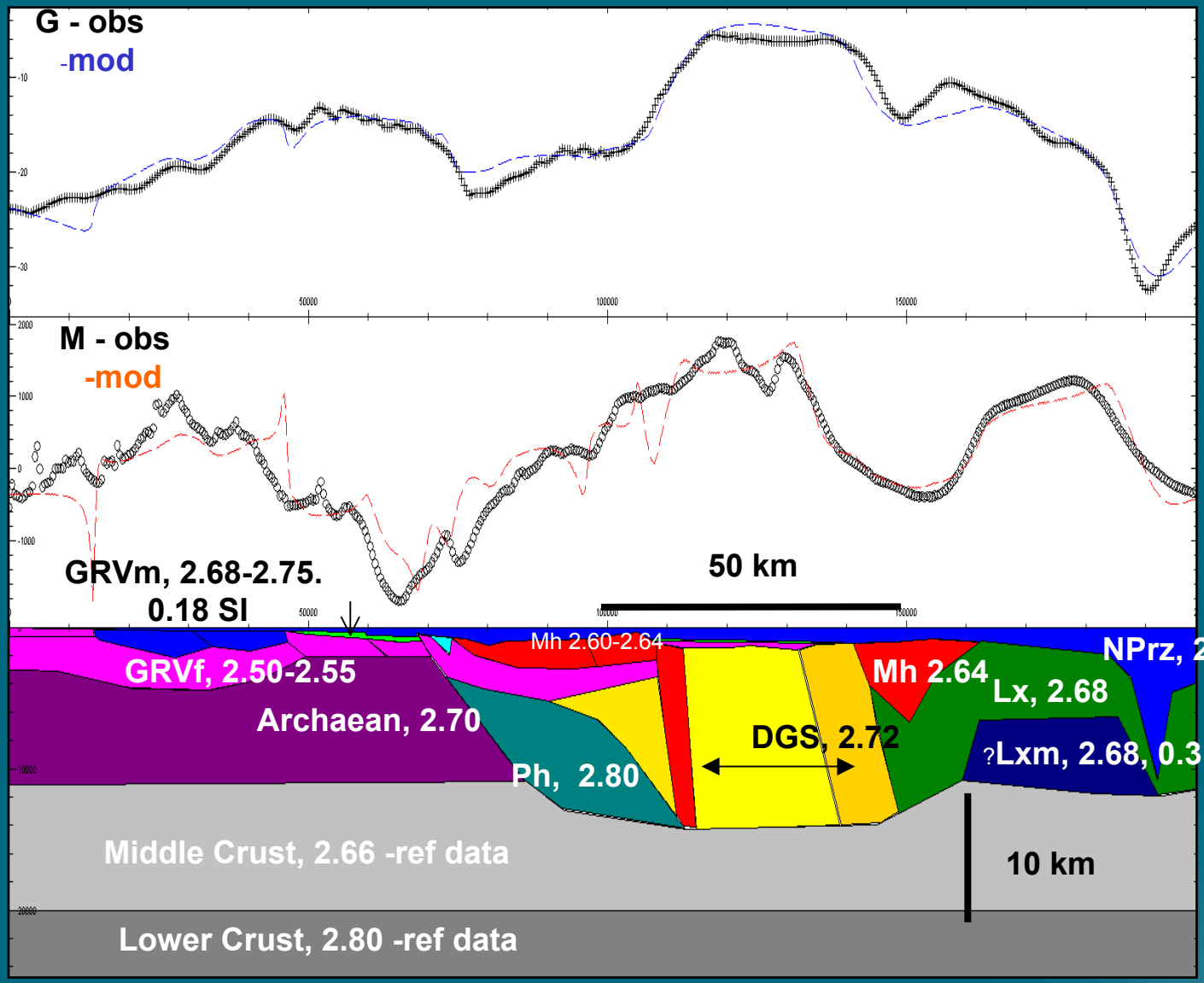


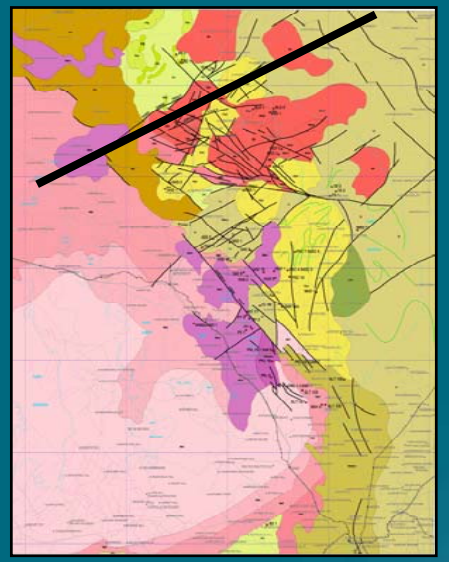


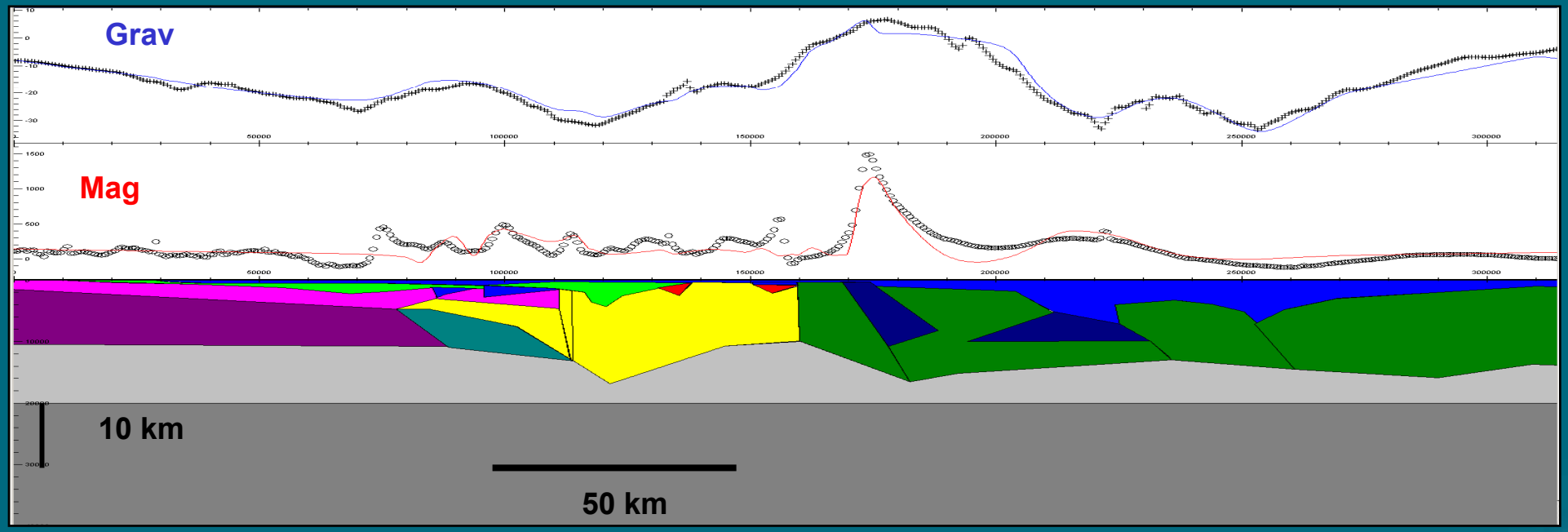
Geophysical Interpretation of the NE Gawler Craton

- Pandurra Fm
- GRV / Roopena Volcanics
- Hiltaba Suite (incl. mafics)
- Wallaroo Gp
- Donington Suite
- Hutchison Gp
- Archaean basement

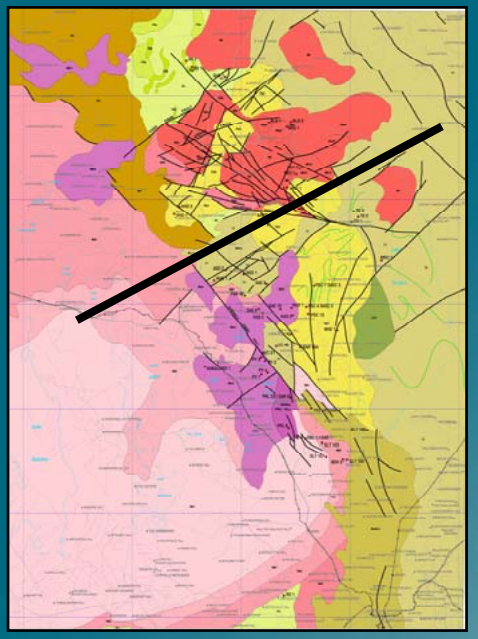
Geophysical models test basement structure and composition

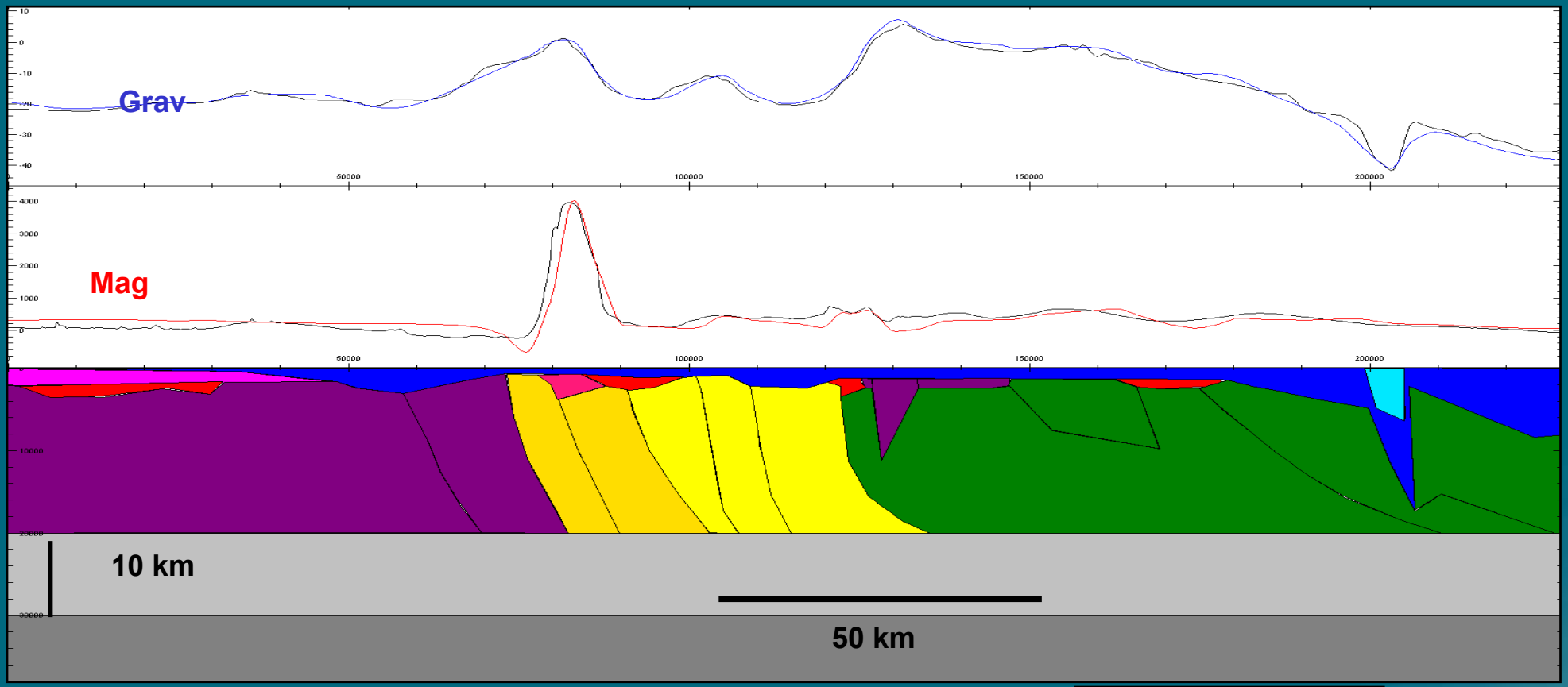




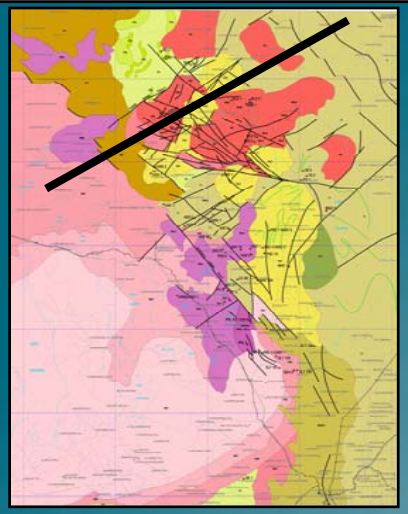


Emmie Bluff model

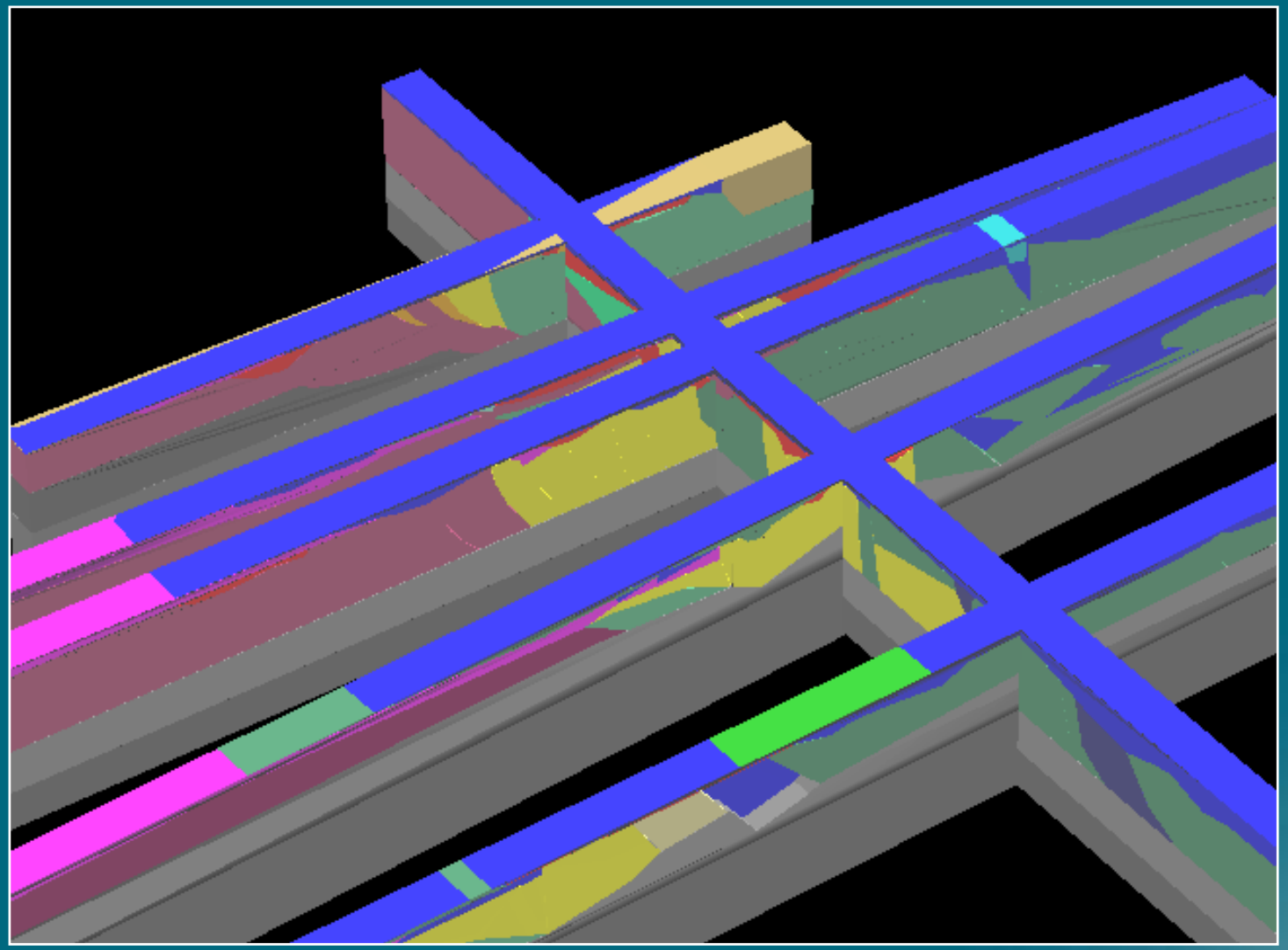




Bills Lookout model



3D models test structural continuity



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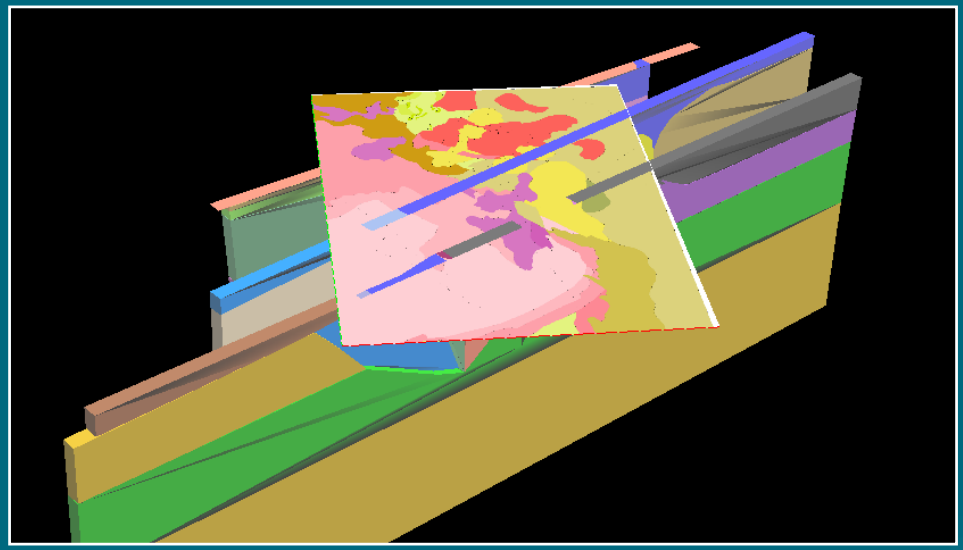
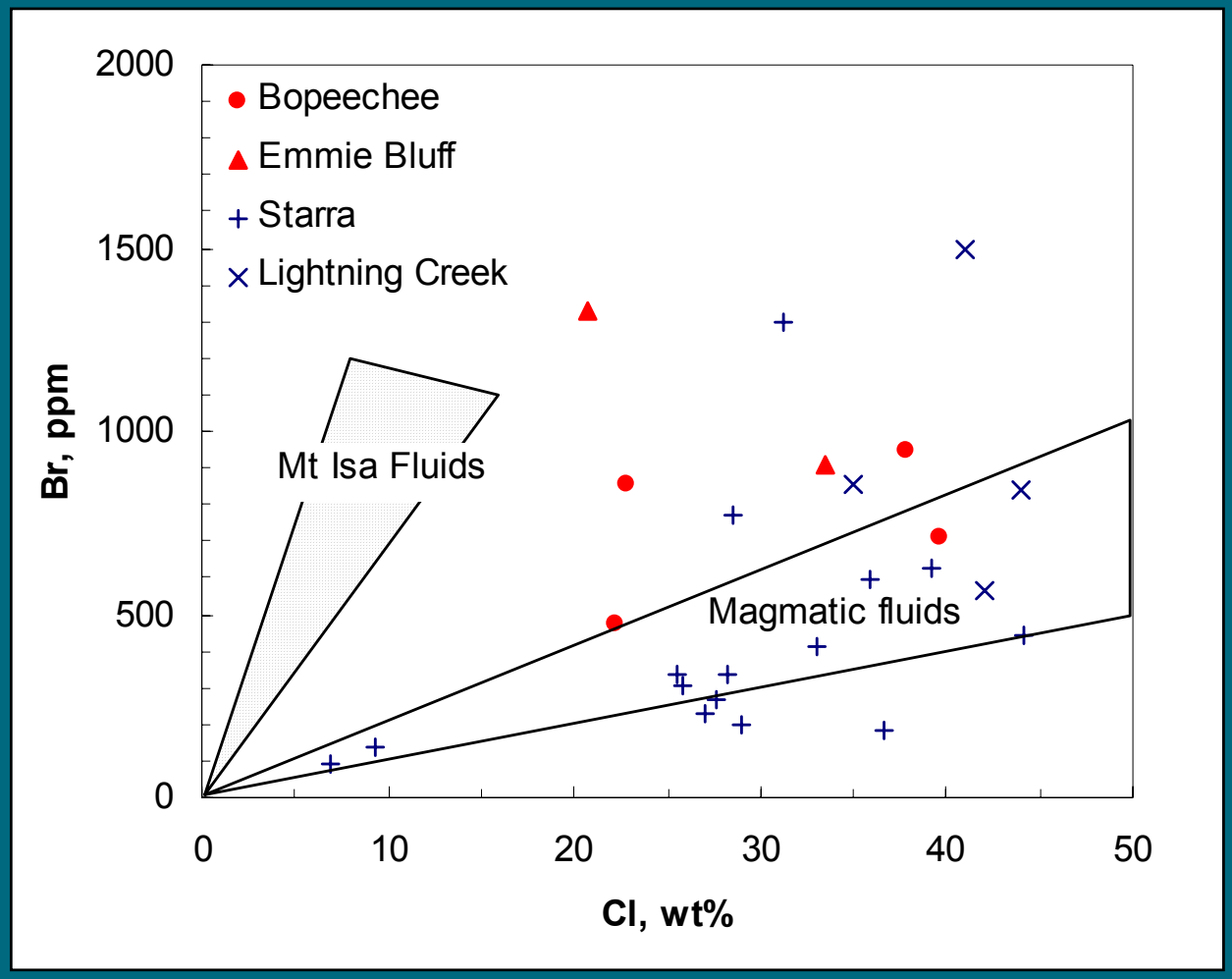
New Insights



- Structural style typical of regional dextral transtension at ~1590 Ma
- Hiltaba suite intrusion appears to be controlled by NW faults opening NNE accommodation spaces
- GRV also appear to be deposited in half-graben structures in Stuart Shelf, but flat-concave up sheets in main ranges
- Basement lithology and structure continuous with “outcropping” areas to south

Where are the metal sources and fluid pathways within the regional framework?



Fluids were buffered by a variety of rock-types in the basement

Sources of metals

GRV / Hiltaba Mafic rocks: Cu >100 ppm (×100-300)

GRV / Hiltaba Felsic rocks: Cu ~ 15 ppm (×1000)

GRV / Hiltaba Felsic rocks: U ~ 50 ppm (×5-10)

Any basement rock: Au ~ 5 ppb (×100)

Hutchison Gp BIFs in basement: a good source of Fe

Sm-Nd isotope data indicate that Cu in Olympic Dam ore can be sourced from 47 km^3 of mafic rock and 385 km^3 of felsic rock

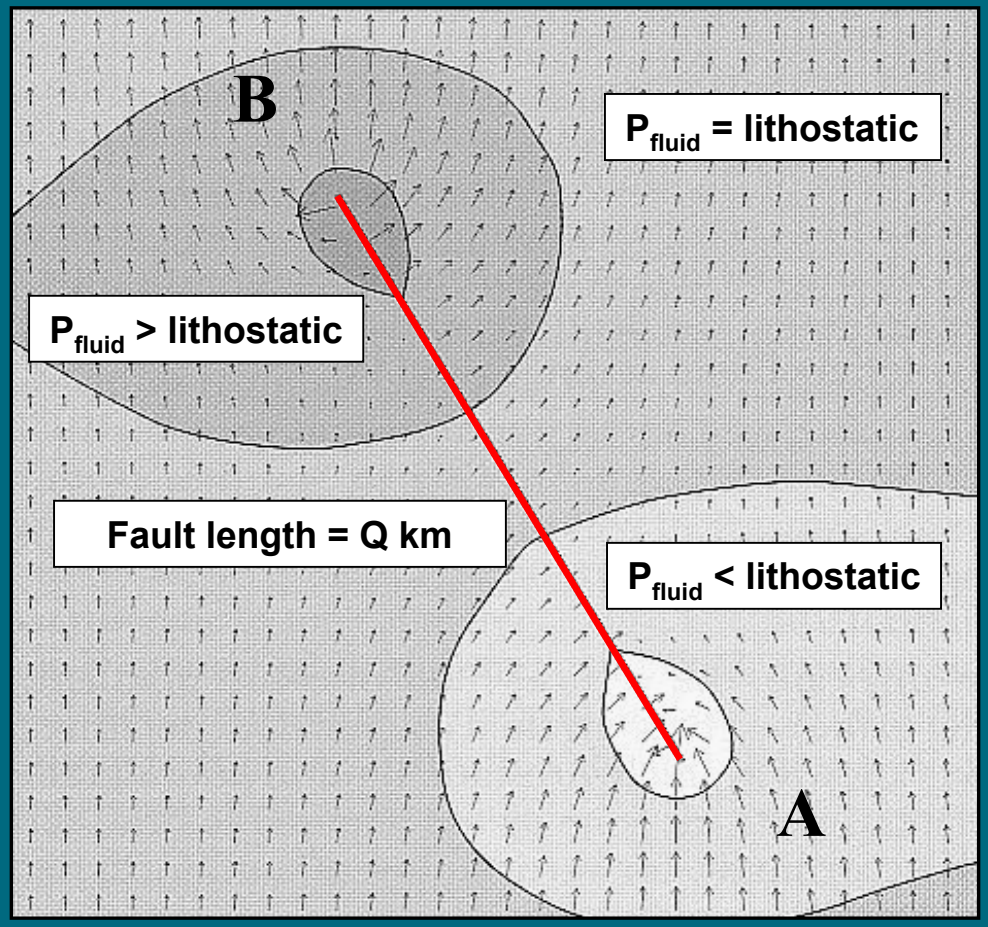
(Johnson & McCulloch,1995)

Depending on the efficiency of the system and the availability of metal,

$10^1 - 10^2$ km^3

of source rock are required

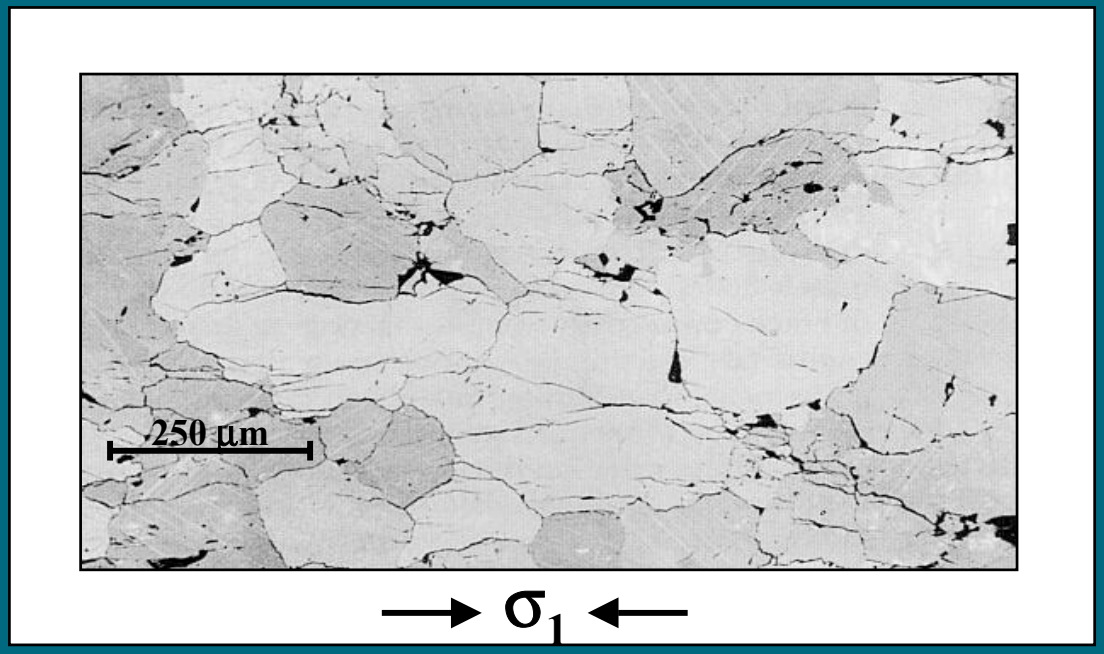
Seismic pumping in active fault systems



Cox et al, 2001

- Source reservoir is proportional fault length
- A fault Q km × 5 km will have a reservoir ~ 20Q km^3

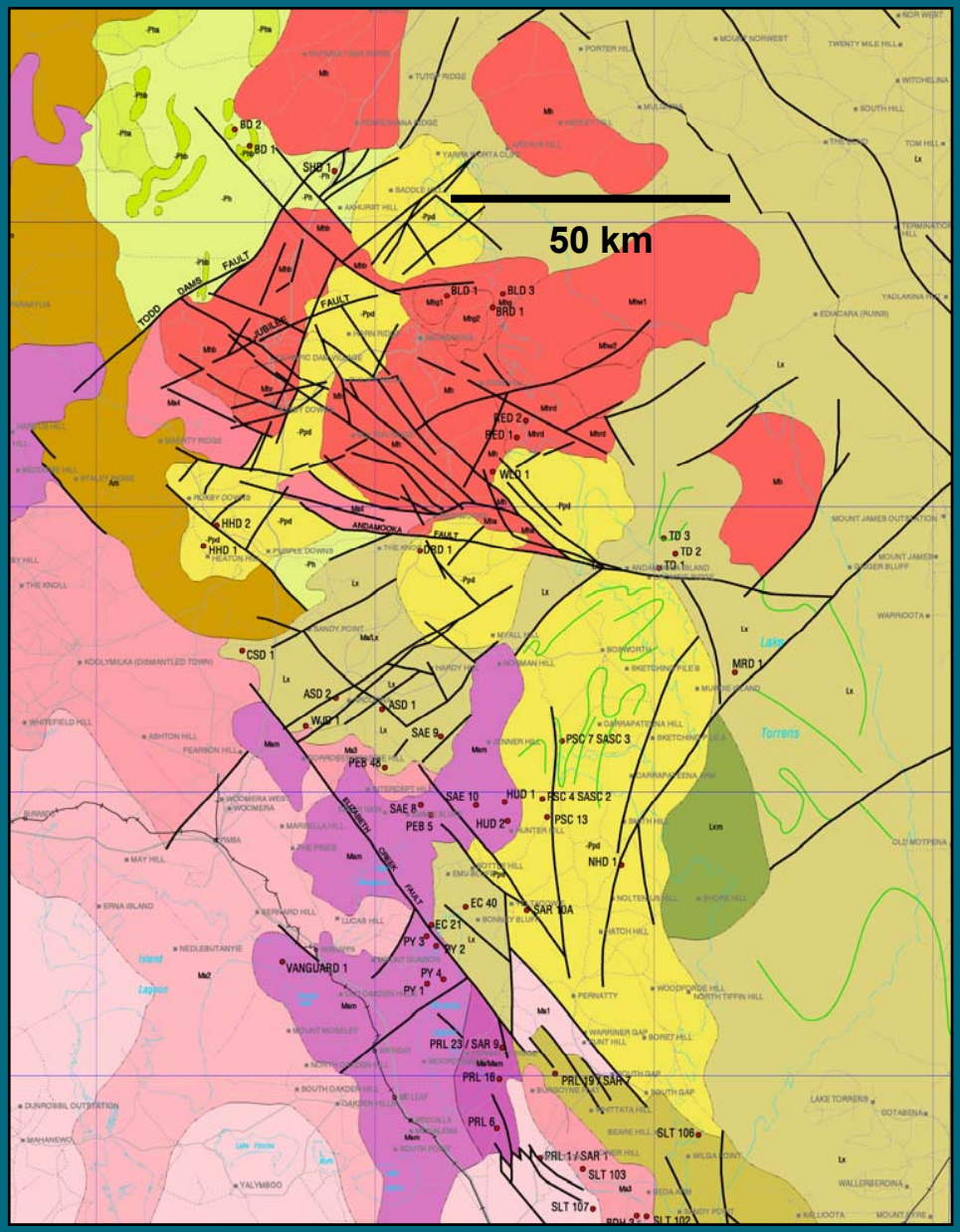
The source rocks can be opened to large volumes of fluid under very small strains 1% - 5%



100 MPa applied to marble at 25°

Interconnected fracture network in 'tight' rock at low temperature and strain

Cox et al, 2001



Faults of these dimensions tap a variety of potential Cu, Au,U & Fe-rich source rocks in the central Olympic province

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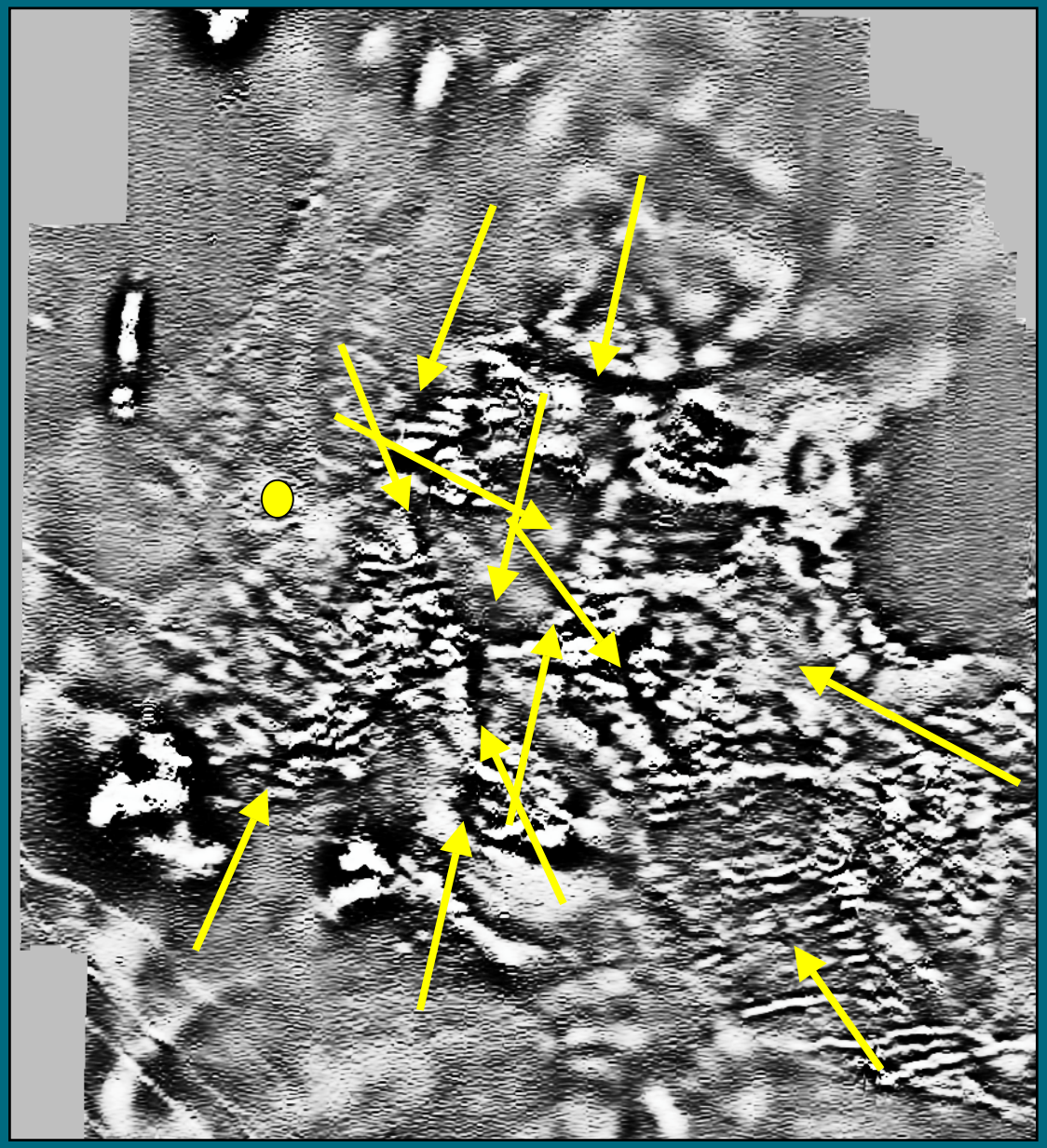
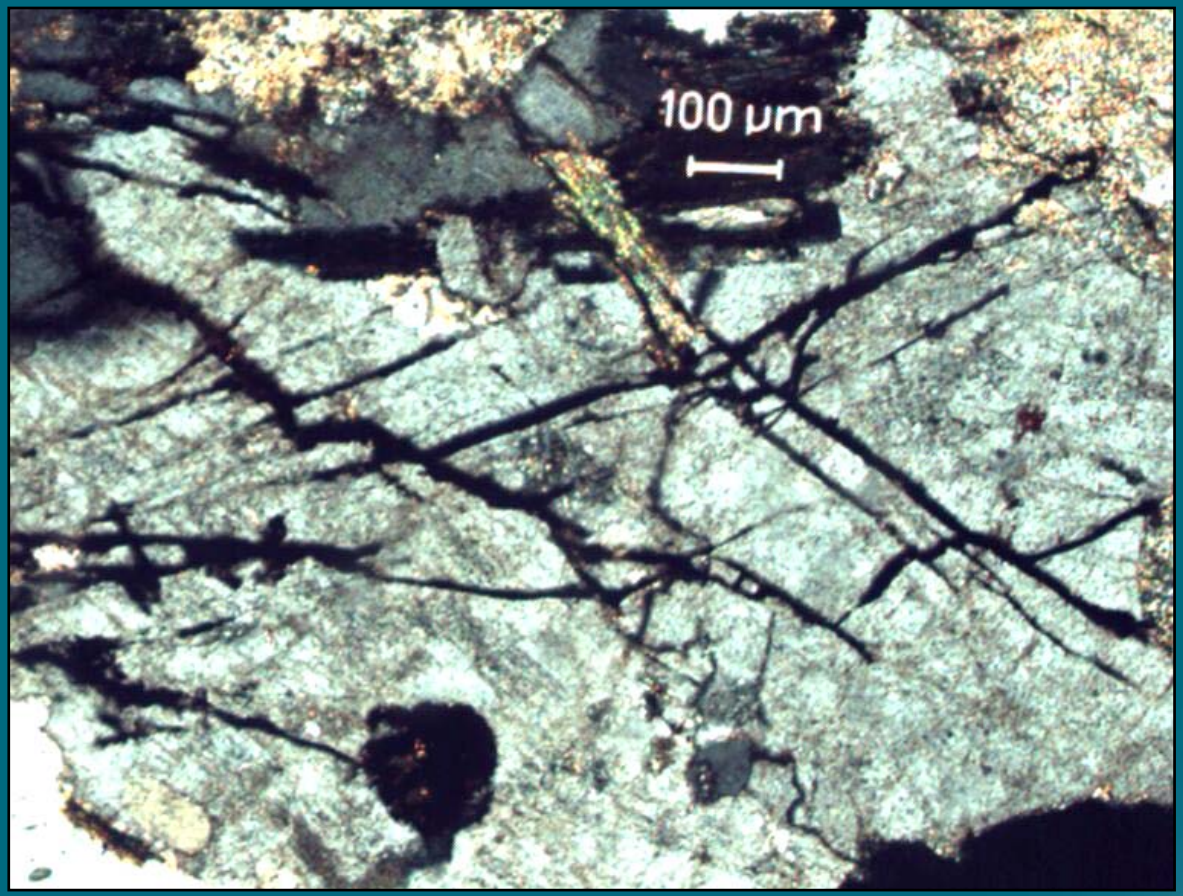


The Olympic Dam region is criss-crossed by a network of faults

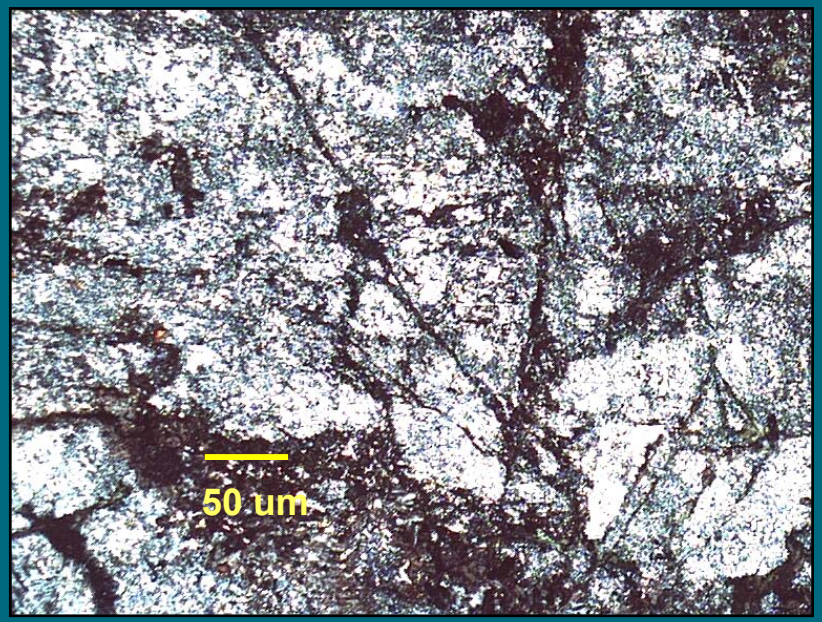
These faults are apparent in the mag data -- 1979 data! -- because they carried oxidising fluids

The demagnetisation is very subtle

‘Tight’ rocks of the OCAP were opened to fluid flow

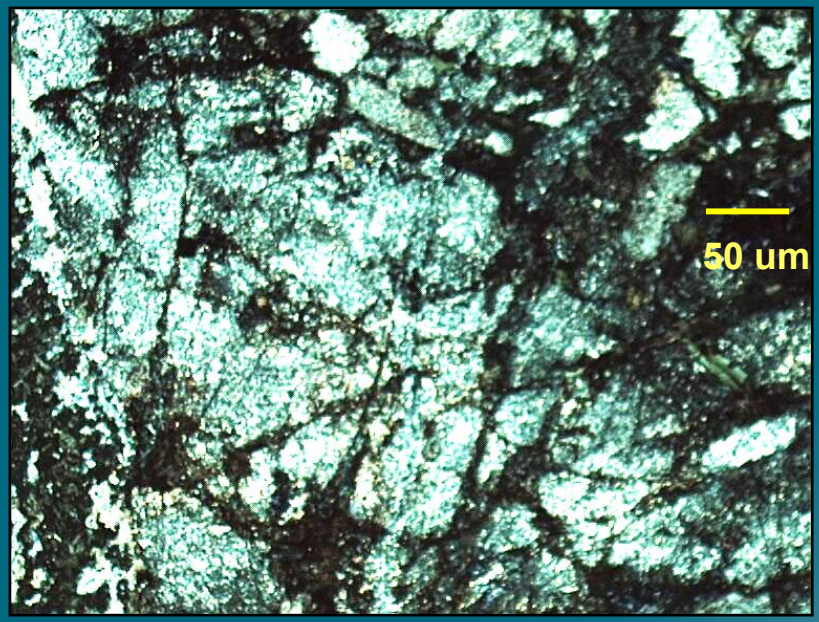


Palaeoproterozoic paragneiss, SHD1 844 m



587.6m

Fractured and altered feldspars in BLD1



614.9 m

BLD1 gabbro was subject to fracture and fluid flow

Fingerprint of a source rock volume?

- OD ore is x8 enriched in Co, depositing carrollite ($Cu(Co,Ni)_2S_4$).
- Co concentrations near OD:

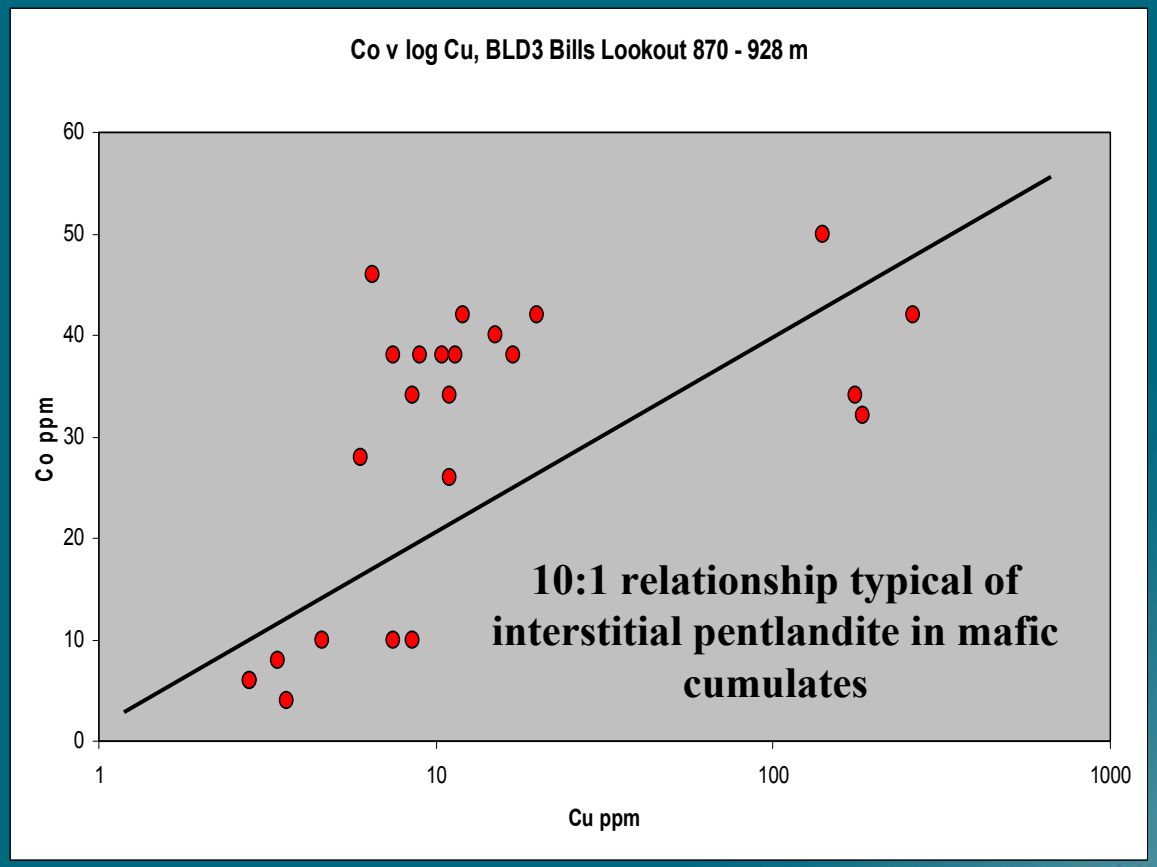
Roxby Downs Granite BDL

Felsic GRV <5 -16 ppm

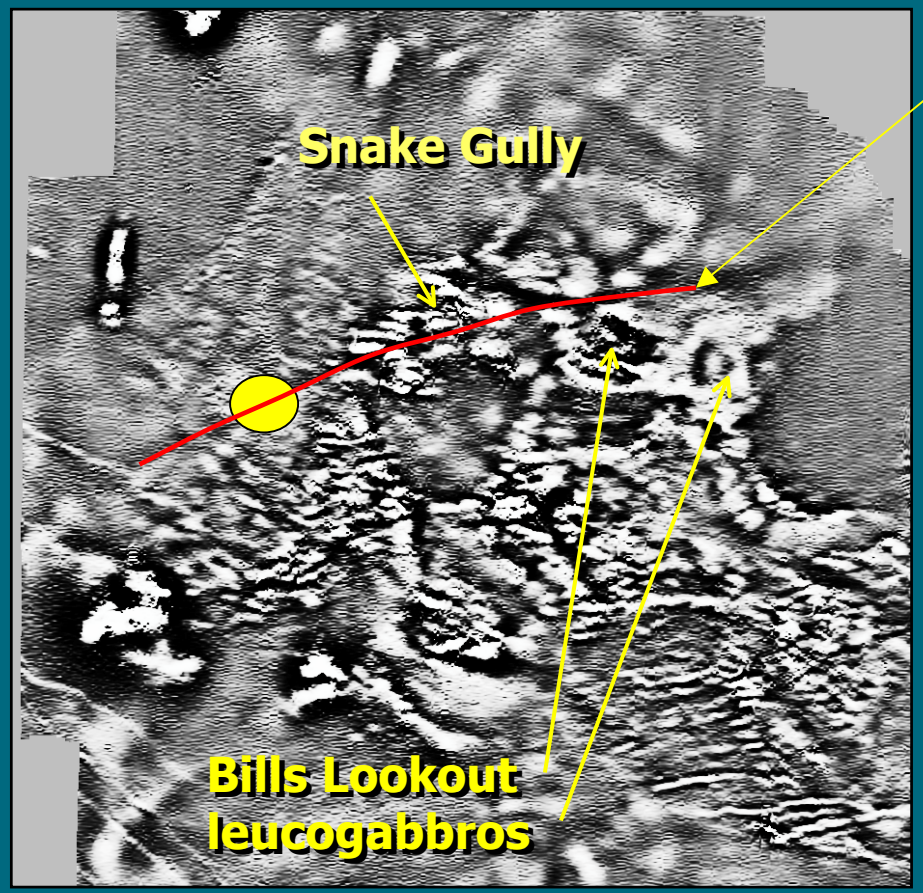
Mafic GRV 60-70 ppm

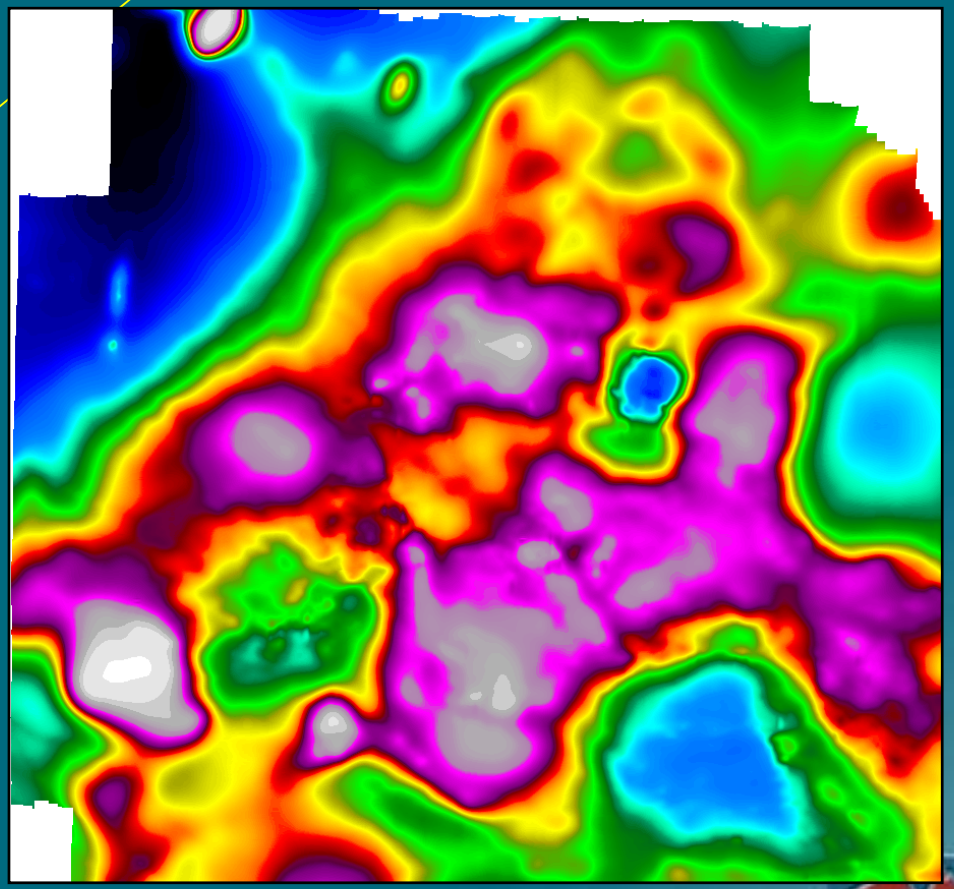
Roopena Volcanics 57 ppm

BLD3 gabbro <4 to 300 ppm



Jubilee Fault





Olympic Cu-Au mineral system

- Crustal fluids sourcing metals
- Faults as pathways and fluid drivers
- Deposition in chemical trap sites -fault porosity and brecciation controls early magnetite?
- System driven by extensional tectonics and high heat flow - likely was rift geodynamic environment