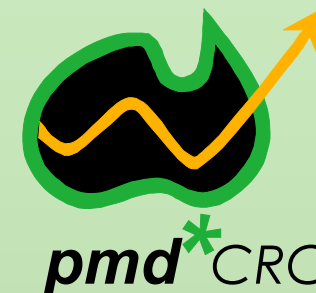


The Y2 project (2001-2004)



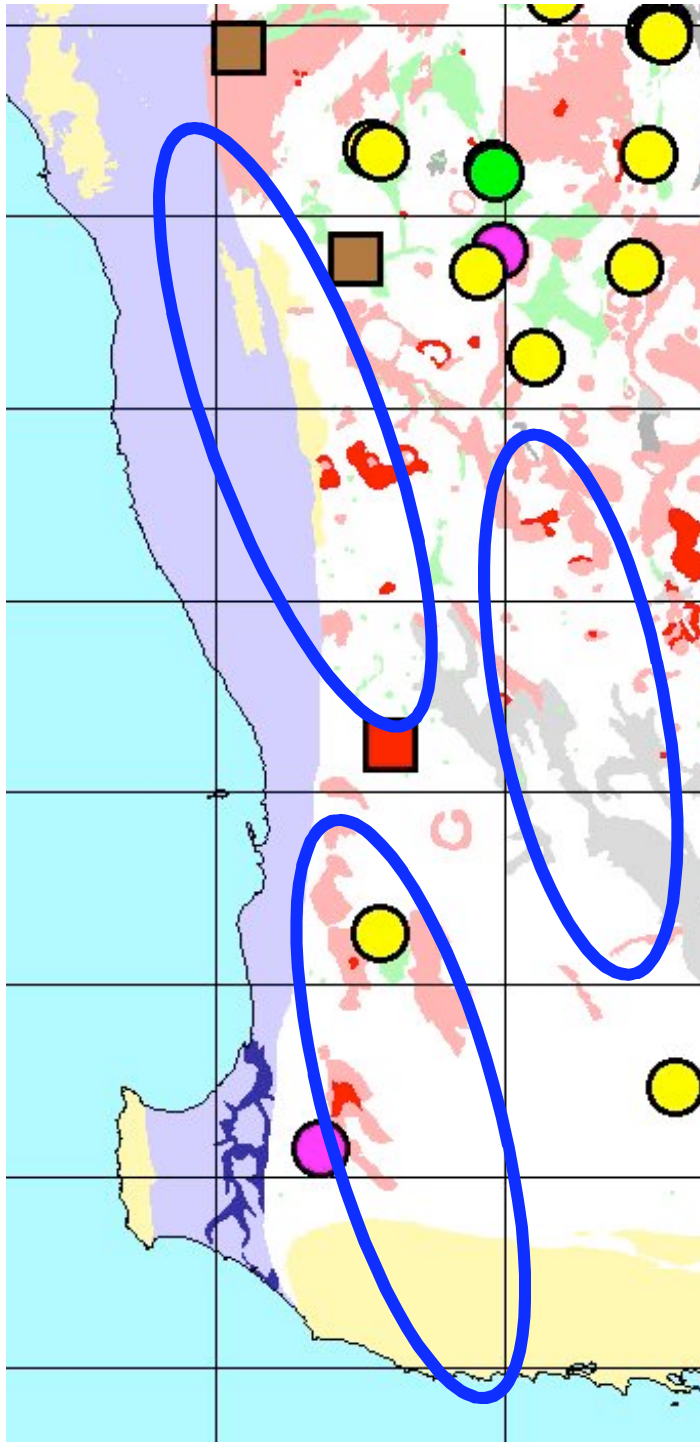
Time-space evolution of the Yilgarn Craton: implications for geodynamics



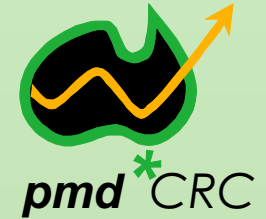
Kevin Cassidy and the Y2 team

'Reduced Discovery Risk through Improved Targeting'





Why is the gold where it is?



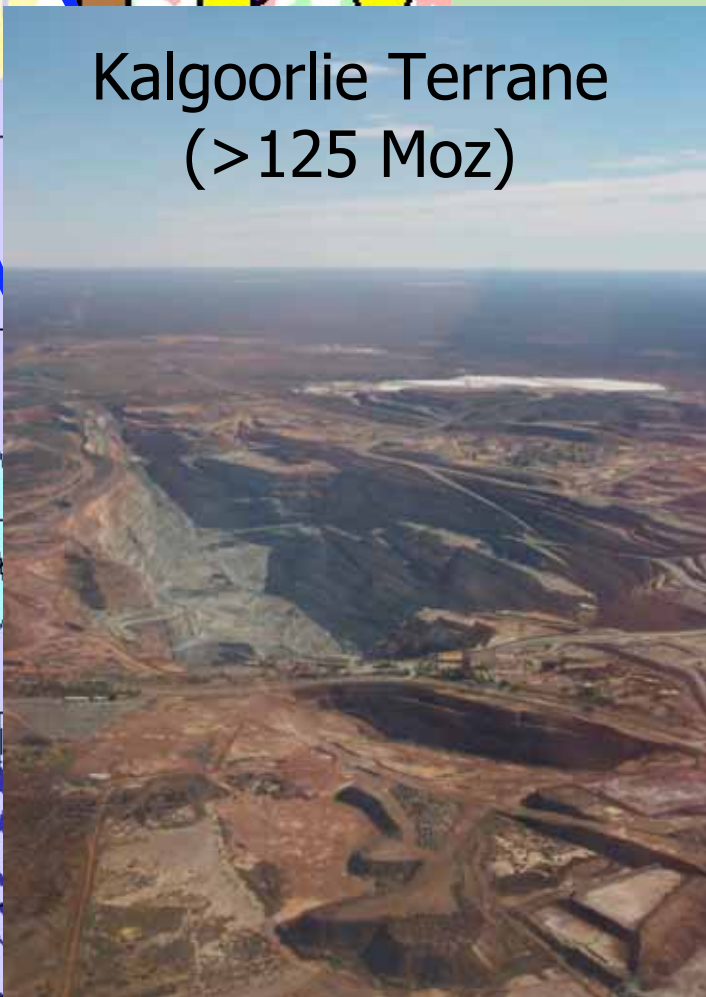
- Yilgarn clearly extremely well-endowed
- But ... major deposits generally in the Kalgoorlie Terrane and the 'Laverton tectonic zone' (Laverton Terrane); little mineralisation in Gindalbie terrane
- What are the essential component processes in space and time?
- How do we recognise the signature of essential processes?

Understanding the 4D evolution of the province and sub-provinces provides the starting point

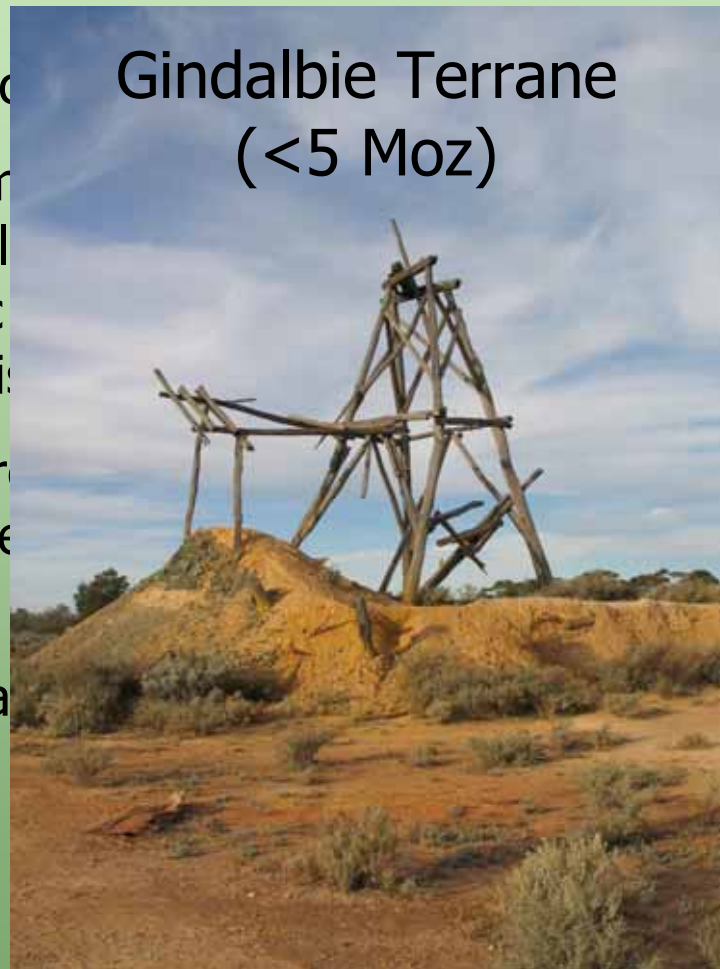
Why is the gold where it is?



Kalgoorlie Terrane
(>125 Moz)



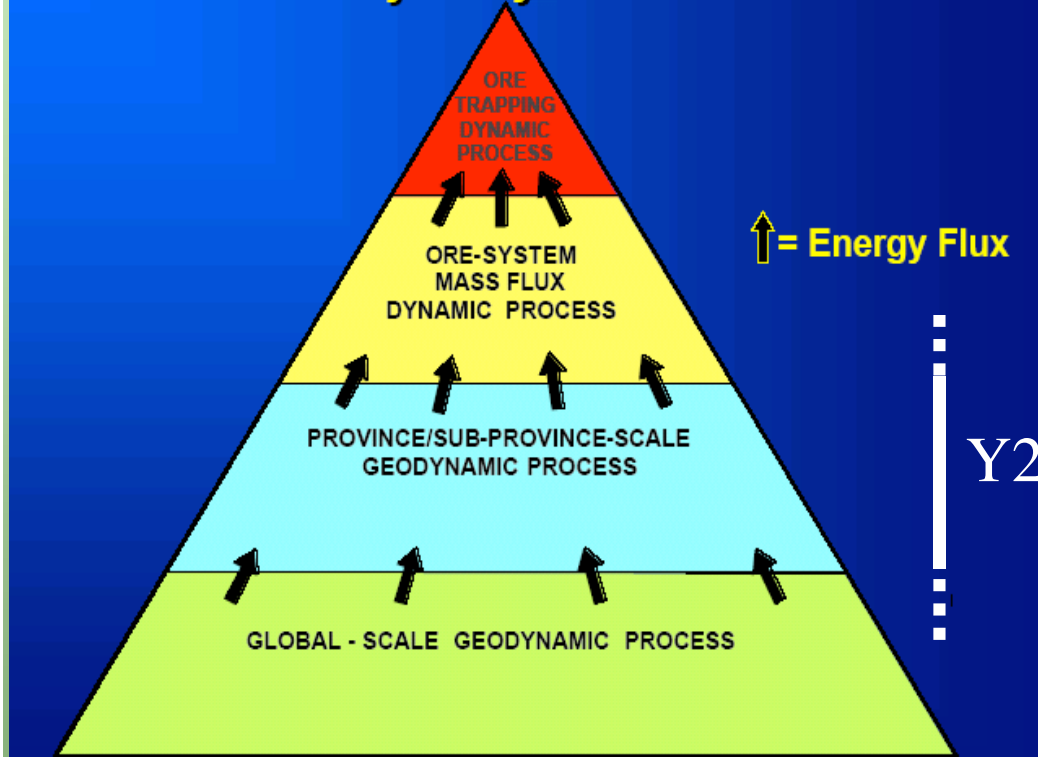
Gindalbie Terrane
(<5 Moz)



Understanding the 4D evolution of the province and sub-provinces provides the starting point

Predictive mineral discovery?

A Hierarchy of Dynamic Process



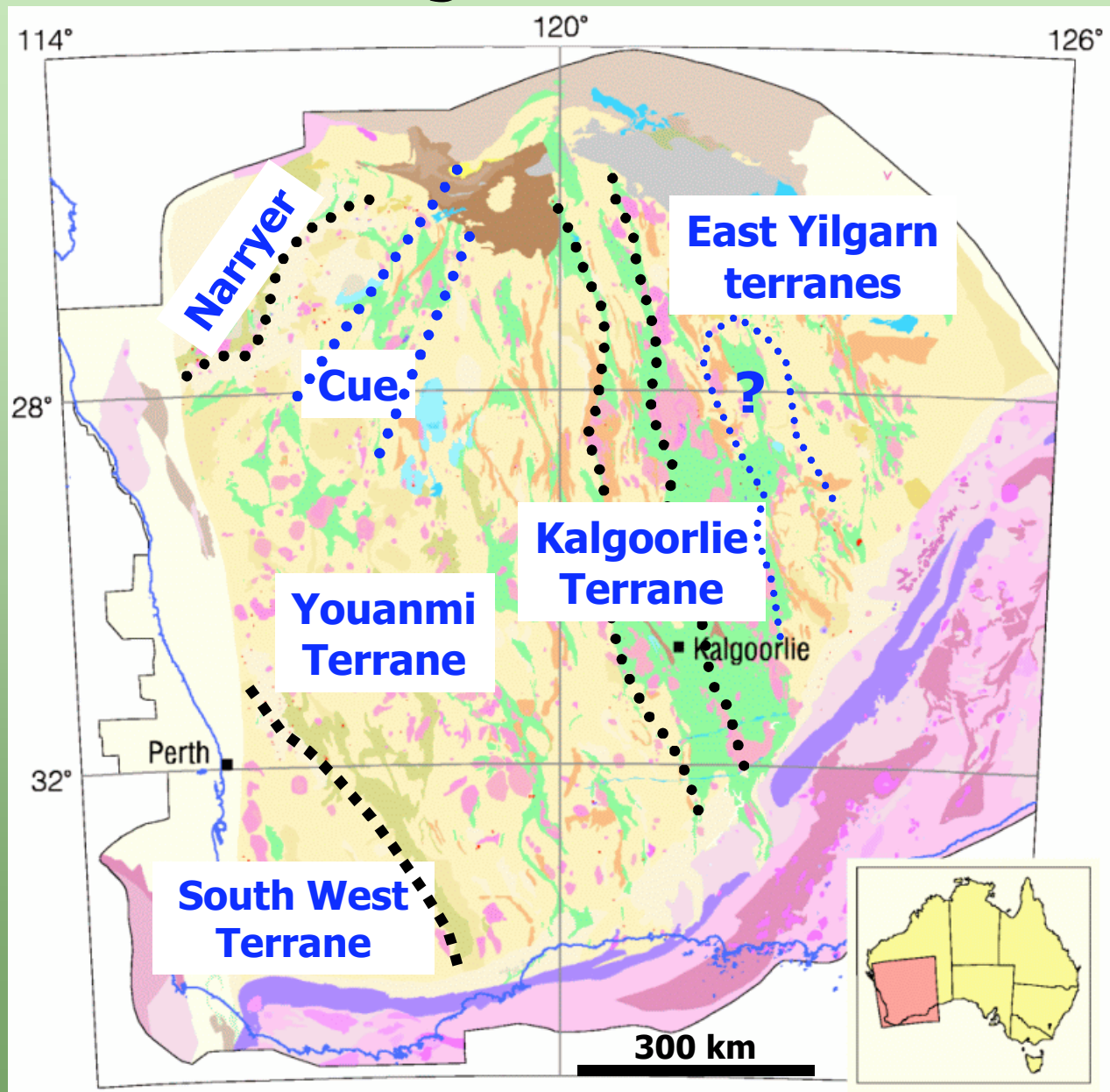
- ore deposits are focal points of large-scale energy and mass flux systems
- important to recognise system even though the precise genetic links with mineralisation are unclear
- spatial prediction depends on the architecture and dynamics of ore systems
- knowledge of complex processes at a variety of scales paramount

Hronsky (2004)

Time-space evolution constrains:

1. What is the P-T and geodynamic histories
2. What is the architecture of the system

Yilgarn Craton: Subdivision



Main components:

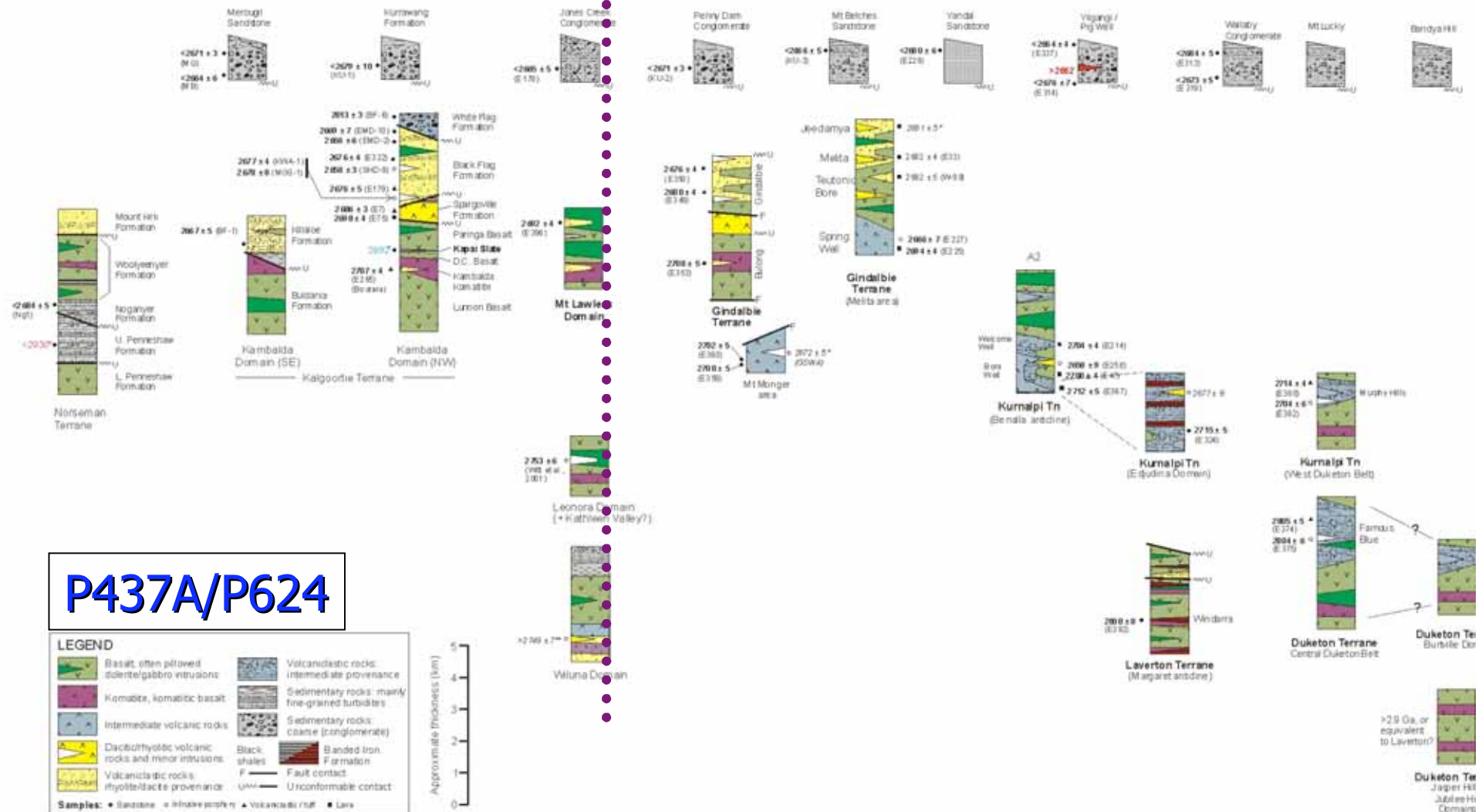
- >3.2-2.6 Ga Narryer & South West
- >3.0-2.6 Ga Youanmi Terrane
- ~3.0-2.95 Ga Cue domain
- >2.76-2.63 Ga Kalgoorlie Terrane
- poorly defined ~2.95-2.63 Ga East Yilgarn terranes

eastern Yilgarn: Stratigraphic framework

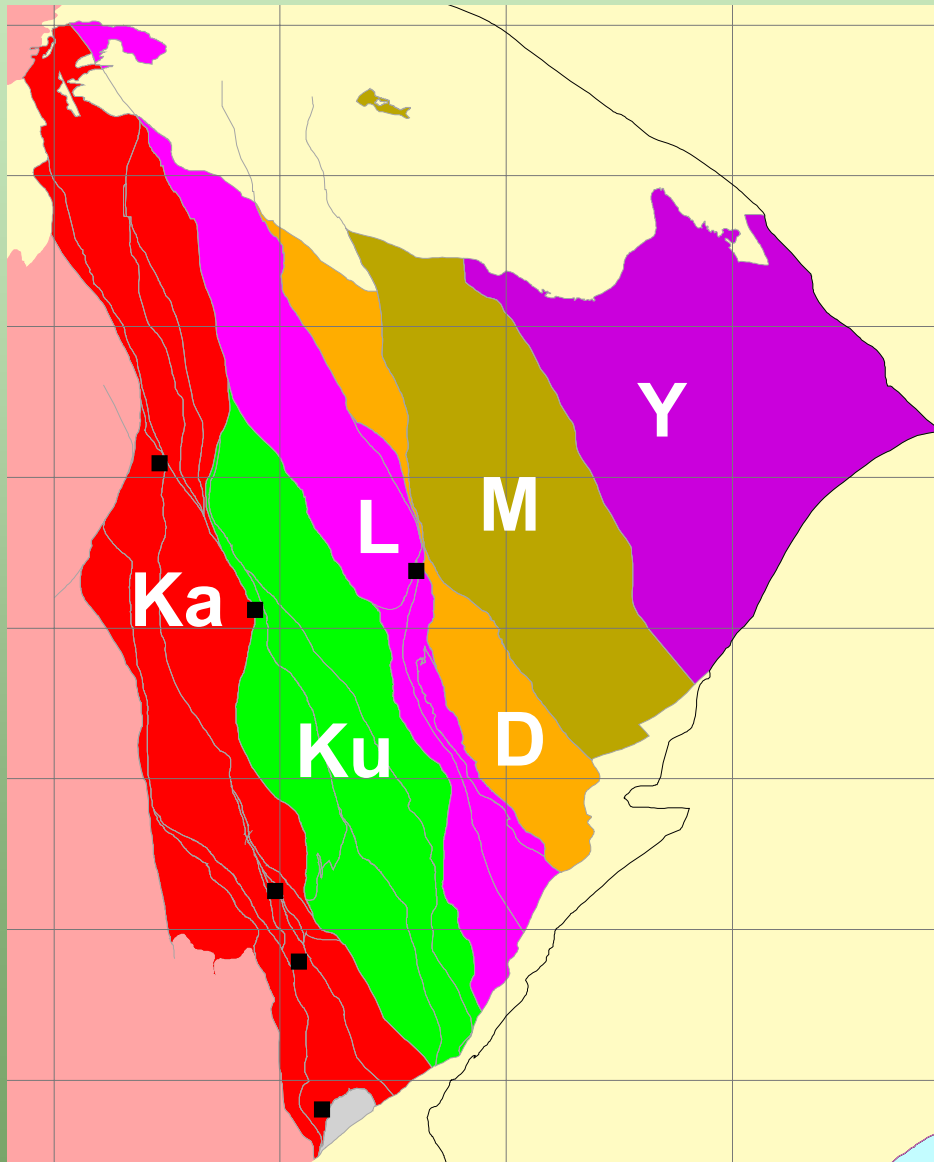


Kalgoorlie Terrane

East Yilgarn terranes



eastern Yilgarn Craton subdivision

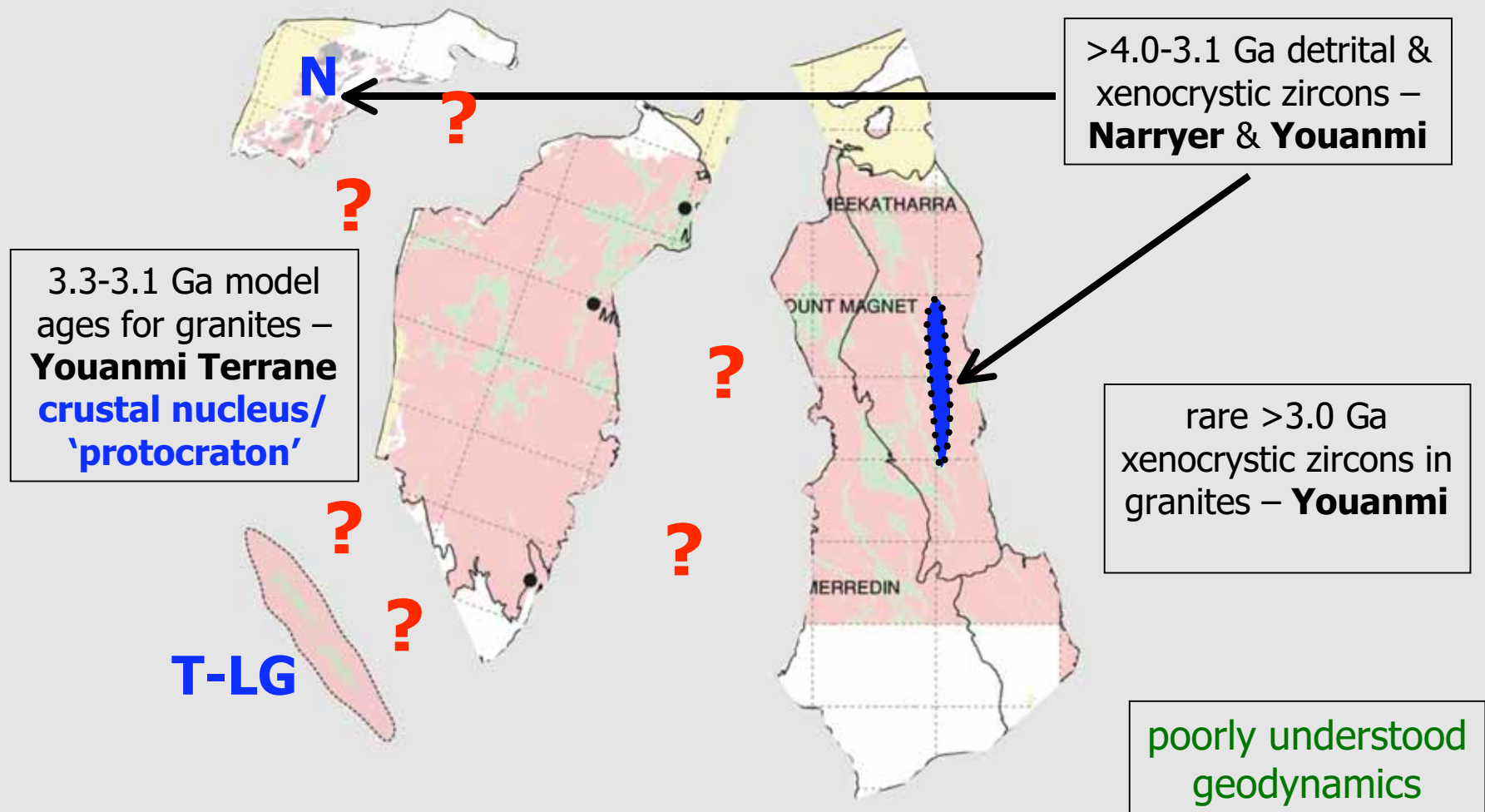


- 6 major terranes identified in eastern Yilgarn (based on GSWA, P482, P437A, P624, with pmd*CRG modifications)
 - Kalgoorlie [Ka]
 - Kurnalpi [Ku]
 - Laverton [L]
 - Duketon [D]
 - Merolia [M]
 - Yamarna [Y]

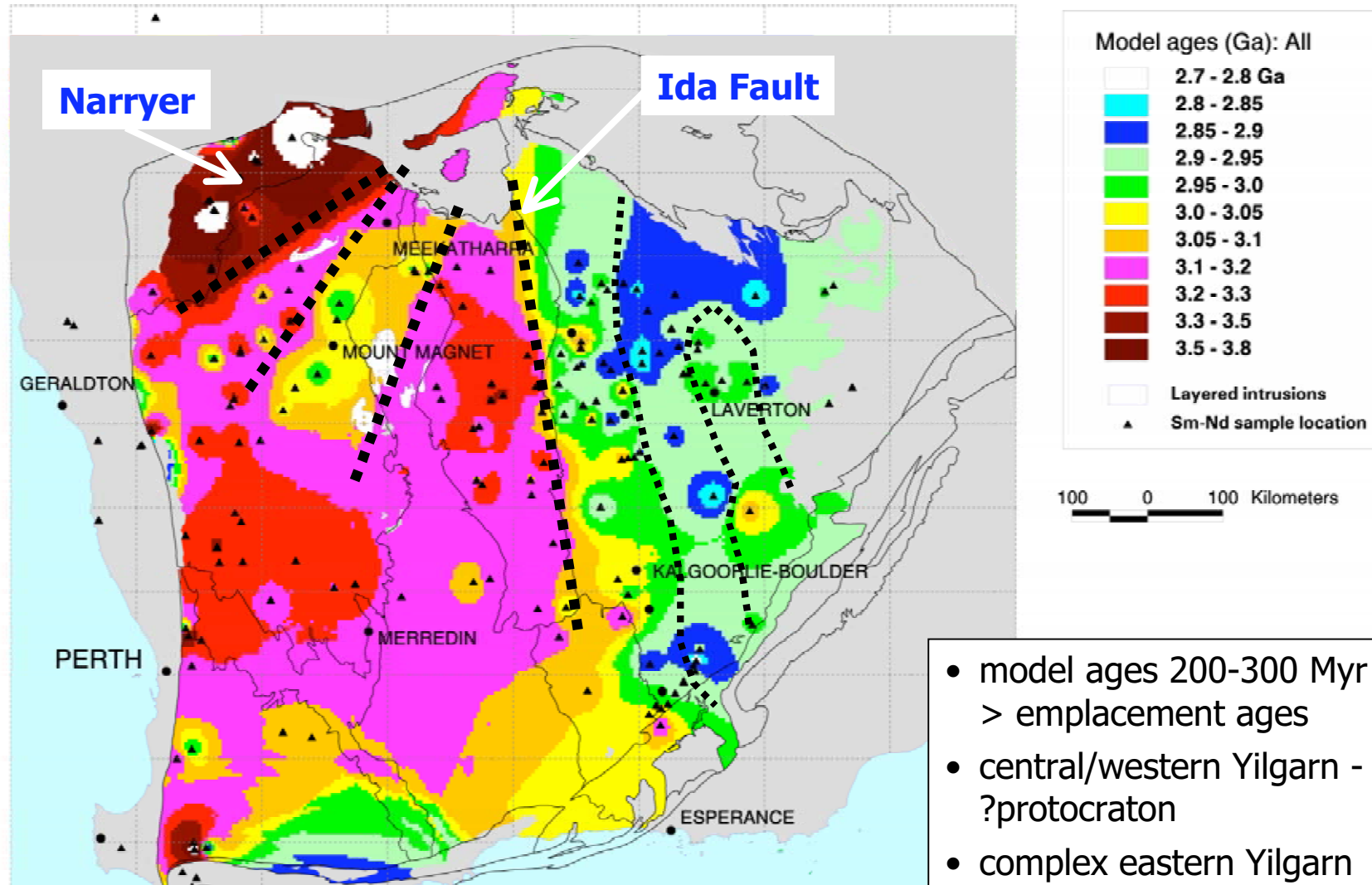
} East Yilgarn terranes
- some terranes subdivided into geological domains

Pre-3.0 Ga

gneiss, layered intrusions, supracrustals – Narryer (3.73 [Manfred Complex], 3.68, ~3.4-3.3 Ga), Toodyay-Lake Grace (>3.2 Ga)

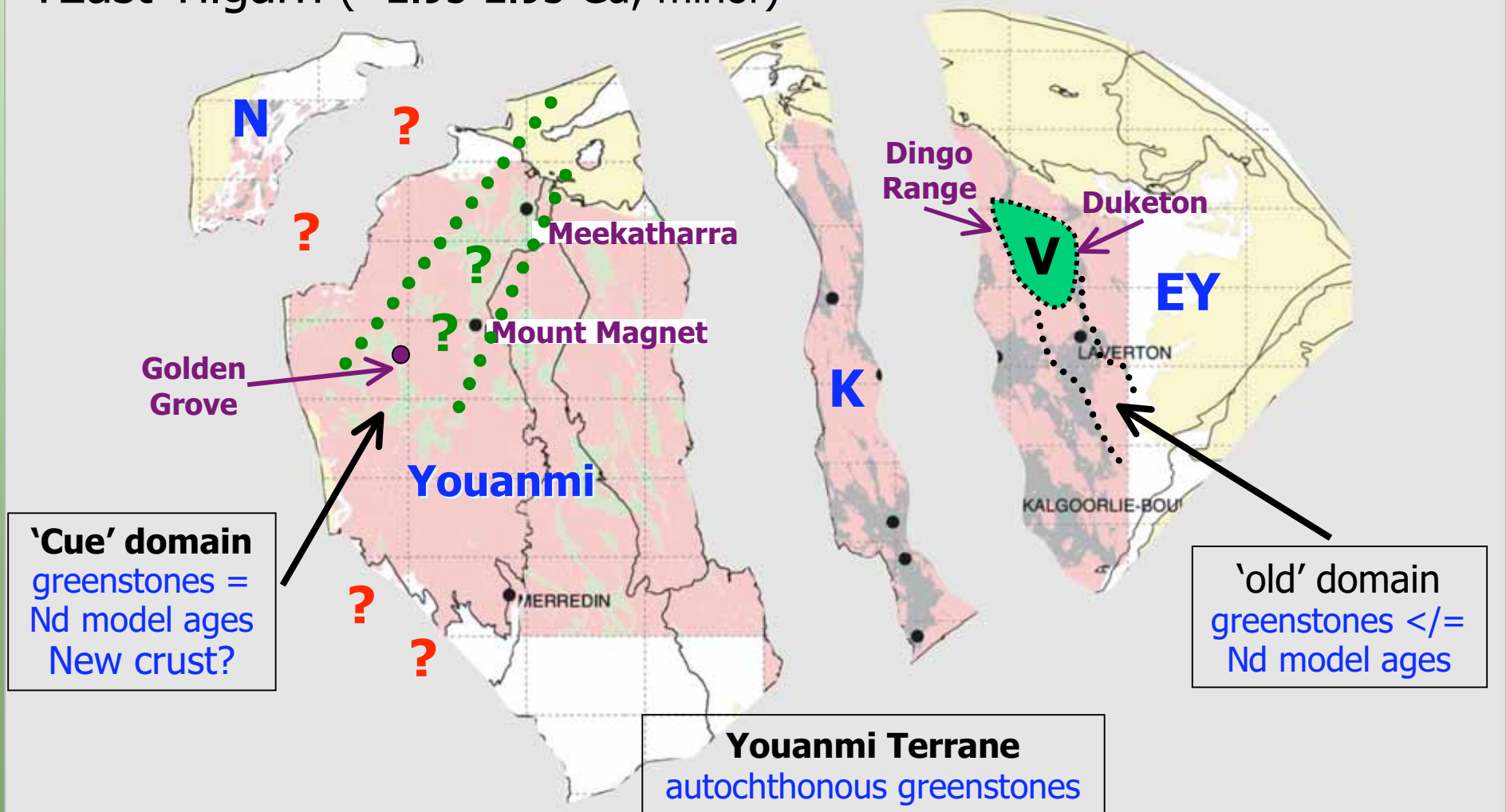


Yilgarn granites: Nd isotope map



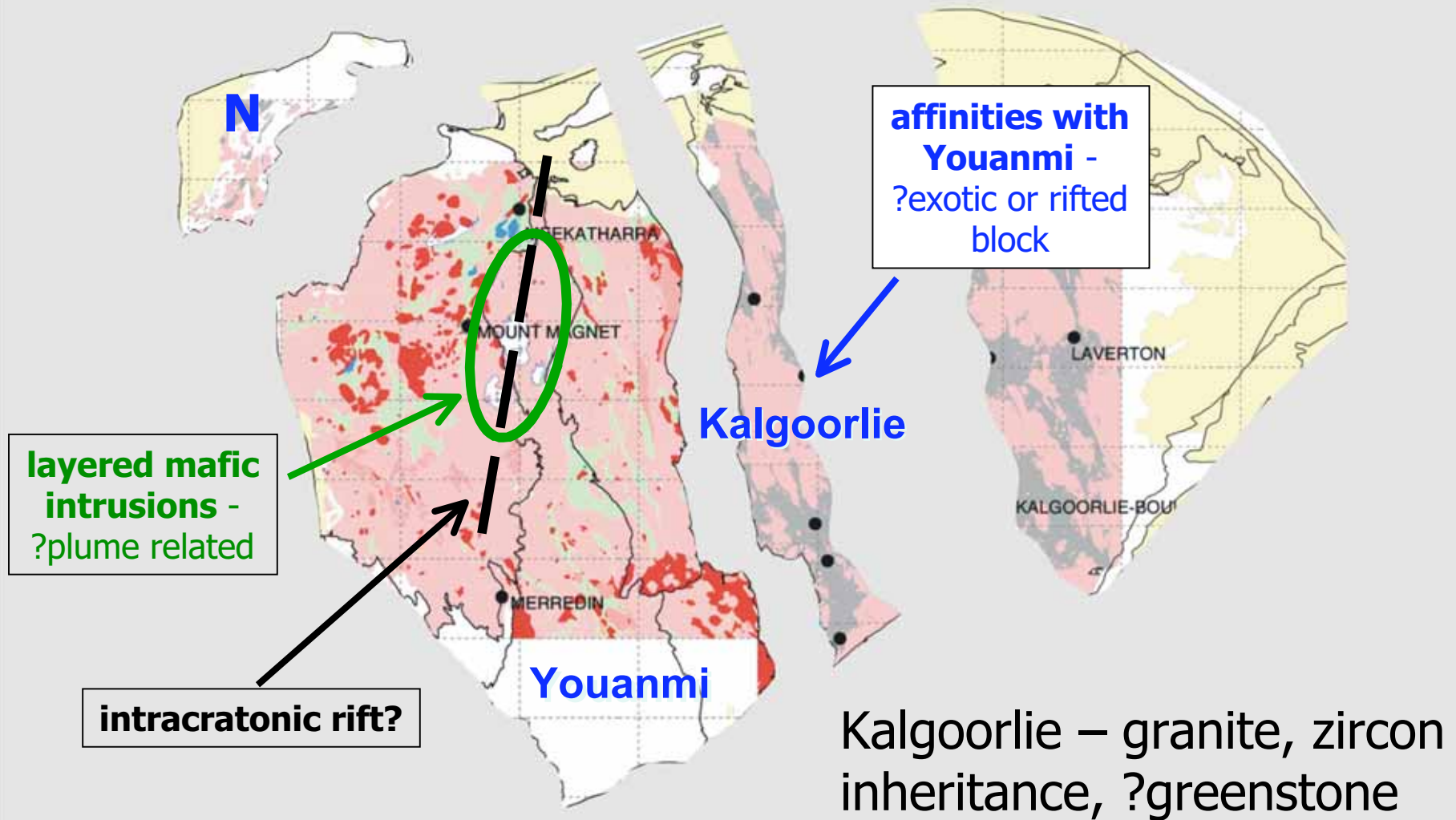
ca 3.01, 2.97-2.93 Ga

greenstone deposition, granites – Youanmi (~3.01, 2.97-2.93 Ga),
?East Yilgarn (~2.95-2.93 Ga, minor)



ca 2.81 Ga

Youanmi – layered mafic intrusions, felsic volcanism, granite



granite-greenstone (young to east) – Youanmi; Kalgoorlie (minor)

The map illustrates the geological structure of the Yalgoo region. Key features include:

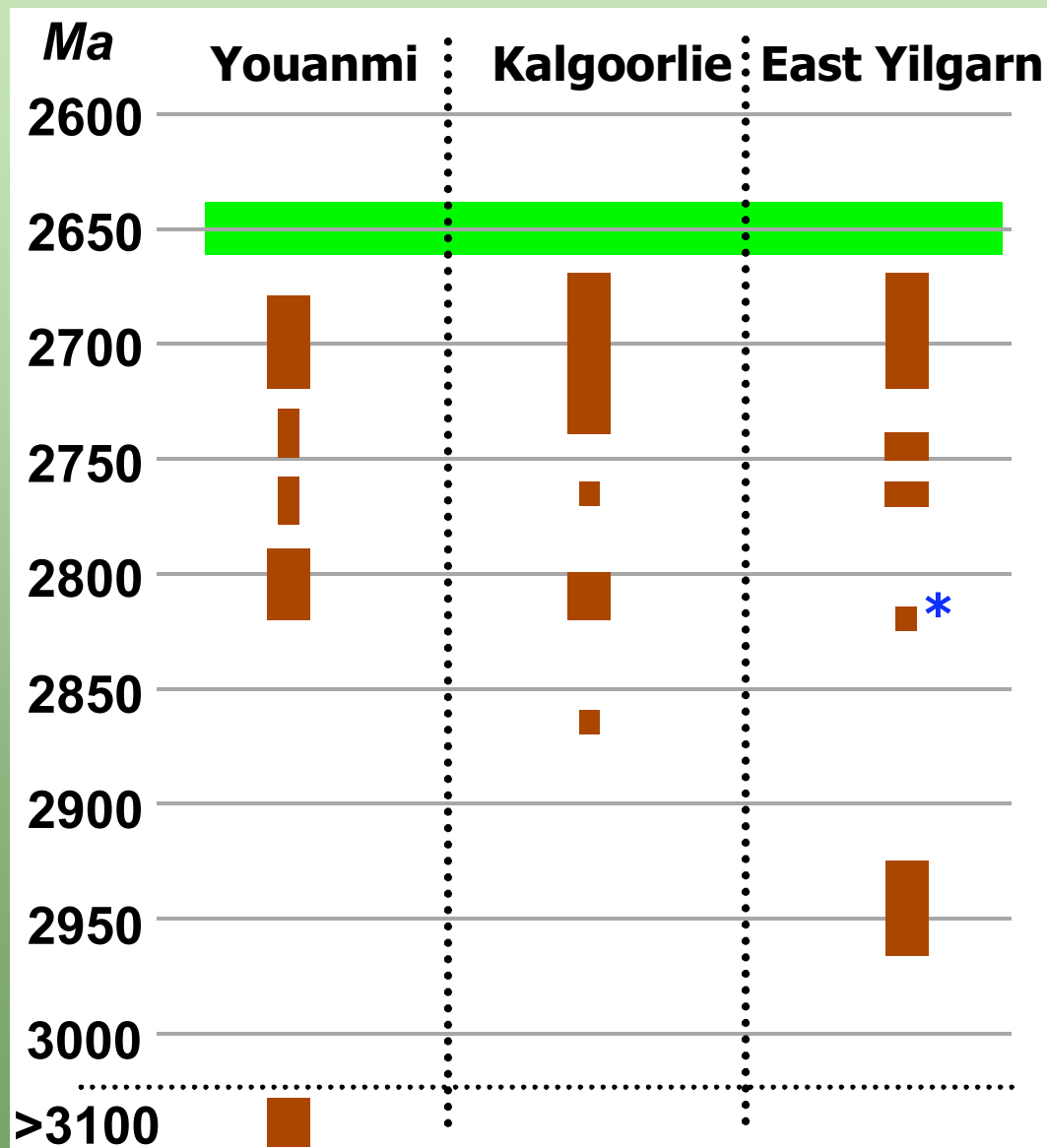
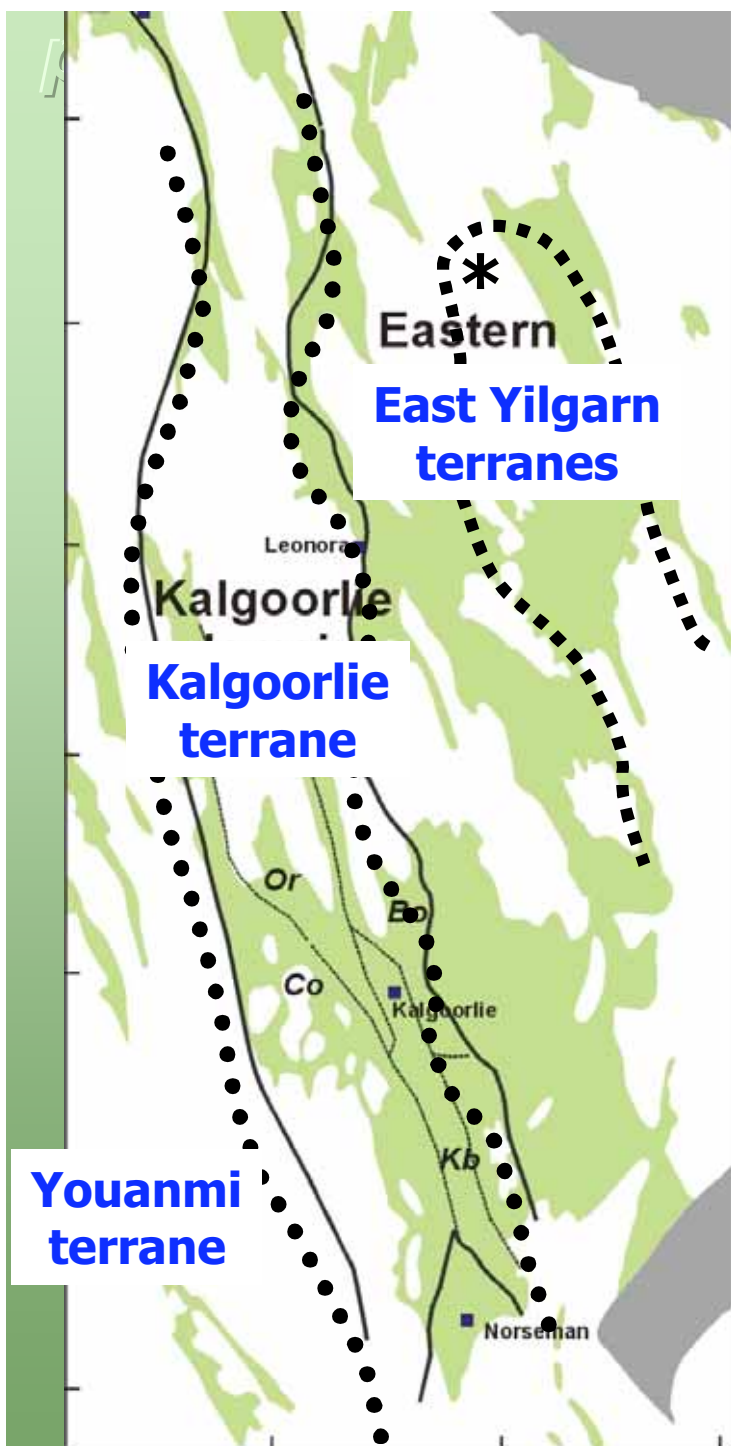
- accreted post 2.78 Ga**: Indicated by a red question mark in the north-western corner.
- sanukitoids 2760-2750 Ma Cue domain**: A large red-shaded area in the center-west, with a black arrow pointing to it from the label.
- Felsic volcanism 2760-2730 Ma Young east?**: A red-shaded area in the south-west, with a black arrow pointing to it from the label.
- Yalgoo**: The central geological domain, labeled in blue.
- Kalgoorlie**: A domain to the east of Yalgoo, labeled in blue.
- Felsic volcanism? 2740-2730 Ma Zircon inheritance**: A red-shaded area in the south-east, with a black arrow pointing to it from the label.
- Geological Features**:
 - MEEKATHARRA** and **MOUNT MAGNET**: Labeled in the central red area.
 - MERREDIN**: Labeled in the south-west red area.
 - LAVERTON** and **KALGOORLIE-BOLI**: Labeled in the south-east red area.
 - N**: A blue letter indicating North in the top-left corner.
 - Black arrows**: Point from the text labels to their respective geological domains.
 - Red dashed line**: A line with a red arrowhead pointing east, crossing the boundary between the Cue domain and the Yalgoo domain.
 - Red question marks**: Located in the north-west and south-east corners.

sanukitoids
2760-2750 Ma
Cue domain

**Felsic
volcanism**
2760-2730 Ma
Young east?

**Felsic
volcanism?**
2740-2730 Ma
Zircon
inheritance

eastern Yilgarn: zircon inheritance



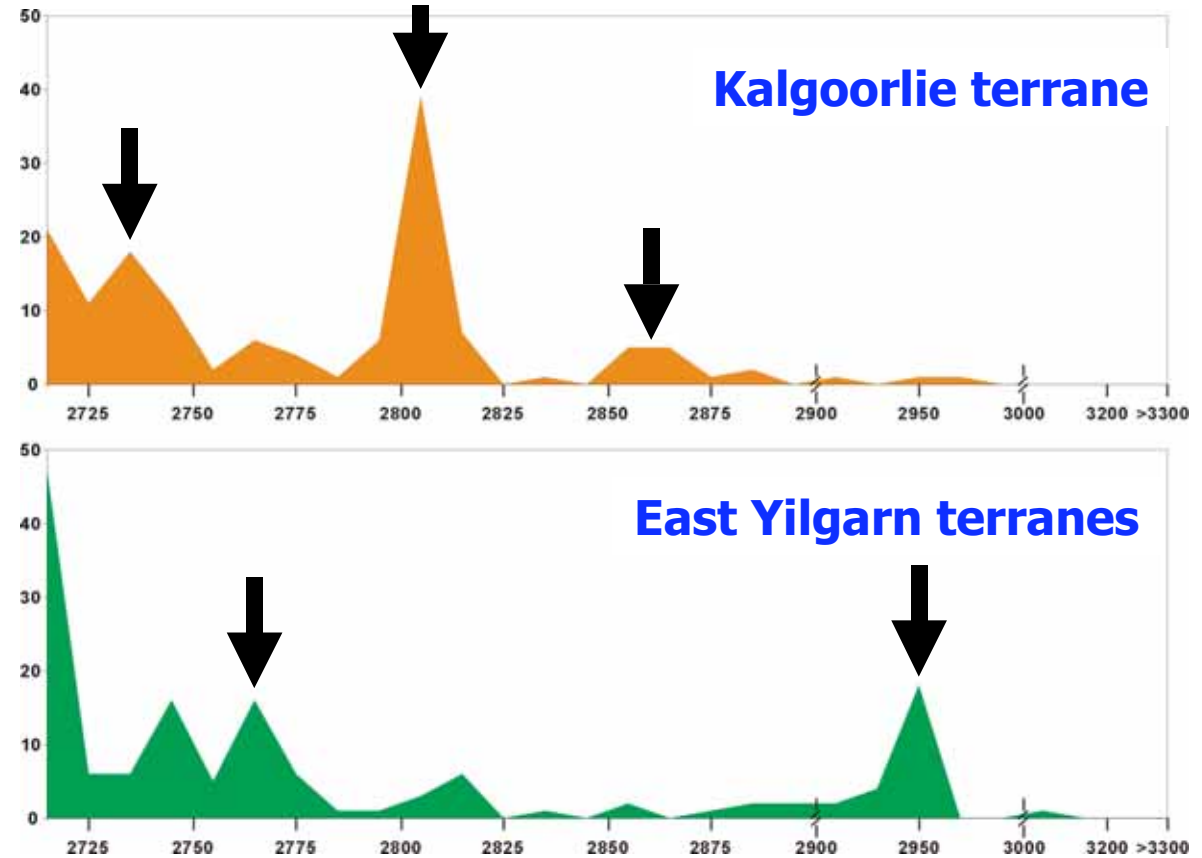
eastern Yilgarn: zircon inheritance



Eastern
East Yilgarn
terrane

Kalgoorlie
terrane

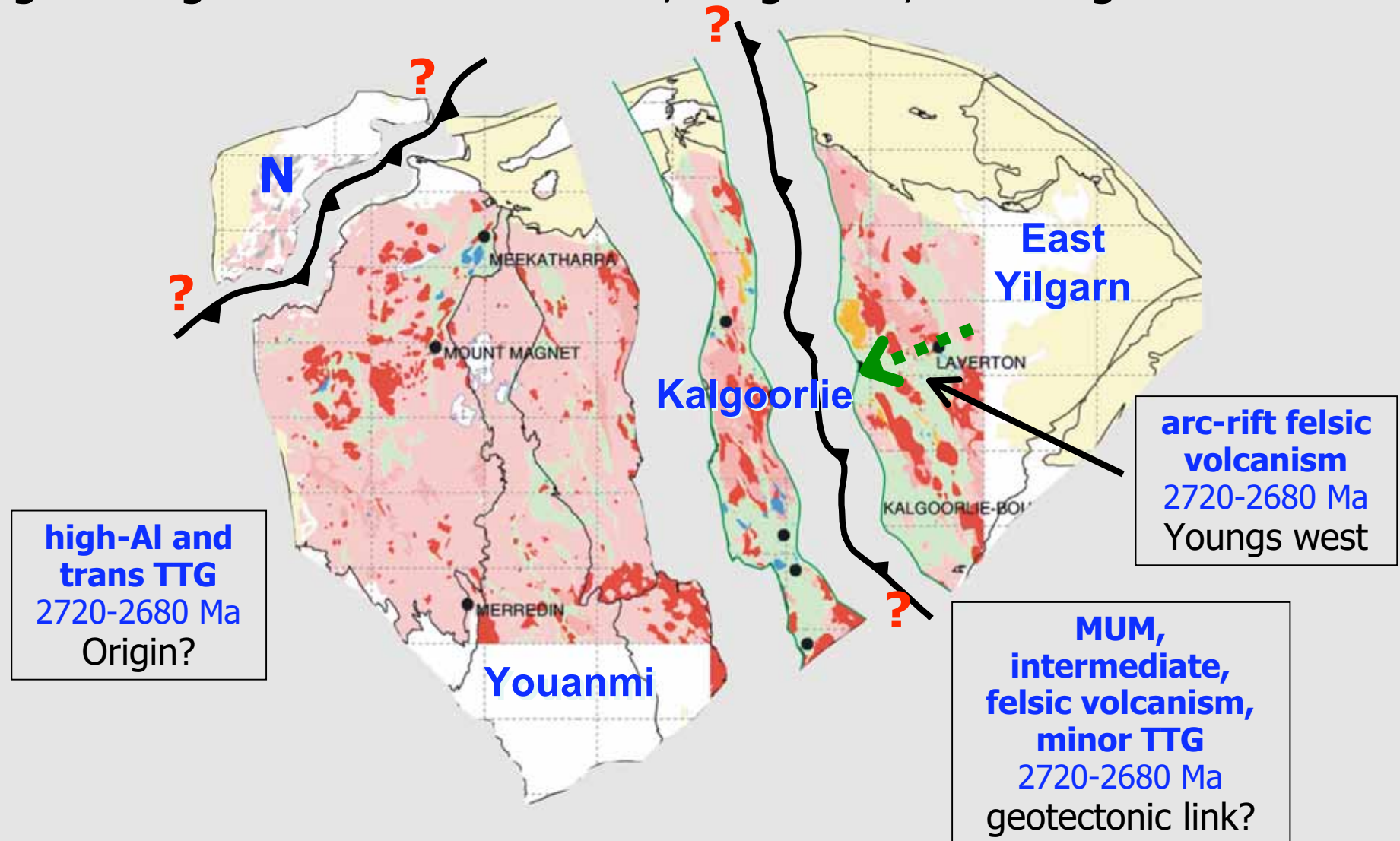
Youanmi
terrane



- crustal break co-incident with Kalgoorlie terrane boundary
- similar profiles for felsic volcanic rocks and 'late basins'

ca 2.72-2.68 Ga

granite-greenstone – Youanmi, Kalgoorlie, East Yilgarn



eastern Yilgarn Craton: Felsic volcanism

- distinct felsic volcanic associations in Kalgoorlie and East Yilgarn terranes
- 'break' at eastern boundary of Kalgoorlie Terrane

Kalgoorlie Terrane:

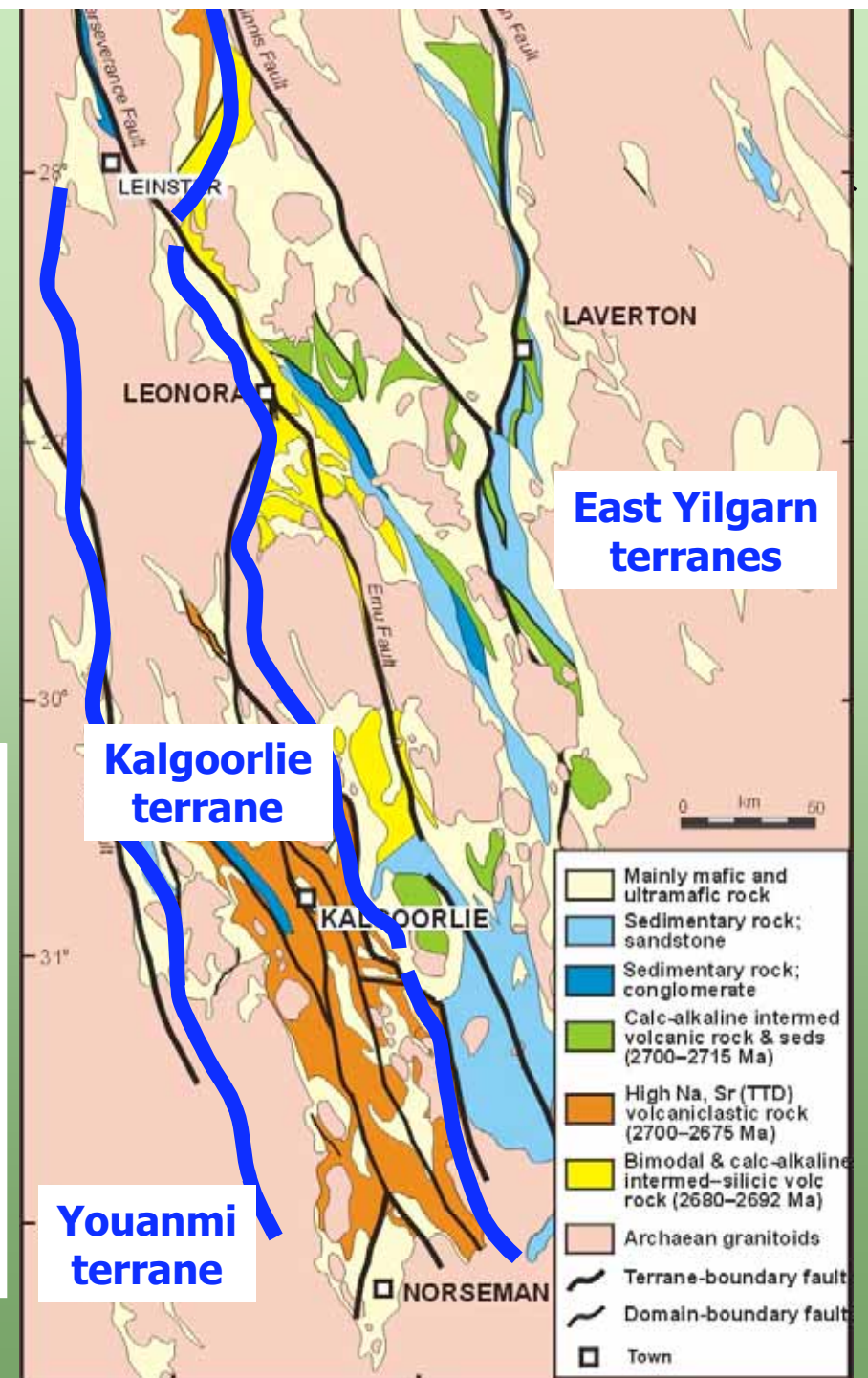
2690-2660 Ma - HREE-depleted (TTG) andesite-rhyolite & assoc. sedimentary rocks

East Yilgarn terranes:

2715-2700 Ma - calc-alkaline intermediate volcanic complexes & sedimentary rocks

2715-2680 Ma - bimodal basalt-rhyolite complexes and felsic sub-alkaline

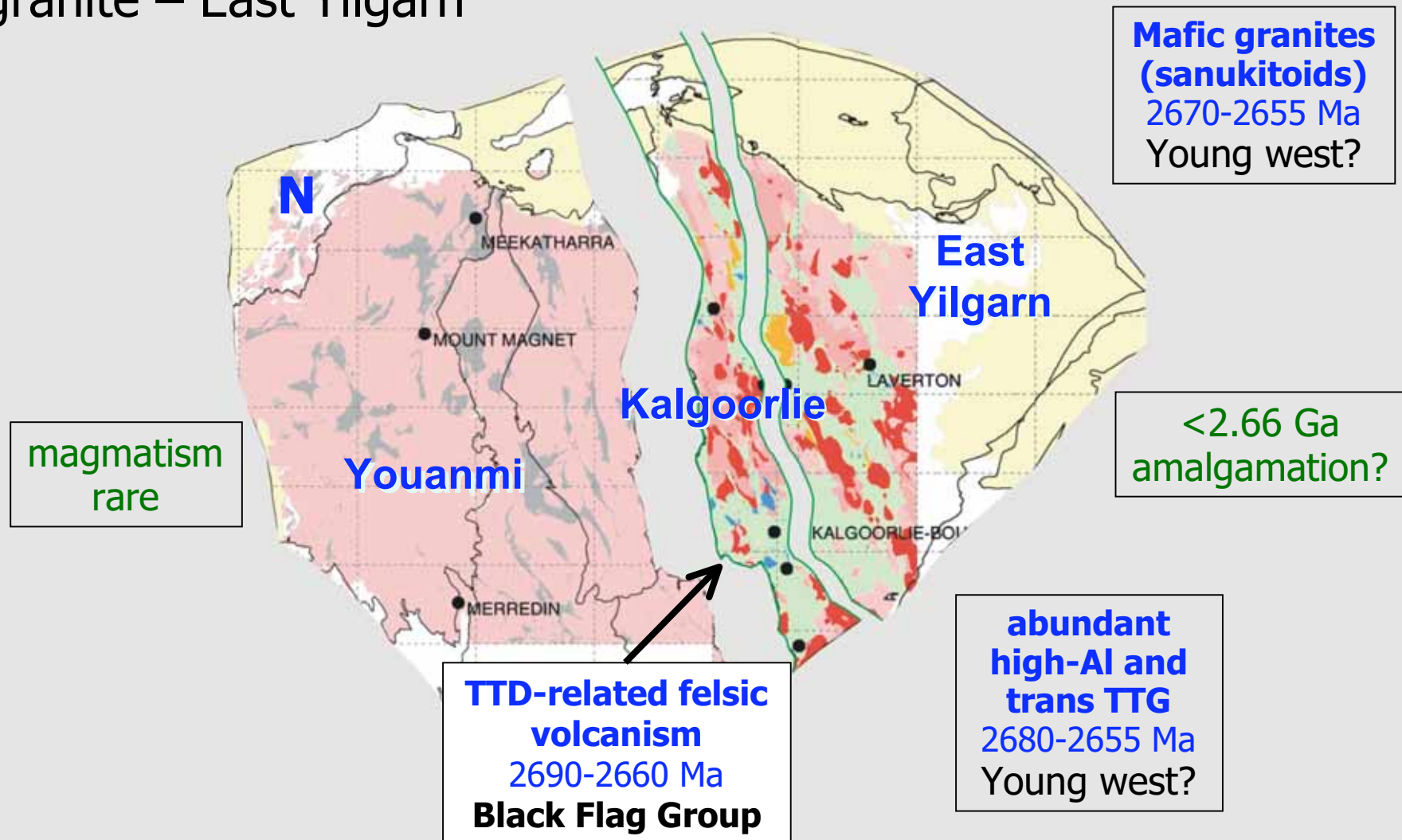
Brown et al. (2001)



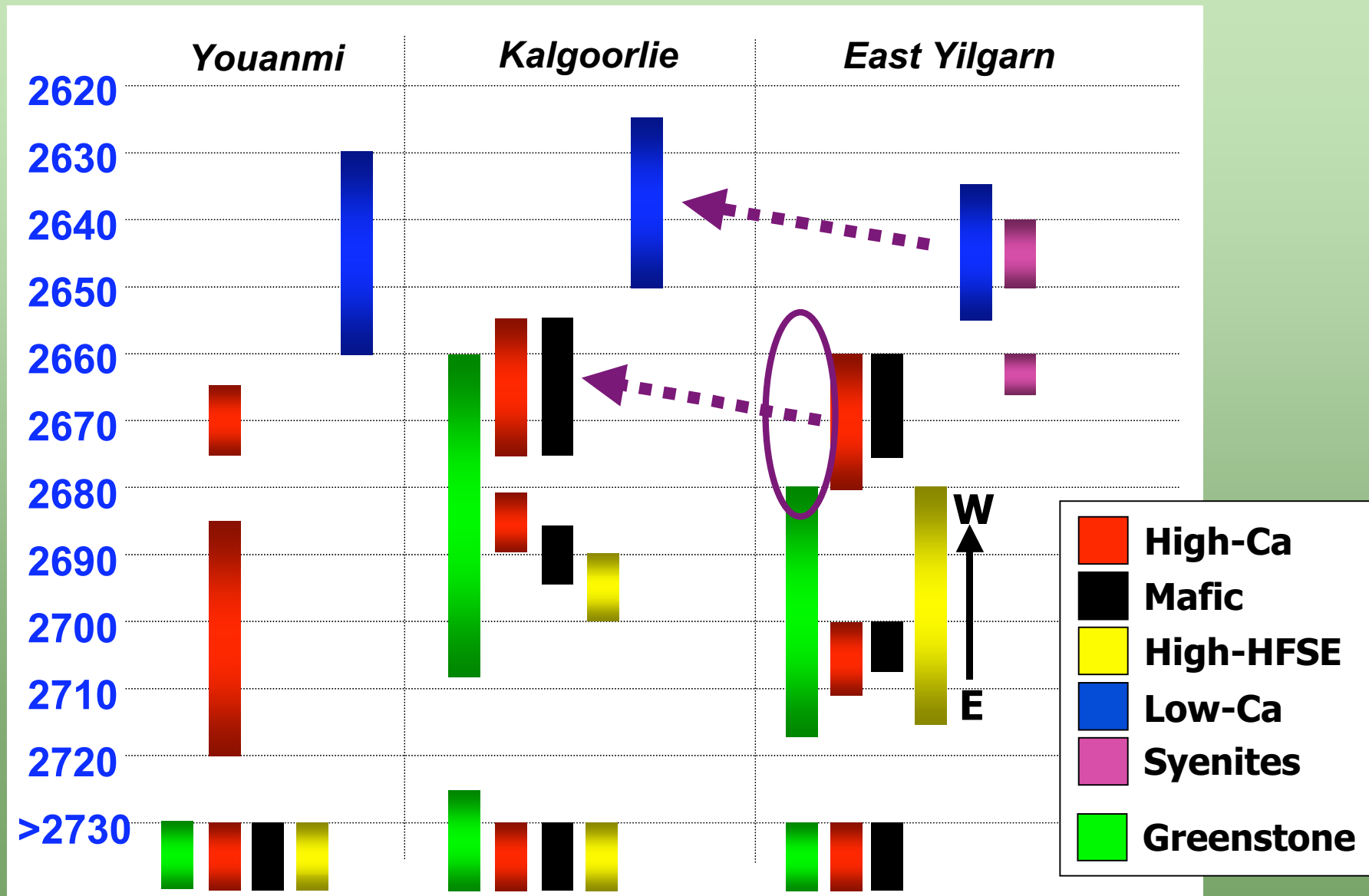
ca 2.68-2.66 Ga

granite-greenstone – Kalgoorlie (?amalgamation)

granite – East Yilgarn



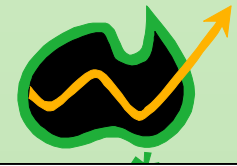
eastern Yilgarn Craton: Magmatism



eastern Yilgarn: Tectonic summary

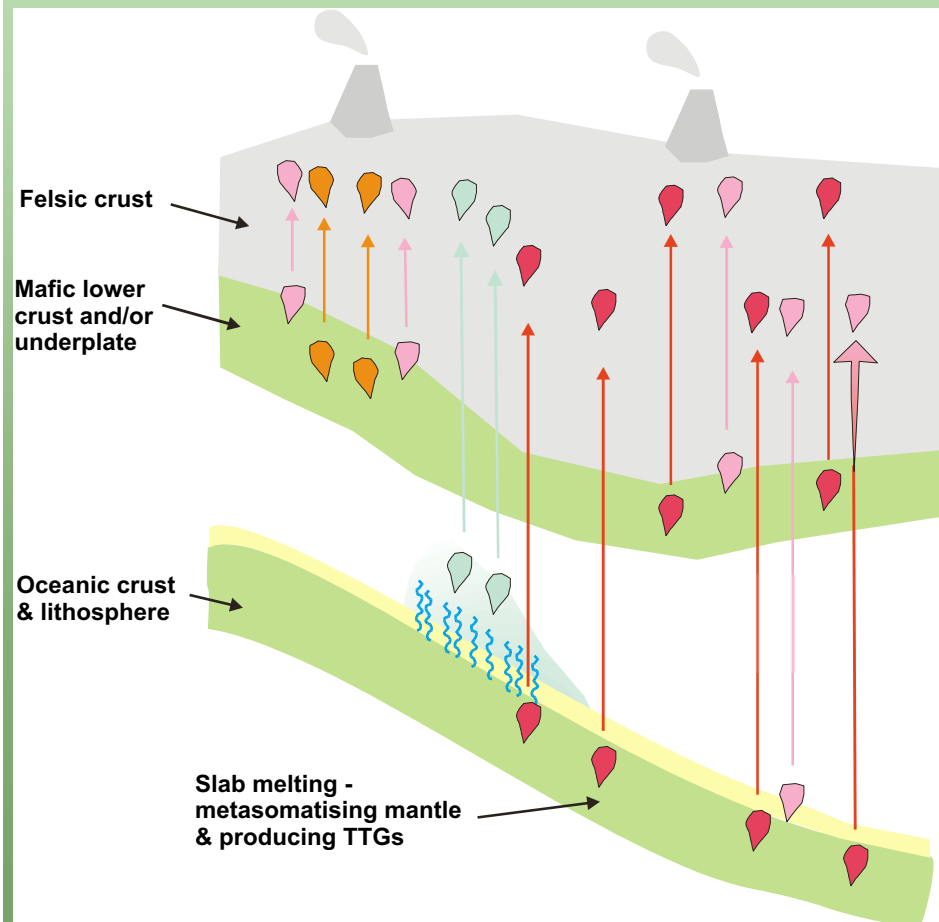
High-Al and Transitional TTG's & associated sanukitoids

- Consistent with subduction environment
- Variably slab-derived to crust-derived

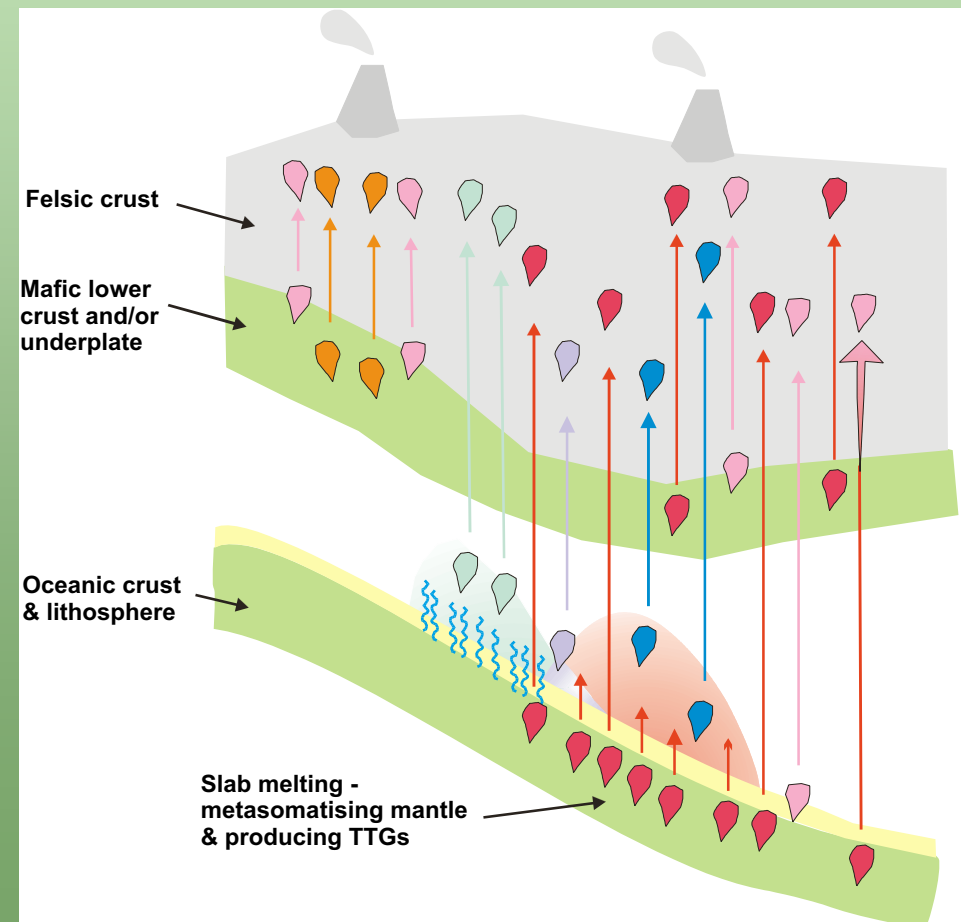


	andesite
	sanukitoid
	Low-Al TTG
	High-Al TTG
	Transitional TTG

Pre-2670 Ma

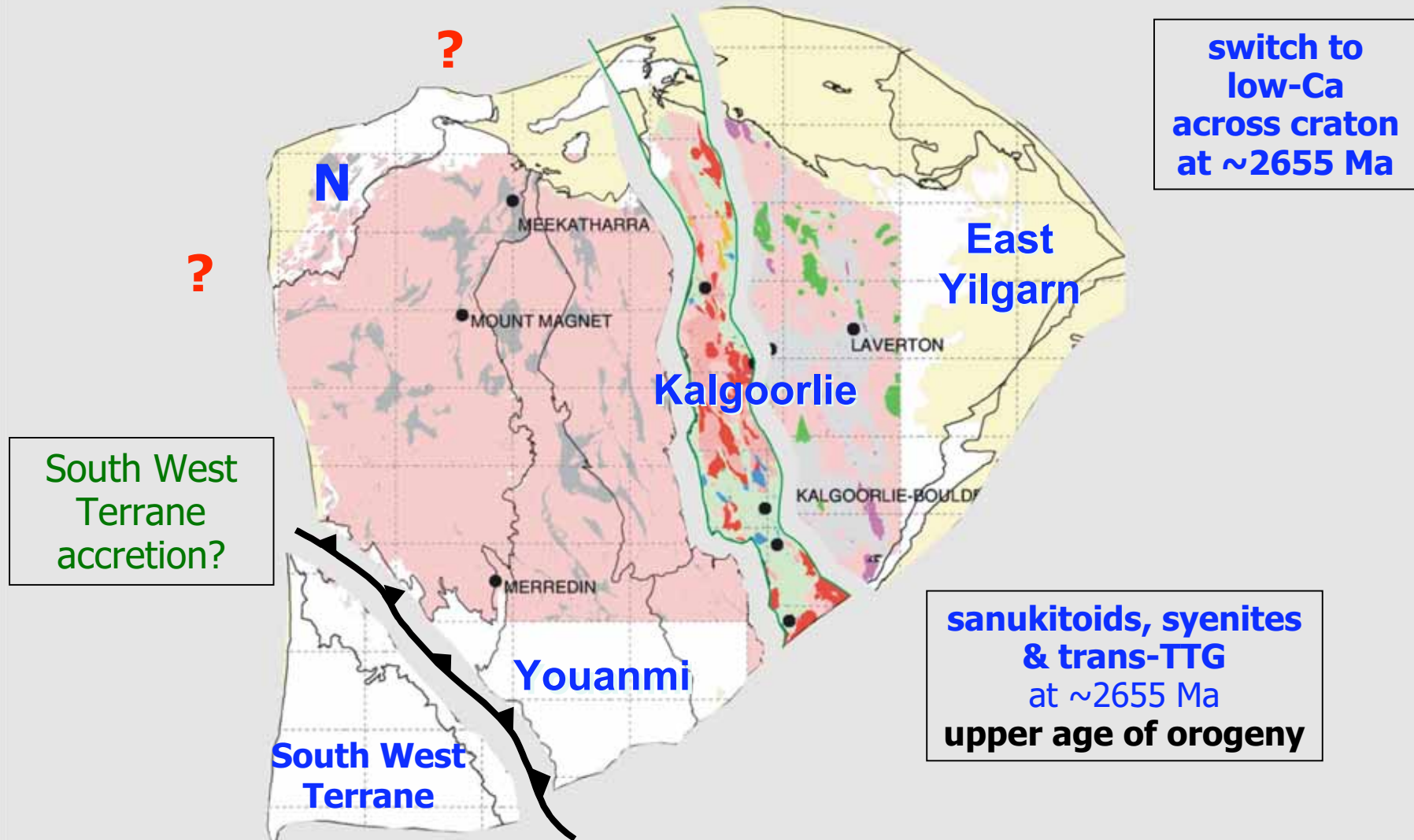


2670-2655 Ma

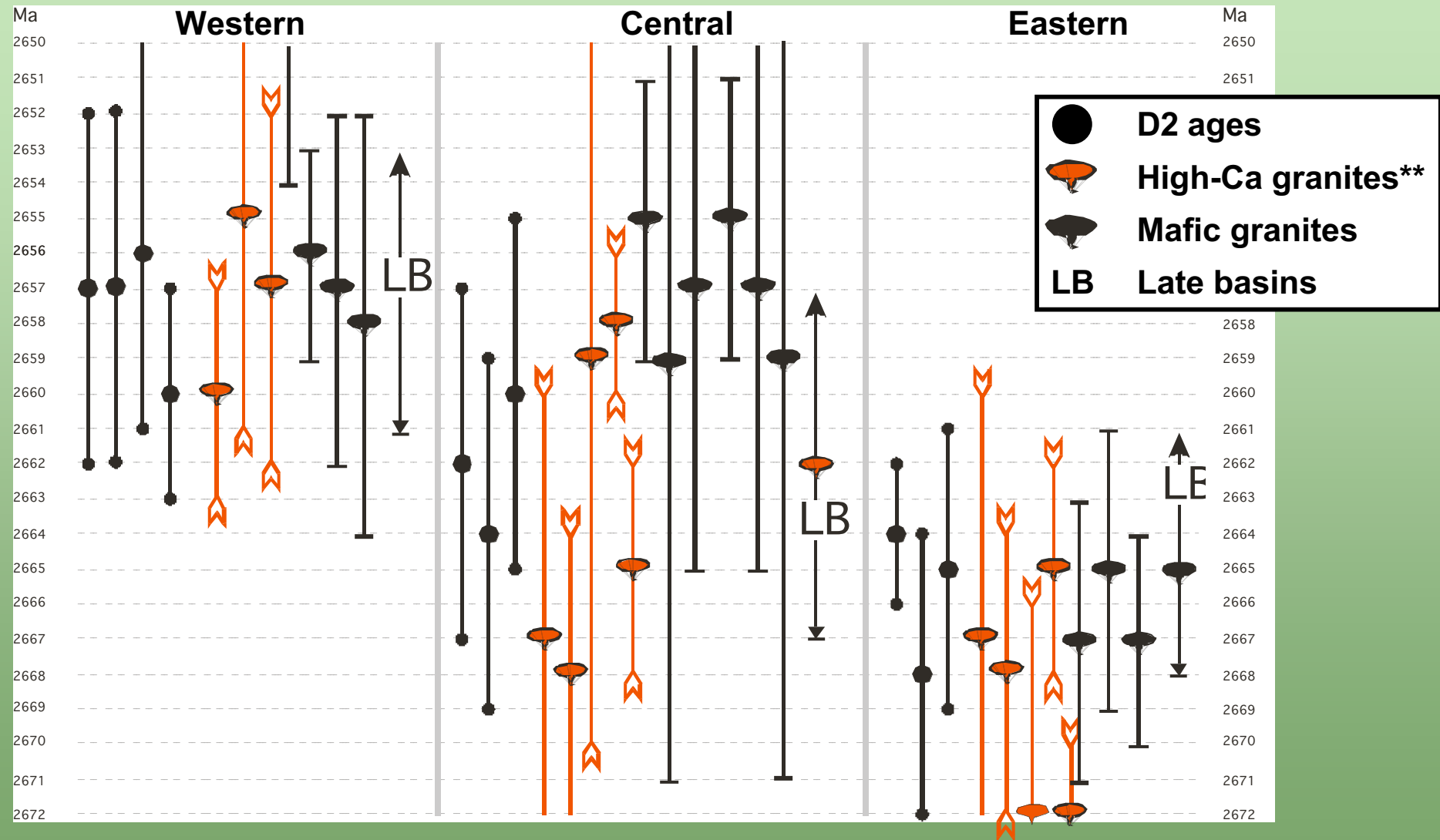


ca 2655 Ma

granite – Kalgoorlie (Mafic, High-Ca), East Yilgarn (Low-Ca, Syenitic)



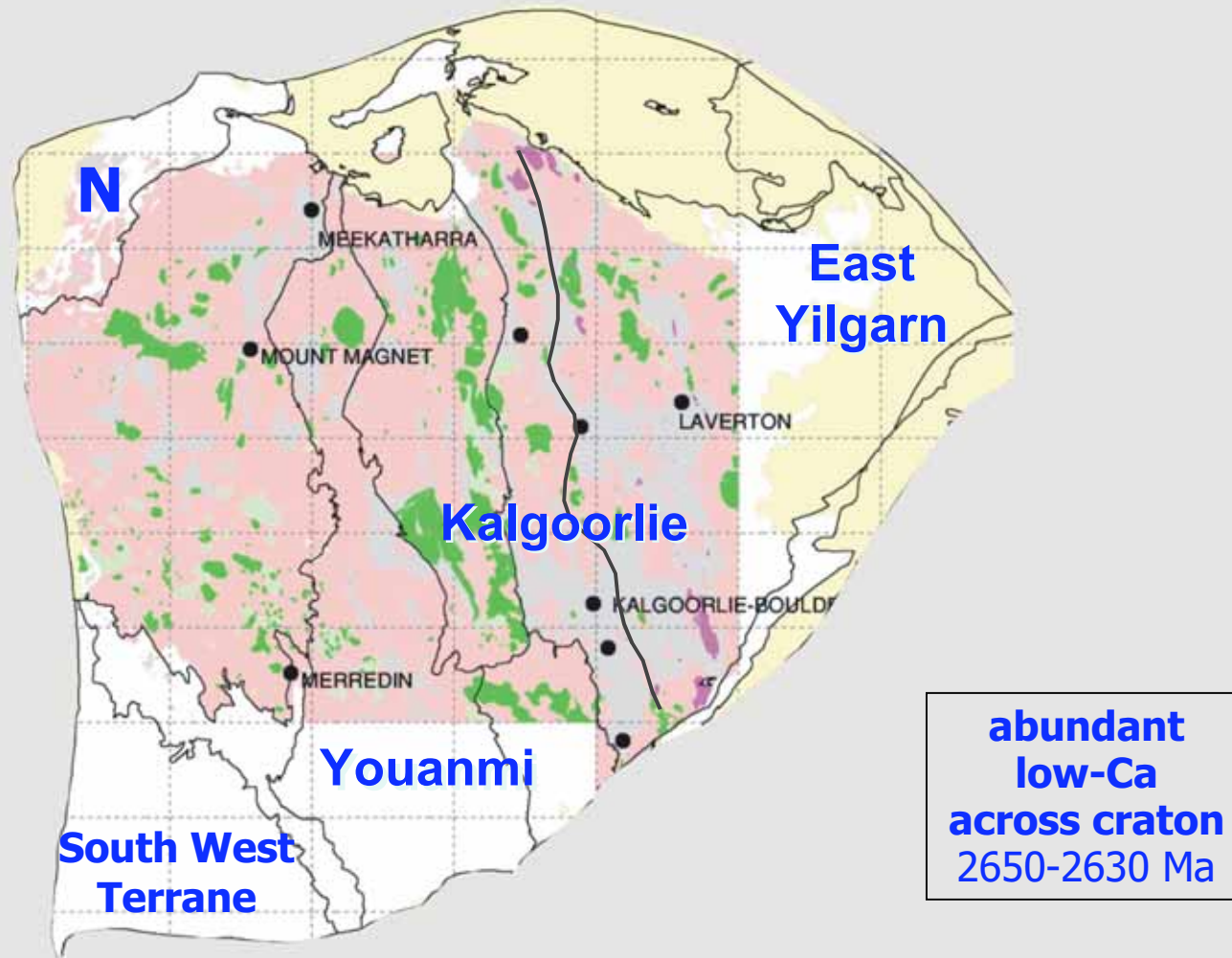
eastern Yilgarn Craton: Felsic magmatism



diachronous deformation, late basins and granites from east to west

ca 2.65-2.63 Ga

Craton-wide Low-Ca granite 'bloom'; Syenitic in East Yilgarn



Yilgarn Craton: Evolution summary

- geochemistry, zircon inheritance and Nd data consistent with significant involvement of variably older crust
- **a number of distinct terranes:** Youanmi, Narryer, South West, Kalgoorlie & several in the east Yilgarn
- poorly understood early history (>2.81 Ga), although majority of early granites are High-Al TTGs -- slab melting or thick crust?
- post 2.8 Ga consistent with convergent tectonics
- Kalgoorlie Terrane either an exotic terrane or perhaps a crustal block rifted off the Youanmi Terrane and re-accreted
- East Yilgarn terranes comprises a mix of geologically-disparate crustal blocks --> **an accreted collage?**