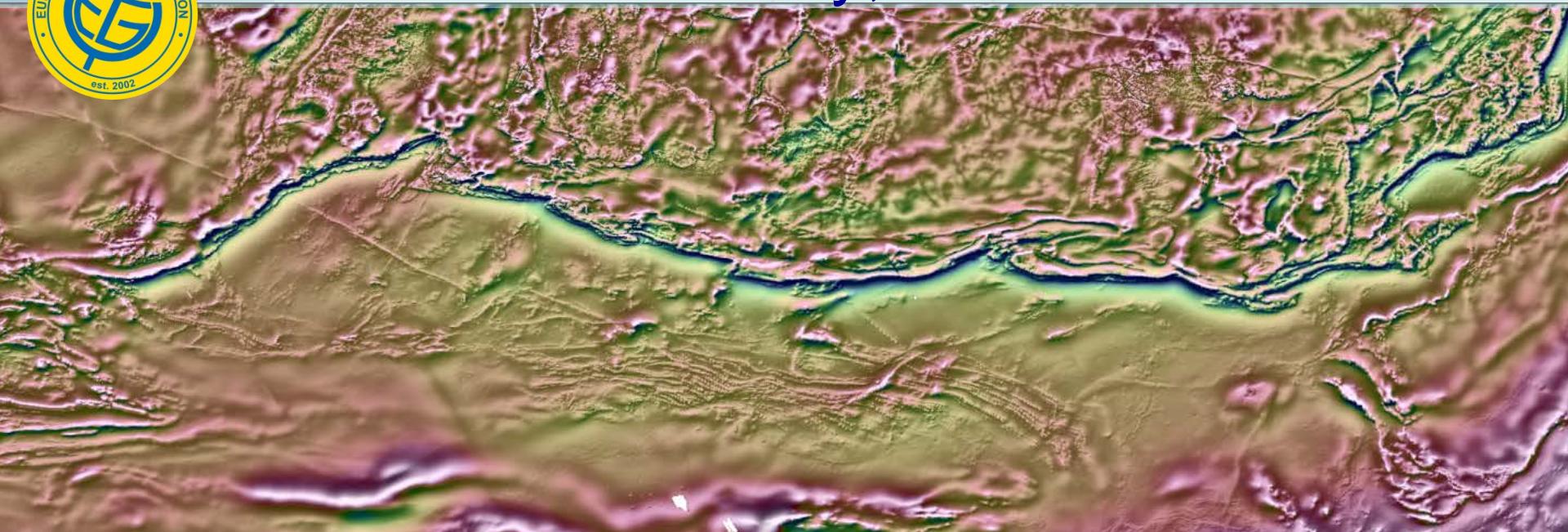


Finding mineral potential in greenfields regions with structural geophysical interpretation, west Kimberley, Australia



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Centre for EXPLORATION
TARGETING



THE UNIVERSITY OF
WESTERN AUSTRALIA

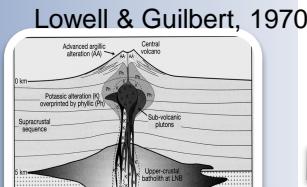


Geological Survey of
Western Australia



Understanding regional prospectivity

- Five steps to generate a knowledge driven mineral prospectivity map

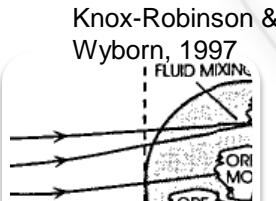


Preliminary Research

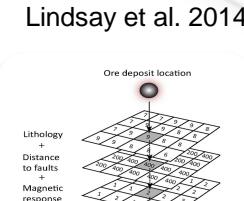
- Mineral system model
- Regional geology
- Data collection



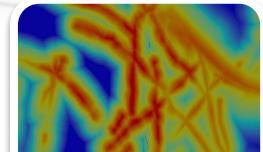
- Interpretation
- Petrophysics
 - Structural interpretation
 - Joint forward modelling



- Selection of evidence layers
- Source
 - Pathway
 - Trap

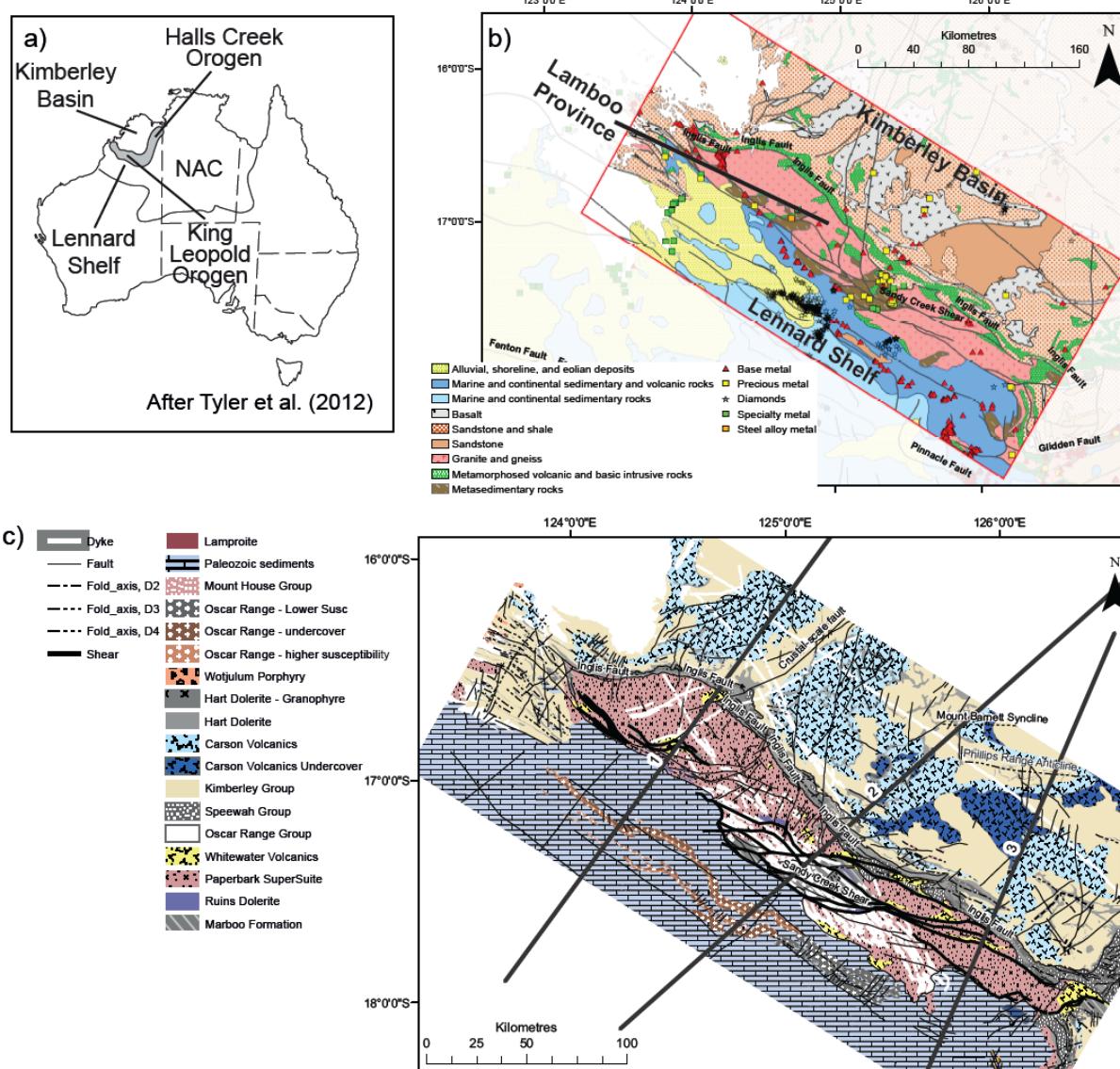


- Evidence layers
- Preparation
 - Categorise
 - Standardise



- Model calculation
- Mineralisation favourability
 - Fuzzy Logic
 - Inference network

The west Kimberley: King Leopold Orogen and Lennard Shelf



The west Kimberley: King Leopold Orogeny and Lennard Shelf

- **Hooper Orogeny**

1870-1850 Ma

- Hart/Carson LIP

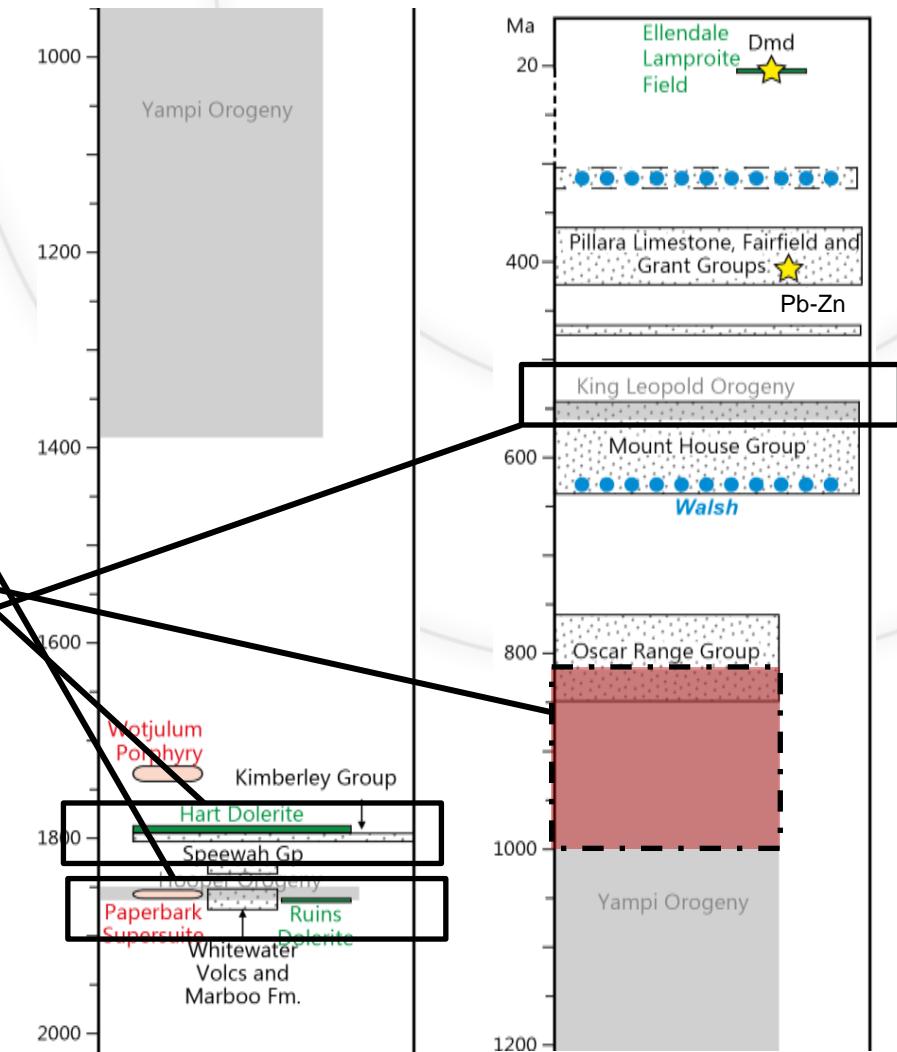
- Follows c. 1820 Ma Halls Creek Orogeny (east Kimberley)

- **Yampi Orogeny**

<1400 Ma – 800 Ma

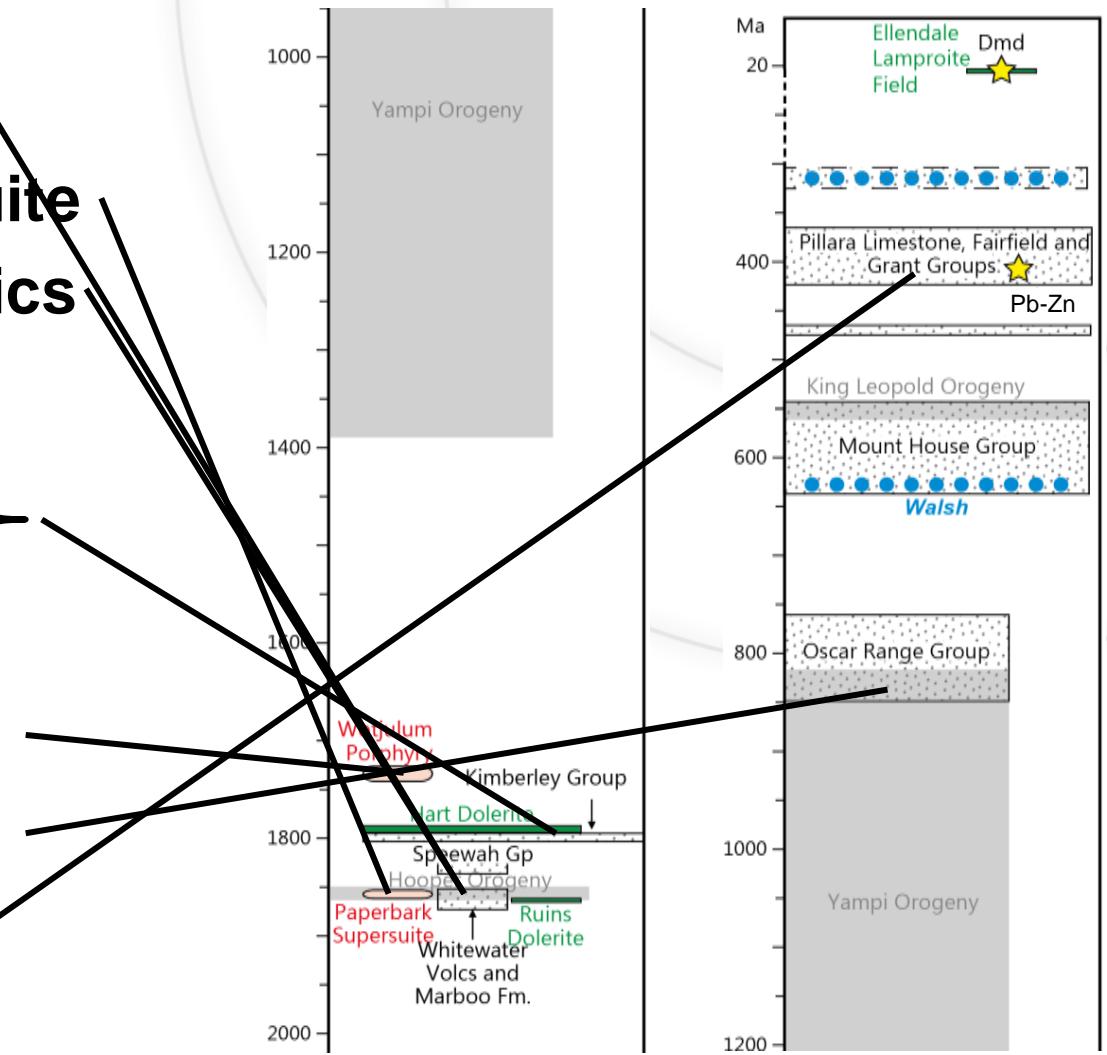
- **King Leopold Orogeny**

c. 560 Ma



The west Kimberley: King Leopold Orogeny and Lennard Shelf

- Marboo Formation
- Paperbark Supersuite
- Whitewater Volcanics
- Speewah Group
- Kimberley Group
 - Carson Volcanics
- Hart Dolerite
- Wotjulum Porphyry
- Oscar Range Group
- Devonian limestone units

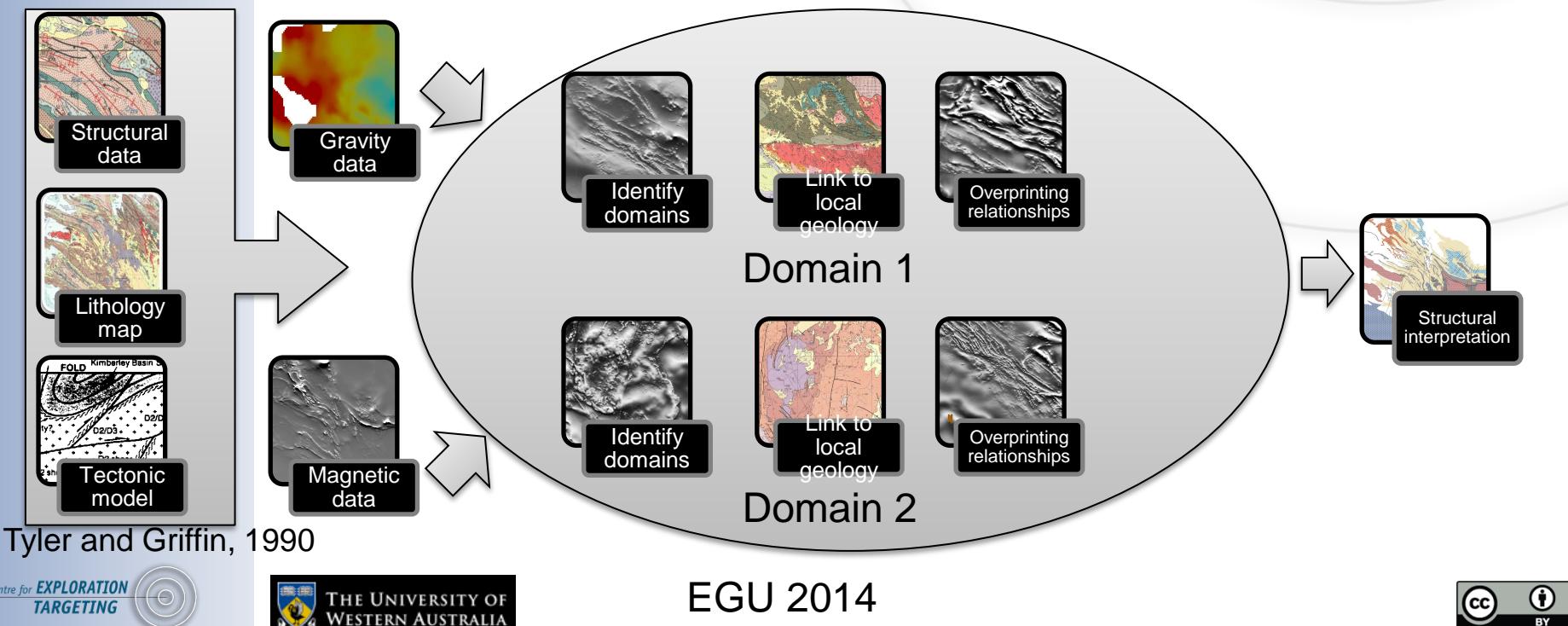


EGU 2014

Modified after Johnson 2013

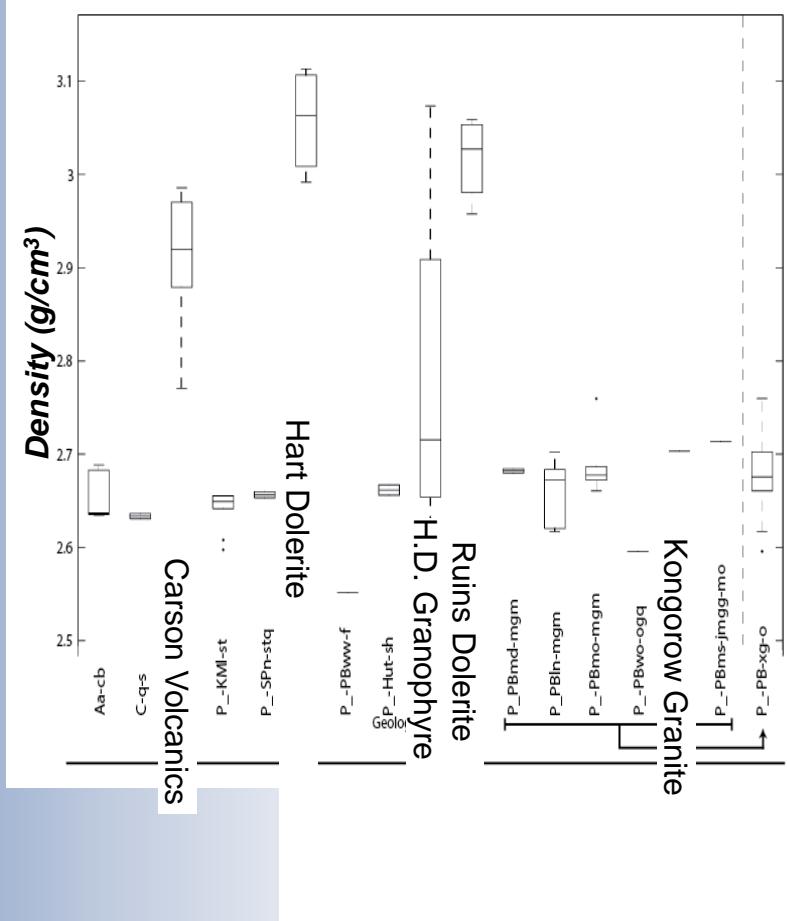
West Kimberley – architecture and evolution

- **Domain-based structural interpretation**
 - Aeromagnetic and gravity data
 - Events defined on the basis of local overprinting relationships
 - Grouped into regional tectonic events based on field observations, magnetic stratigraphy, structural grain, deformation, and orientation

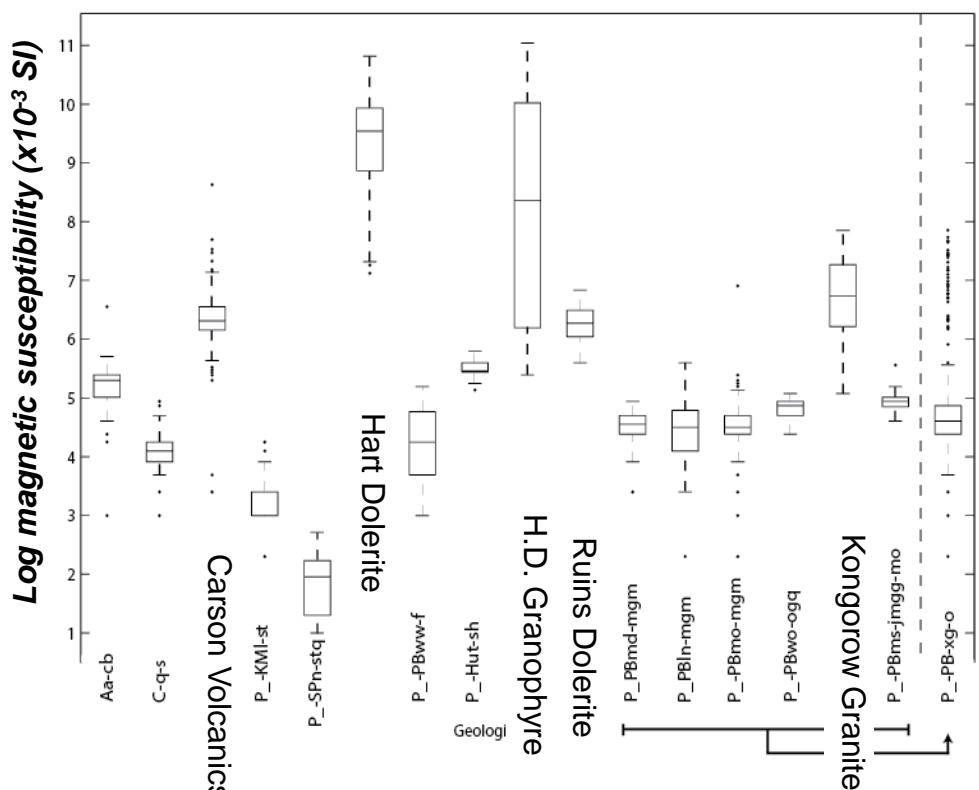


Petrophysical data

Density



Magnetic susceptibility



700000

750000

17°0'0"S

8120000

8080000

8040000

8000000

7960000

7920000

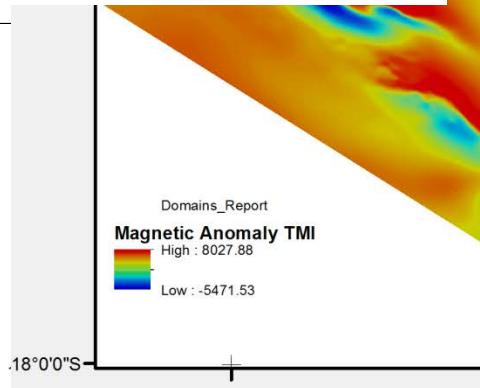
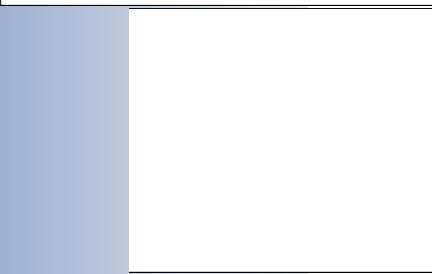
7880000

7840000

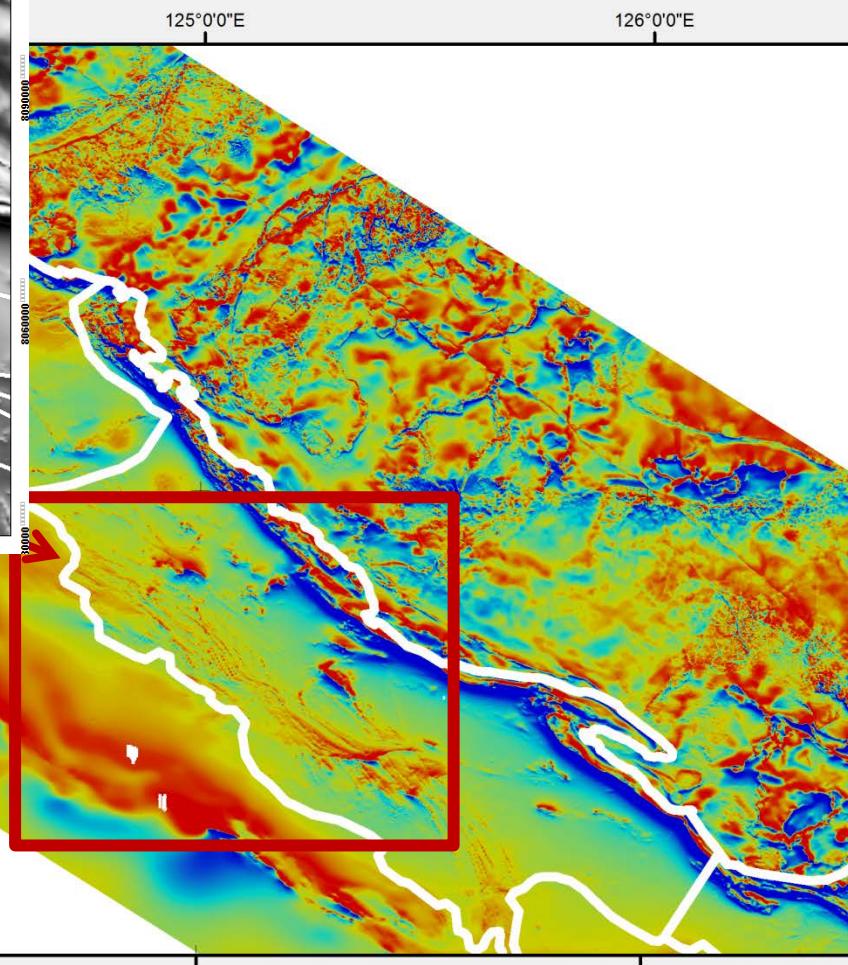
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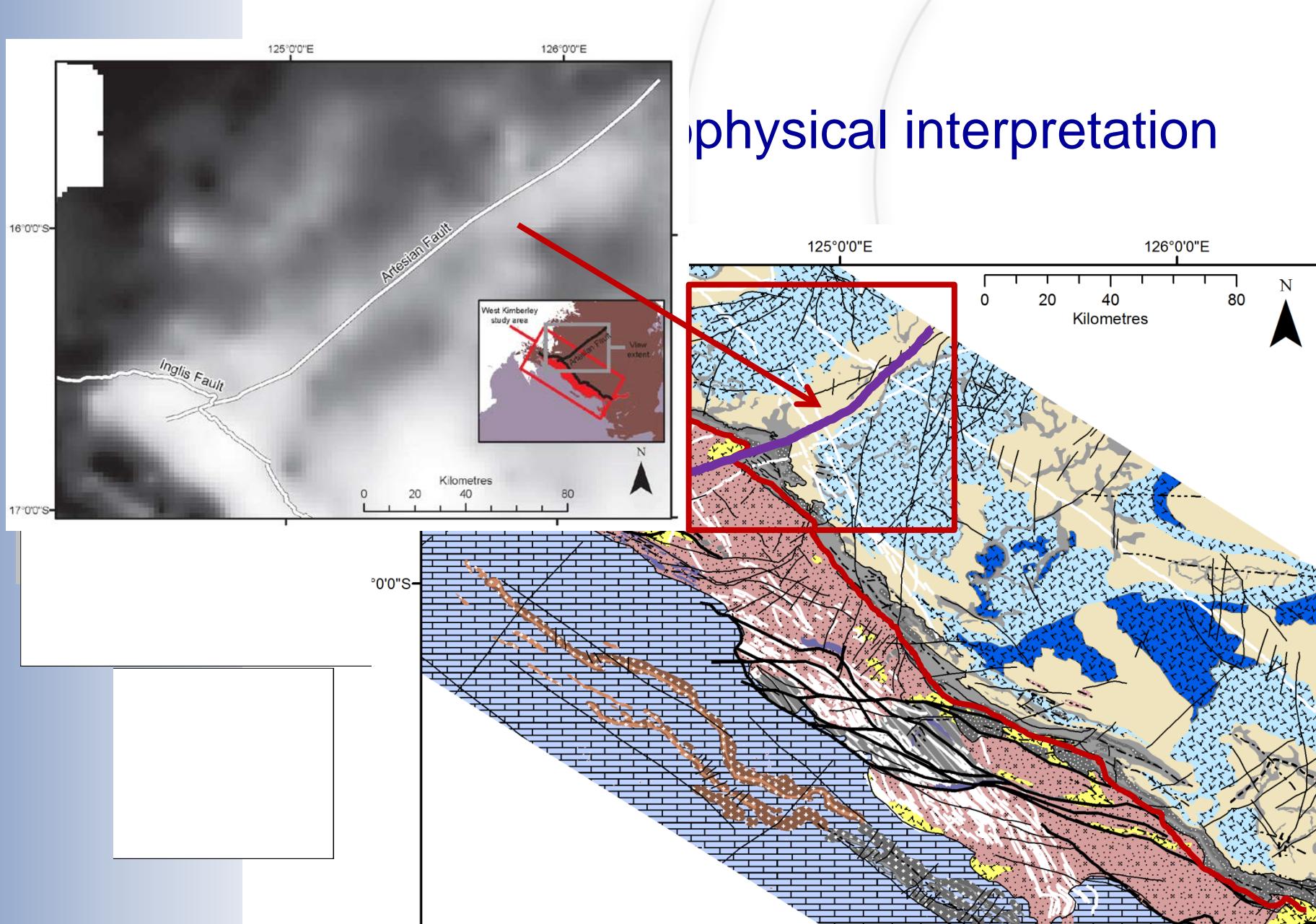
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750000



Physical interpretation

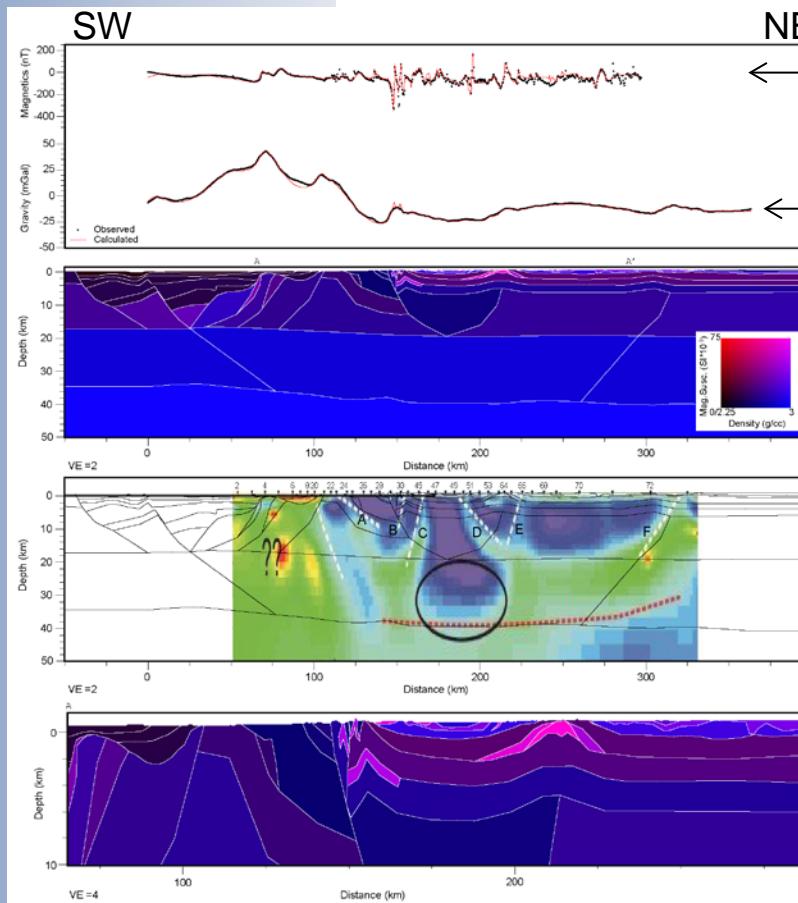




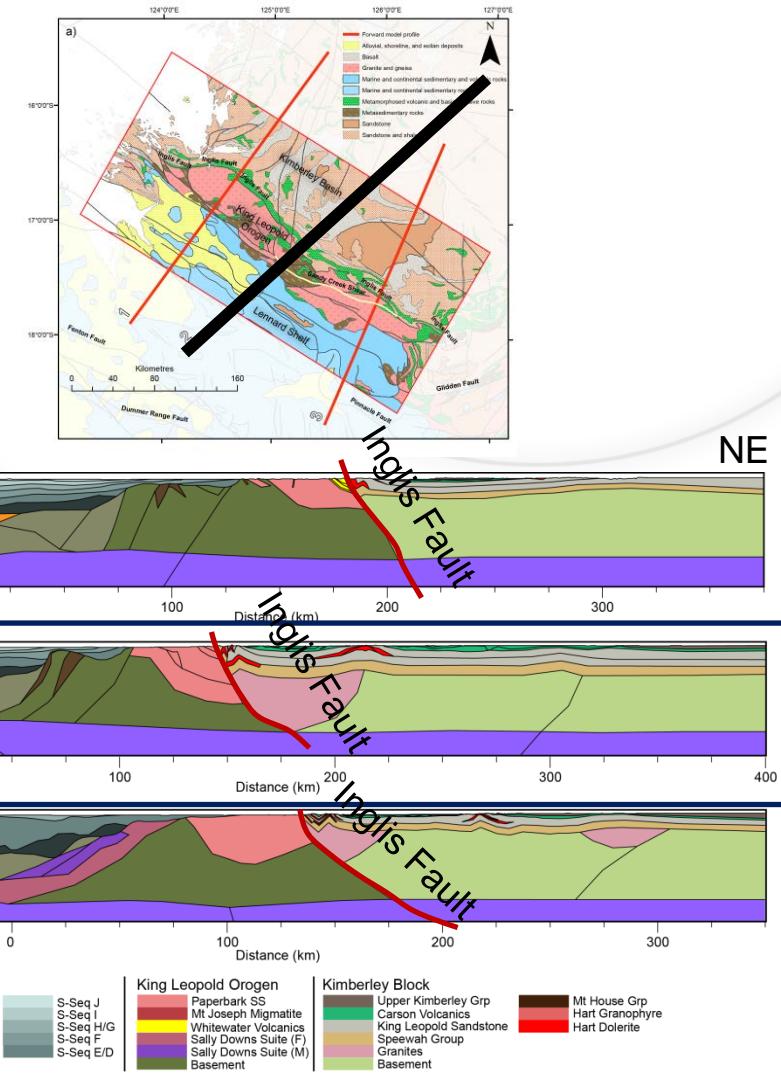
physical interpretation

West Kimberley – forward modelling

Joint magnetic and gravity modelling



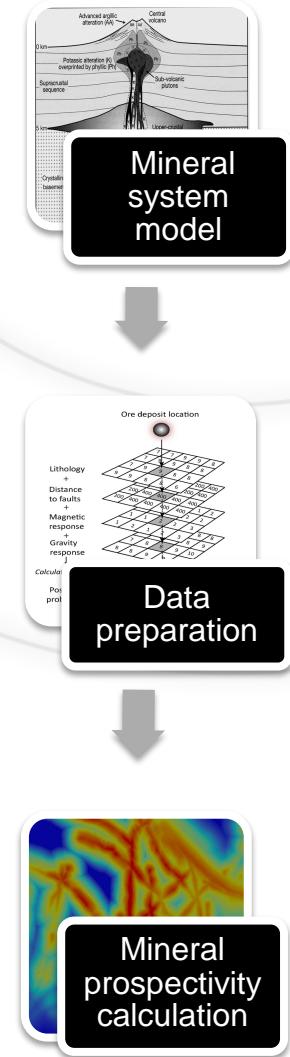
Magnetic response
Gravity



West Kimberley mineral prospectivity

- Multi-commodity regional prospectivity analysis
 - Nickel sulphide
 - Orogenic gold
 - Intrusion-related base metals, MVTs, epithermal Au, stratiform-hosted base metals, Sn-W
- Mineral Systems Approach
 - “Predictor” maps representing metallotects combined using a fuzzy inference network
 - Provide an indication of relative geological favourability for deposits, not a probabilistic prediction of actual deposit locations
 - Influenced by the imperfect data distributions and genetic model

**MORE DETAILS IN THE POSTER RED 63
(ERE3.1/GMPV14/TS9.6 17h30 – 19h00 tonight)**



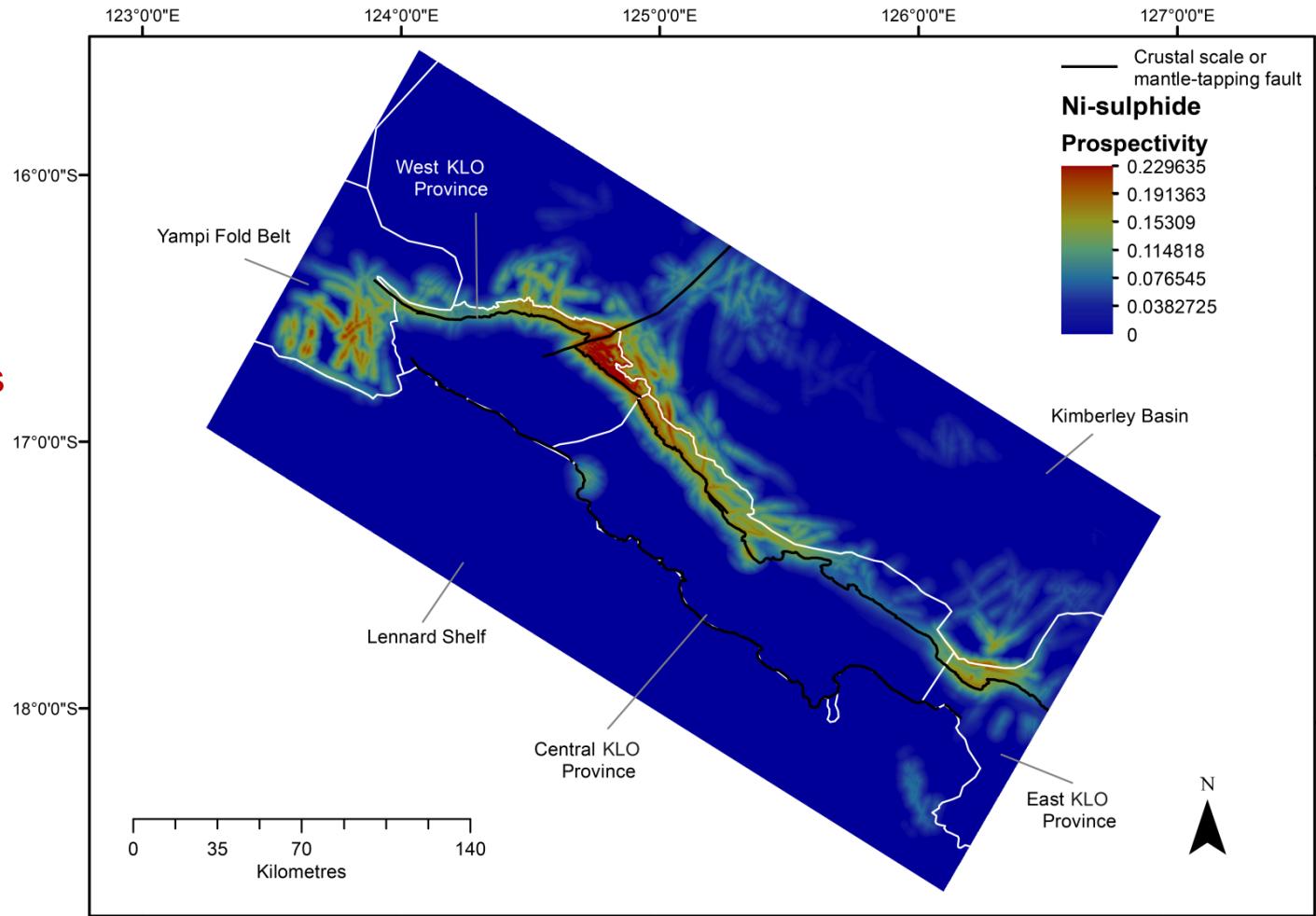
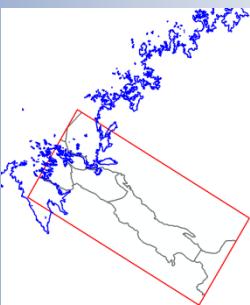
West Kimberley mineral prospectivity

Commodity	Source evidence layers combined with fuzzy OR	Pathway evidence layers combined with fuzzy OR	Trap evidence layers combined with fuzzy OR
Ni-sulphides	Distance to Hart Dolerite 0.81	Mantle-tapping Faults 0.63 Post faults(E4 C2 E5 C3 E6) 0.56 Syn faults(E3) 0.63 Dykes 0.63	Fault intersection density 0.4 Fault jogs density 0.45 Dyke jogs density 0.45 Alteration index 0.4
CHBM (Carbonate-hosted base metals)	Distance to Pinnacle Fault System 0.81	Distance to basement high 0.56 Distance to transfer faults 0.56 Distance to edges 0.56	Within Devonian Limestone 0.4
Au - 'Orogenic'	Distance to Paperbark Suite 0.72	Mantle-tapping faults 0.63 Post faults (E2 E3 E4 C2 E5 C3 E6) 0.56	Alteration index 0.4
<p>Combination of weights = fuzzy membership value</p> <p>Eg. Inglis Fault</p> <p>Map (0.9) * confidence (0.7) = 0.63</p> <p>Distance from Inglis Fault – linear decrease out to 10km</p>			
Au – epithermal	Distance to Whitewater Dolerite 0.72	Mantle-tapping faults 0.63 Post faults (E2 E3 E4 C2 E5 C3 E6) 0.56 Syn faults (C1) 0.63	Competency contrast 0.4 Structural complexity 0.4 Distance to Hart Dolerite 0.45 Distance to Carson Volcanics 0.4 Distance to Marboo Formation 0.4 Distance to Ruins Dolerite 0.35 Alteration Index 0.4 Competency contrast 0.4
Sn-W	Distance to Paperbark Suite 0.72	Mantle-tapping faults 0.63 Post faults (E2 E3 E4 C2 E5 C3 E6) 0.51 Syn faults (C1) 0.63	Structural complexity 0.4 Distance to Hart Dolerite 0.45 Distance to Carson Volcanics 0.4 Distance to Marboo Formation 0.4 Distance to Ruins Dolerite 0.35 Distance to Wotjulum Porphyry 0.4
Stratiform-hosted base metals	Distance to Marboo Formation 0.72 Distance to Special Formation 0.72 Distance to Kimberley Group 0.72	Post faults (C1 E2 E3 E4 C2 C3 E6) 0.49 Syn faults (E1) 0.56 Basin Juxtapositions (E5) 0.56	Organics (Devonian Limestone) 0.4 Alteration Index 0.4 Marboo Formation 0.4
Intrusion. Related Base Metals	Distance to Hart Dolerite 0.81 Distance to Ruins Dolerite 0.63 Distance to Paperbark Suite 0.72	Mantle-tapping faults 0.63 Post faults (E2 E3 E4 C2 C3 E6) 0.56 Syn faults (E3) 0.63	Distance to Wotjulum Porphyry 0.4 Structural complexity 0.4 Alteration index 0.4

Combined with fuzzy PRODUCT operator
small weights have greatest influence
conservative

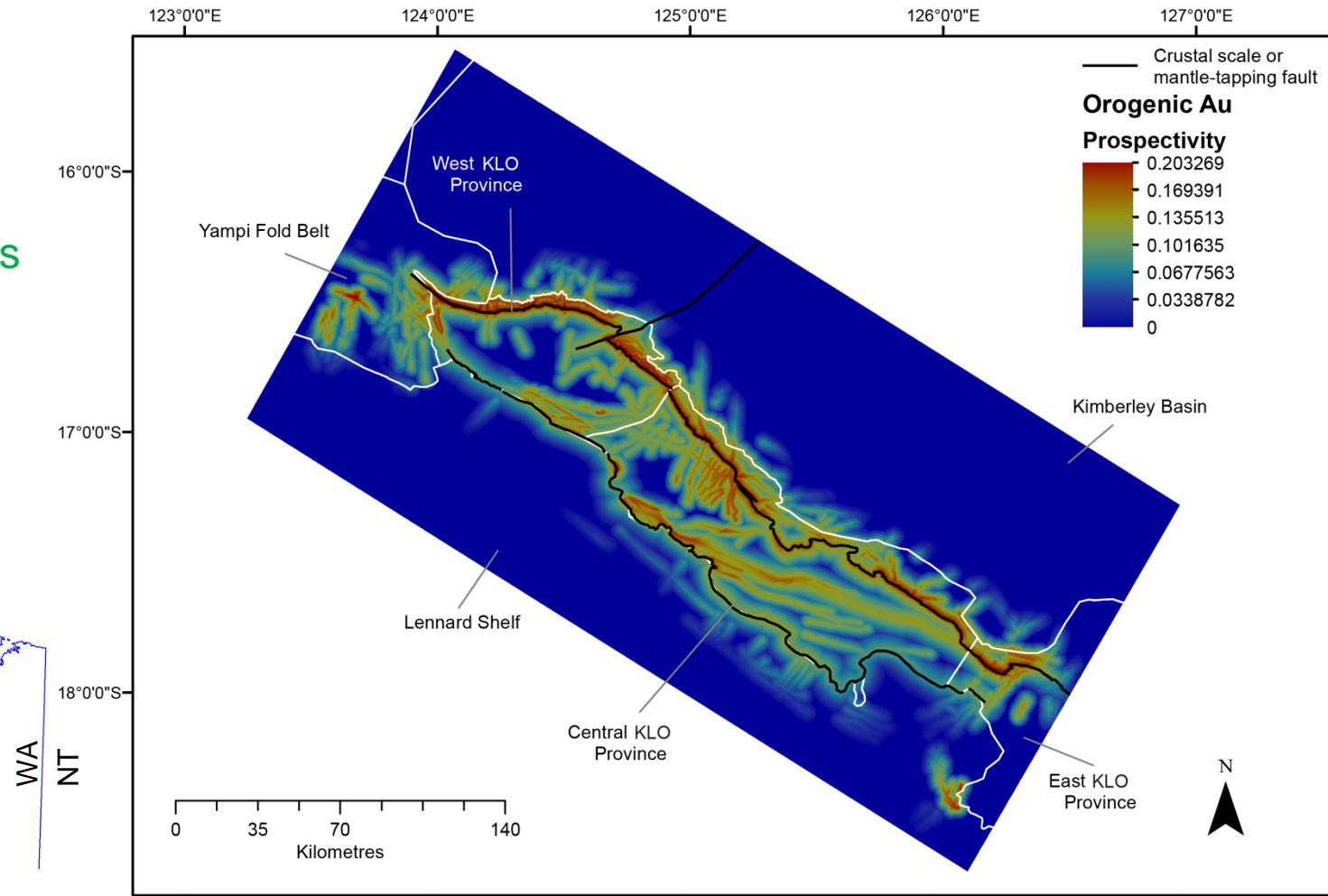
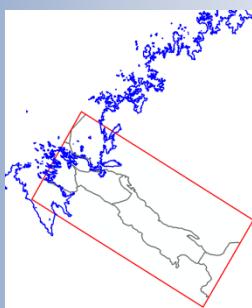
West Kimberley Ni-sulphide

- Hart Dolerite
- Inglis Fault
- Dolerite dykes
- Fault jogs
 - dilation zones
 - ?embayments



West Kimberley orogenic Au

- Paperbark Supersuite
- Inglis Fault
- Shear zones
- “Structural complexity”
- Mafic units



Summary

Summary – Geophysical structural interpretation

- Provides relatively robust data for input into mineral potential mapping
- Crustal-scale structure focusing mineral prospectivity eg. Inglis Fault
- Prospectivity modified by the presence of acceptable lithological conditions eg. Hart Dolerite
- Northern edge of the Paperbark Supersuite is found to be prospective for multiple mineral systems
- The prospectivity indicates periods of reactivation and magmatic events
- The undercover part of the Oscar Range is found to be prospective for MVT deposits

Knox-Robinson, CM, and Wyborn, LAI, 1997, Towards a holistic exploration strategy: Using Geographic Information Systems as a tool to enhance exploration: Australian Journal of Earth Sciences, v. 44, no. 4, p. 453-463.

Johnson, S. 2013 The birth of supercontinents and the Proterozoic assembly of Western Australia: Geological Survey of Western Australia, 78p.

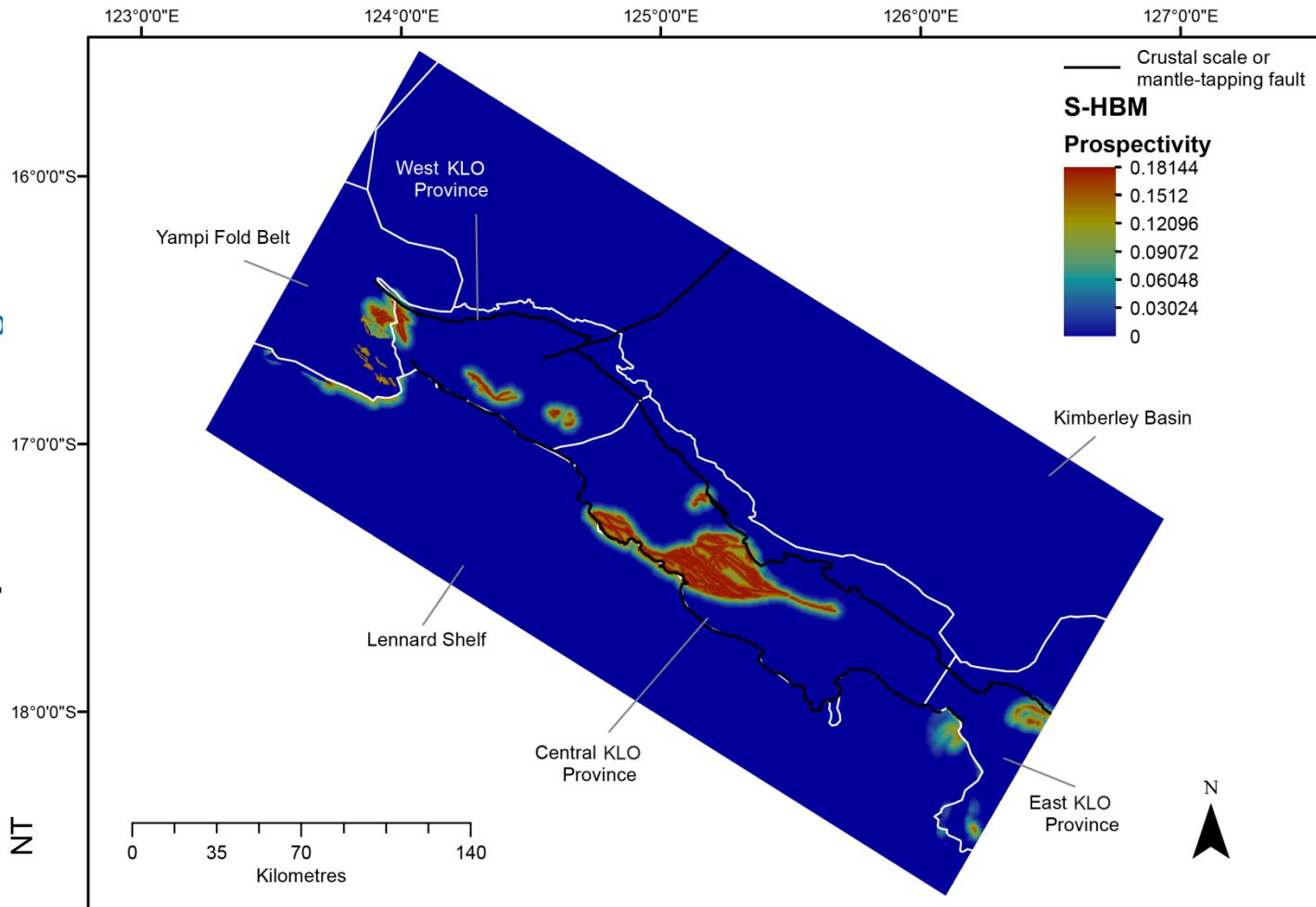
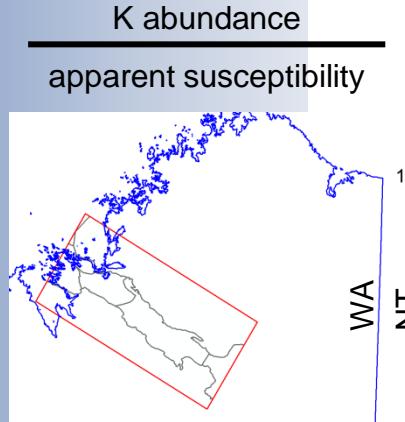
Lindsay, MD, Betts, PG and Ailleres, L (2014) Data fusion and porphyry copper prospectivity models, southeastern Arizona, Ore Geology Reviews.61, 120-140.

Lowell J. D. & Guilbert J. M. 1970. Lateral and vertical alteration-mineralization zoning in porphyry ore deposits. Economic Geology 65, 373-408.

Tyler, I. M., and Griffin, T. J., 1990, Structural development of the King Leopold Orogen, Kimberley region, Western Australia: Journal of Structural Geology, v. 12, no. 5-6, p. 703-714.

West Kimberley S-HBM prospectivity

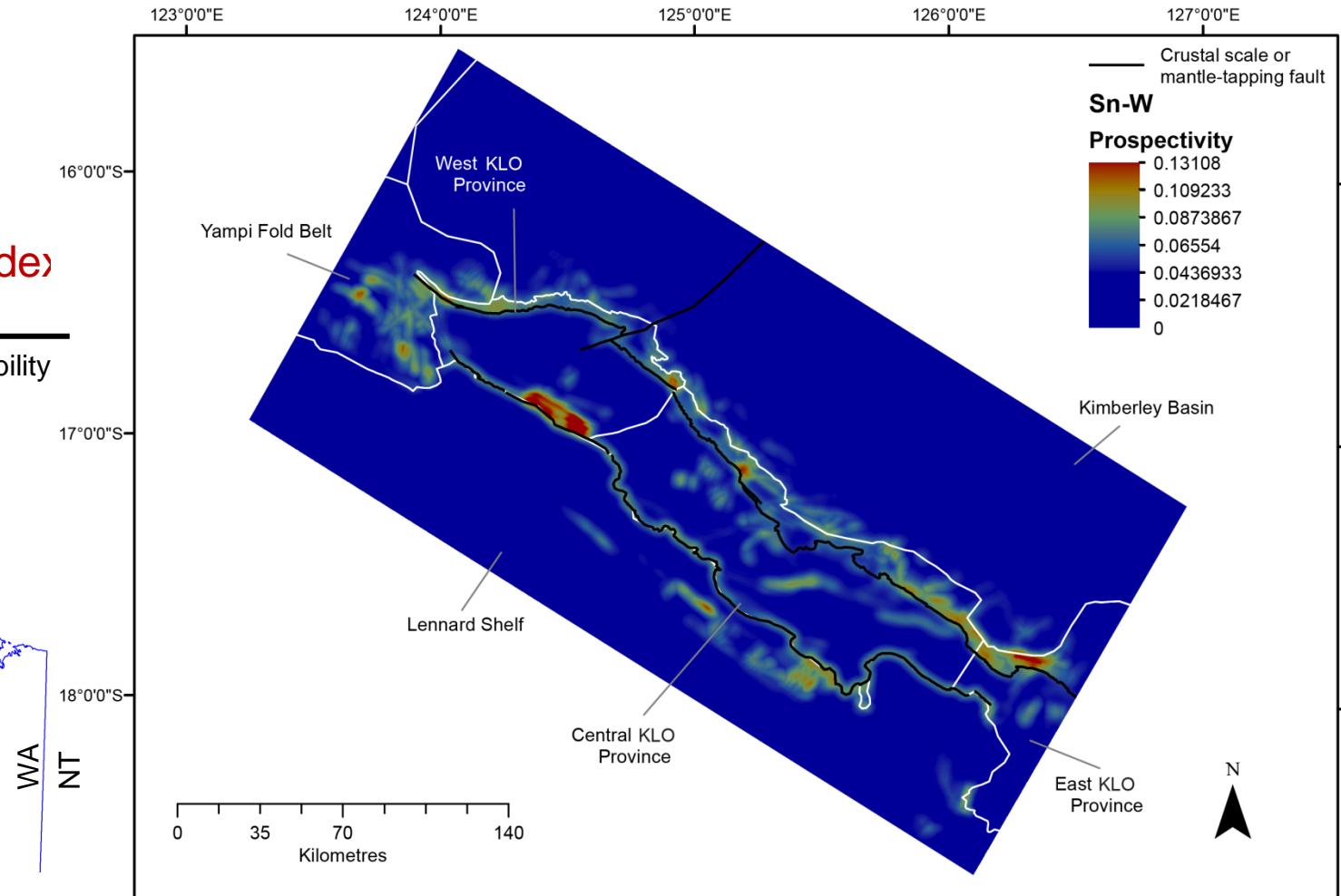
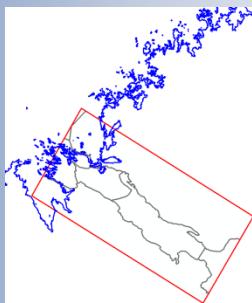
- S-HBM
(Stratiform-hosted base metals)
- Marboo
- Kimberley Group
- Speewah
- Alteration index



West Kimberley Sn-W prospectivity

- Paperbark Supersuite
- Inglis Fault
- Alteration index
- Chemical reactivity

K abundance
apparent susceptibility



West Kimberley IRBM prospectivity

- IRBM (Intrusion-related base metals)
 - Porphyry Cu
- Hart Dolerite
- Paperbark Supersuite
- Inglis Fault
- Second order faults
- Wotjulum Porphyry
- Structurally complex
- Alteration index

K abundance

apparent susceptibility

