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Good Morning…!?

- All that glitters is not necessarily (Yilgarn) gold
- Welcome to I7 Isa Project..!
- Thanks to Project Team for turning up and for turning on a good show

- Multi-commodity region
- Multi-scale, multi-disciplinary
- Multi-cultural experience

"The 5 Questions"

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Theme	Research Stream	Deposits
Architecture	E-W Correlation 3D Maps	Cu Pb-Zn-Ag Cu-Au U
Geodynamics	Tectonostratigraphic Evolution Isotopes/Geochronology Thermal Structure and Magmas	
Fluids and Reservoirs	Permeability Structure Magmas Noble gases and Halogens Carbonaceous rocks	
Drivers	Numerical modelling (FLAC) Topography/Deformation/Heating	
Deposition	Faulting & Mineralisation Geochemical RT modelling Numerical modelling (FLAC/UDEC) Alteration and Remote Sensing	

Day 2 - 20 April 2006			
SESSION: MT ISA			
09:00	Laurent Allieres	I7	Regional scale architecture: 3D maps, models and minefields
09:15	John Miller	I7	Structural controls on Cu distribution at Mt Isa: Implications for exploration targeting
09:30	Andy Wilde	F6/I7	Metal transport and deposition in the Mount Isa Western Fold Belt and Lawn Hill Platform
09:45	John McLellan	I7	Numerical models of fluid pathways in extension-related mineral systems
10:00			Poster Session 4A & B (banquet room)
10:30			Morning tea (banquet room)
10:45	Narelle Neumann	I7	Regional scale correlations – Sequencing the SHRIMP detrital record
11:00	Peter Southgate	I7	Using time-constrained facies belts and sequence architecture to correlate the Western and Eastern successions of the Mt Isa Inlier: Implications for fluid migration
11:15	George Gibson	I7	Geodynamic evolution of the Mt Isa Inlier and its influence on the formation, timing and localisation of fluid flow
11:30	Barry Murphy	I7	Multi-scale analysis of Isan mineral systems
12:00			Discussion
12:15			Poster Session 5A & B (banquet room)
12:45			Lunch (banquet room)

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Project I7

Towards Multiscale analysis of Isan mineral systems

Barry Murphy
University of Melbourne

Acknowledgements

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Project Team

- **JCU**: Oliver, Blenkinsop, Cleverley, McLellan, Rubenach, Butera, Feltrin, Ford, Austin, Edmiston, Lepong, Keys, Nortje
- **GA**: Gibson, Neumann, Southgate, Wyborn, Roy, Barnicoat
- **Monash**: Mark, Schaefer, Ailleres, Wilde, Jupp, Gregory, Duncan
- **UWA**: Bierlein, Gessner, Miller
- **Melbourne**: Murphy, Maas, Kendrick
- **CSIRO**: Walshe, Ord, Modelling team…
- **Industry**: QDNRM : Hutton, NTGS – Bunge, XStrata – Wilson, Gow, Zinifex - Lorrigan, Anderson, Osborne Placer/Barrick - Tullemans, Copper Co. - Maiden, Buckle,

"The 5 Questions"

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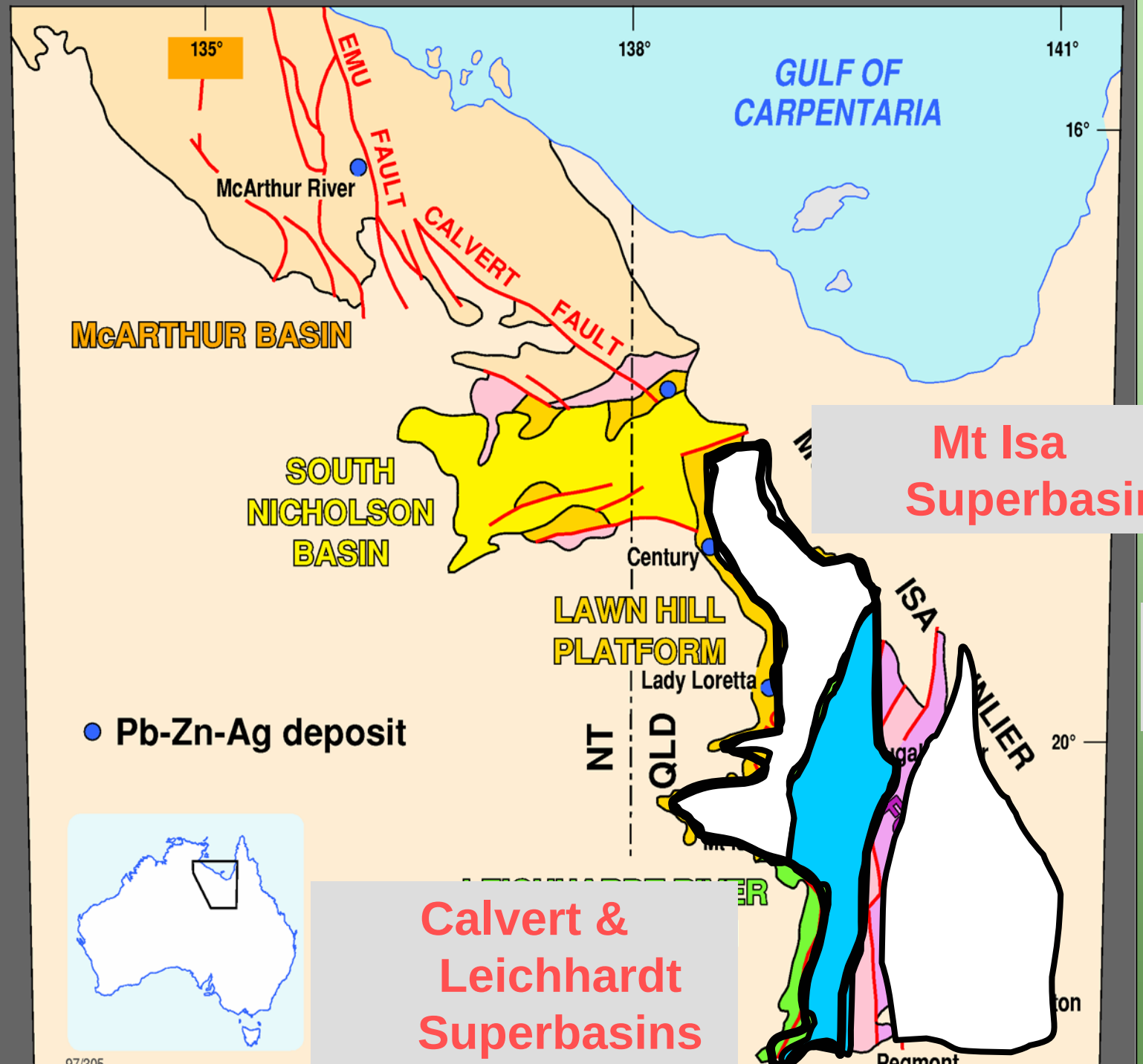
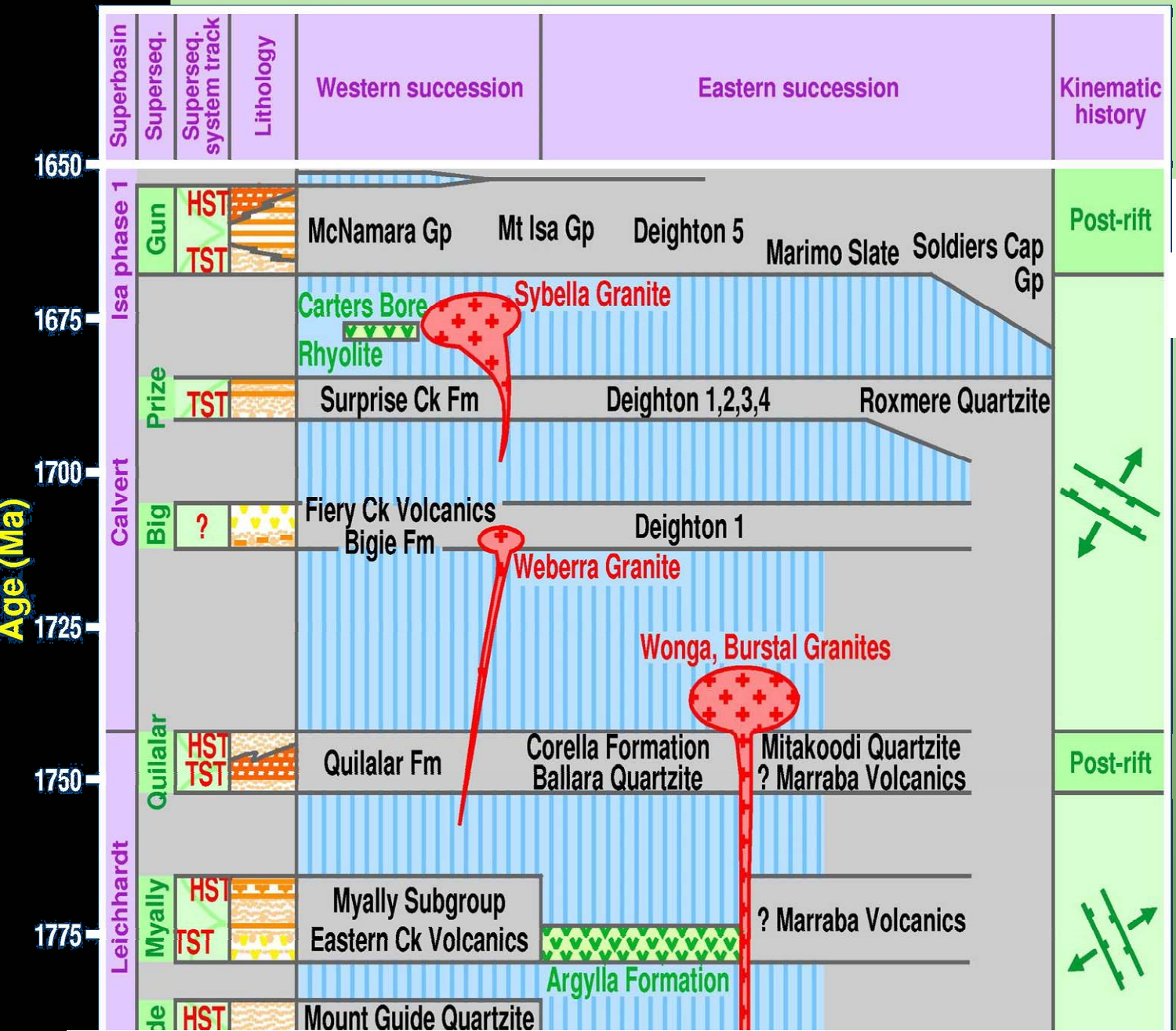
Key Issues

- Why so mineralised?
- …..Doubly extended, doubly inverted?
- Isa Superbasin – late basin, tectonic setting?
- Basin margins, major gradients, major ore
- Age & Timing of PbZnAg, Cu mineralisation
- Integration - relevance to exploration
- Targeting areas


135°
138°
141°
16°
20°
GULF OF CARPENTARIA
EMU FAULT
CALVERT FAULT
McArthur River
McARTHUR BASIN
SOUTH NICHOLSON BASIN
Century
LAWN HILL PLATFORM
Lady Loretta
ISA
NT
QLD
Pb-Zn-Ag deposit
Mt Isa Superbasin
Rift geometry preserved
Calvert & Leichhardt Superbasins
Inversion structures dominant



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Gun SS, Sag/PM/FB?

Event?

Prize SS, sag

Big, rift

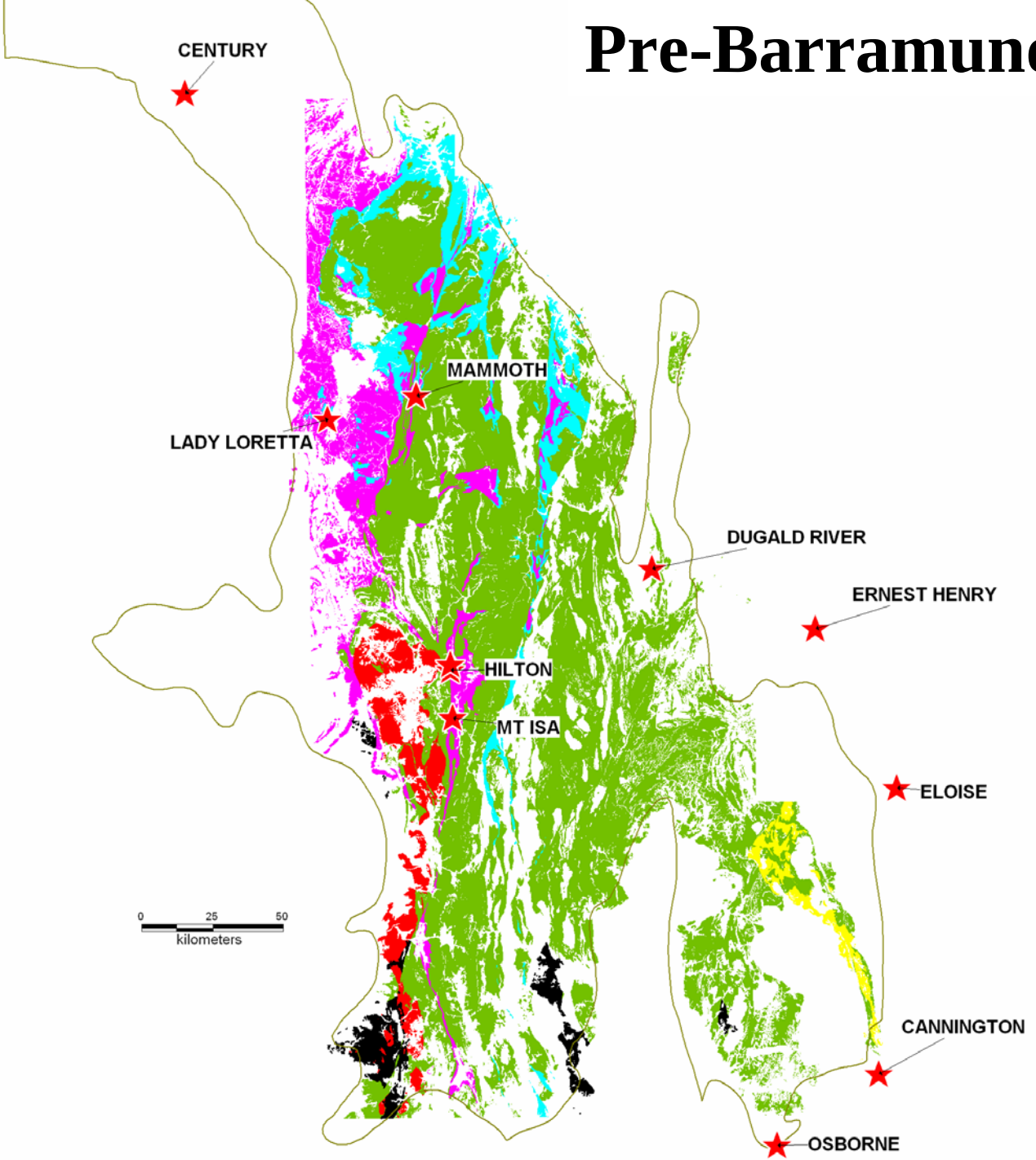
Sag, Only Platform facies

Myally rift

- **…..Doubly extended, doubly inverted?**

Paradigm Shift

Pre-Barramundi Basement



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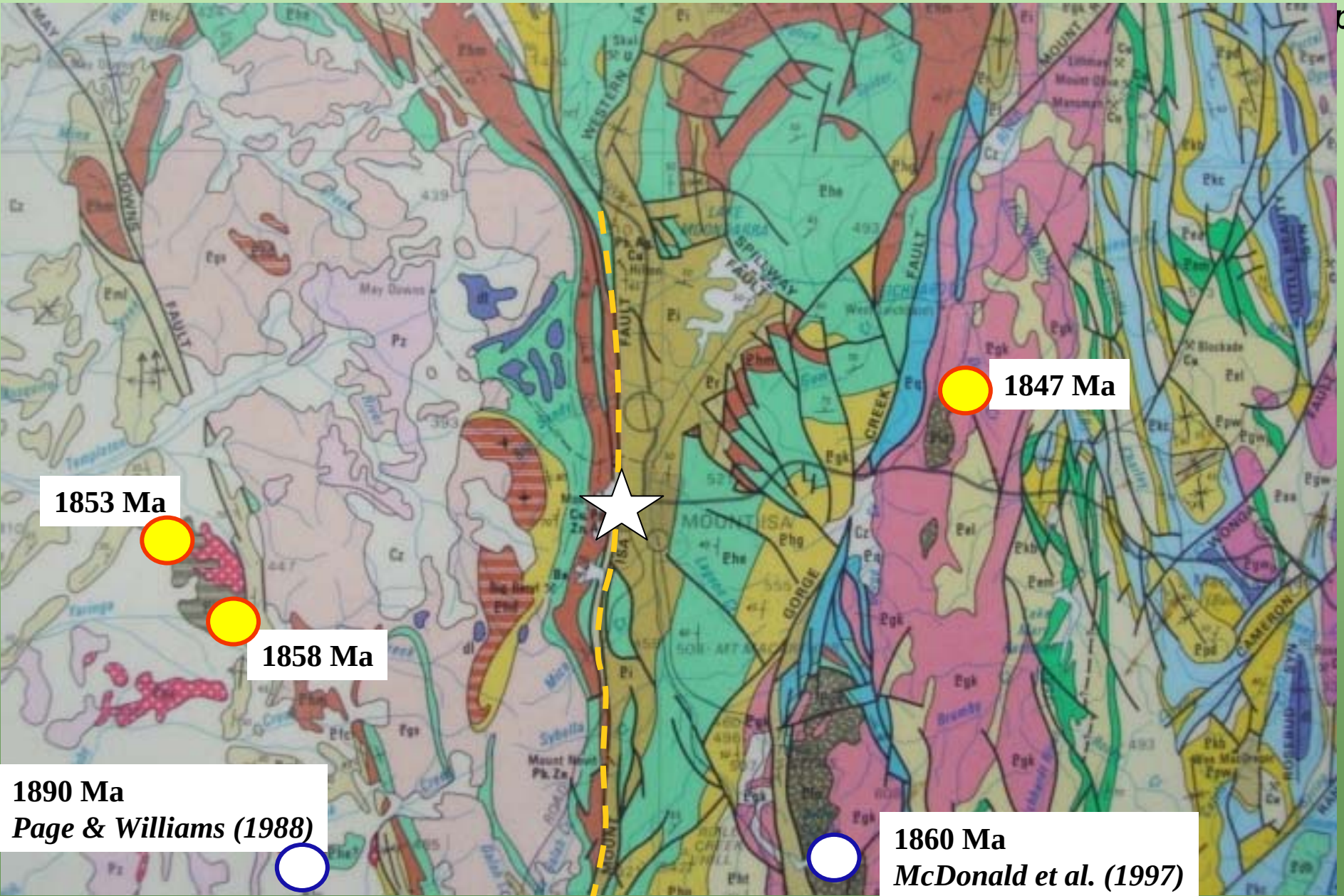
100k_by Super_Basin

- Calvert
- Isa
- Leichhardt
- Soldiers Cap
- Sybella SS

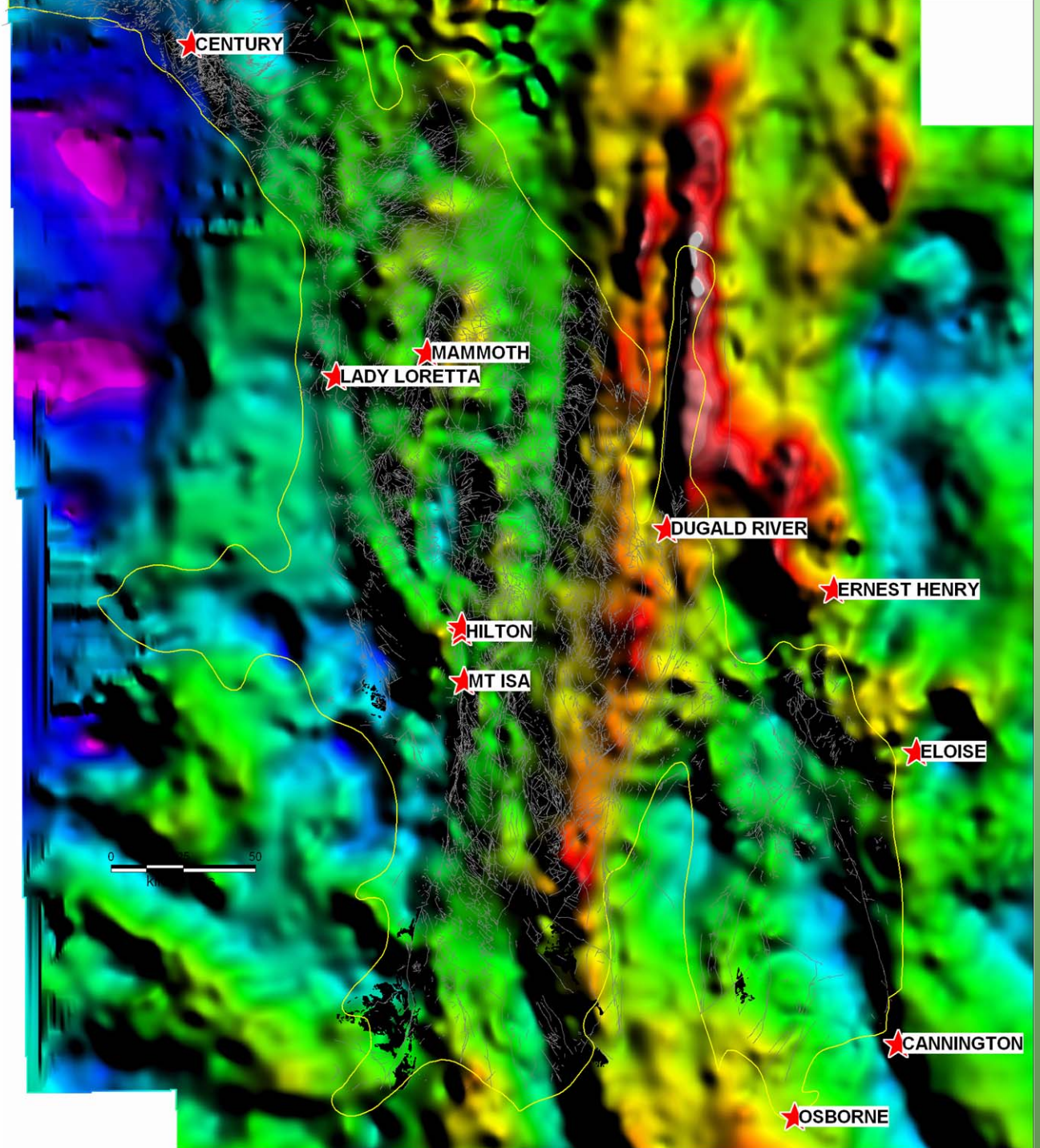
Basement Configuration - Trans-crustal breaks?



U-Pb

Lu-Hf

Sm-Nd



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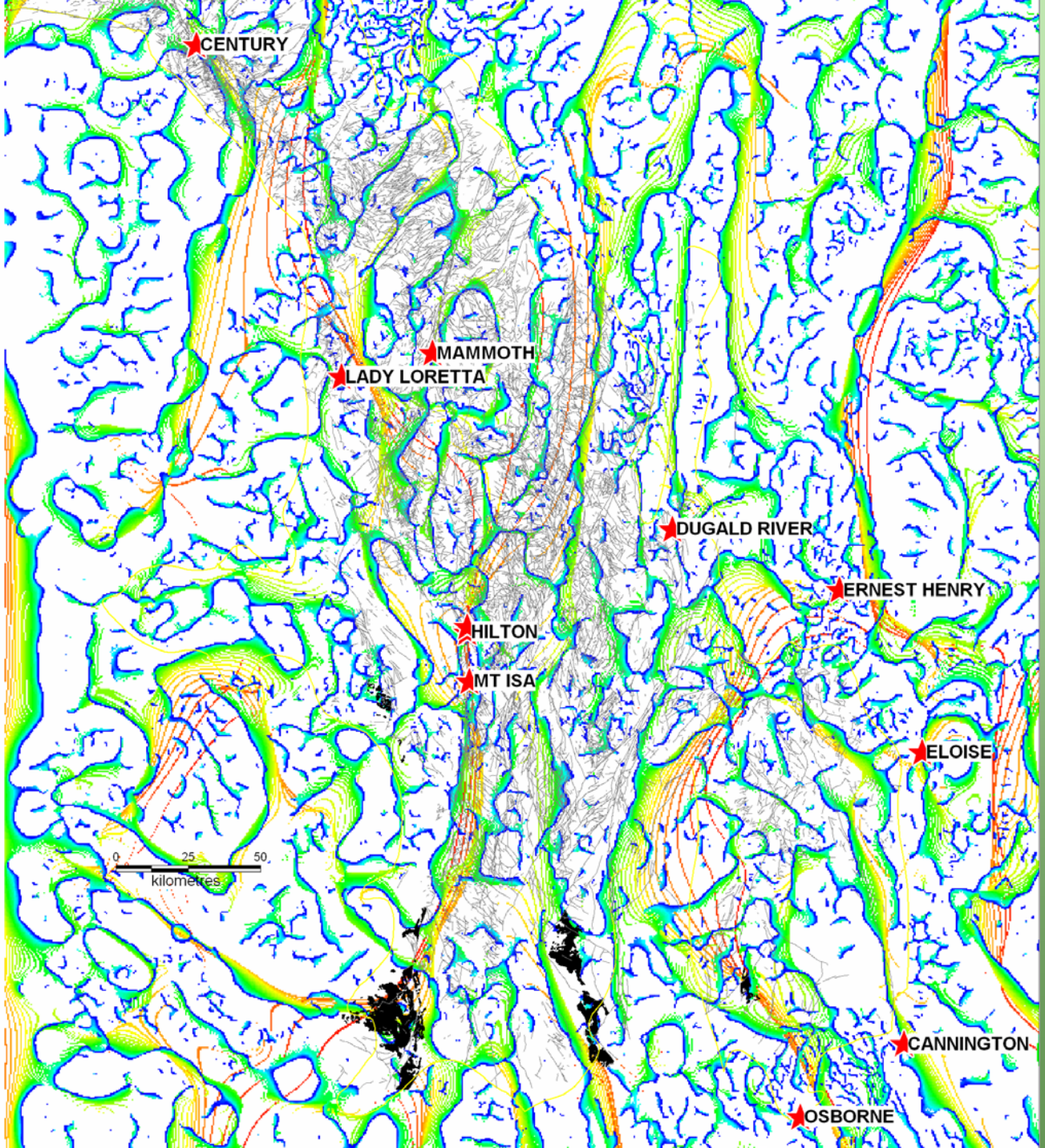
Gravity Colour Drape



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Gravity Worm Height

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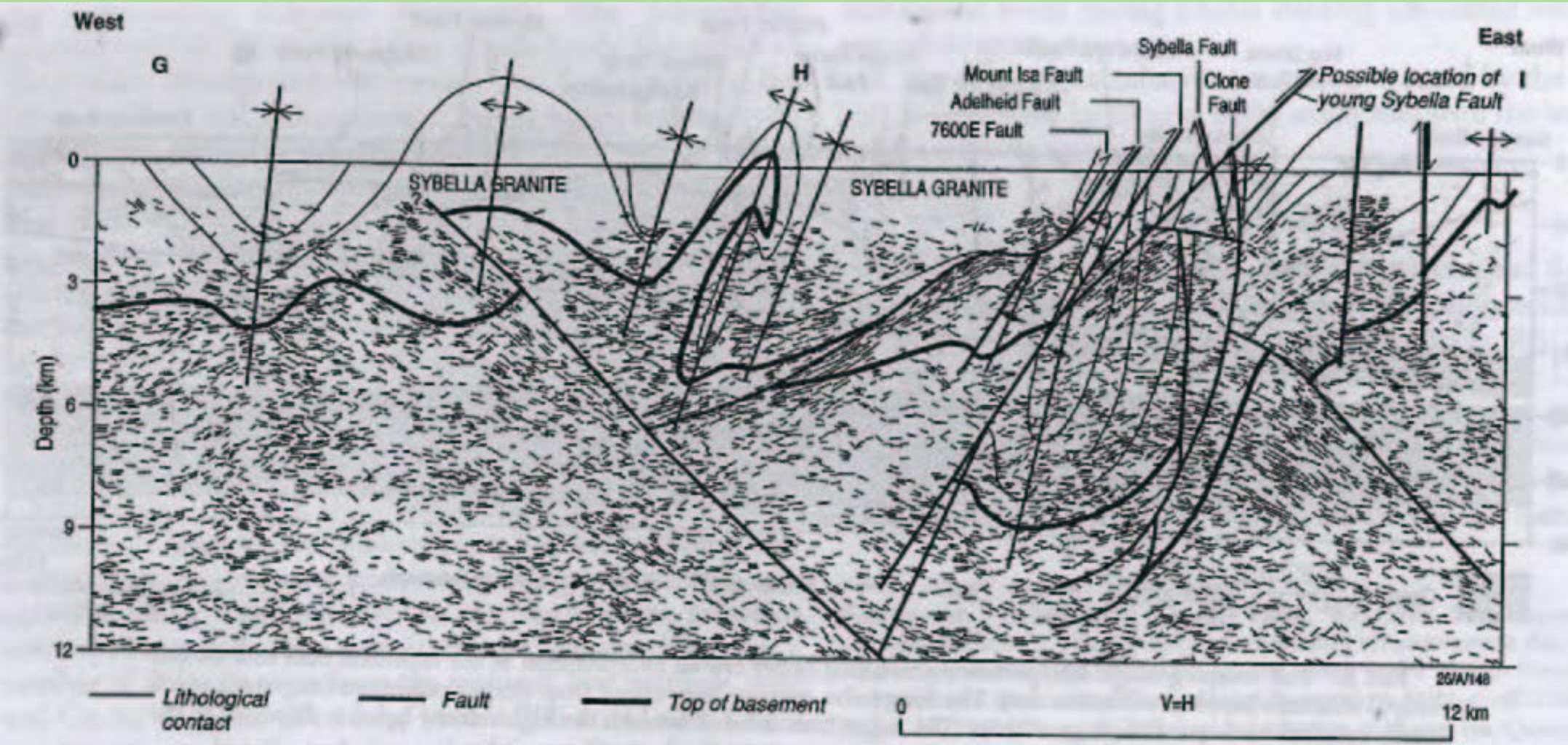
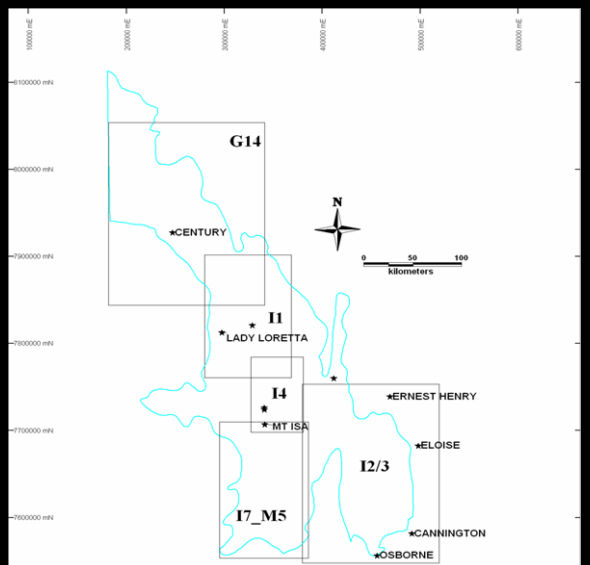
Seismic Reflection Profile



Major E-dipping detachment?

I1



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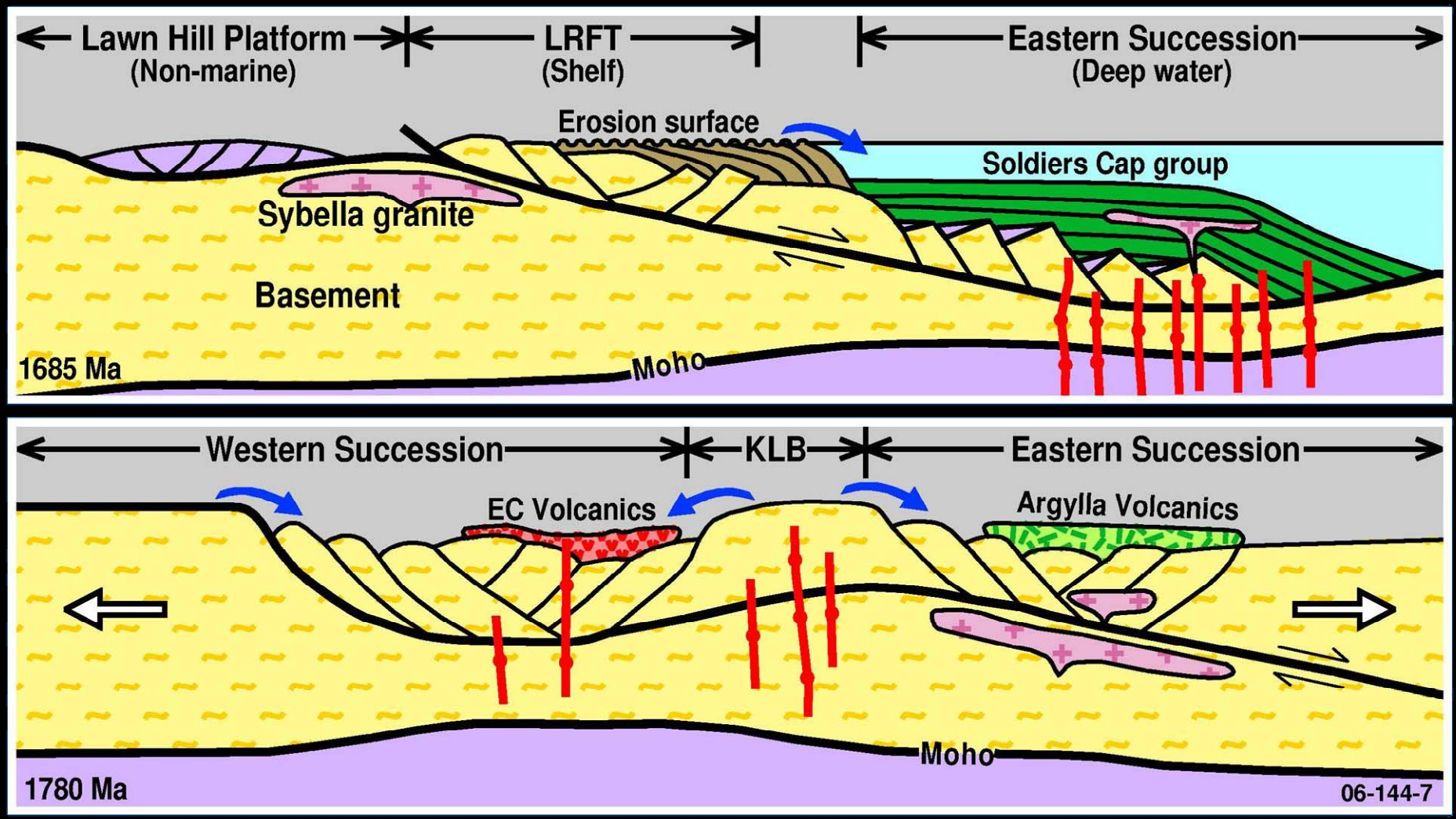
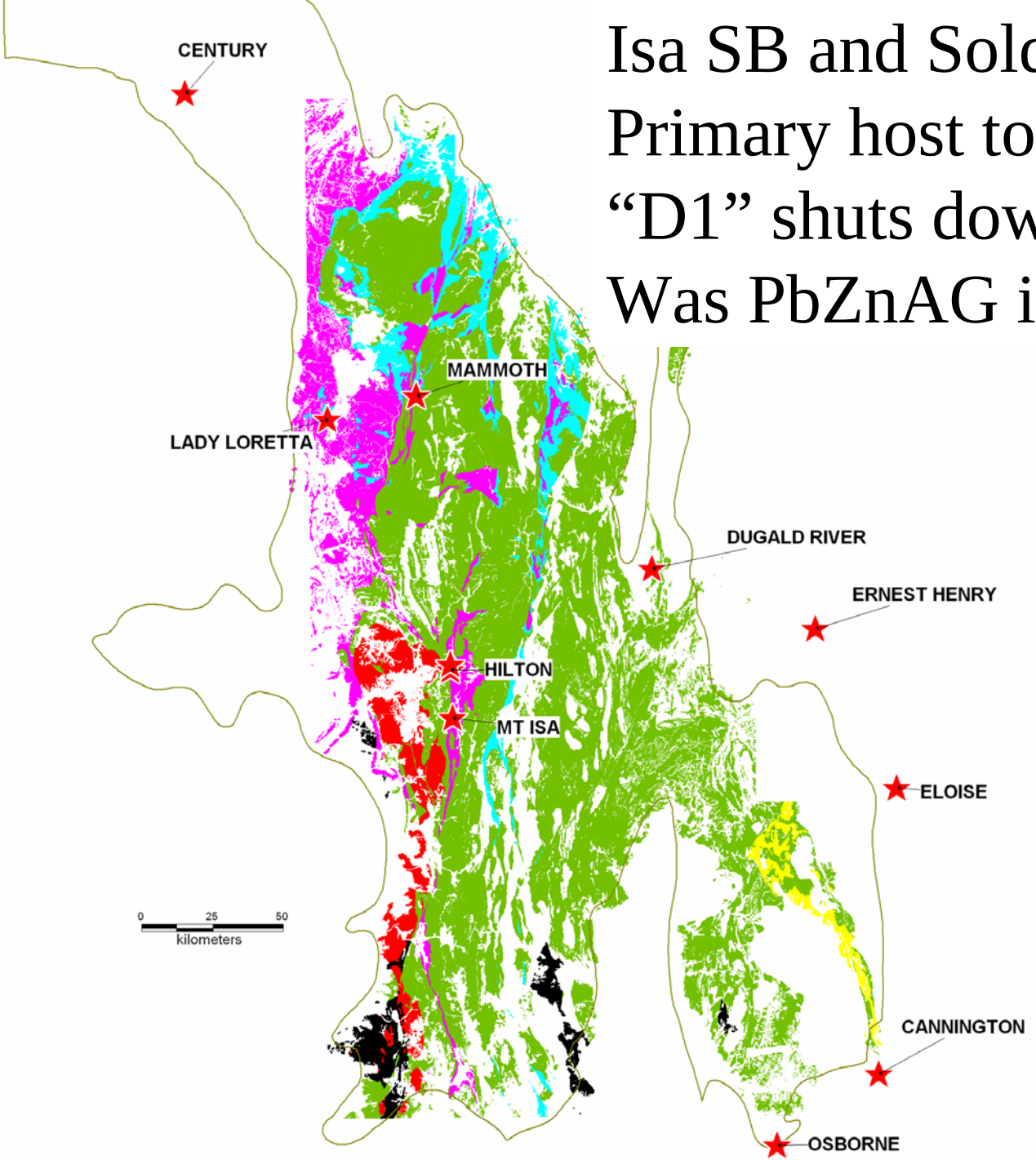


Isa SB and Soldiers Cap

Primary host to major deposits

"D1" shuts down Calvert SB – N-S

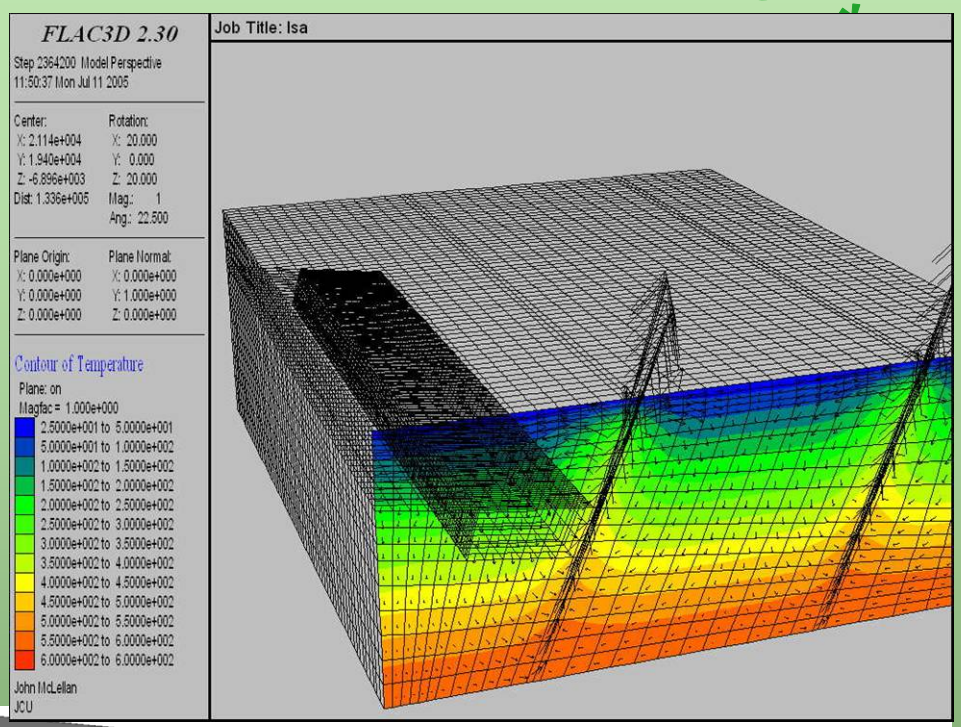
Was PbZnAG initiated early &/or late?

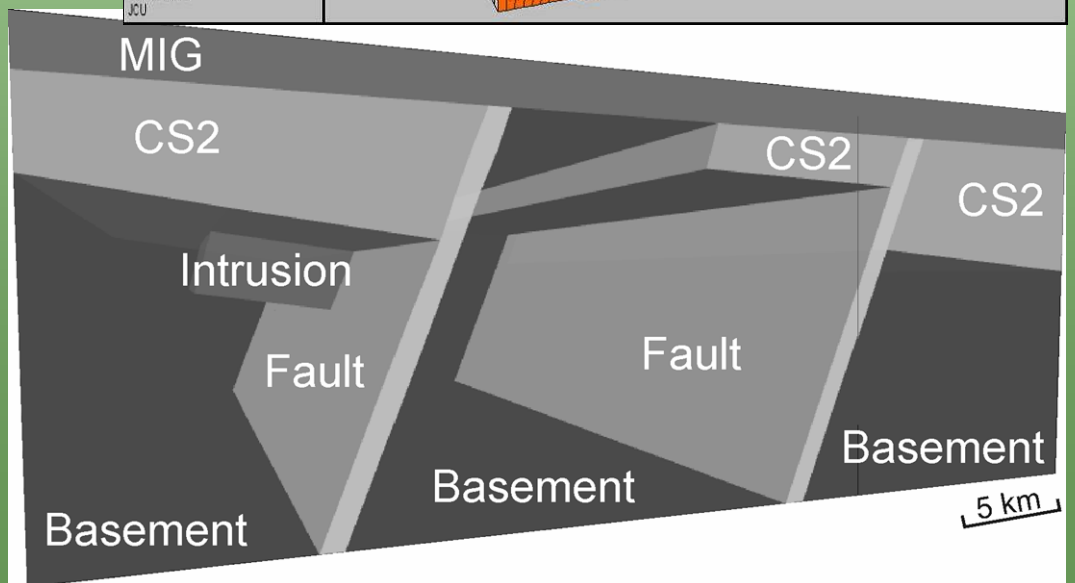


Scenario Testing

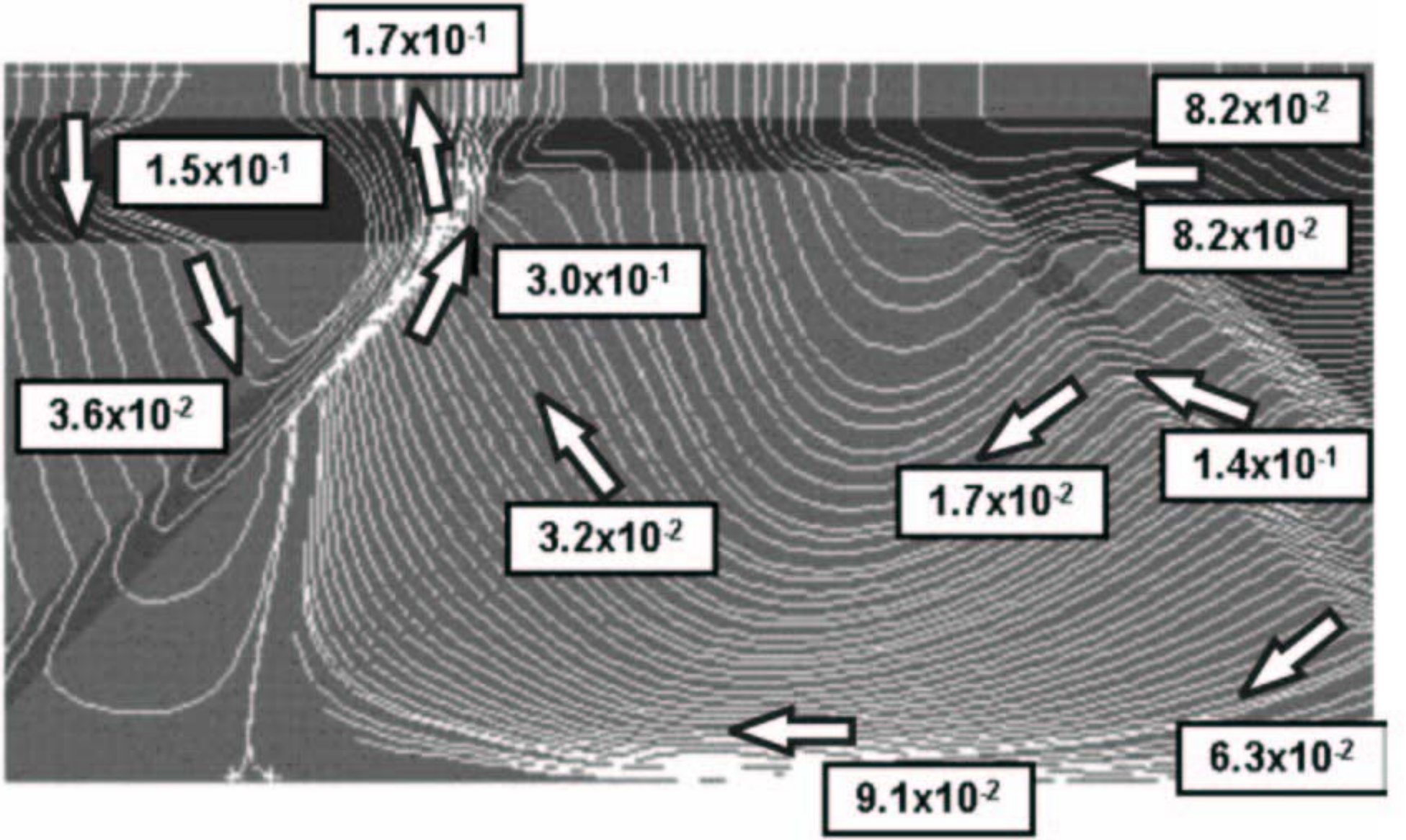
Thermal contours and fluid flow at early stages of deformation - Extensional Setting

a) Elevation of isotherms around faults
b) Attenuation of isotherms near the surface wrt convection in basement (scouring metals at high temperature then deposition at surface)
c) Thermal decay following convection cell collapse





3-D model for Isa style deposits.
MIG – Mount Isa Group,
CS2 – Cover Sequence 2 rocks



Competing Topo driven and convective flow

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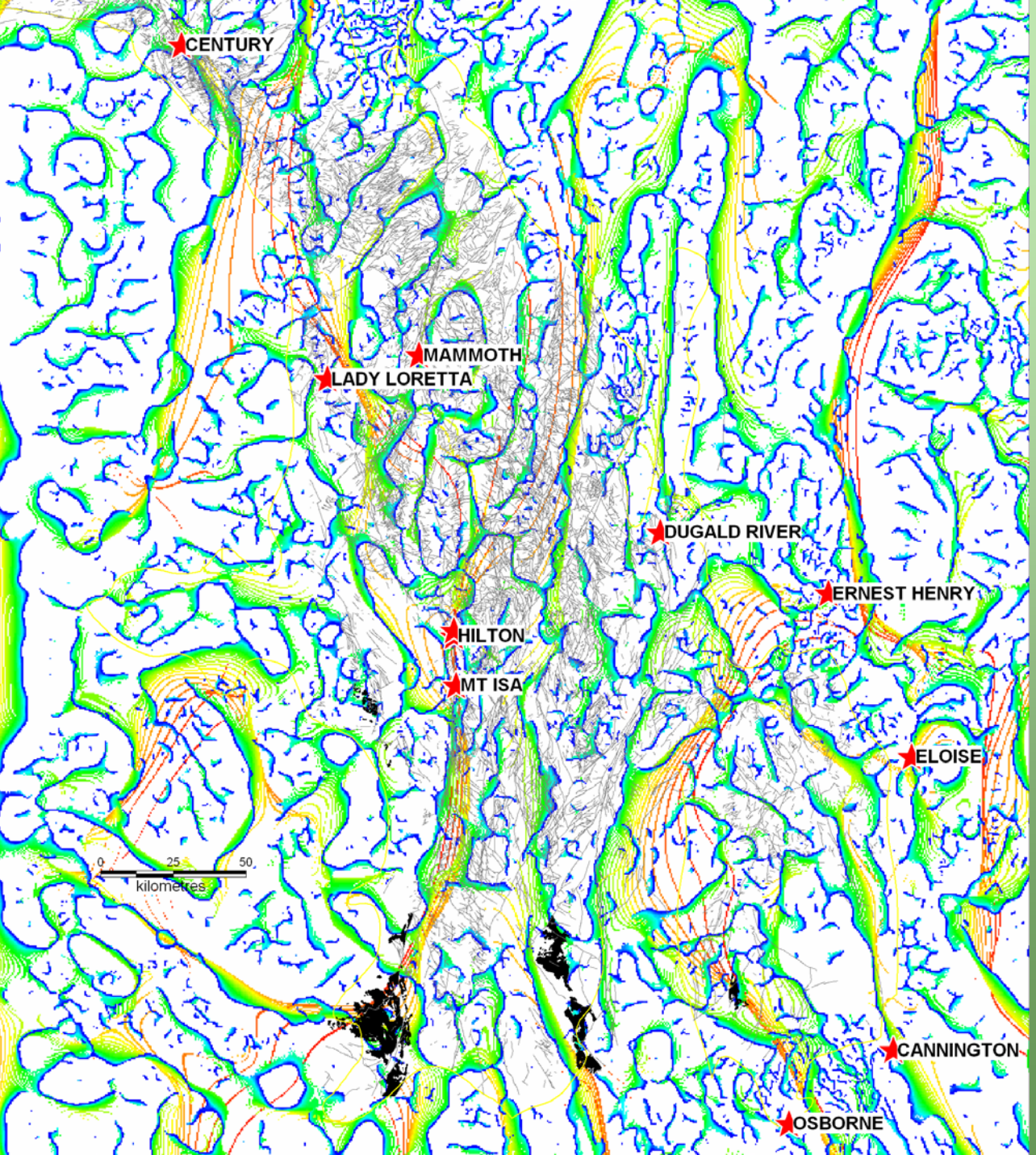
Why is the orebody *there*?

- **Exploration Targeting…e.g. GITS**
- **Terrane scale elements – what elements?**
- **Basin margins, gradients and ore**



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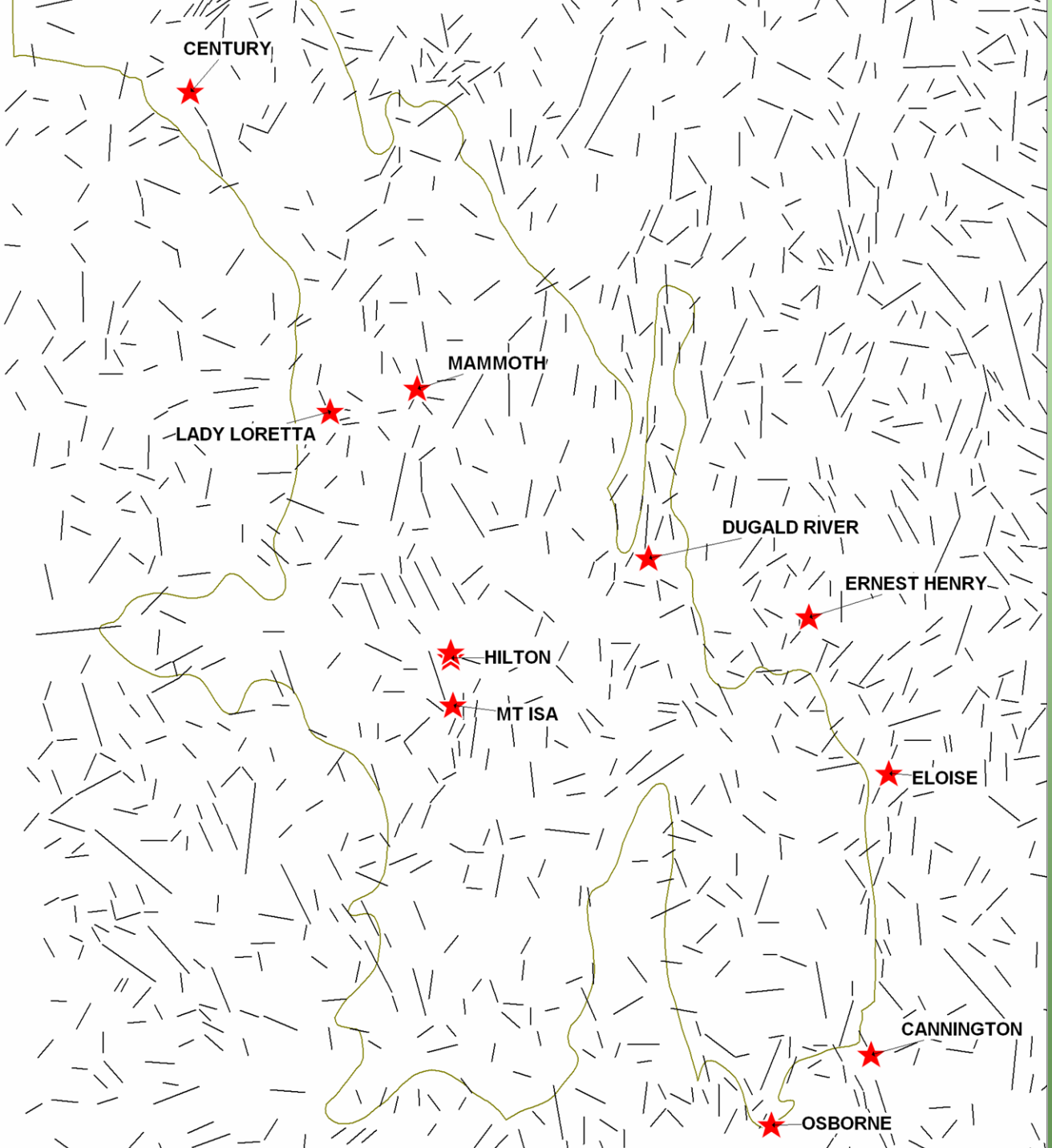
Gravity Worm Height



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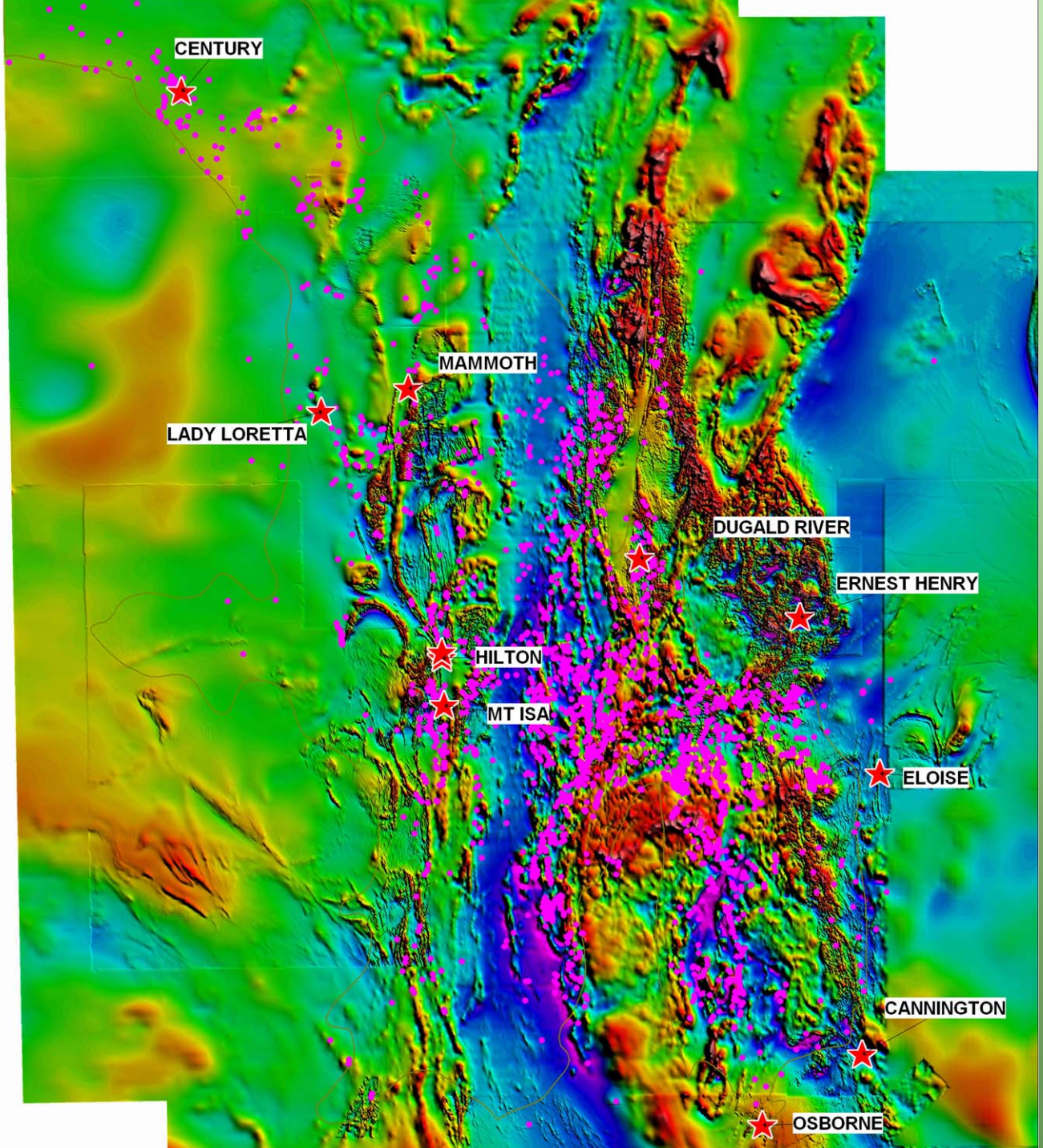
Gravity
> 5km Long Edges



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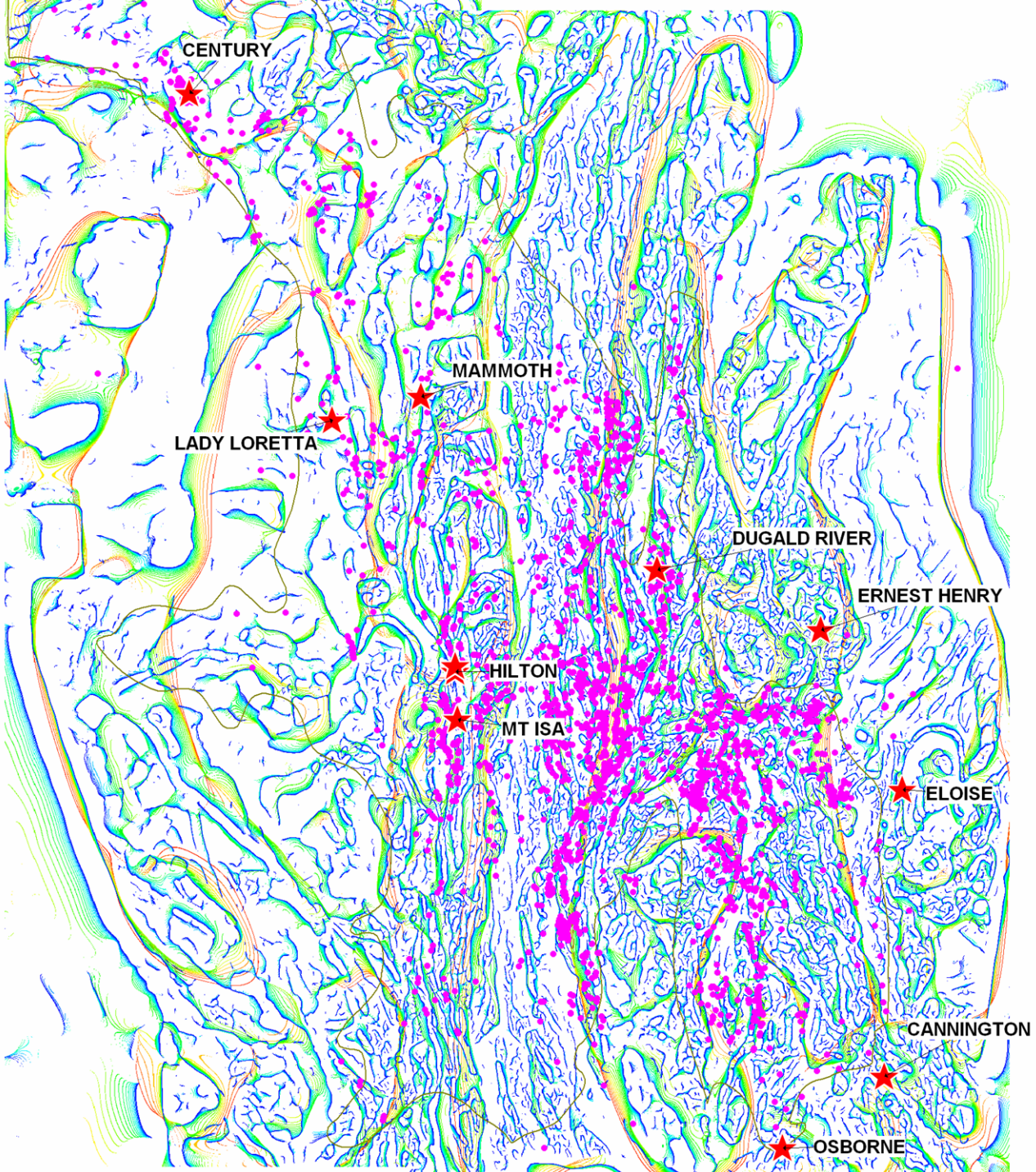
Magnetics
TMI



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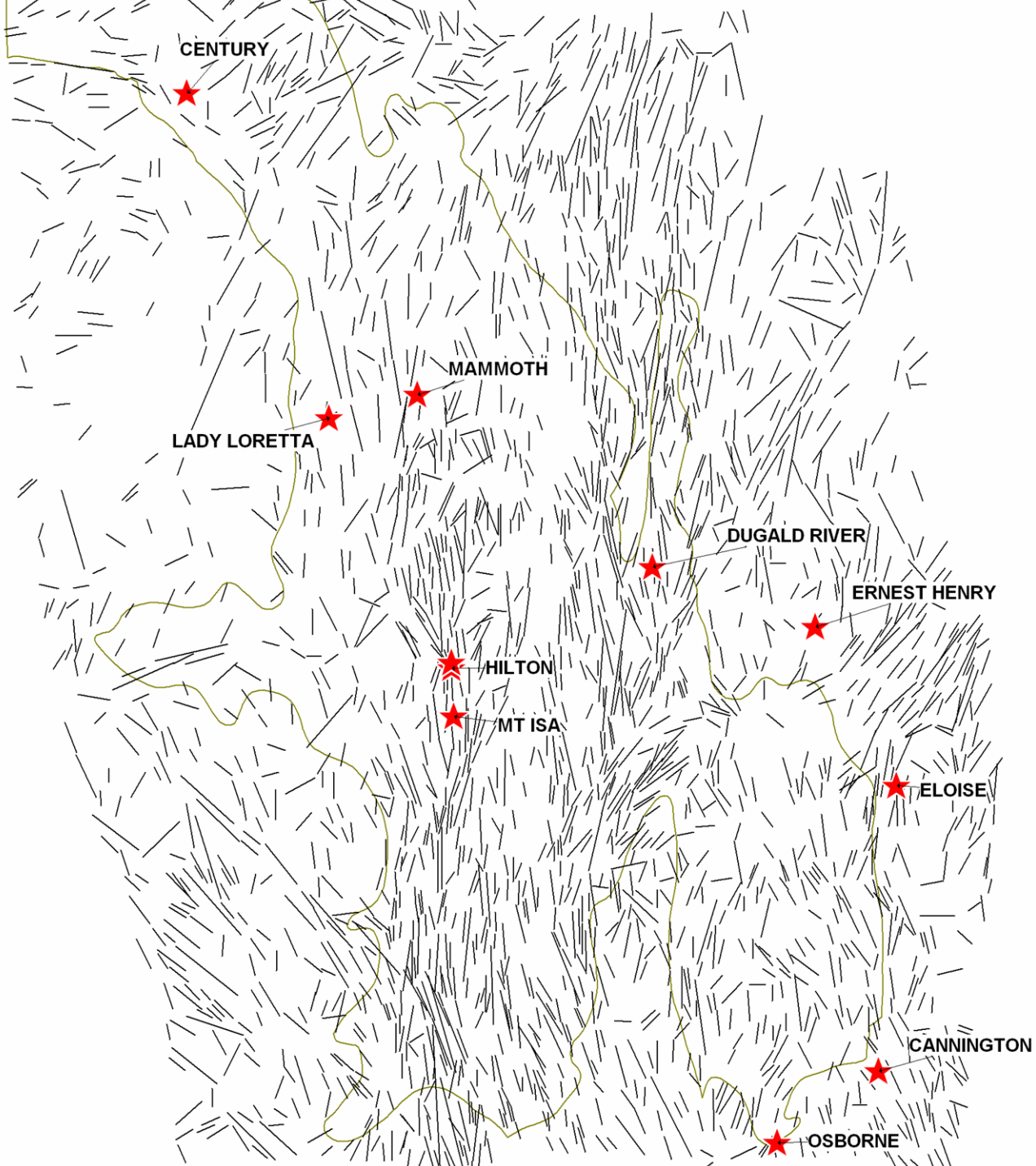
Magnetics Worm Height



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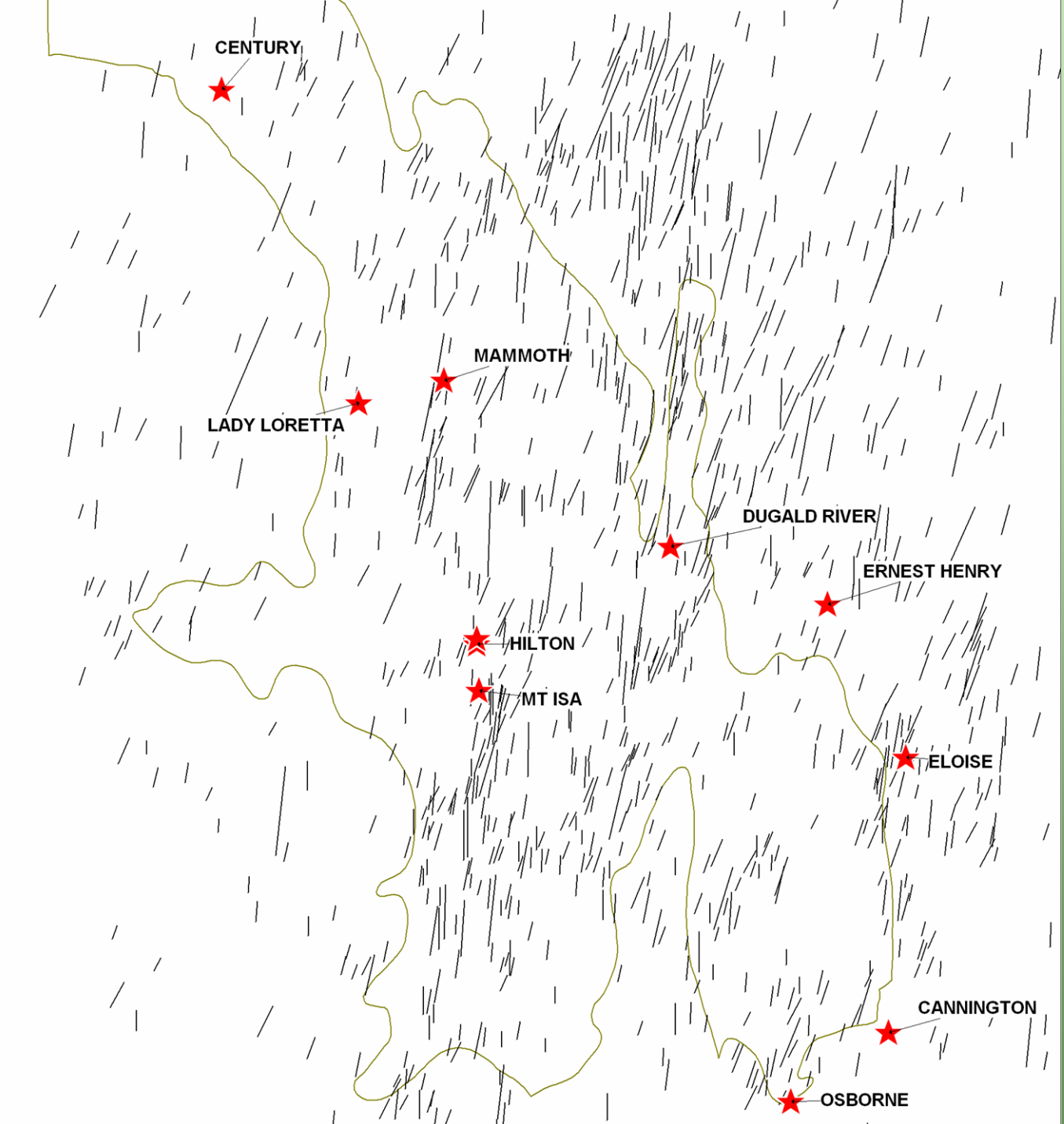
Magnetics
>5km Long Edges



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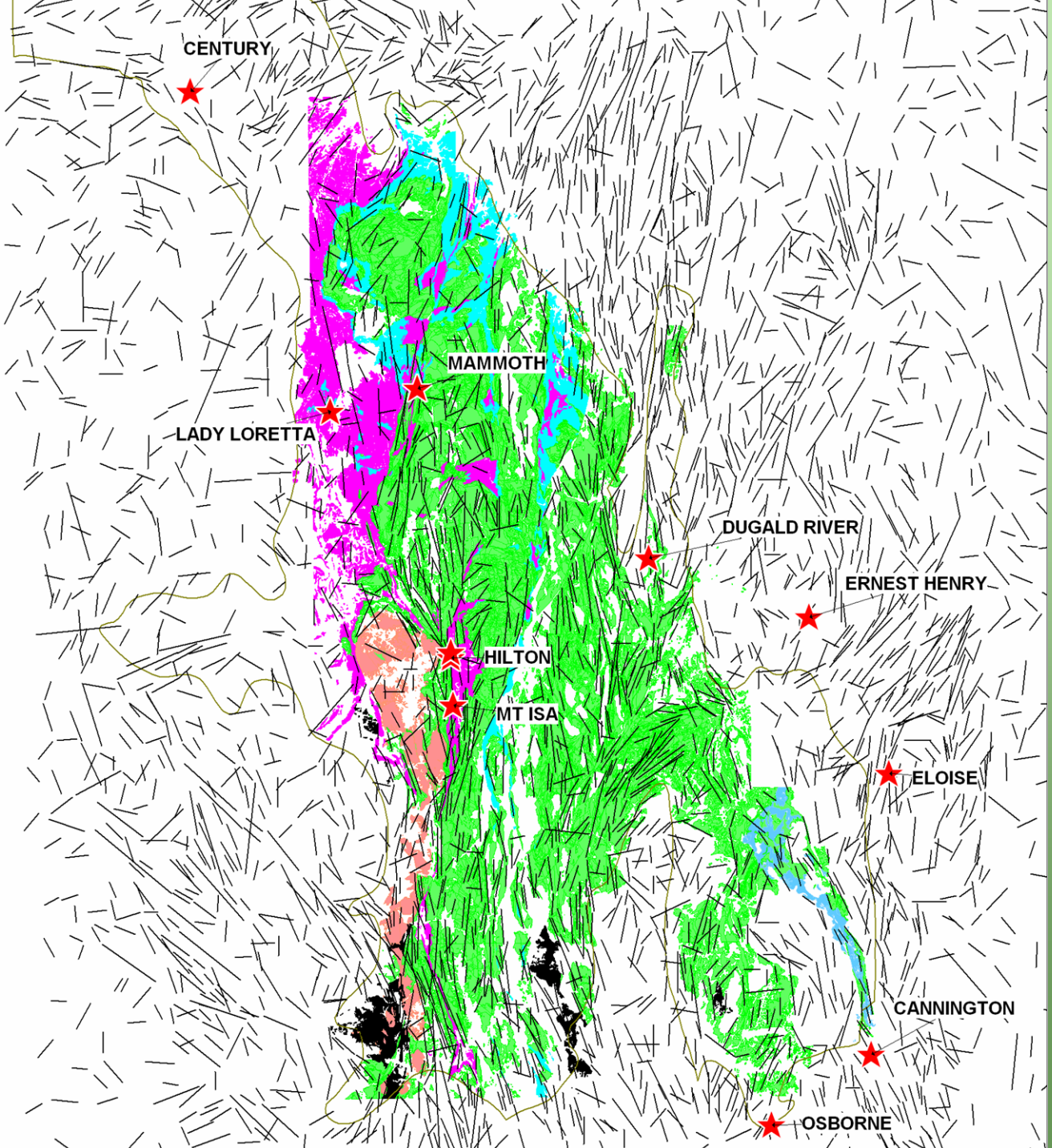
Gravity & Magnetics > 5km Long Edges

Grav_trend_over_5km by trend

330 to 360	(462)
300 to 330	(369)
270 to 300	(366)
240 to 270	(300)
210 to 240	(367)
180 to 210	(436)

Mag_trend_over_5km by trend

330 to 360	(763)
300 to 330	(230)
270 to 300	(88)
240 to 270	(110)
210 to 240	(285)
180 to 210	(731)



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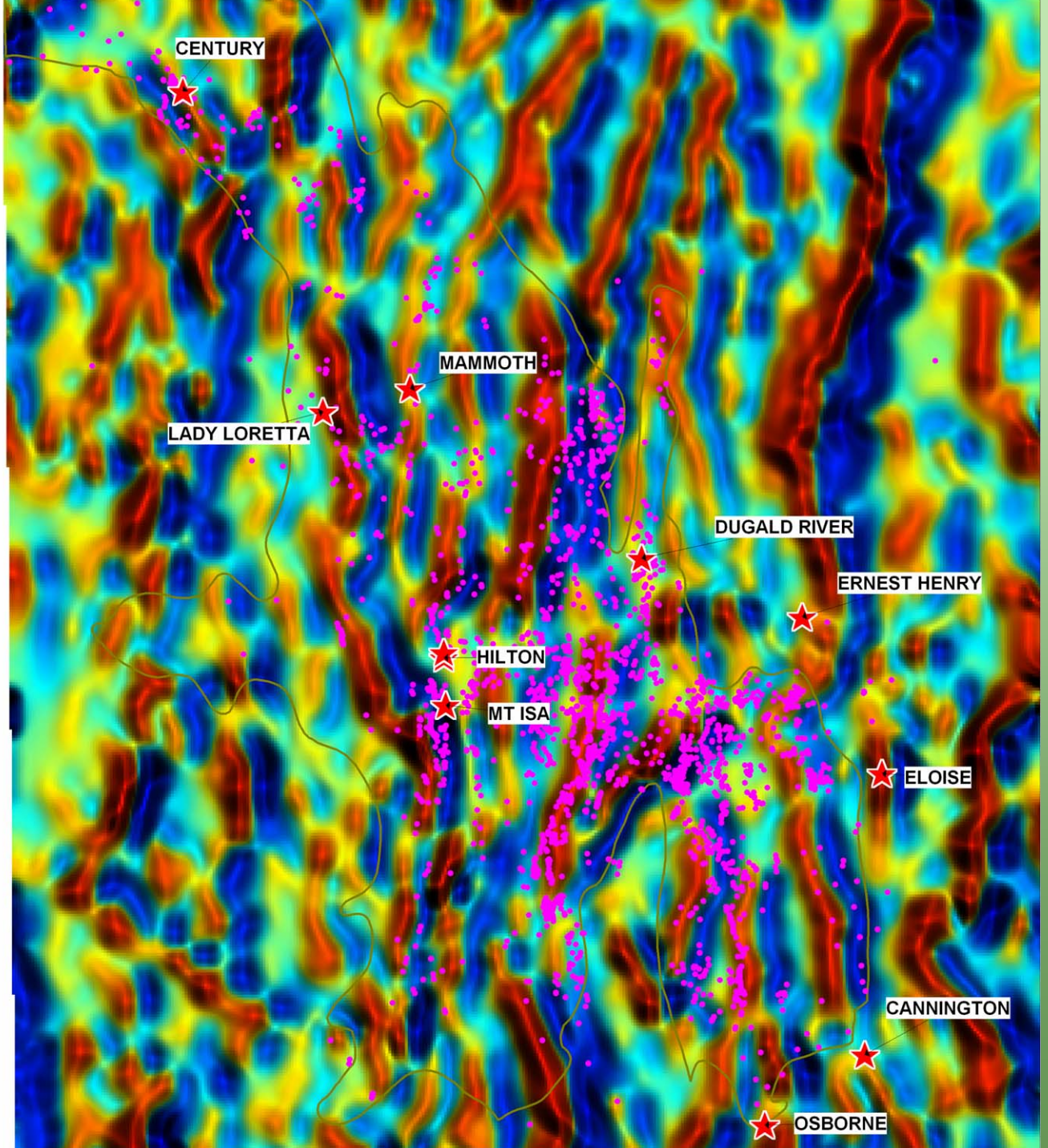
Gravity & Magnetics Ø5km Long Edges

ØNo Magic bullet



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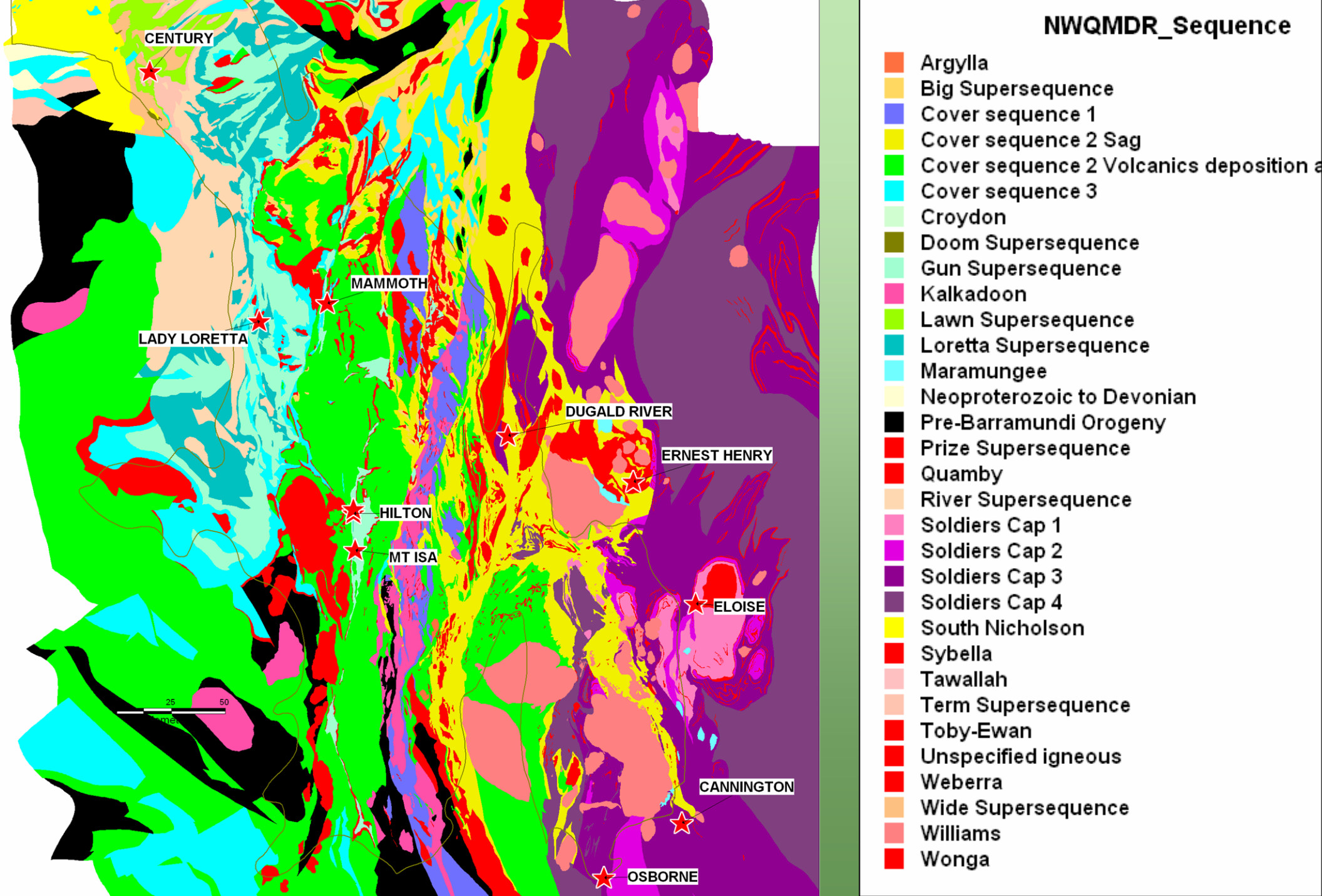
Follow the Worm Trails

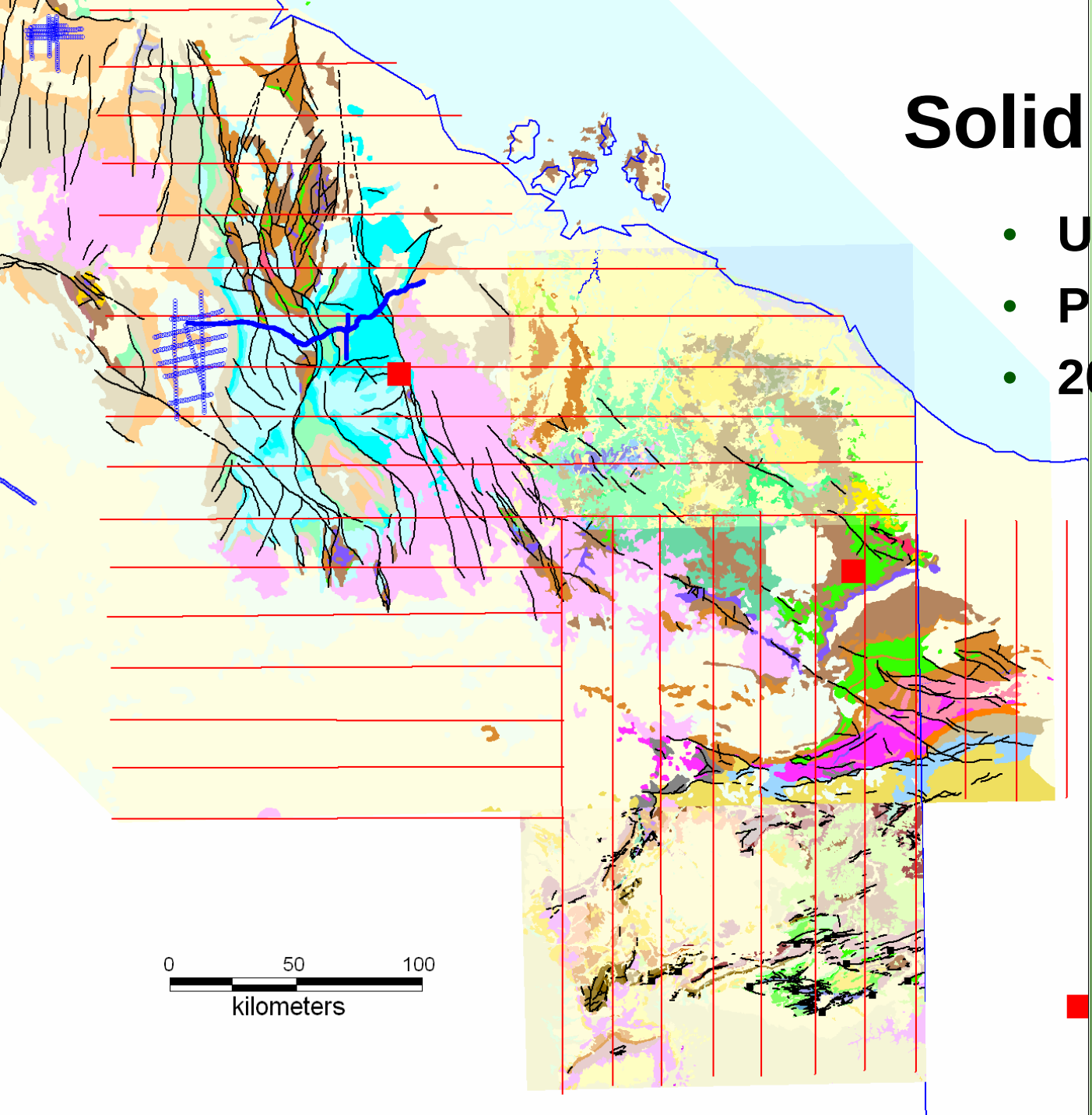

CENTURY
MAMMOTH
LADY LORETTA
DUGALD RIVER
ERNEST HENRY
HILTON
MT ISA
ELOISE
CANNINGTON
OSBORNE
25
50
NWQMDR_Sequence
Argylla
Big Supersequence
Cover sequence 1
Cover sequence 2 Sag
Cover sequence 2 Volcanics deposition a
Cover sequence 3
Croydon
Doom Supersequence
Gun Supersequence
Kalkadoon
Lawn Supersequence
Loretta Supersequence
Maramungee
Neoproterozoic to Devonian
Pre-Barramundi Orogeny
Prize Supersequence
Quamby
River Supersequence
Soldiers Cap 1
Soldiers Cap 2
Soldiers Cap 3
Soldiers Cap 4
South Nicholson
Sybella
Tawallah
Term Supersequence
Toby-Ewan
Unspecified igneous
Weberra
Wide Supersequence
Williams
Wonga

Still to come/Untold Stories….

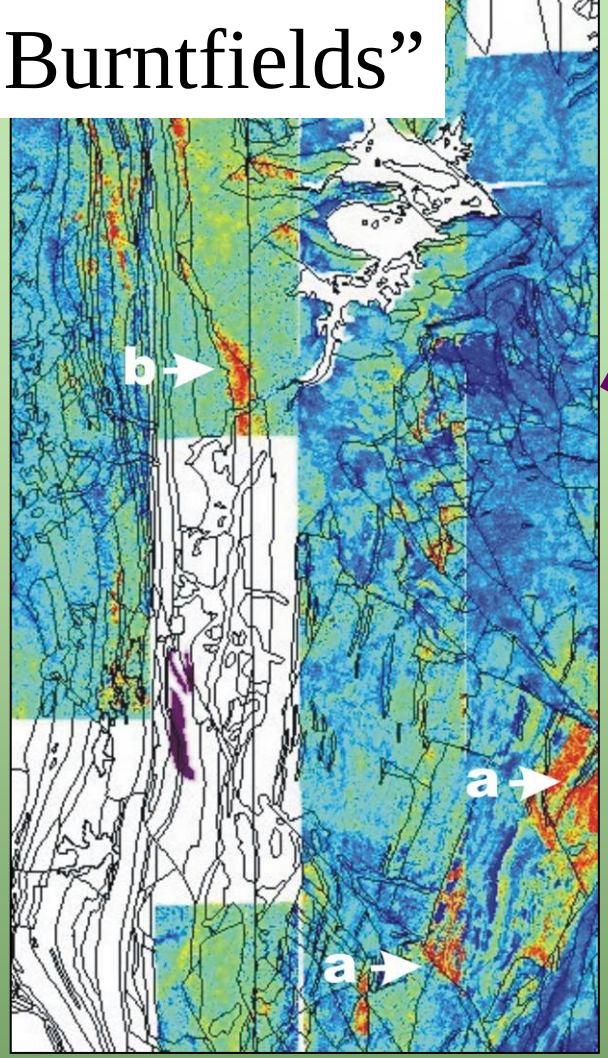
- Extend 3D to McArthur River region
  - Constrain Basement and Superbasin distributions undercover
- Intermediate scales
  - – characterisation of footprints Hyperspectral/Multispectral, XRD, XRF, local architectures
- Fluid sources - Halogens/Noble Gases
- Thermal and permeability modelling
- Scenario Testing - Timing & Geometries - Early, Late(r)?
  - Age – interpretation of Pb model ages
  - PbZnAg - host rock control, replacement
  - Cu less fussy wrt host rock, late basins fluid source?
    - UDEC 112.5 degrees?
- New Data acquisition – Smart Exploration Initiative

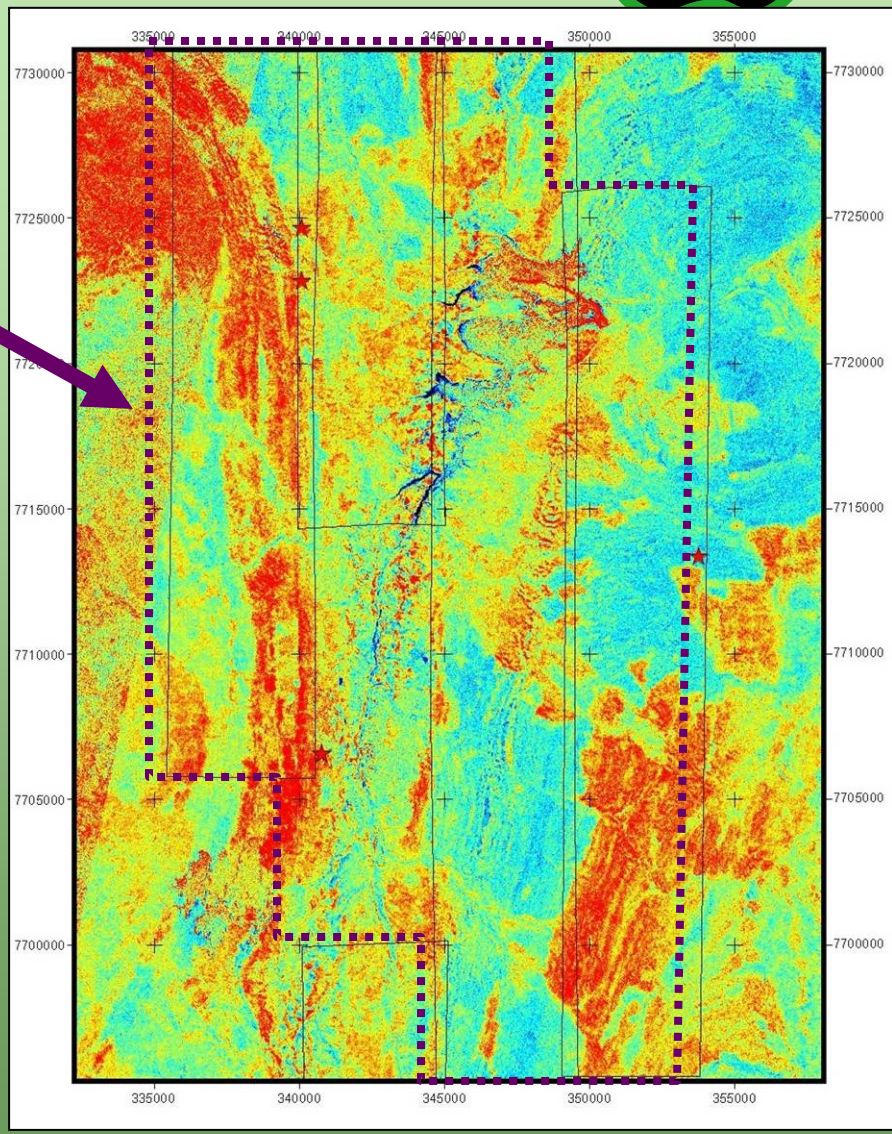
Solid Geology

- Under construction
- Proposed cross sections
- 20km spacing



Intermediate “Burntfields”



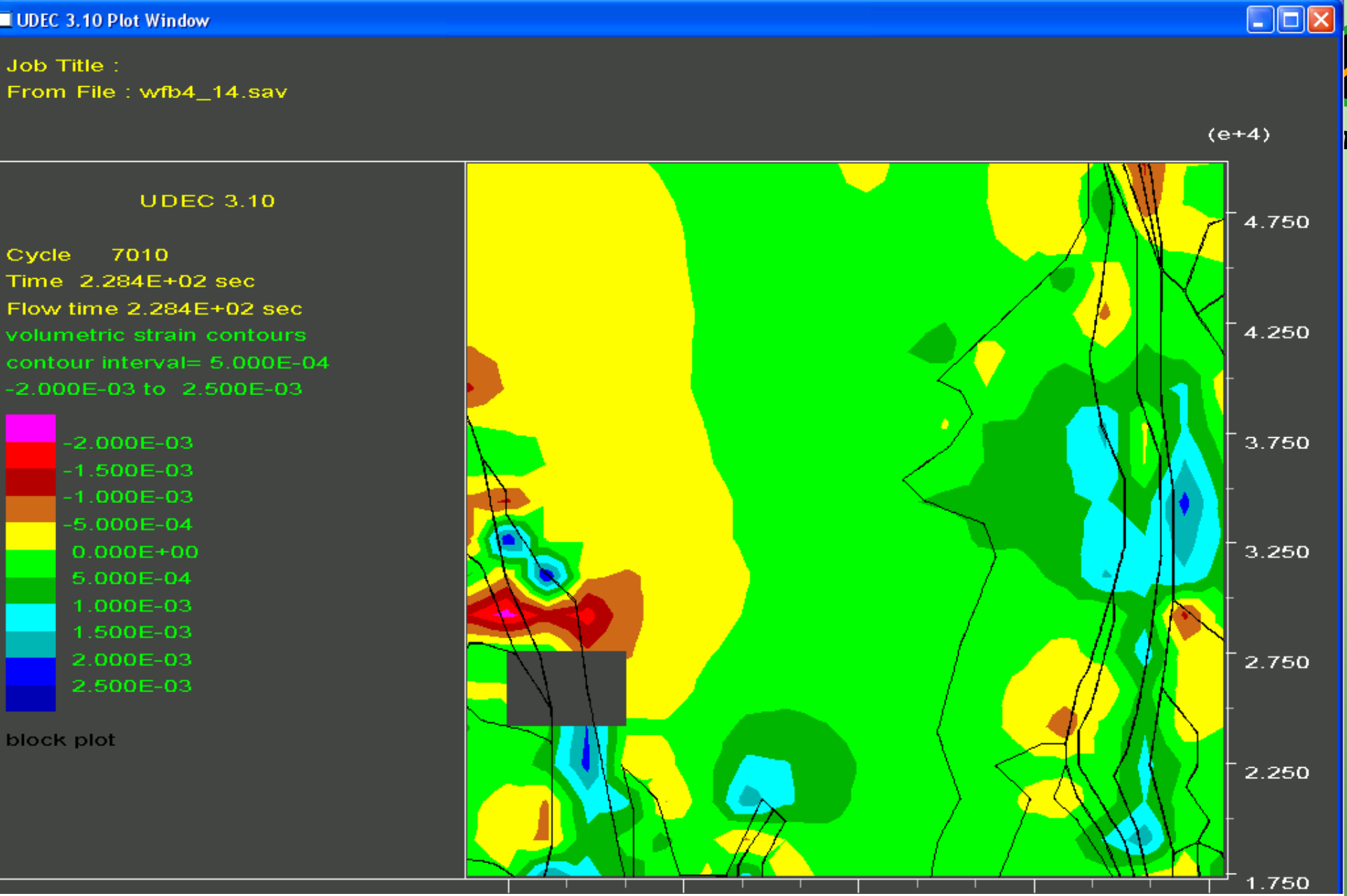


ASTER

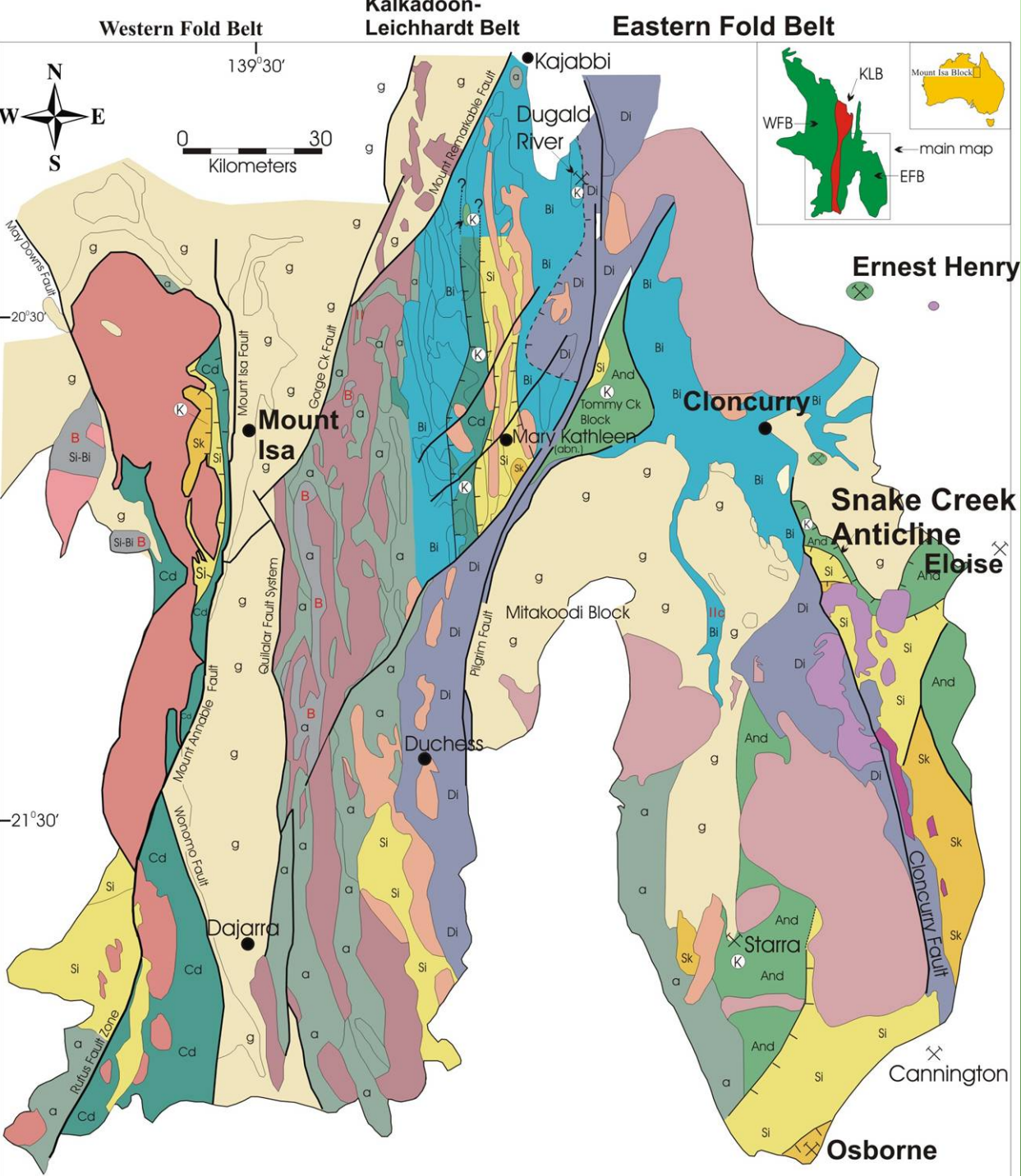
- **Mineral maps INADEQUATE!**
- **Need classification, neural network analysis**

HYMAP

- **Needs alteration mapped on ground**
- **Processing by experts!**



UDEC plot of dilation (max values in blue) around the Sybella Granite, indicating the position of Mt Isa (circle). Stress regime applied is 112.5°.



Isograd Map

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- Early - Syn-Sybella meta & migmatization, (extensional?) ~1675Ma
- Main Isan orogeny - Crd, And & Sil in ECV
- Assoc. metasomatism - Crd rocks & tourmalinites
- Possible connection with Mt Isa Pb-Zn deposit?

Seismic Refraction Profile

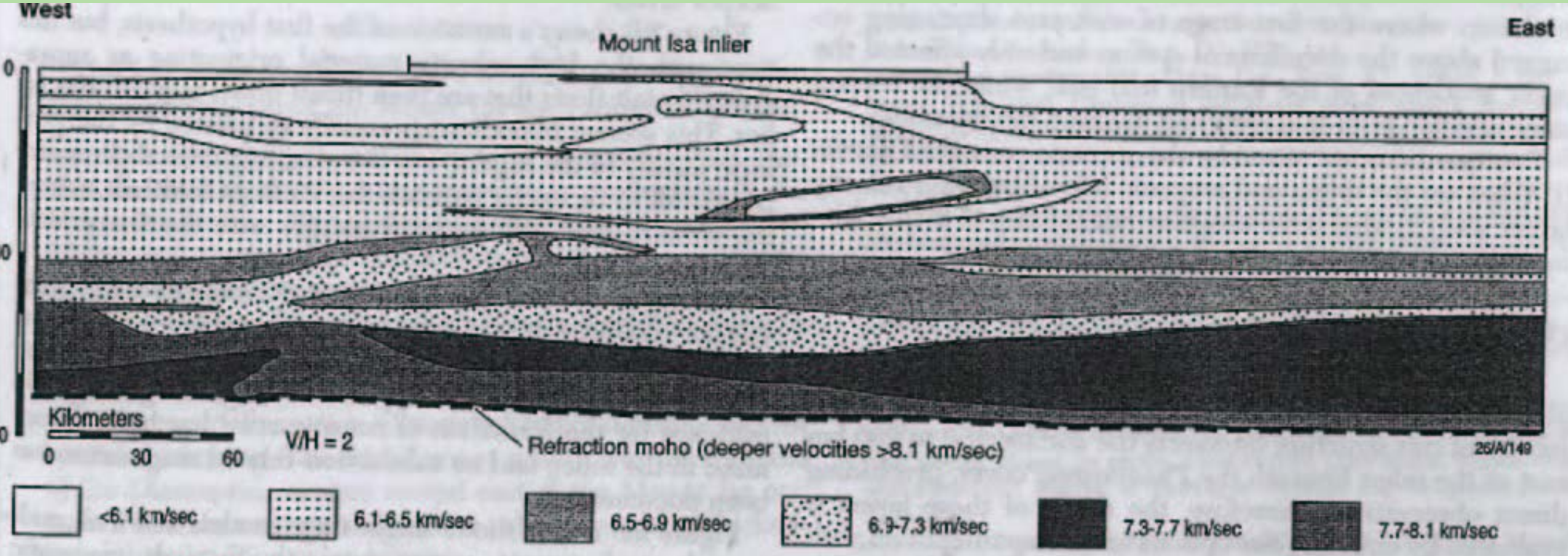
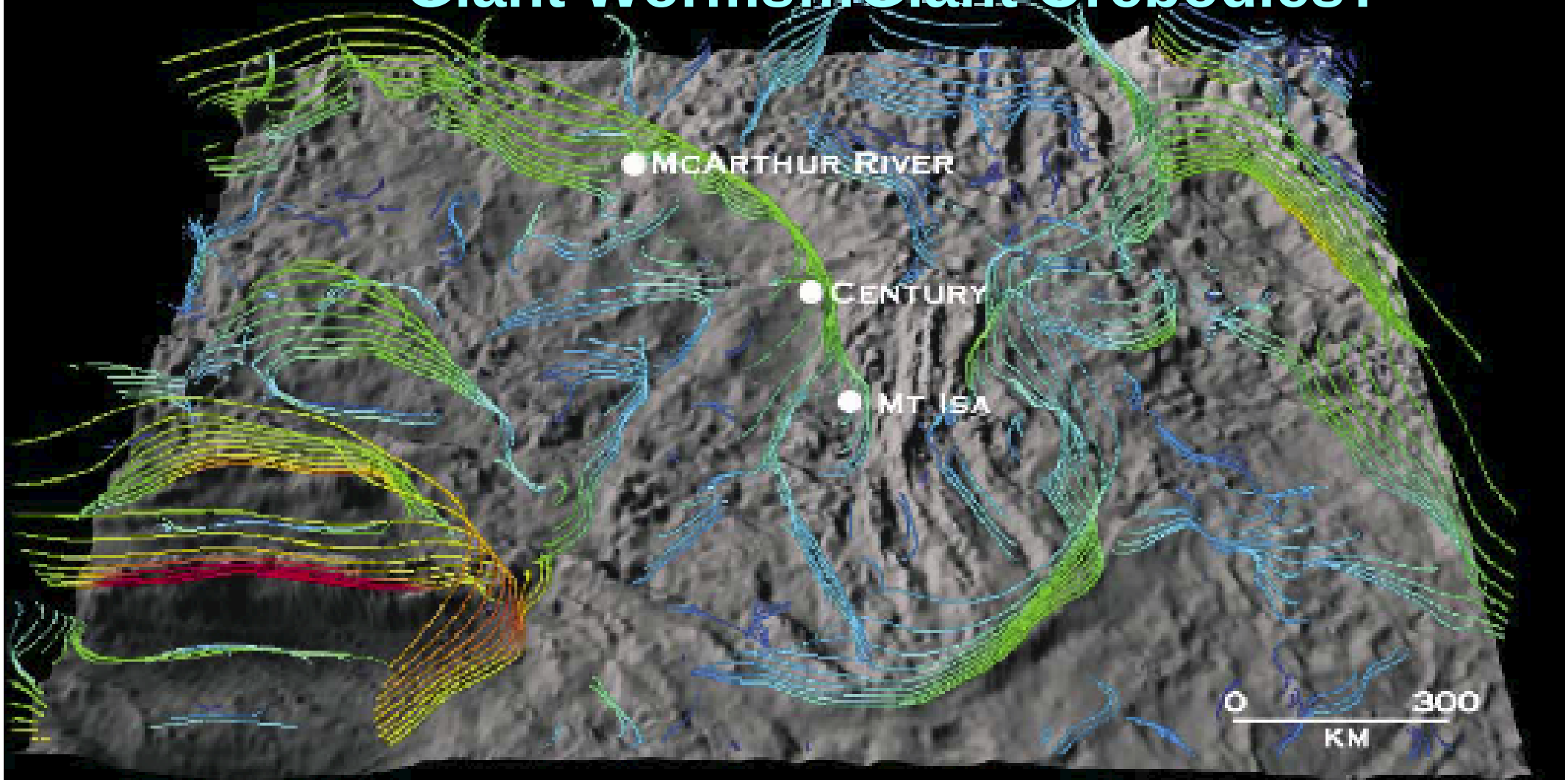


FIG. 7. Vertically exaggerated image of crustal seismic velocities based on interpretation of the refraction profile (Goncharov et al., 1996). The image highlights the transitional nature of the lower crust and the alignment of mid-crustal high-velocity (mafic lithologies) layers beneath the Mount Isa inlier.

Giant Worms…Giant Orebodies?



Basement Margin…PbZnAg assoc?