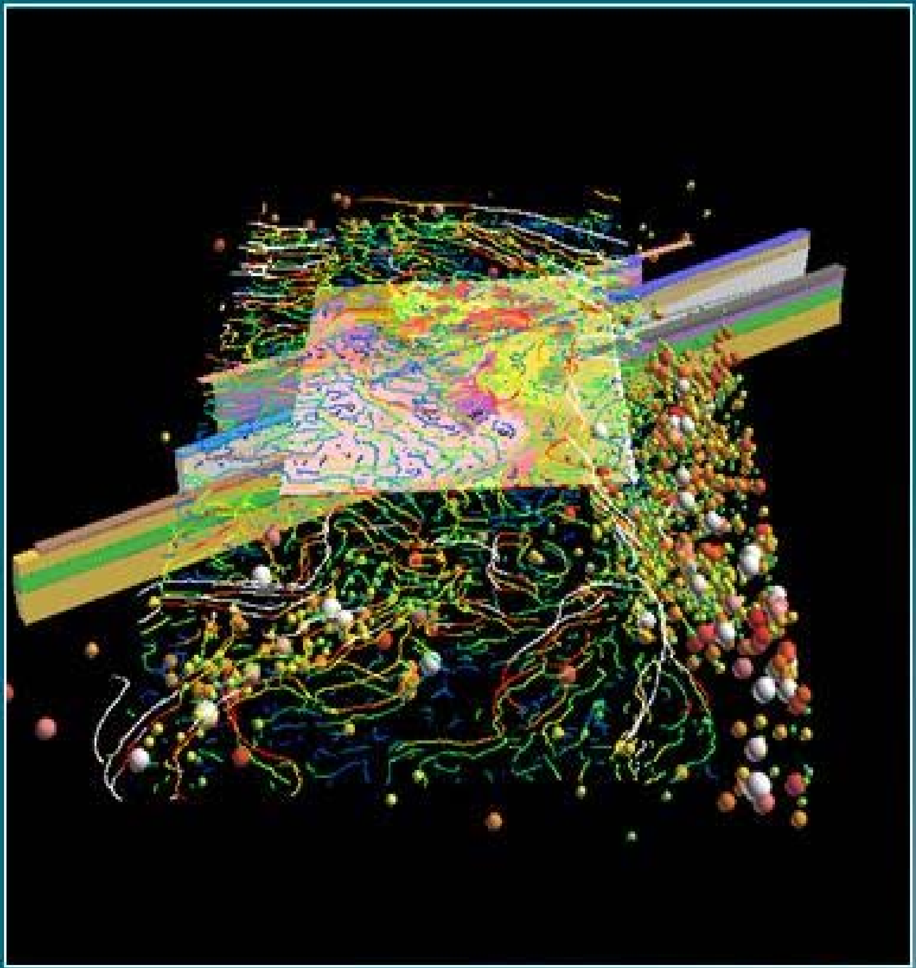
Observable crustal controls on hydrothermal activity in the Olympic Cu-Au province



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Minerals & Energy Resources — Government of South Australia

Continental Evolution Research Group — University of Adelaide

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CRC LEME — Cooperative Research Centre for Landscape Environments and Mineral Exploration

Presentation Outline

- Development of a crustal architectural model for the OCGP
- What was happening at 1590 Ma ?
- Implications for fluid pathways
- Implications for fluid buffering

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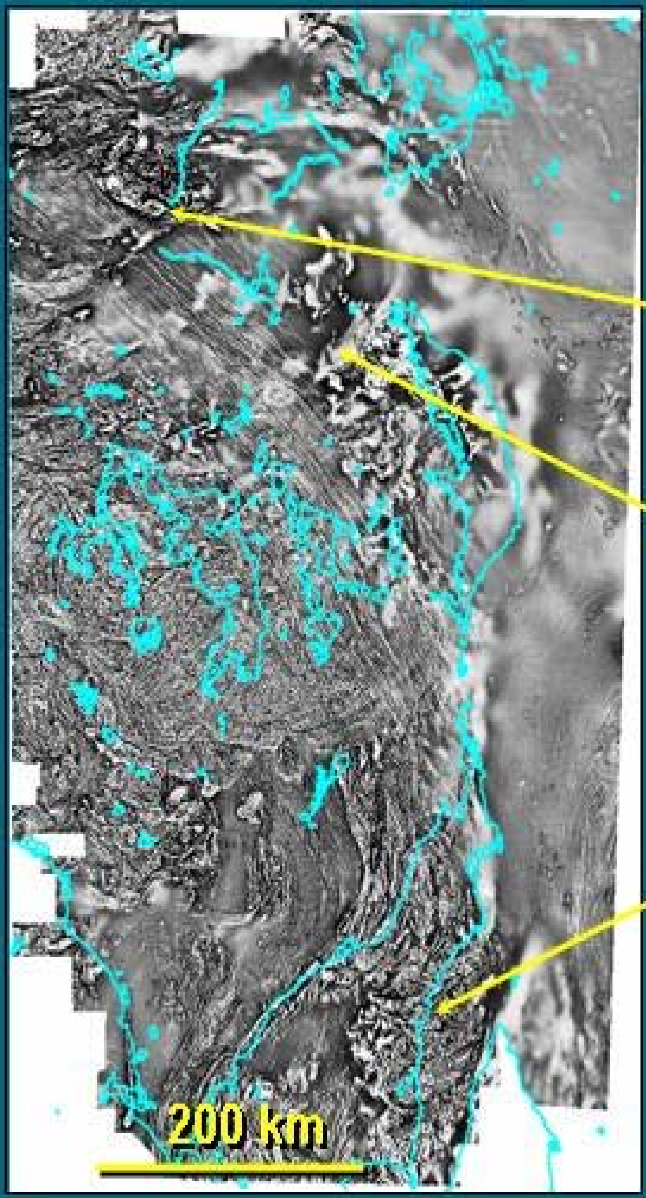
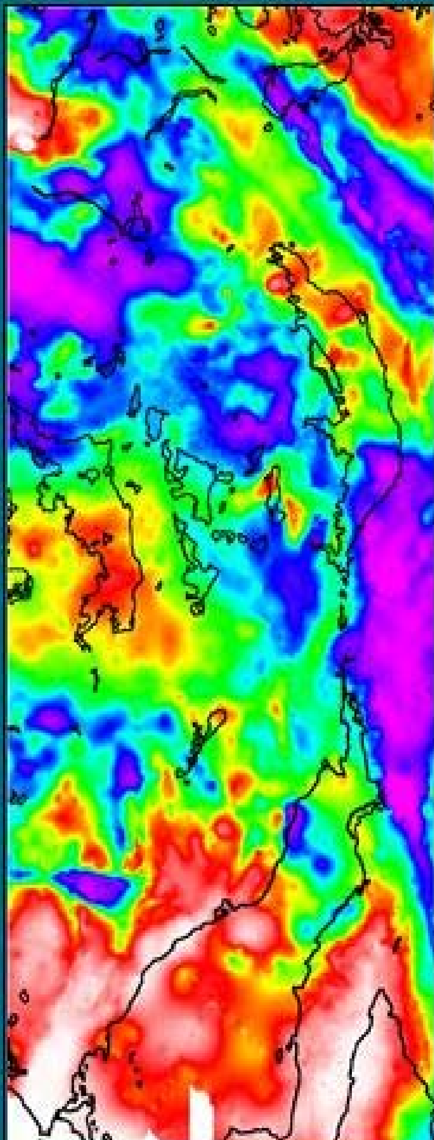
Under cover in the magnetoscape

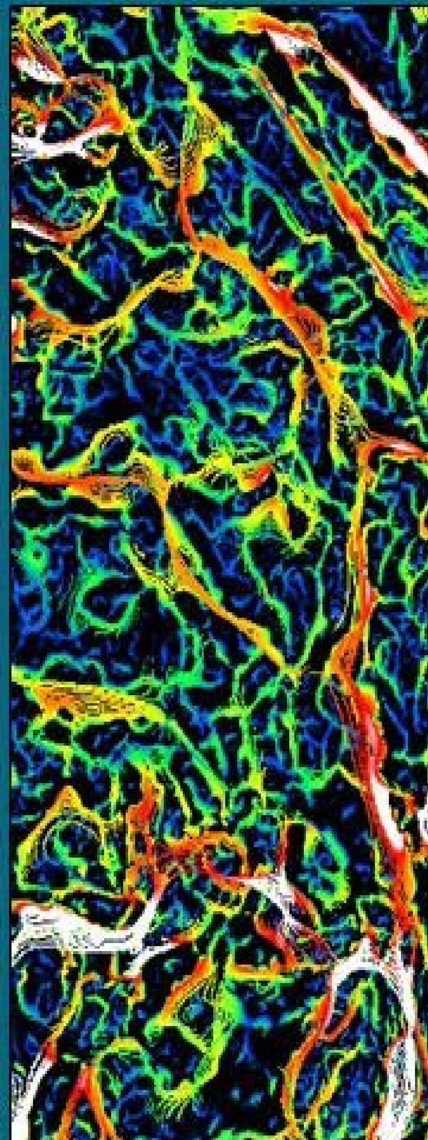


New stitch of residual total magnetic intensity data, 1VD RTP

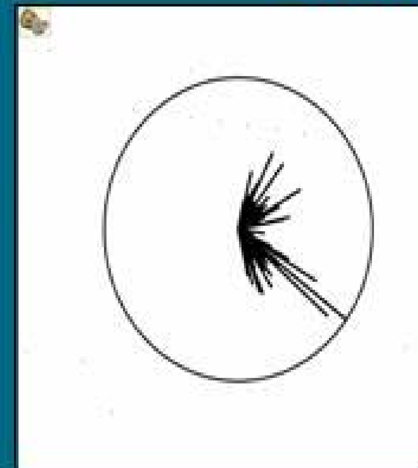
OCGP Gravity



Gravity Worms

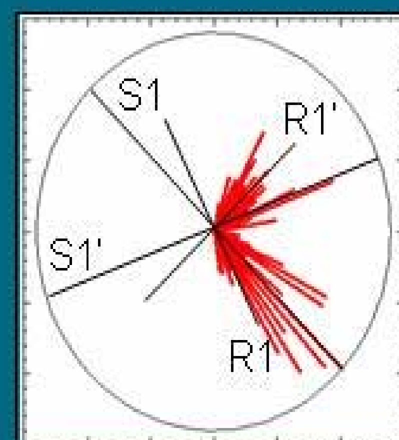


Structure

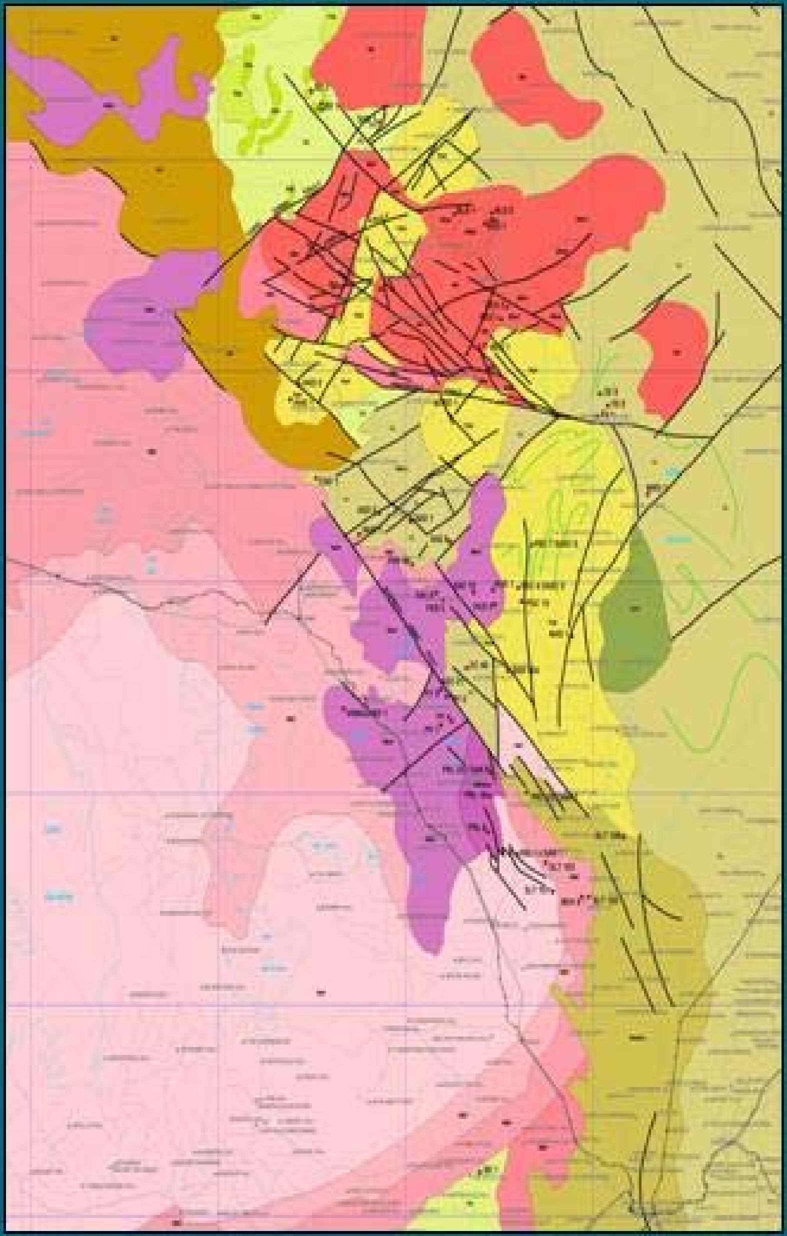


Edge histogram depth slicer

500 m to 41 km UC



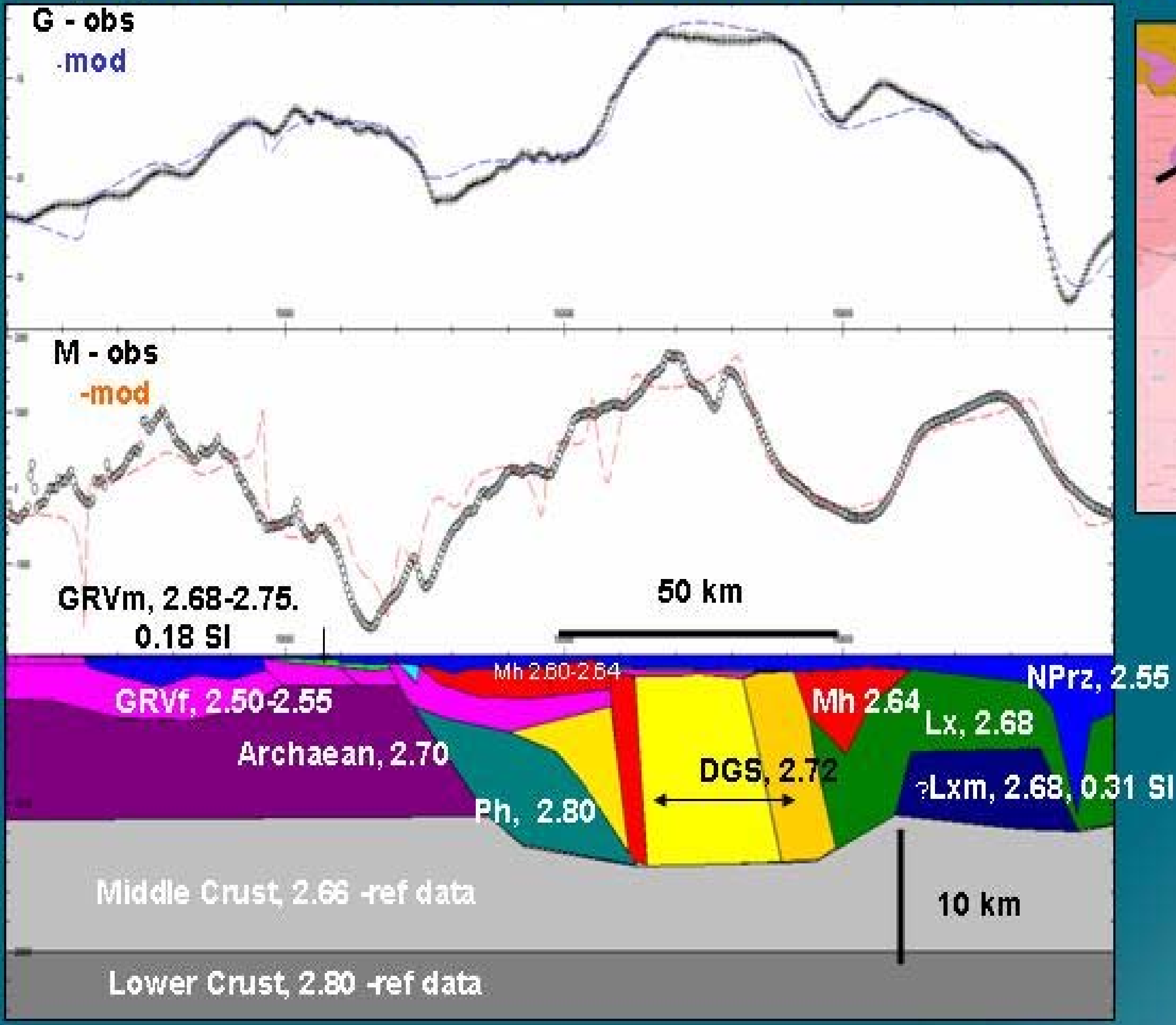
Edge azimuth histogram

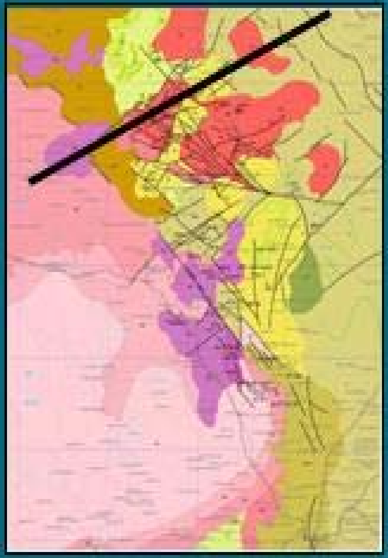


Geophysical Interpretation of the NE Gawler Craton

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

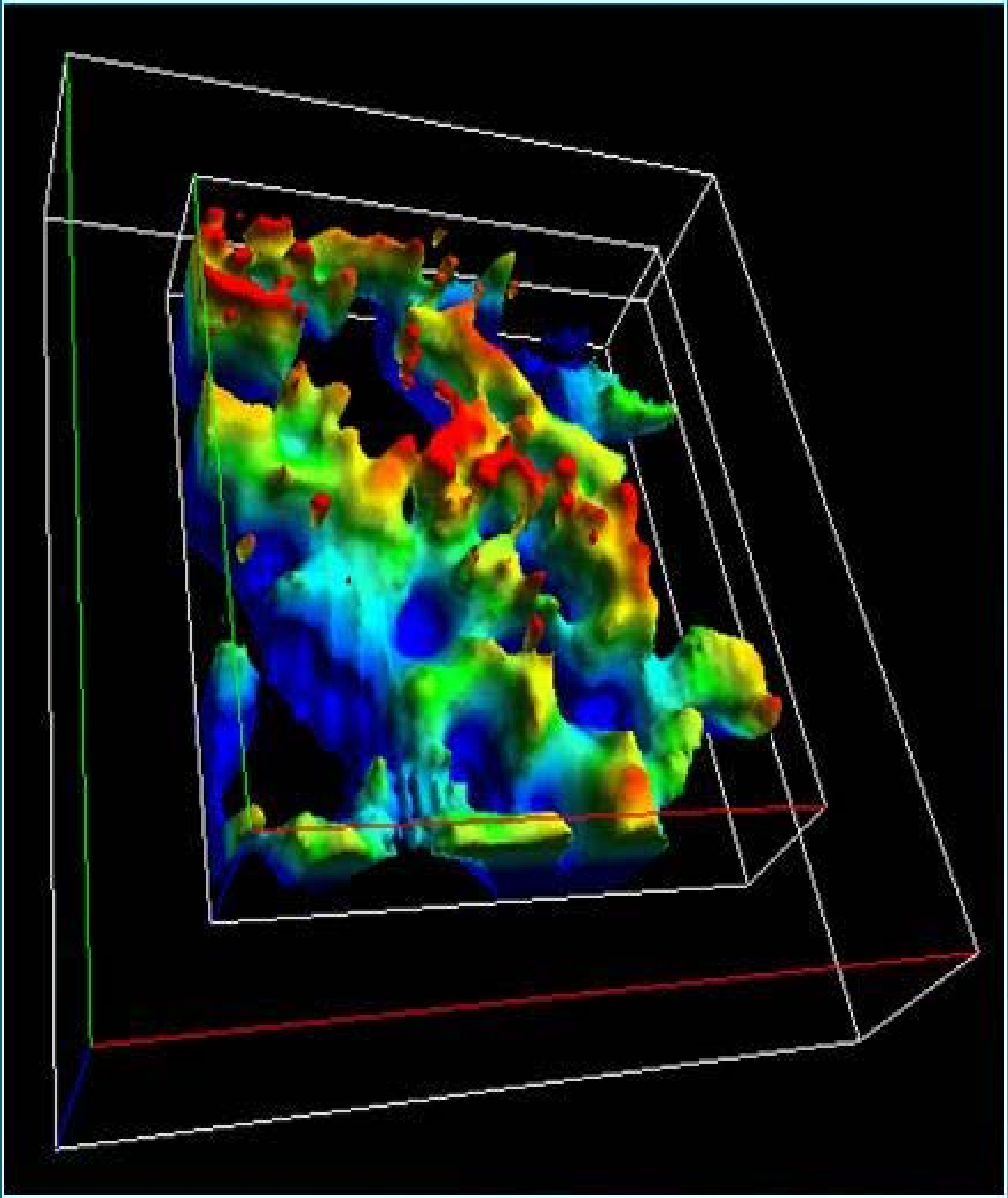
Geophysical models test basement structure and composition



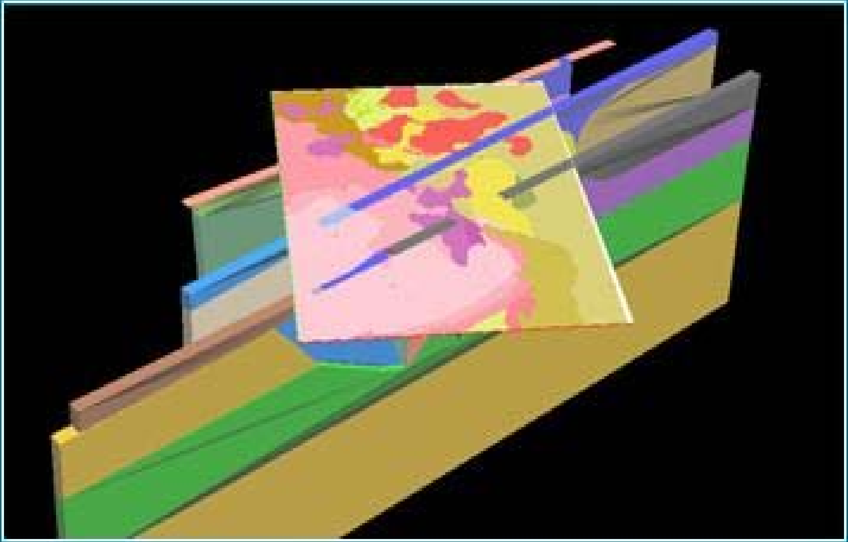


Inversion of magnetic data

- Susceptibility isosurface
- Uses UBC / MIRA code
- Preliminary
- Builds 3D volume
- Confirmation of structural model



Insights from crustal architecture



- Basement in OCGP forms continuous, eastward-younging belts with "outcropping" areas to south
- Structural style typical of regional brittle dextral transtension in the OCGP at ~1590 Ma
- Basin formation processes accommodate GRV + sediment deposition
- Hiltaba suite intrusion appears to be controlled by NW faults opening NNE accommodation spaces
- Basement architecture and evolution is 1st order control on fluid composition, buffering & conduits at 1590 Ma

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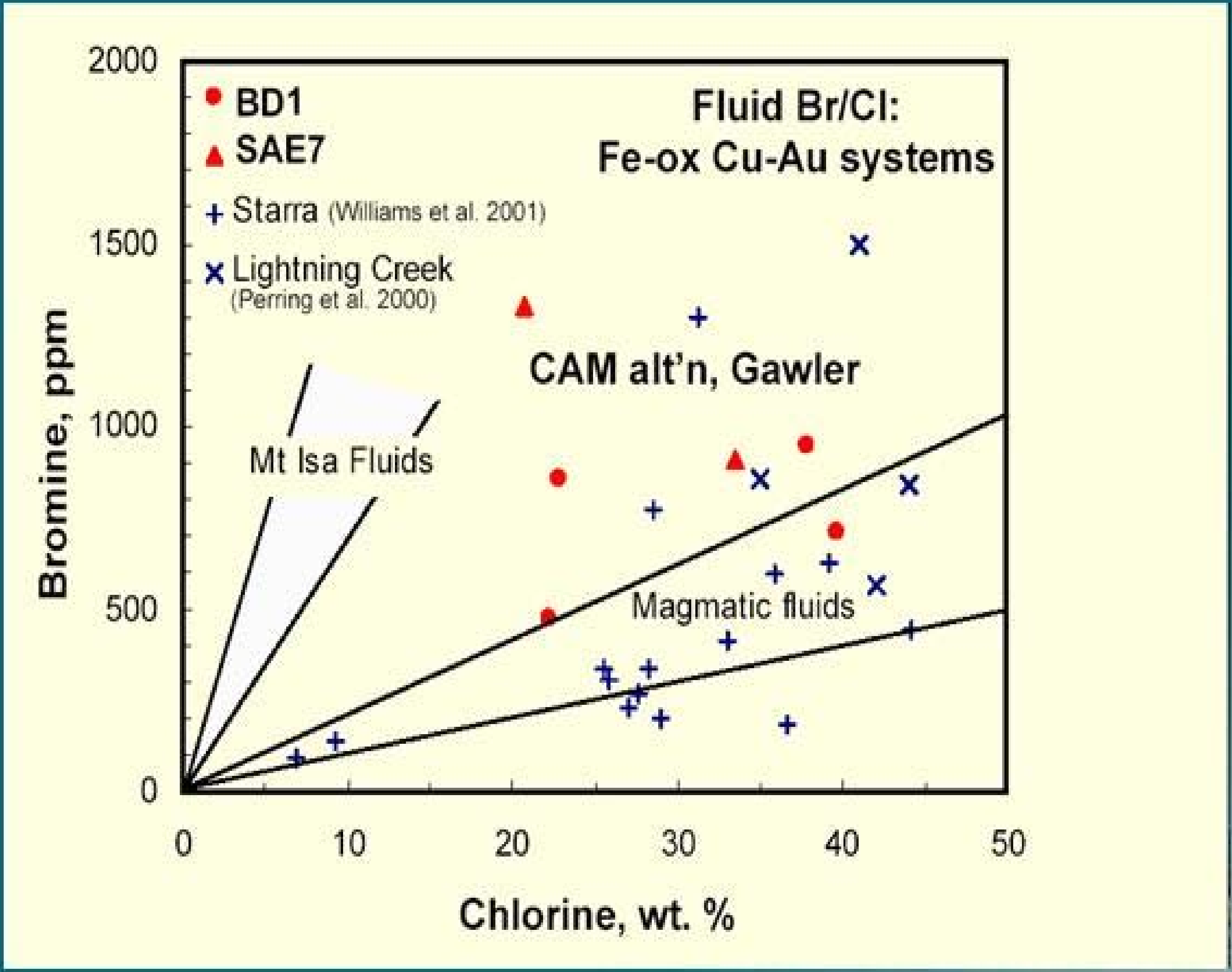
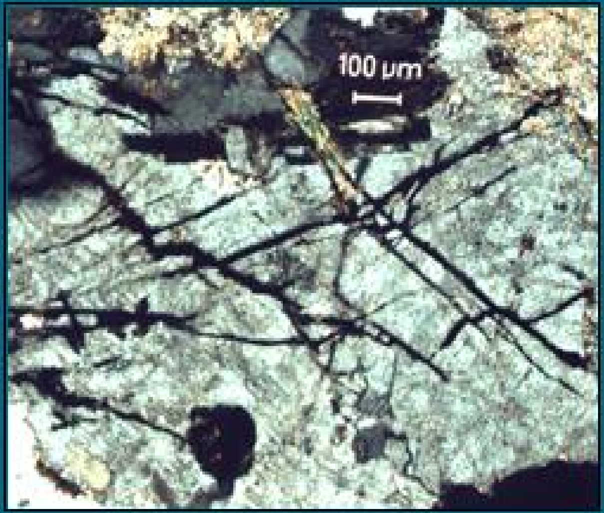
Cu-Au fluids were buffered by a variety of rock-types in the basement

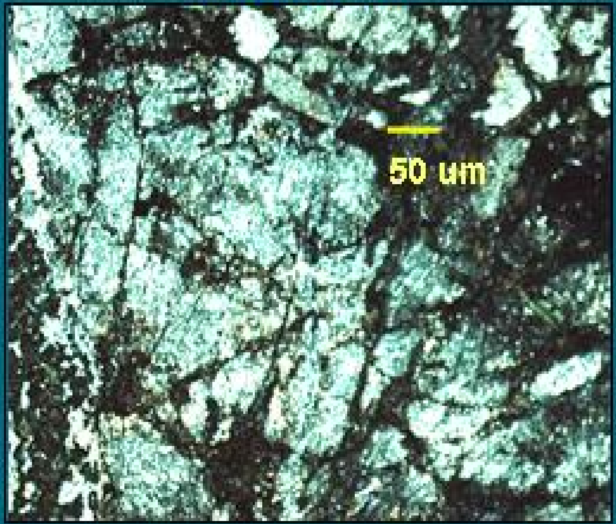
(Bastrakov et al., 2002)

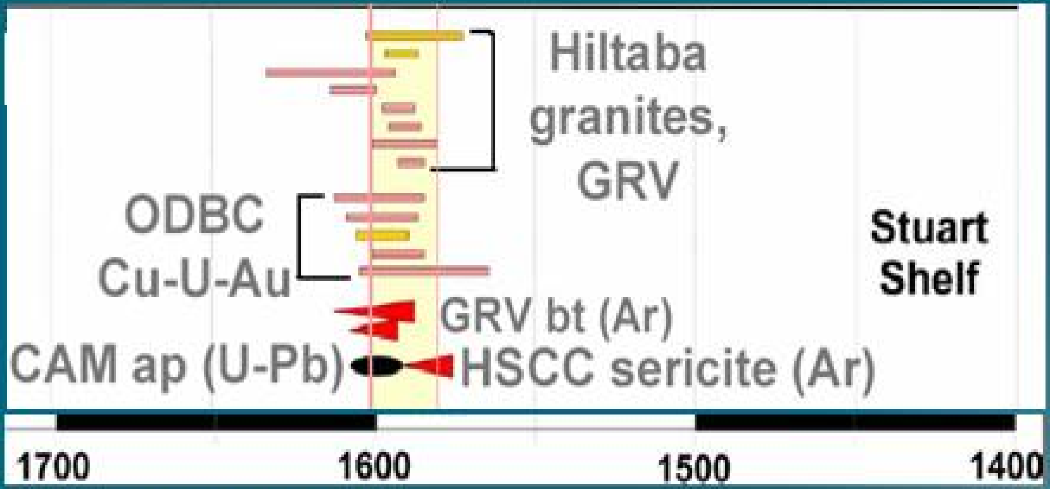


‘Tight’ rocks of the OCGP were opened to fluid flow, depositing ser-hm ~1590 Ma



Palaeoproterozoic paragneiss, SHD1, 844 m





From Skirrow et al., 2002

Fractured and altered feldspars in BLD1 gabbro, 588 & 615 m

Scale of the Mineral System

- Depending on the efficiency of the system

and the availability of metal,

$10^1 - 10^2$ km^3 of Cu source rock

are required to generate 32 Mt in the Olympic Dam fluid system

- A fault N km × 5 km will have a fluid reservoir

~ 20N km^3 (Cox et al., 2001)

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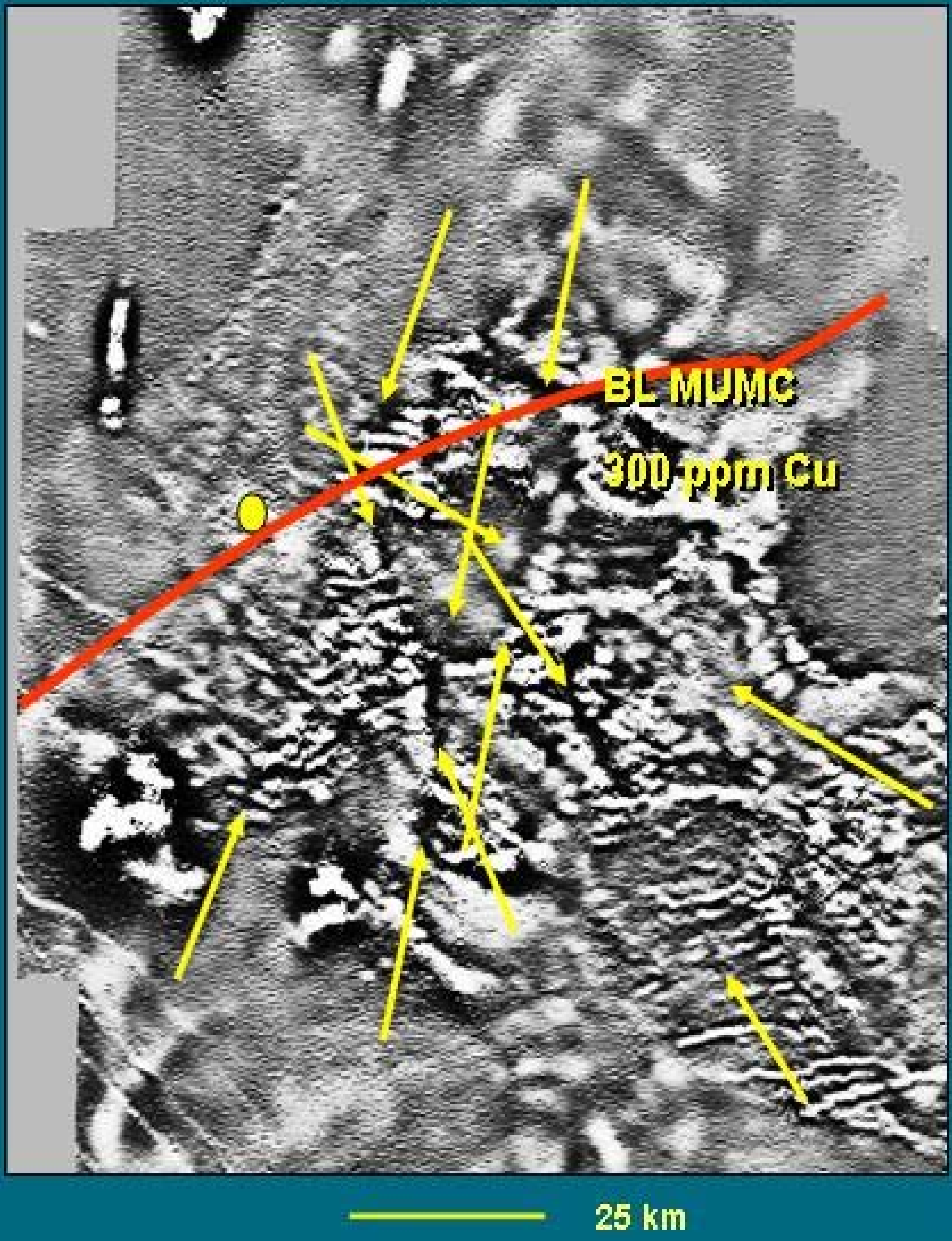
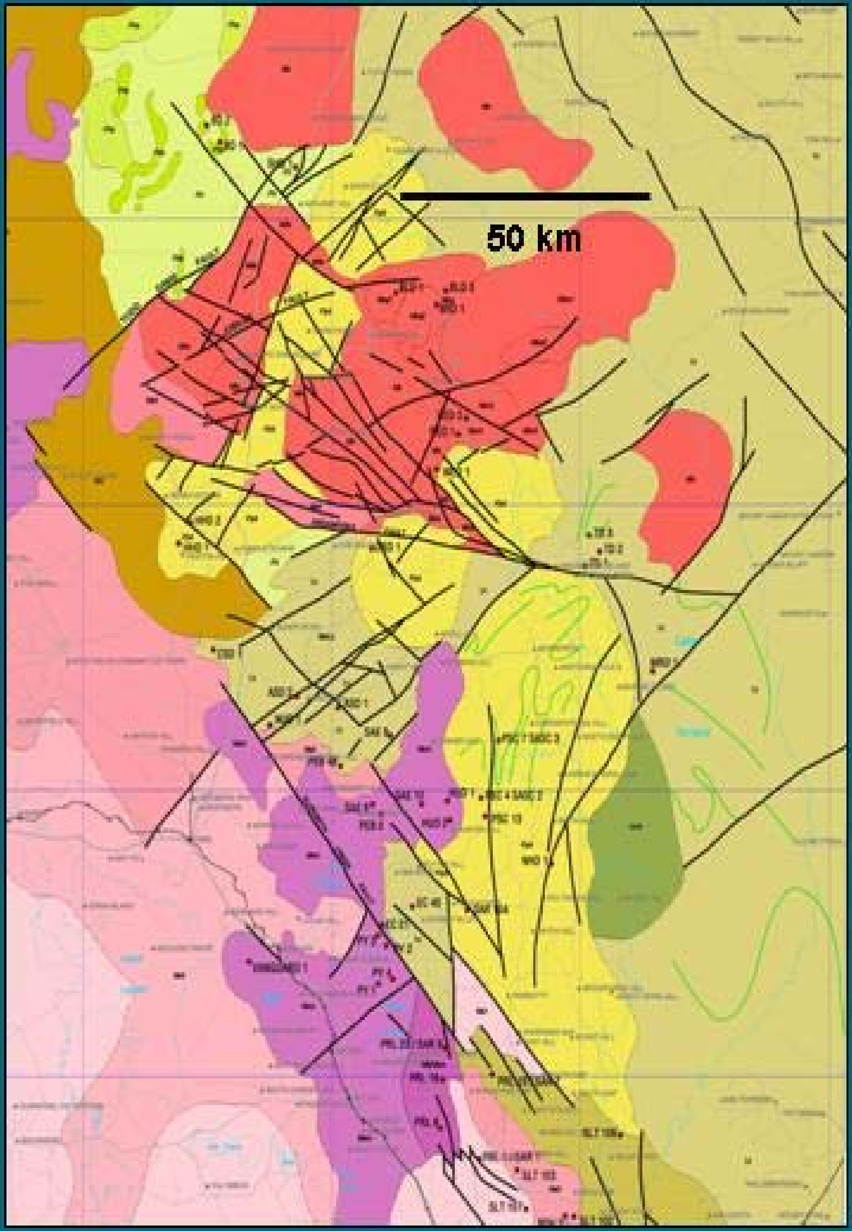


The Olympic Dam region is criss-crossed by a network of faults

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

The demagnetisation is very subtle



Implications

- 1590 Ma faults of these dimensions tap a variety of potential Cu, Au,U & Fe-rich source rocks in the OCGP
- The total length dimensions of the 1590 Ma architecture suggests potential for more Cu-Au fluid systems

Olympic Cu-Au –

a 1590 Ma structurally controlled fluid system

- Basement architecture continuous with belts to south, forming an apparently outward-stepping concentric system
- This system was put under transtension and high heat flow at 1590 Ma: half-graben, granites, volcanism and faulting
- Basement rocks at 1590 Ma were fertile sources Cu, Au, Fe, U, and were pervaded by altering fluids of mixed compositions
- Faults acted as fluid conduits and fluid drivers

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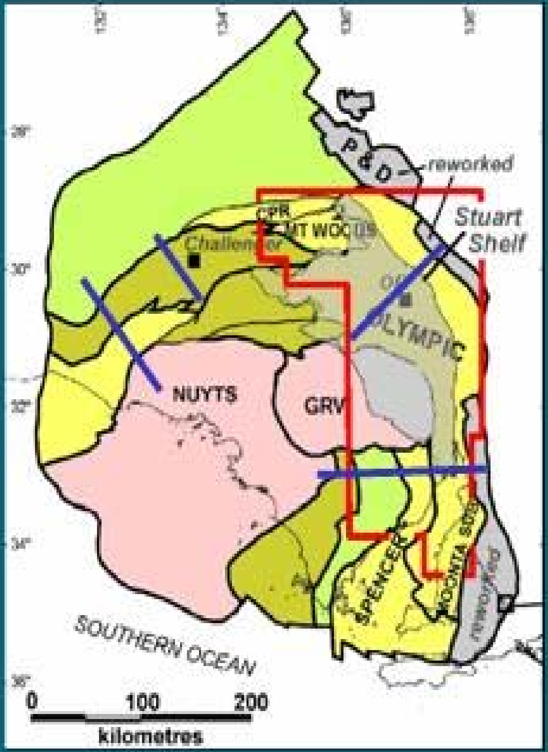
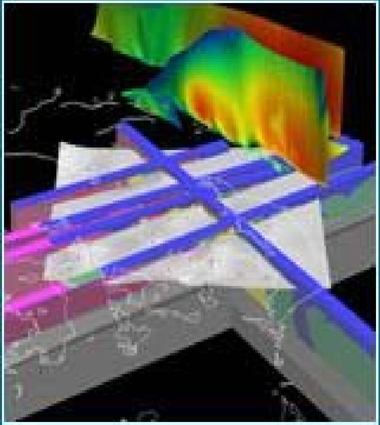
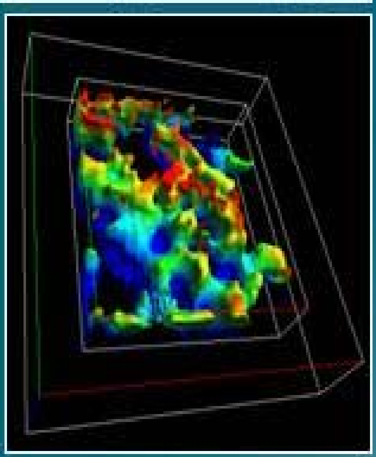
Future Work

- MT Geotransect across OCGP at Olympic Dam and south of Gawler Ranges will test contiguity of structural belts –PhD project with PIRSA







- Constrained G & M inversions to refine crustal model, possibly with a view to full fluid FEM modelling
- Geotransects of the Fowler Domain and Challenger area for Ni-PGE and Au system architecture –Hons & PhD projects

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