The Architecture A1 Project

"What are the fundamental characteristics of mineralised (trans-lithospheric) fault systems?"

Mt Isa Workshop; Mt Isa, November 13, 2003

JAMES COOK UNIVERSITY
THE UNIVERSITY OF WESTERN AUSTRALIA
MONASH UNIVERSITY
THE UNIVERSITY OF MELBOURNE
AMIRA INTERNATIONAL
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Geoscience Australia

The Architecture A1 Project

"Tectonic and geochemical characteristics of a well-endowed major fault (MIFZ)"

Mt Isa Workshop; Mt Isa, November 13, 2003

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Participants

Project Leader: Frank Bierlein, Monash University

Research Team: R. Weinberg, P. Betts, T. Lees, I. Vos, A. Morey (Monash), M. Barlow, B. Goleby, B. Drummond (GA), B. Murphy (Melbourne)

Industry mentors: J. Hronsky (WMC), F. Robert (Barrick Australia), M. Etheridge (SRK), G. Broadbent (Rio Tinto), J. Dougdale (MPI), R. Smith (AngloGold)

Commencement Date: May 2002
Project Duration: 3 years
Linkages: across entire pmd*CRC

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Aim of the A1 Project:

To understand why some fault systems are mineralised, and why others are barren (set of critical parameters?)

Objective of the A1 Project:

Predictive mineral discovery at significantly reduced risk

(fundamental shift)

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A coherent concept aimed at predicting the mineral potential of major fault systems…

…via a multi-disciplinary approach:

Tectonic Targets & Deposits Database

Key Area Studies
(Mt Isa, Yilgarn, HBR, Lachlan)

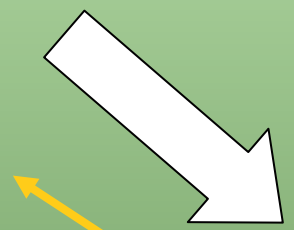
database criteria

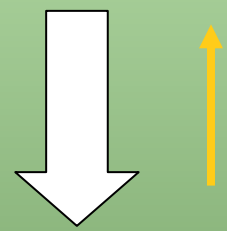
validate

input

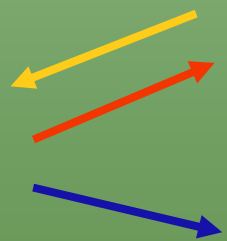
geology, structure, tectonics, geochronology, geochemistry, geophysics (seismics, worming)

+ literature
pmd*CRC projects!





Process Understanding (critical parameters)

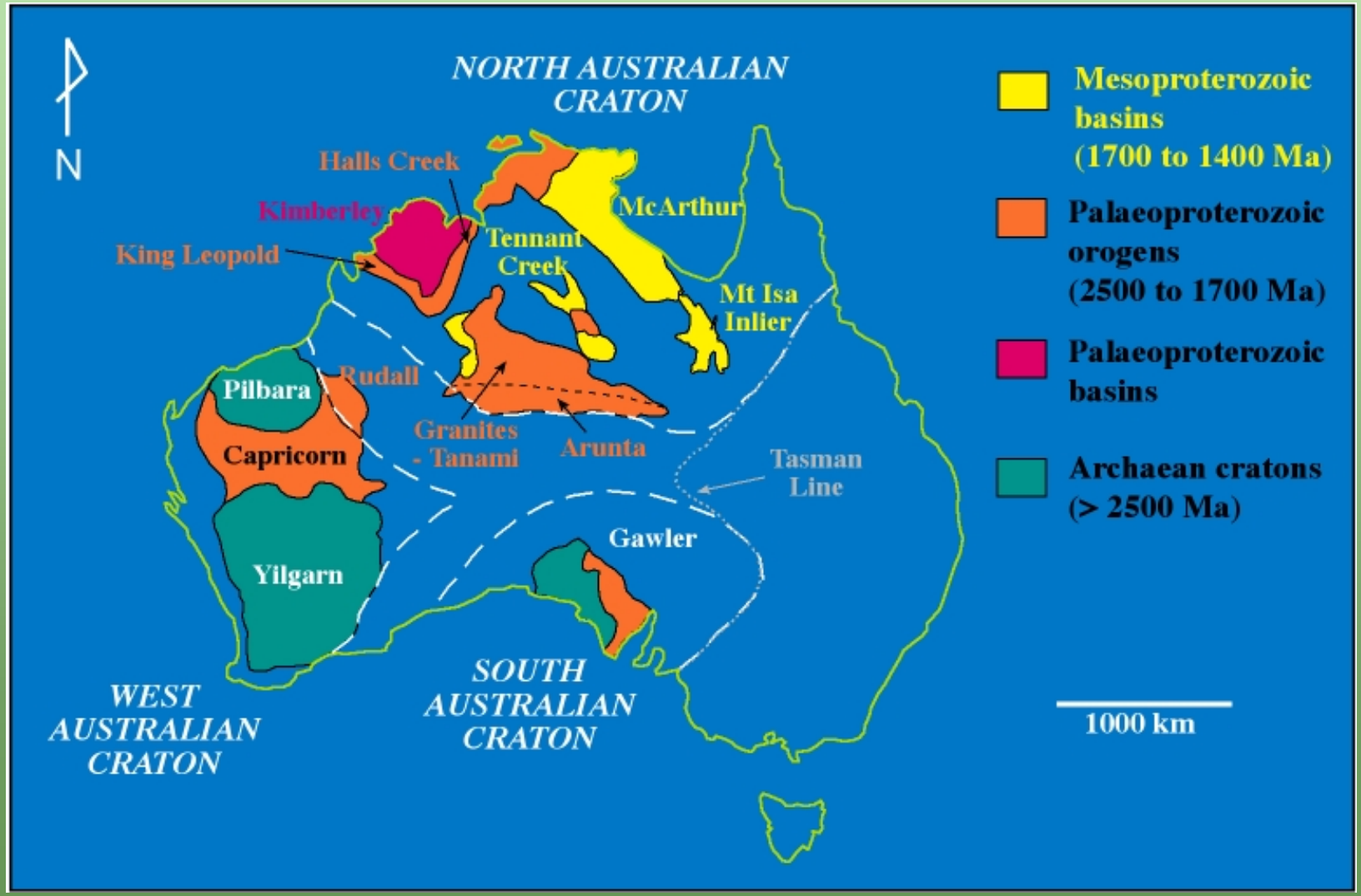


Modeling Scenarios
(numerical, habitat)

Application to Industry
targeting at reduced risk

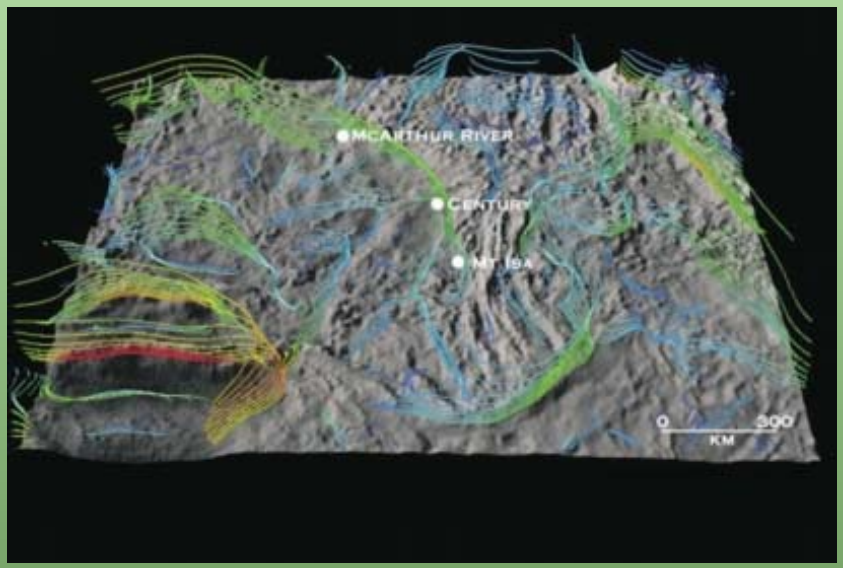
MIFZ basement study (Bierlein & Betts, 08/02 - 09/03)

MIM; P. Gow, D. Wilson

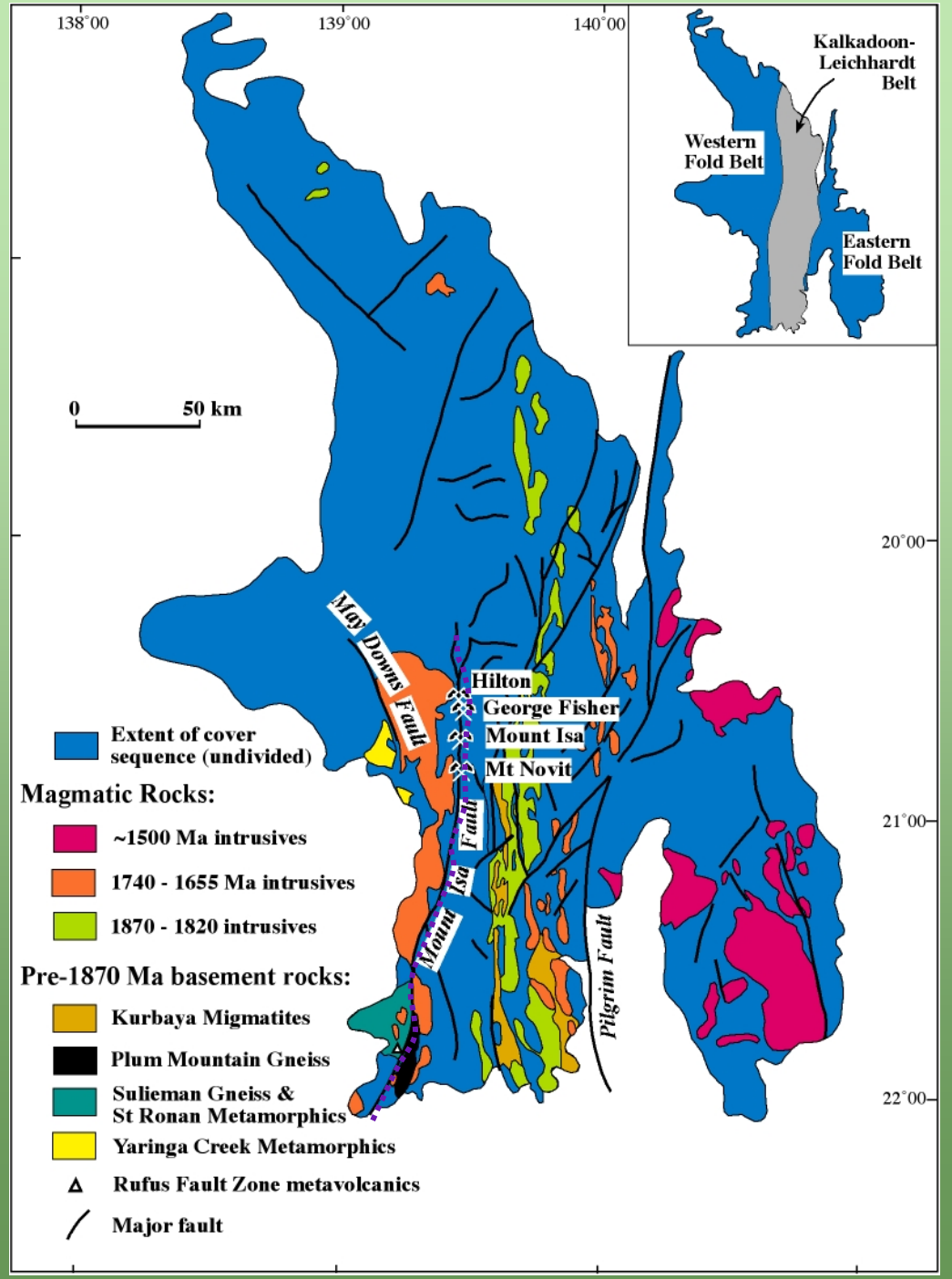


MIFZ - a Barramundi-aged suture?

Coincident with major 'worm'
(e.g., Hobbs et al., 2001)



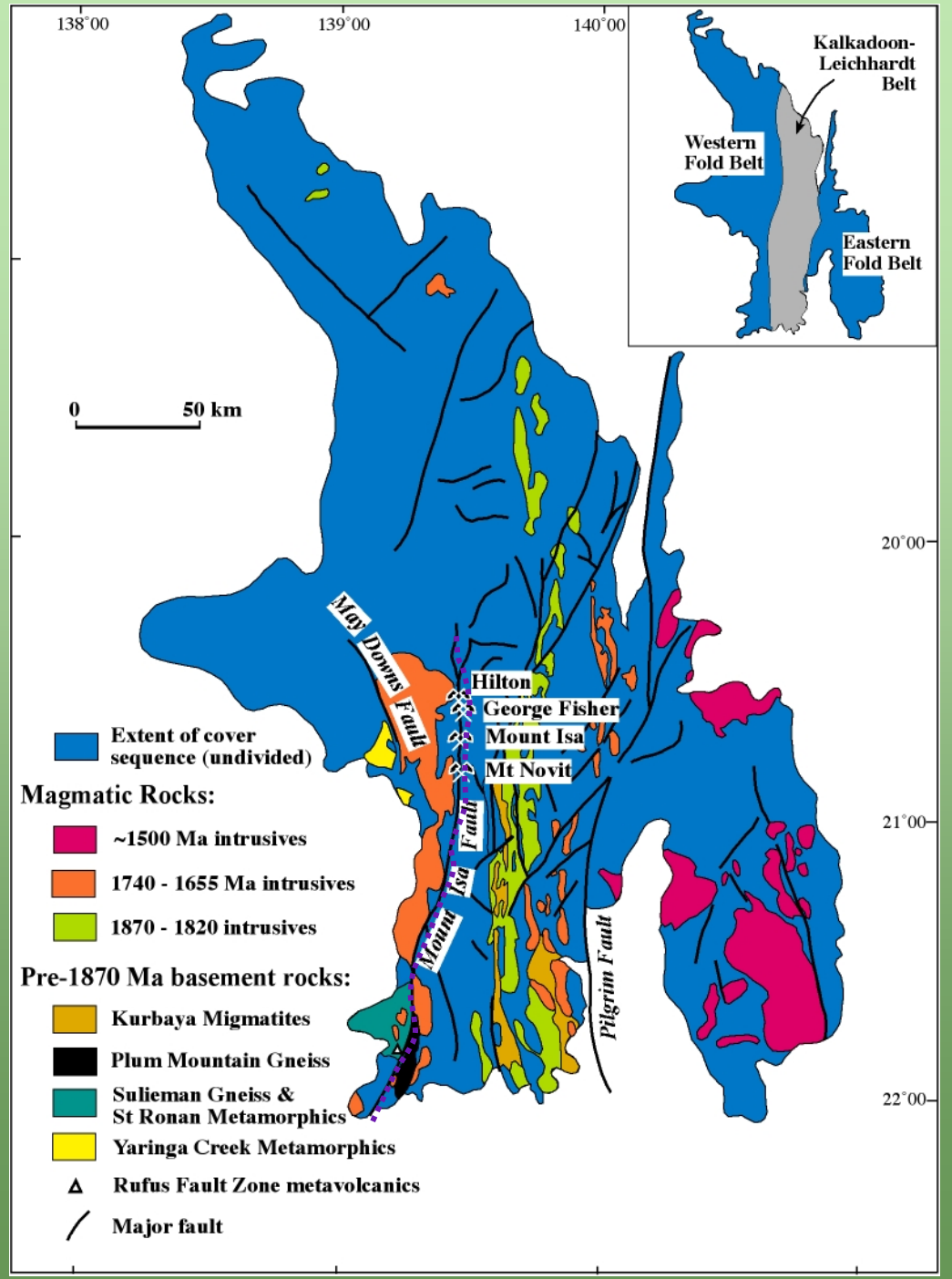
Profound role in focusing mineralised fluids from lower crustal/mantle sources



Does MIFZ demarcate boundary between two distinct lithospheric blocks?

Tectonic processes during amalgamation of NAC?

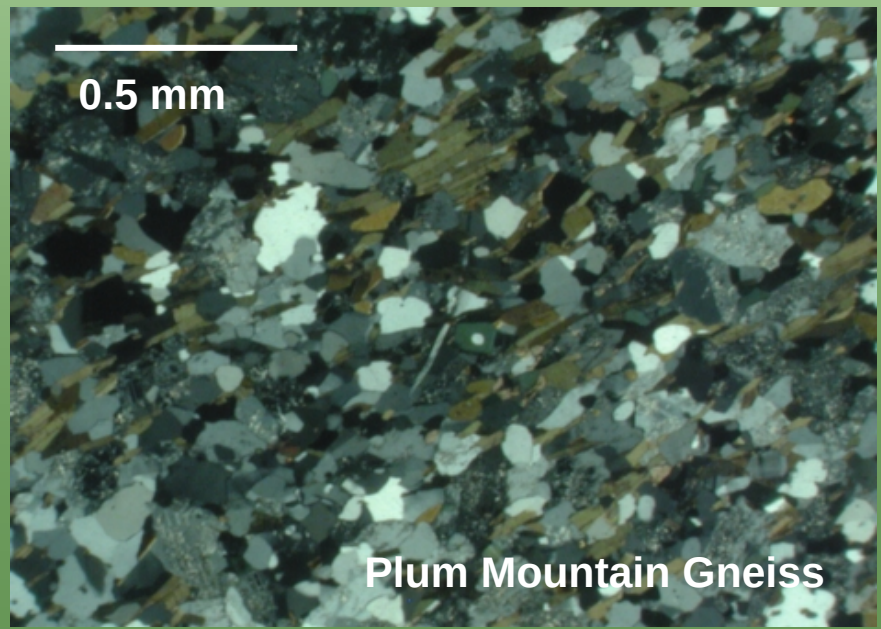
Fingerprint pre-Barramundi Orogeny basement rocks from E and W of MIF (whole-rock geochemistry; Sm-Nd isotope systematics; forward modelling)



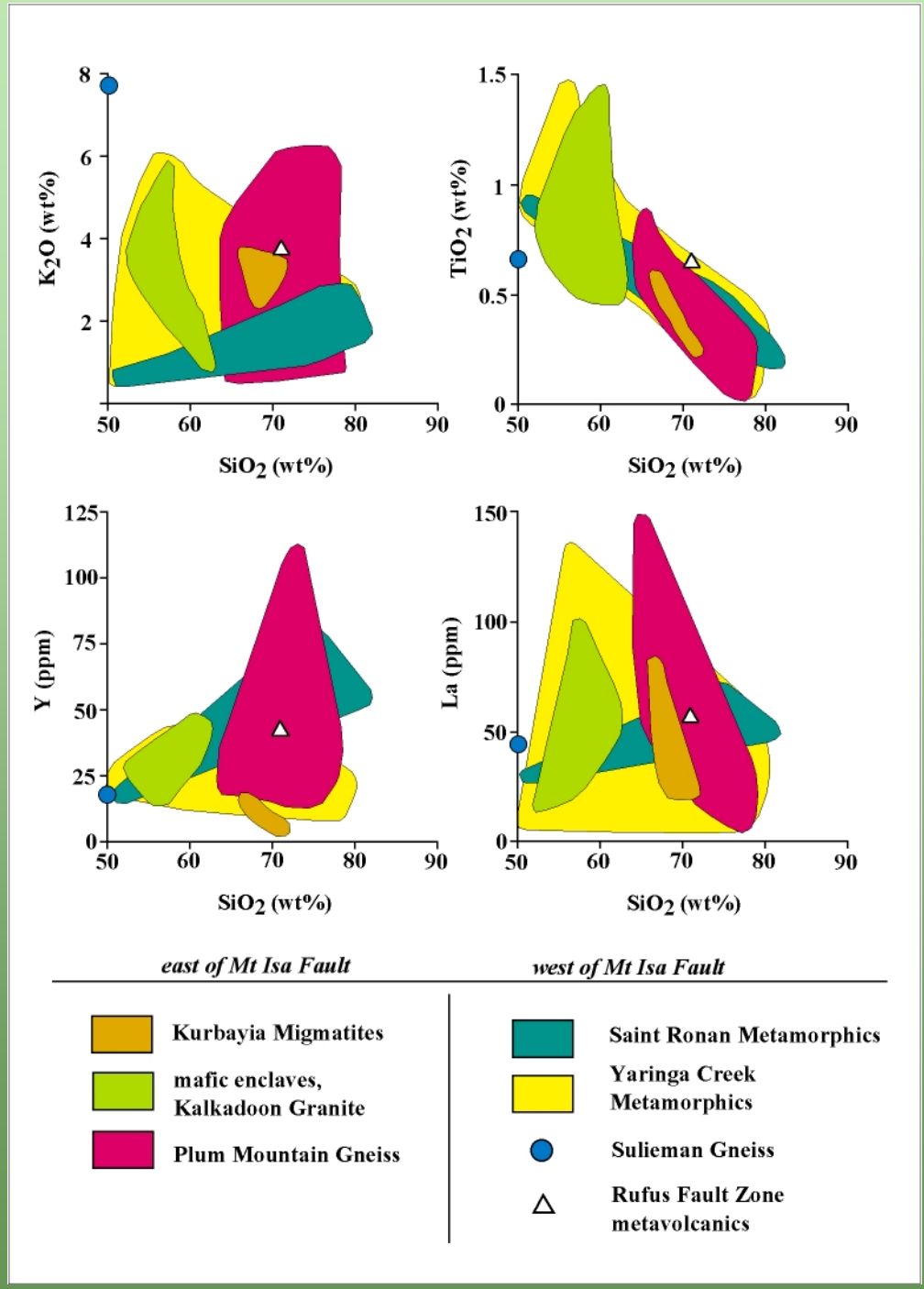

Yaringa Creek Metamorphics


Kalkadoon Granite mafic enclave

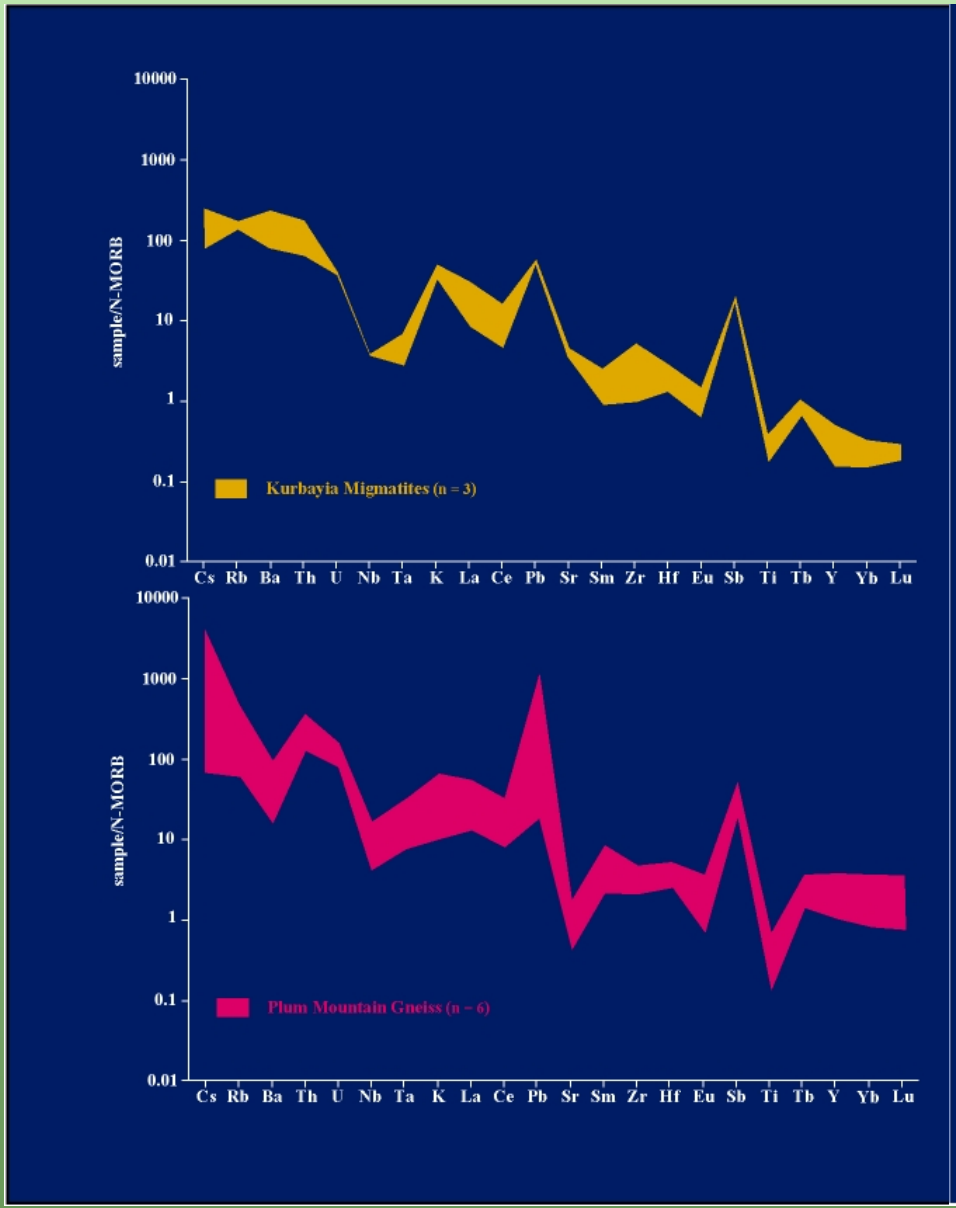

Kurbaya Migmatites

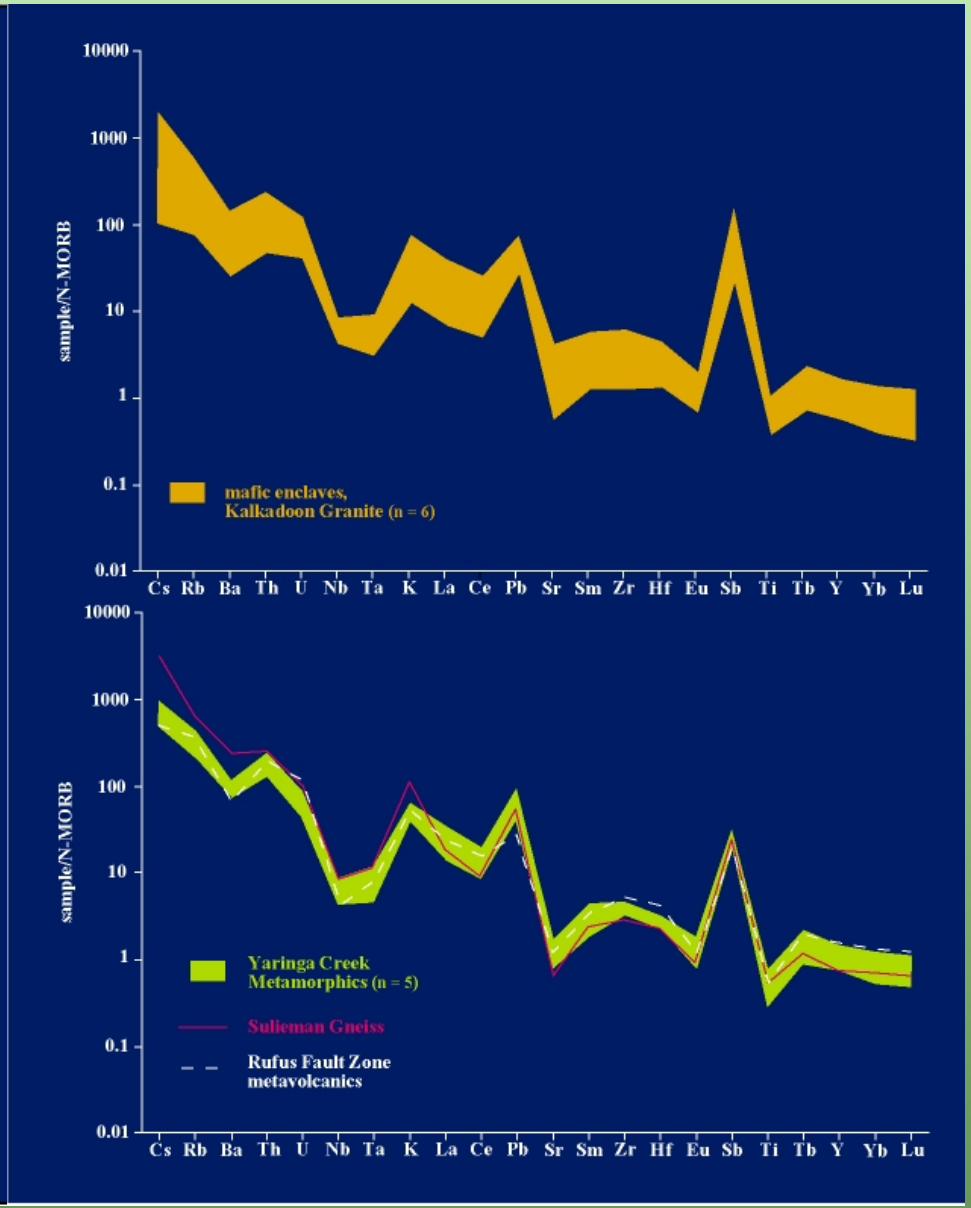


Plum Mountain Gneiss



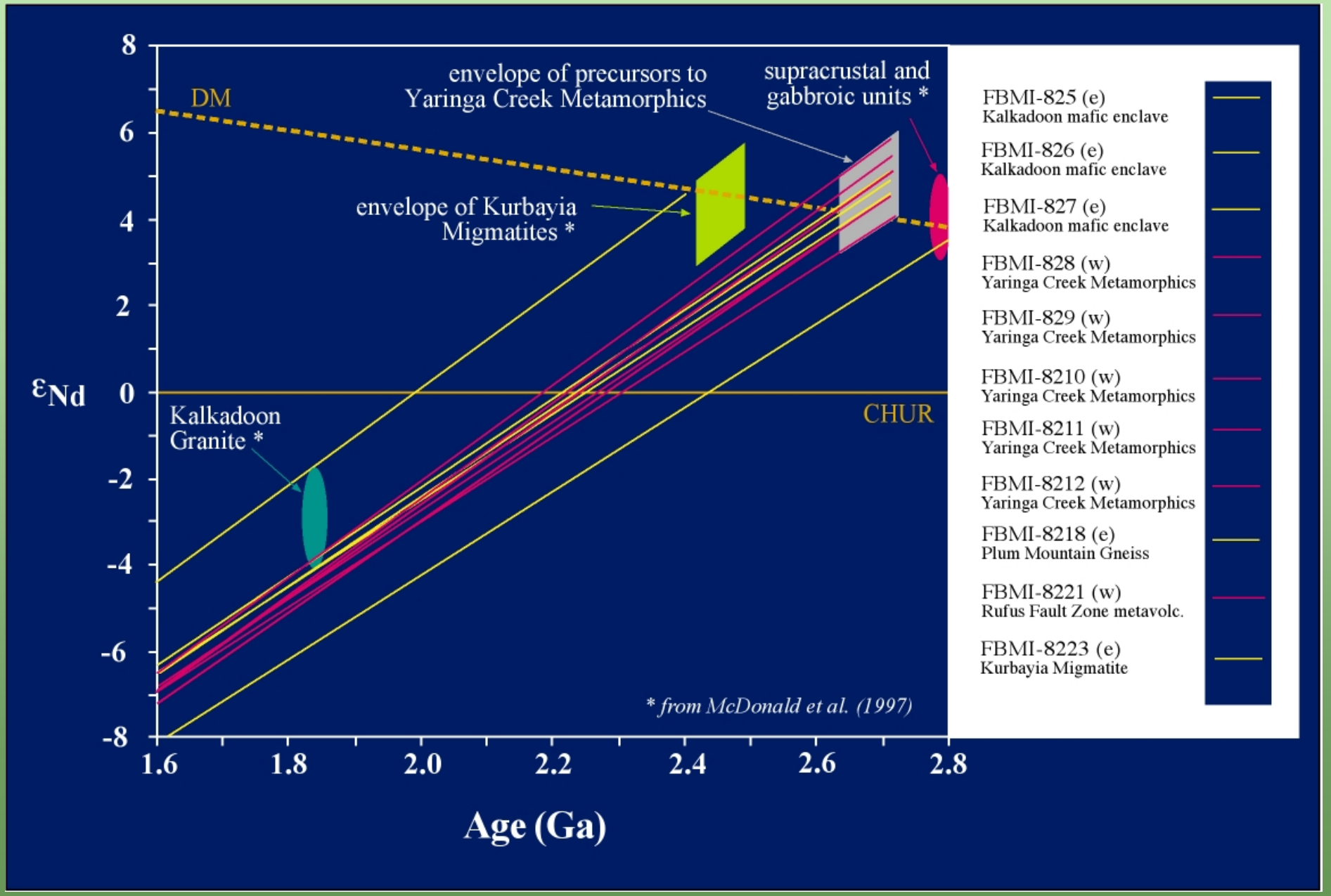
(includes data from OzChem db)





East of Mt Isa Fault

West of Mt Isa Fault


8
6
4
2
0
-2
-4
-6
-8
εNd
1.6
1.8
2.0
2.2
2.4
2.6
2.8
Age (Ga)
DM
envelope of precursors to Yaringa Creek Metamorphics
supracrustal and gabbroic units *
envelope of Kurbayia Migmatites *
Kalkadoon Granite *
CHUR
* from McDonald et al. (1997)
FBMI-825 (e) Kalkadoon mafic enclave
FBMI-826 (e) Kalkadoon mafic enclave
FBMI-827 (e) Kalkadoon mafic enclave
FBMI-828 (w) Yaringa Creek Metamorphics
FBMI-829 (w) Yaringa Creek Metamorphics
FBMI-8210 (w) Yaringa Creek Metamorphics
FBMI-8211 (w) Yaringa Creek Metamorphics
FBMI-8212 (w) Yaringa Creek Metamorphics
FBMI-8218 (e) Plum Mountain Gneiss
FBMI-8221 (w) Rufus Fault Zone metavolc.
FBMI-8223 (e) Kurbayia Migmatite

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Chemical resemblance across basement lithologies

Formed in arc-related setting; rapid uplift, erosion, arc magmatism
(contribution from mantle wedge, crustal contamination, subducting slab)

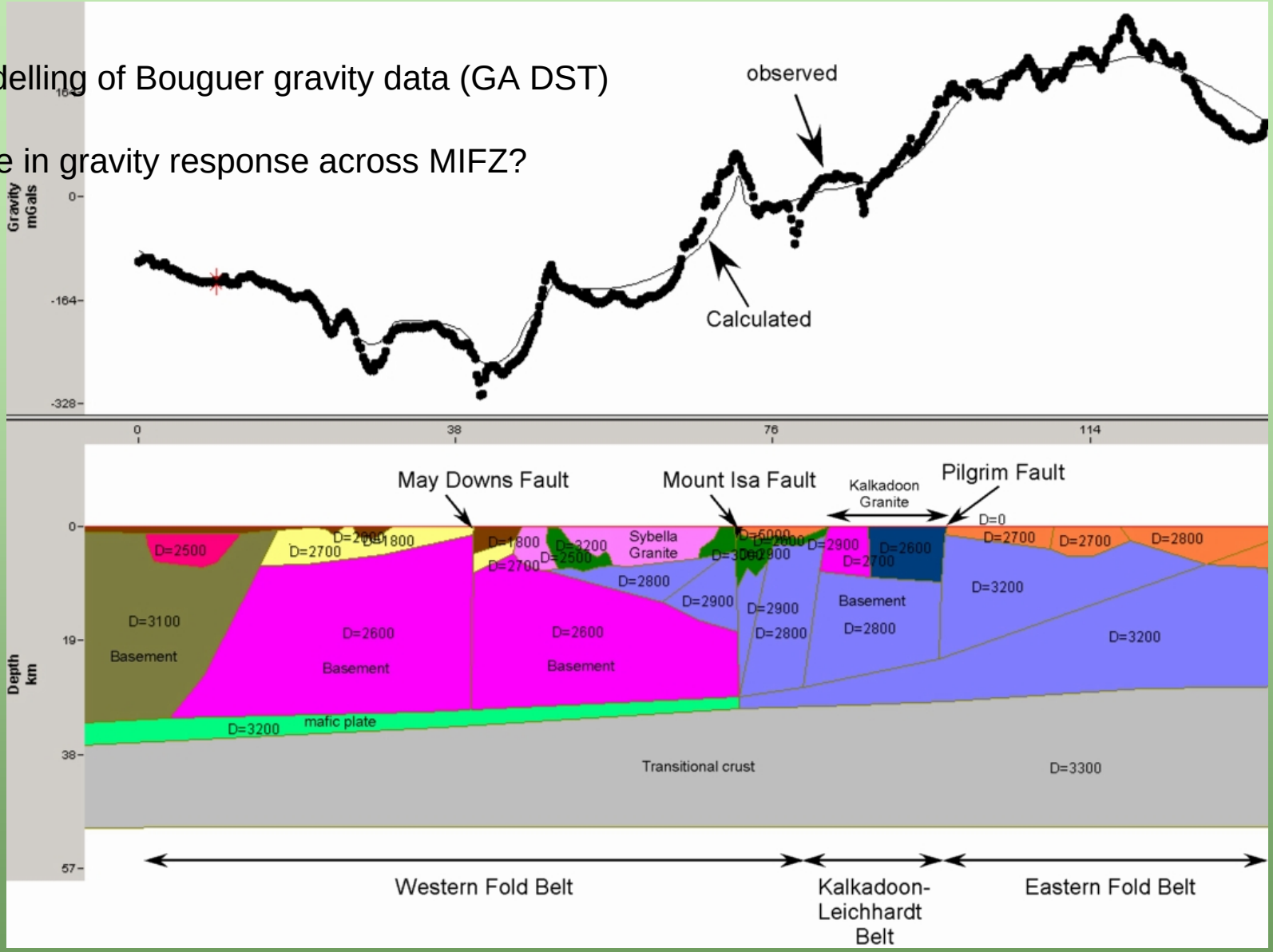
T_{DM} ages 2.38 - 2.82 Ga; repeated melting events from common, isotopically indistinguishable protolith

Crustal blocks must have been within close proximity of each other

Western fold belt part of NAC before Barramundi Orogeny?

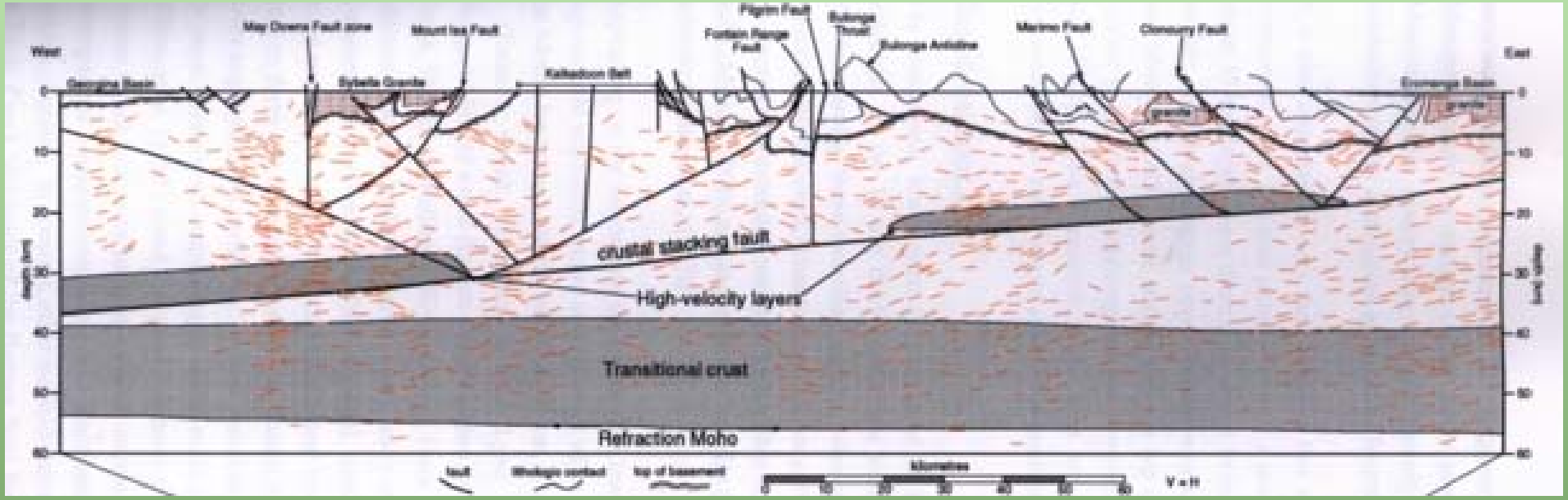
Forward modelling of Bouguer gravity data (GA DST)

Major change in gravity response across MIFZ?



Medium wavelength perturbations: changes in upper crustal rock densities

Long wavelength (>10km) perturbations: changes in medium - lower crustal rock densities



Mt Isa Deep Seismic Transect (from MacGraedy et al., 1998)

Mt Isa Fault dipping 70˚ west; terminates at ~6km into poorly-defined east-dipping, late-stage surface

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Mt Isa Fault - inverted extensional fault or late-orogenic thrust?

Mid-crustal fault, connecting with W-dipping mafic to ultramafic plate

No terrane-bounding suture - unlikely to cut the lower crust

(late-stage decoupling from deep-seated deformation zone along more ductile lower crustal layer?)

Barramundi Worm: mid- to lower crust density contrast due to boundary of mafic underplate and low-density basement rocks

(Mesoproterozoic orogenesis)

Largest contrast west of May Downs Fault Zone & east of KLB

(ancient sutures? Worms not delineated due to offset of sutures during shallow thrusting + underplating during Isan Orogeny)