Mt Isa Western Succession: geodynamic evolution & basin architecture

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Integration & testing of previous research

NW Queensland Mineral Province report

- Rift basin: 13 tectonic events (1800 Ma → Isa D3 event)
- Initial NE-SW rifting (ECV + Myally Gp.) √
- Episodic NW-SE extension (Quilalar thro' McNamara time)

Monash University Rift Model

- Initial E-W (or SW-NE) trending half-graben; bounded by transfer faults (cf NW-SE half-graben favoured by NABRE)

NABRE Sequence Stratigraphy

- Strike-slip basins - convergent margin (NW-SE thickening wedge)
- Post-Quilalar (Myally) age for NE-SW half-graben

Thrust Model (Bell, 1983)

- N over S directed thrusting & duplex development √

Geodynamic Interpretation: critical questions & issues

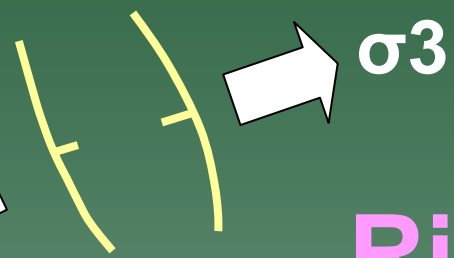
- Extent of basement involvement (pre-1800 Ma => old, cold & brittle)?
- Rift orientation & geometry during ECV & Myally time (1800-1740Ma)?
- Depositional significance of Quilalar Fm (sag phase)?
- Geodynamic significance of Bigie & Surprise Ck Fms (Calvert Superbasin – rift rejuvenation from 1730 -1670 Ma)?
- Timing & causes of basin inversion = Isan orogeny or older (1640 Ma) separate event?

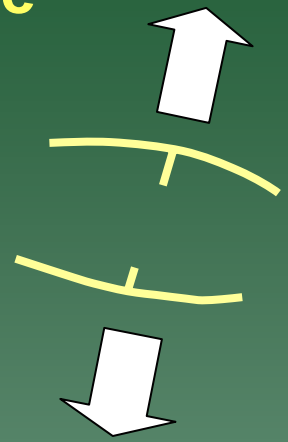
Geodynamic Evolution

Basin Formation

ECV – Myally time
(1800-1740 Ma)

Big – Prize time
1730 -1670 Ma



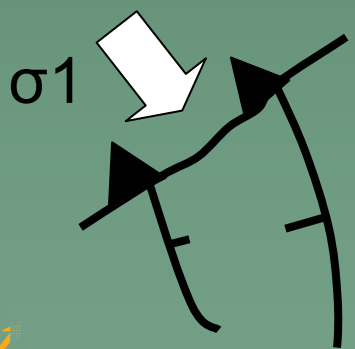


Rift

Rift - Drift

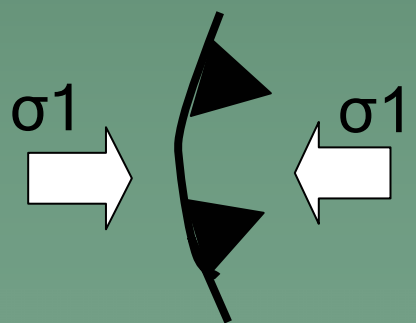
Basin Inversion

D1: 1640 Ma

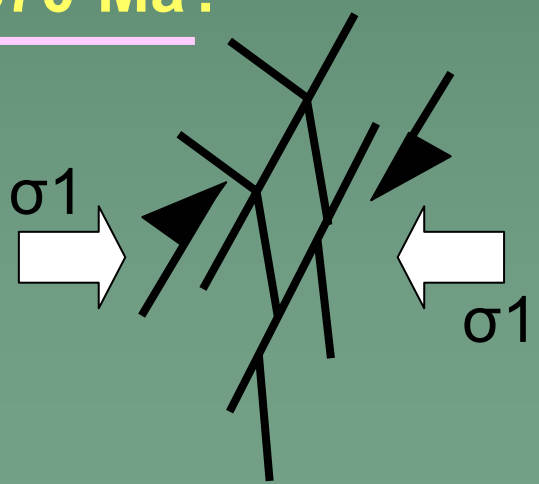


Isa Orogeny

D2: 1590 Ma



D3:1570 Ma?



Time constraints on Geodynamic evolution: Apparent Polar Wander Path

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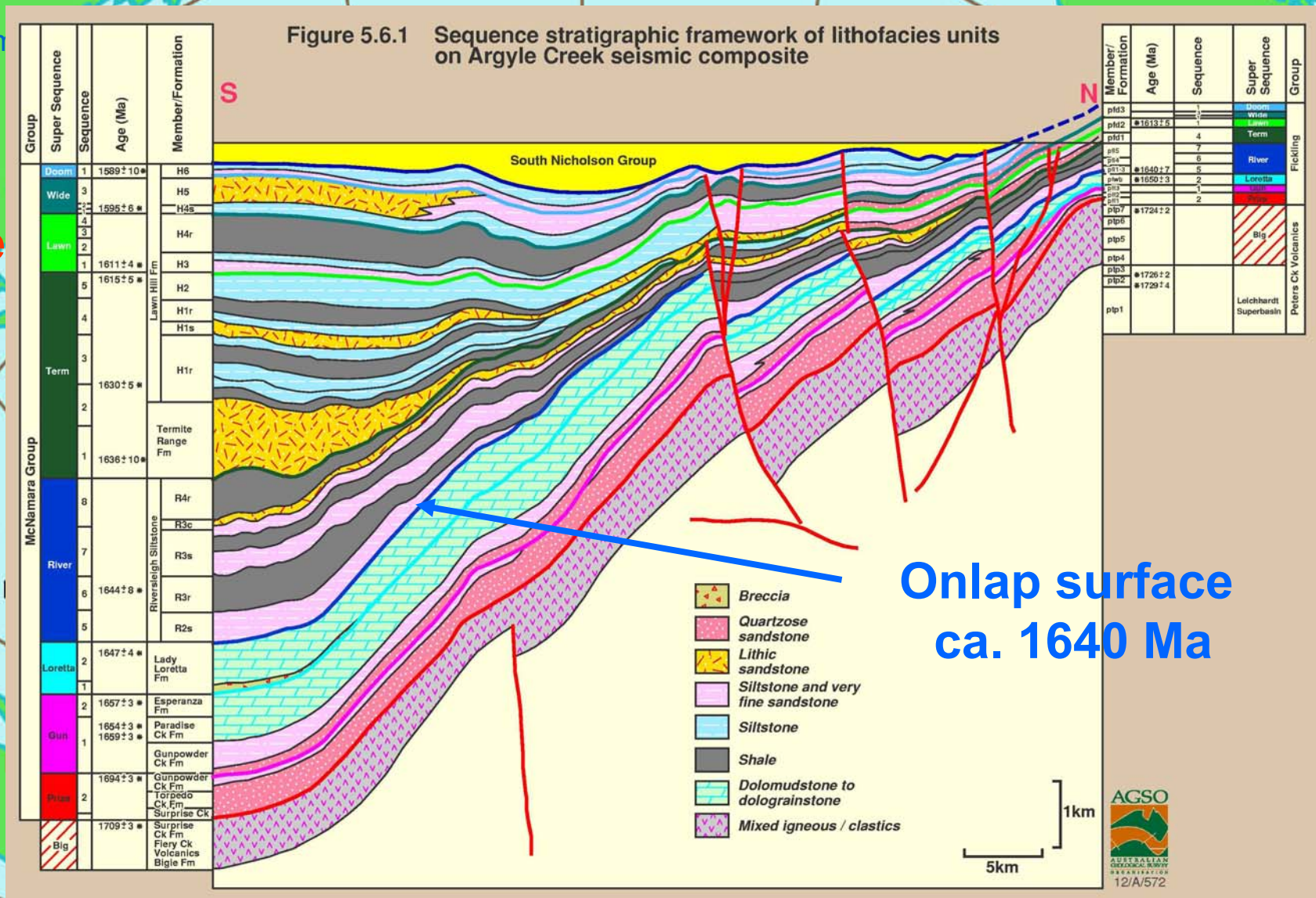
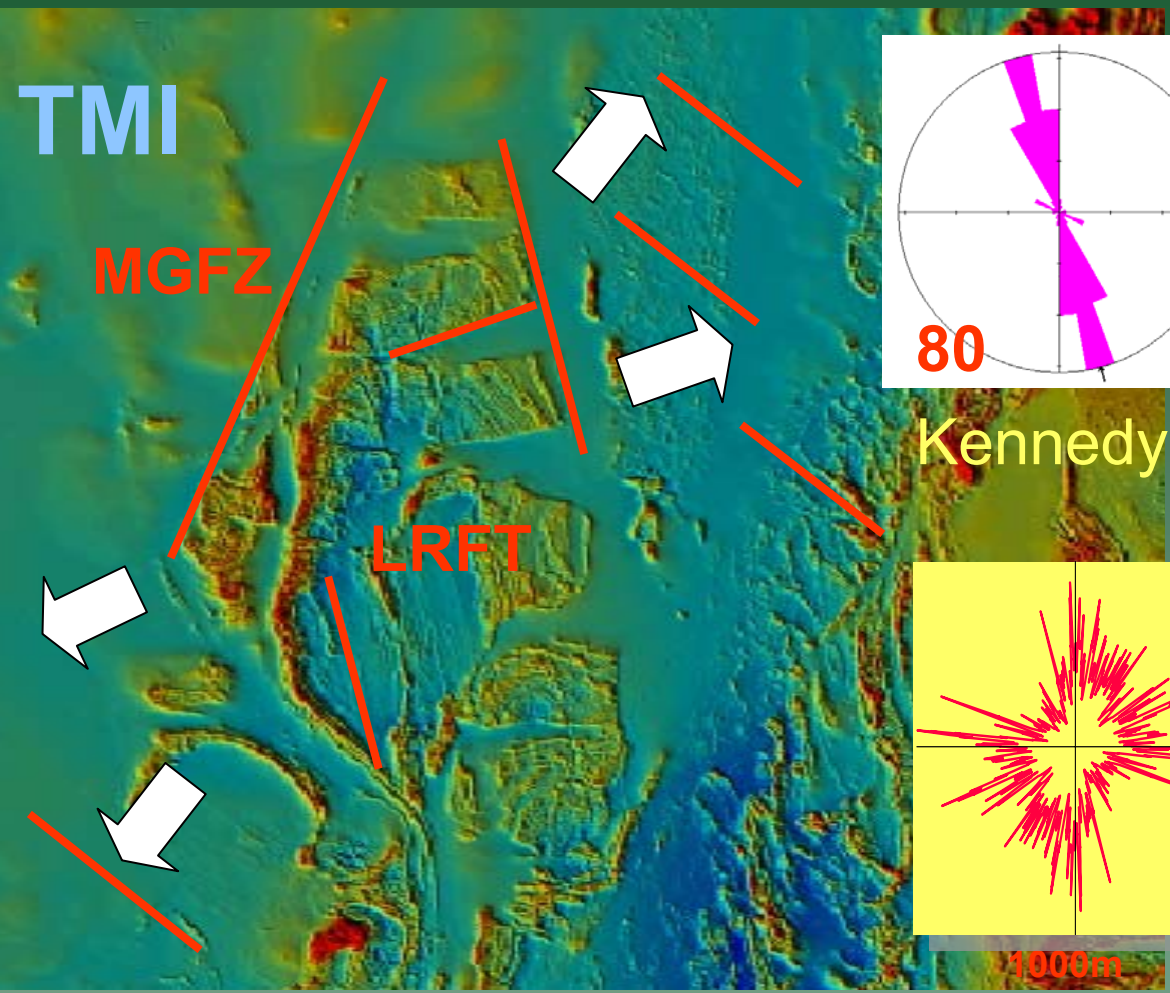
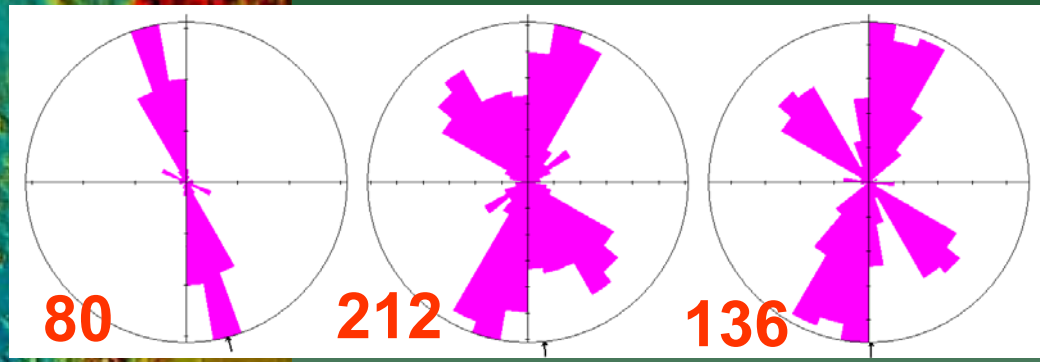


Basement Linear Elements

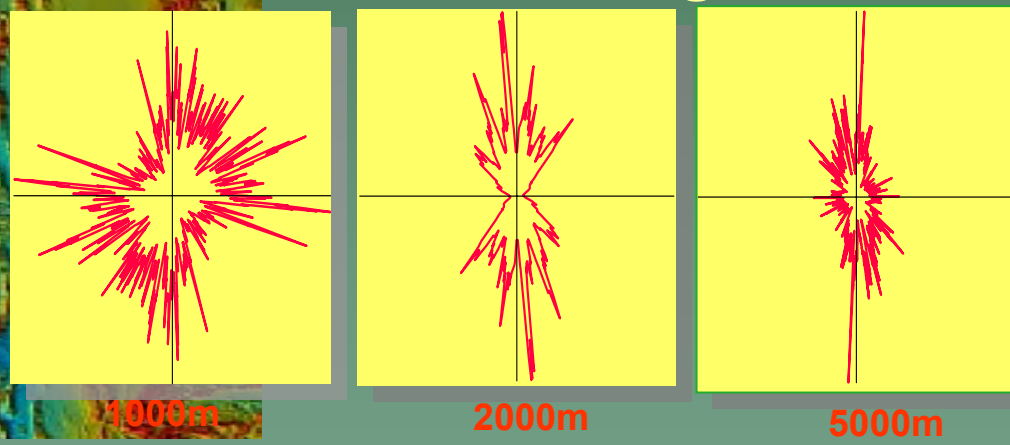


Dykes



Kennedy Prospector Alsace

Mag Worms



Trend Lines

Strong basement control on basin architecture!!

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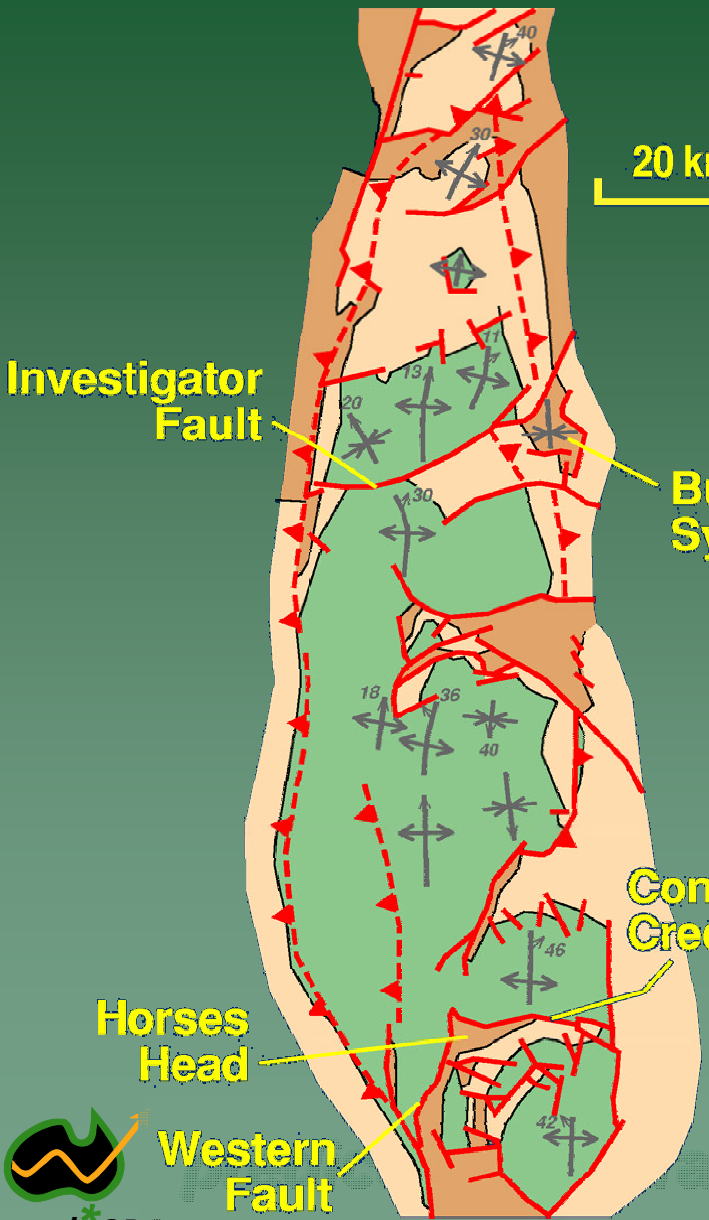
LRFT: key architectural elements



1. Mount Gordon Arch – original (Derrick, 1982) √ or D2 X(Bell, 1983)?
2. Roof thrust X or early normal faults √ (N-S high strain corridors)?
3. East-West Faults (normal or reverse; late or early; south or north-dipping?)

Cover seq. 3

- Mt Isa Gp
- Surprise Cr Fm

Cover seq. 2

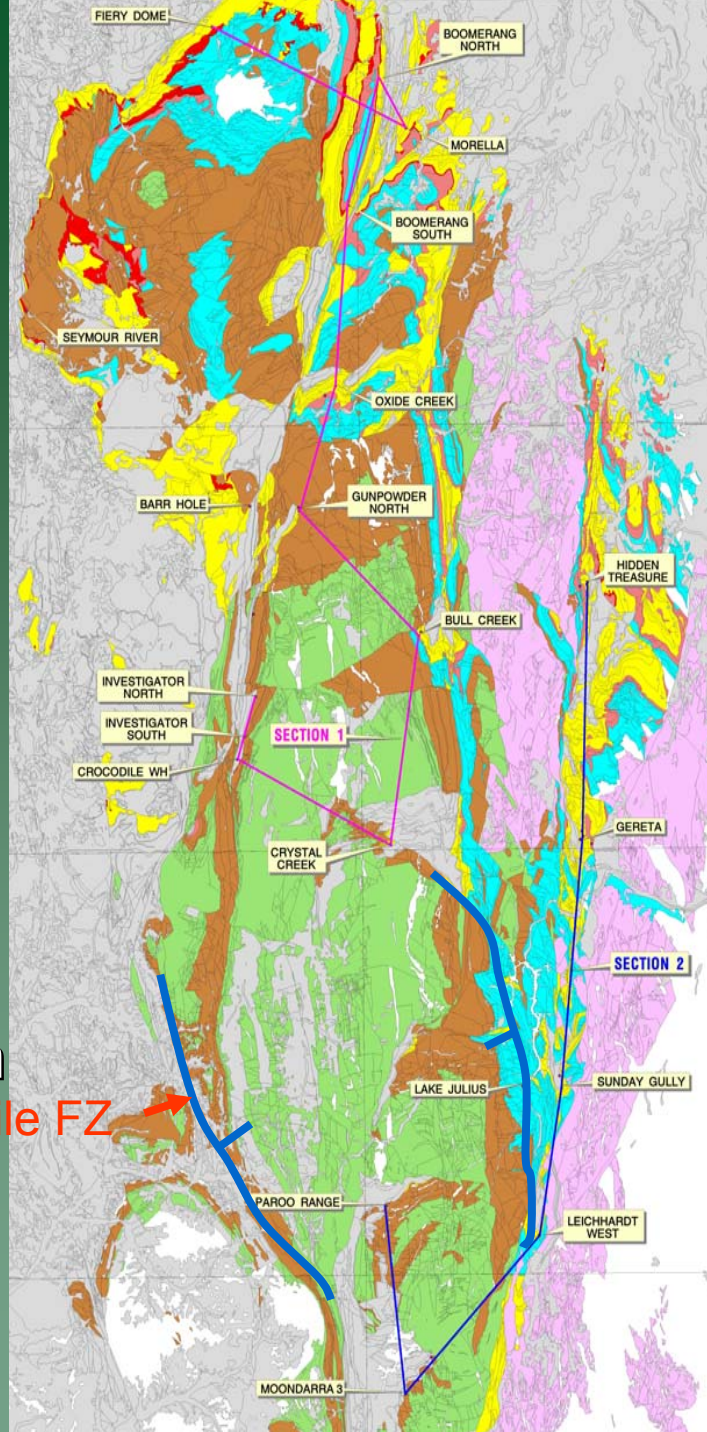
- Myally Subgp
- Eastern Cr Volcs

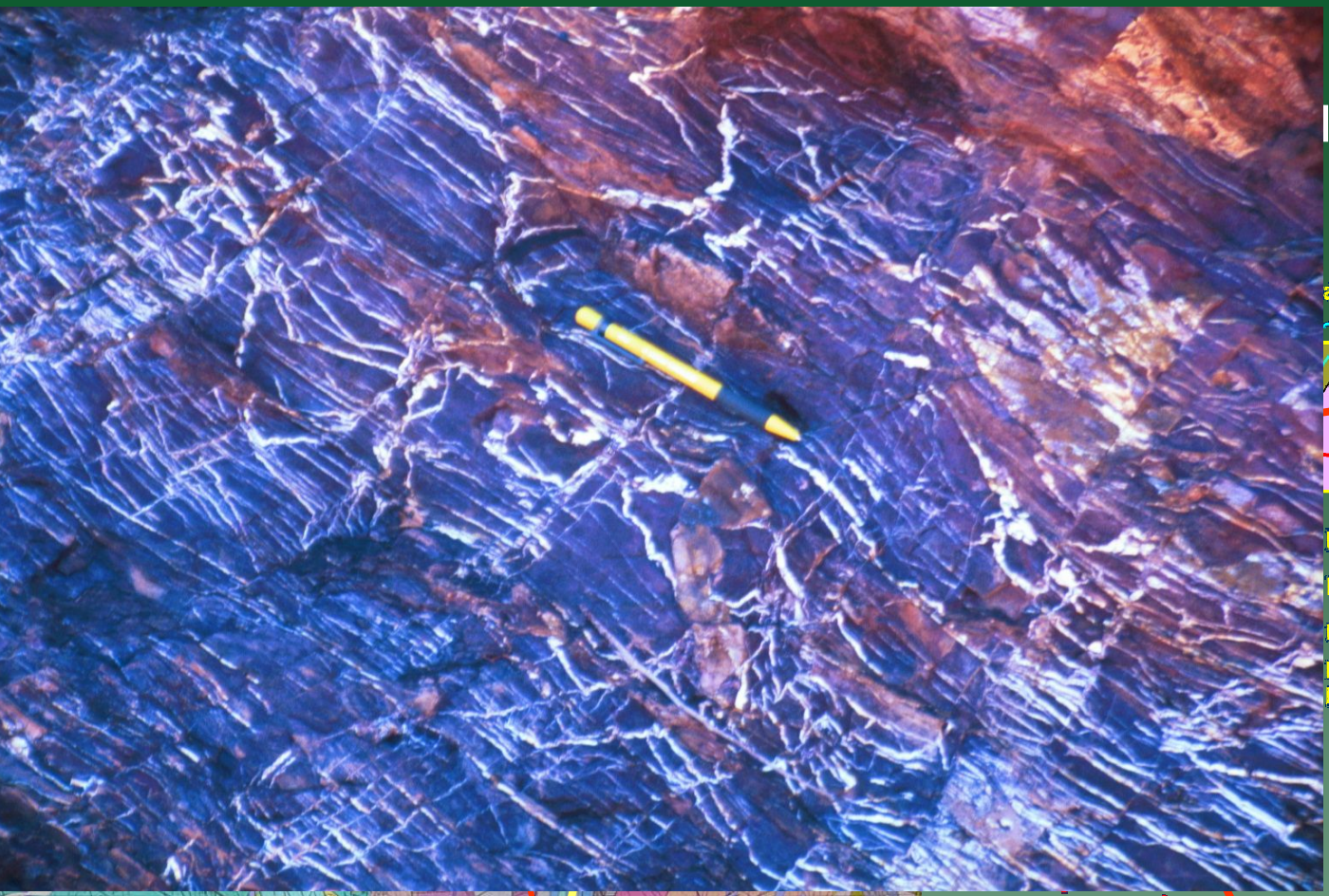
- Fault
- Thrust fault
- Postulated thrust fault (Bell,1983)
- Antiform
- Synform

Rift Preservation

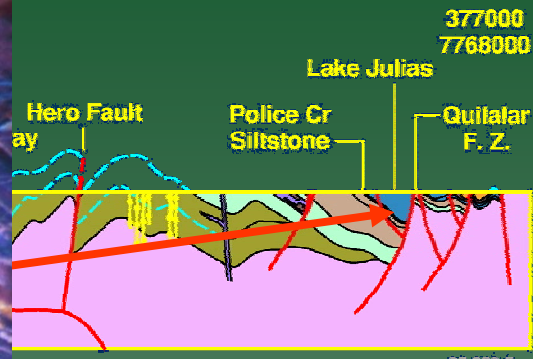
Focus on older Quilalar Fm (blue) & Myally Subgp (brown)

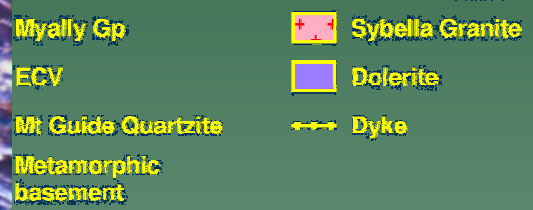
- Complementary to NABRE
- Regional northward dip
- Pre-dates east-west faults
- Thinner on Mt Gordon Arch
- Western & eastern sub-basins
- Eastward thickening in eastern basin
- Overlapping normal faults

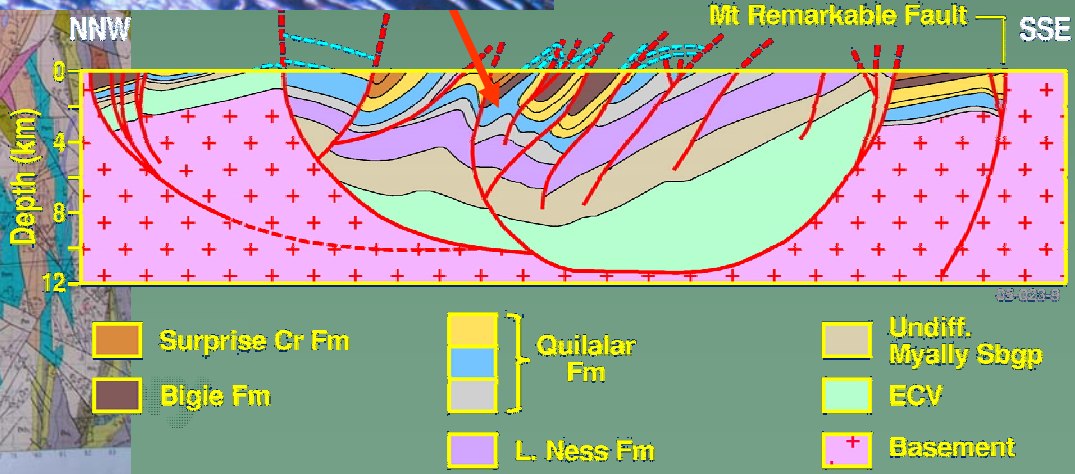


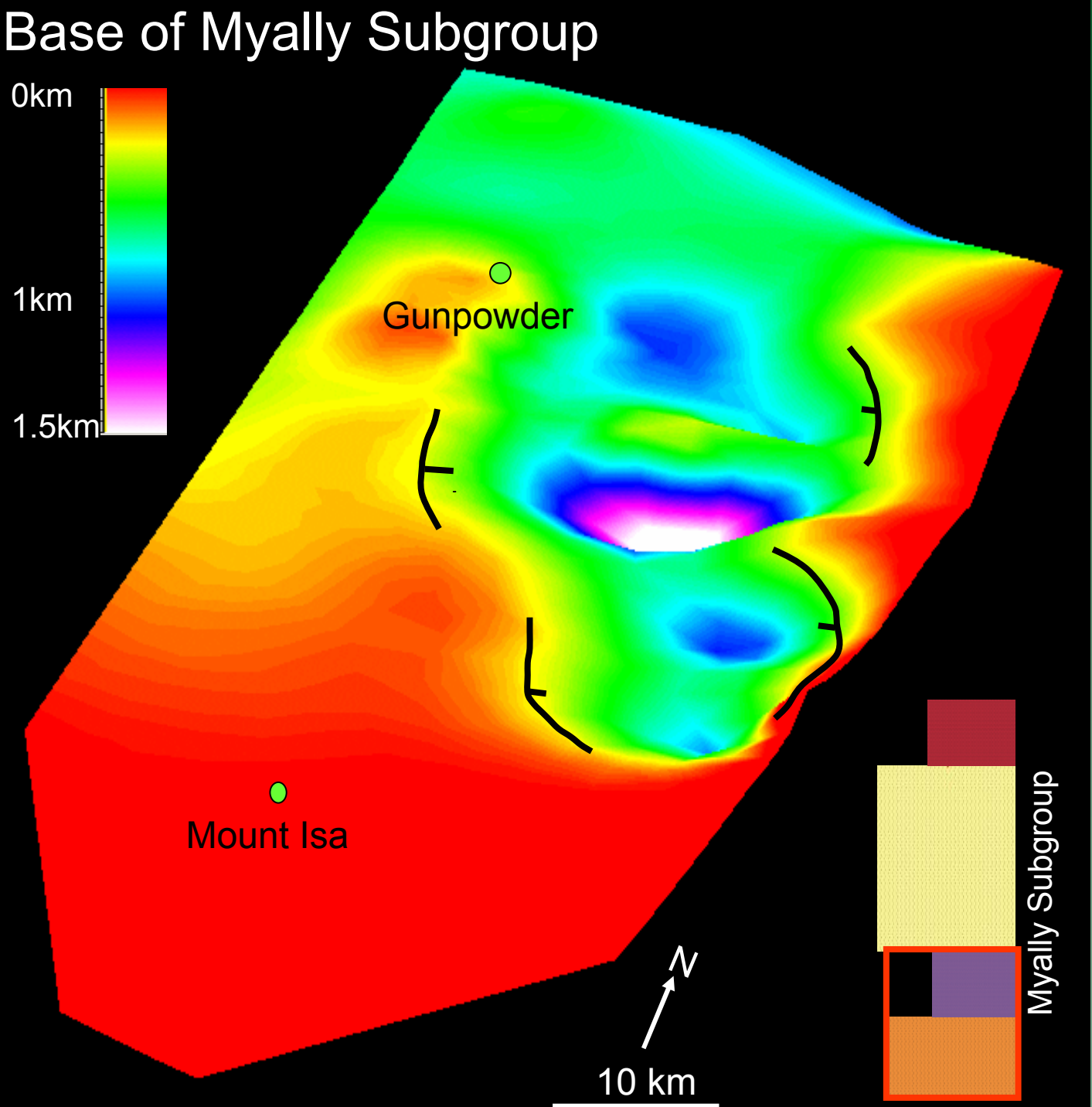


s half-graben





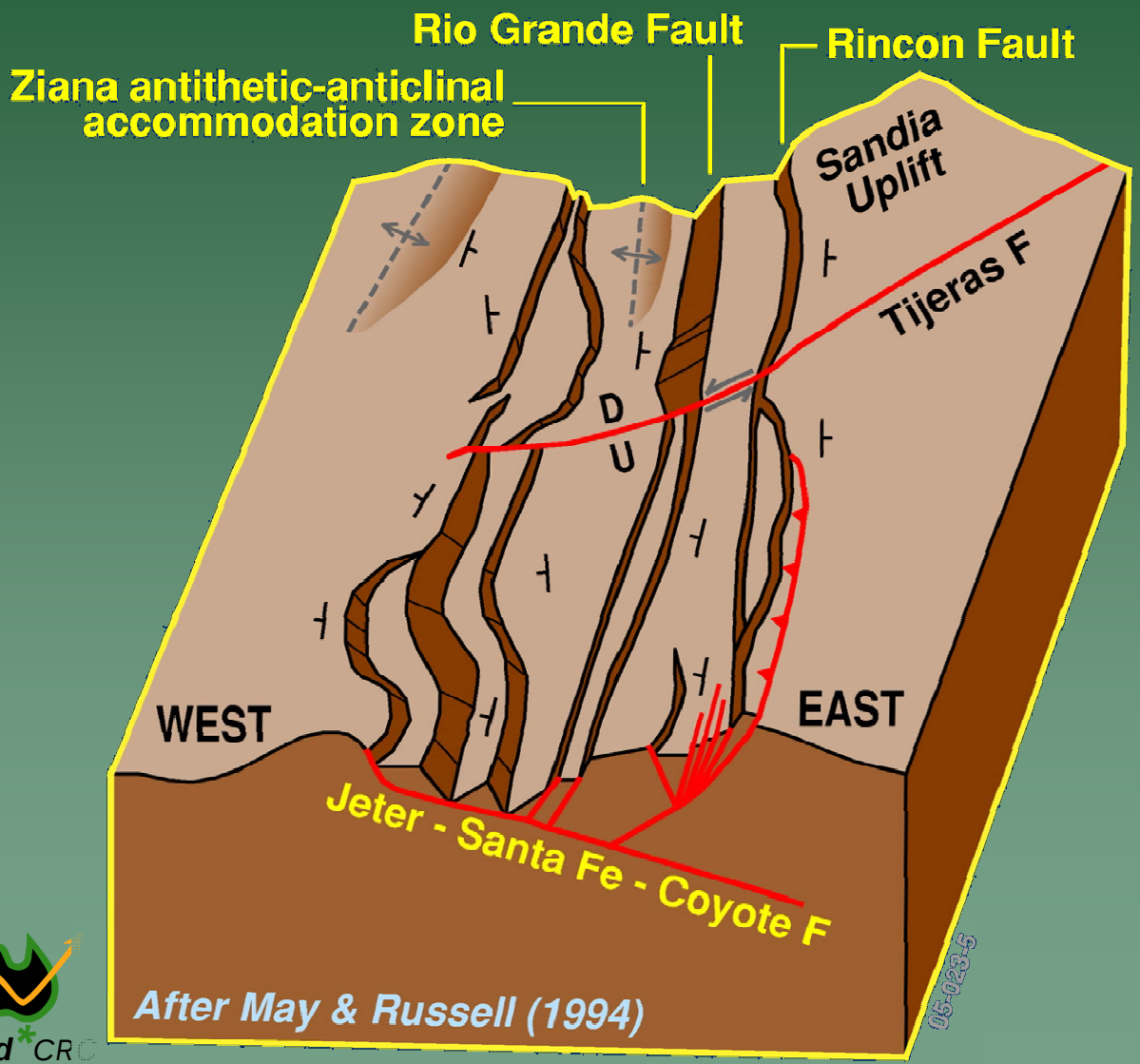




Myally Subgrp: 3D isopach Map

- Individual depocentres
- Orientation of primary basin & growth faults
- Basin architecture (eastward-thickening)
- Secondary basins & structural highs

Modern analogue: Rio Grande Rift, Basin & Range Province



- Normal faults of opposing polarity (= AZ)
- Single detachment
- Central depression but anticlinal structure in core

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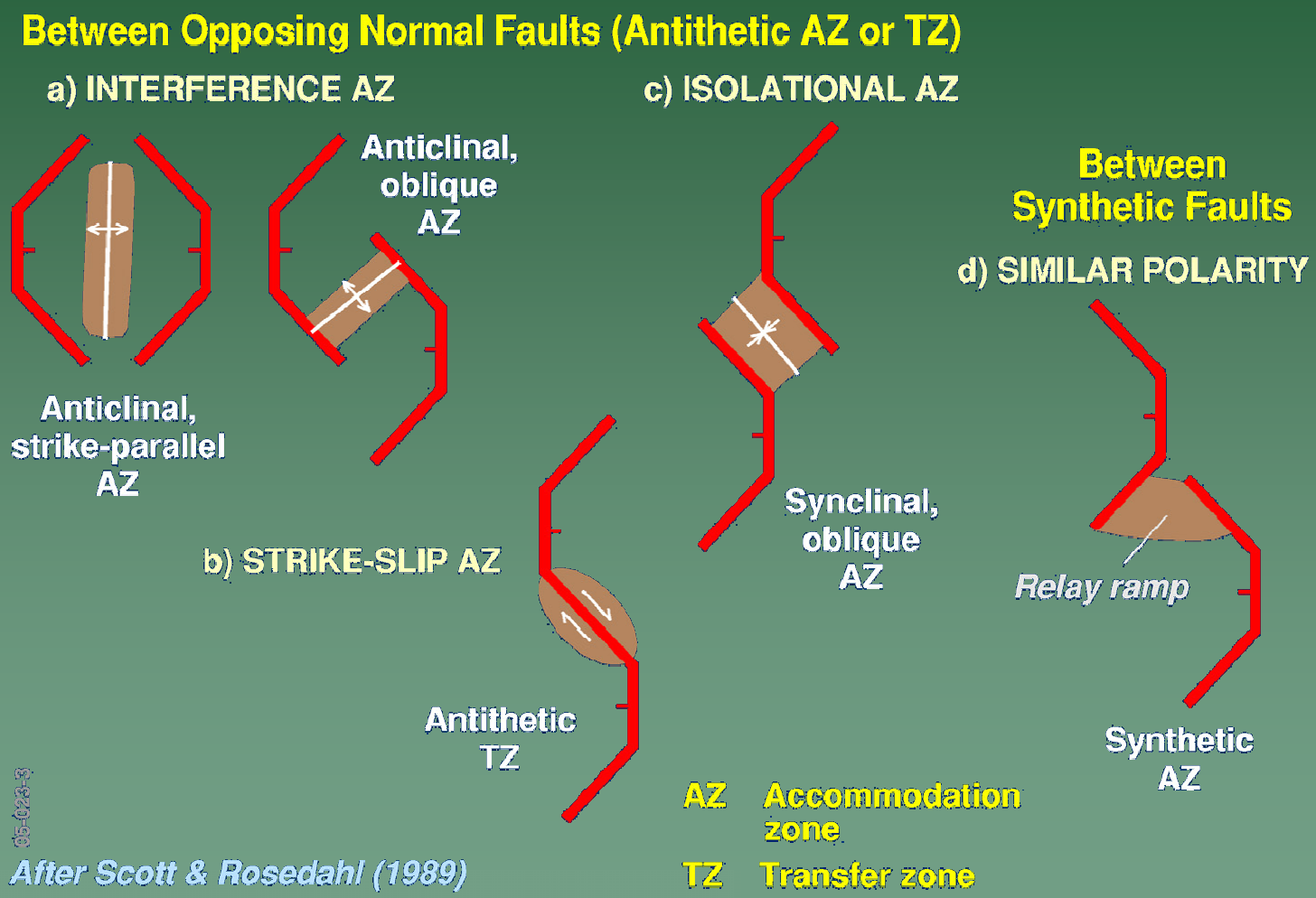
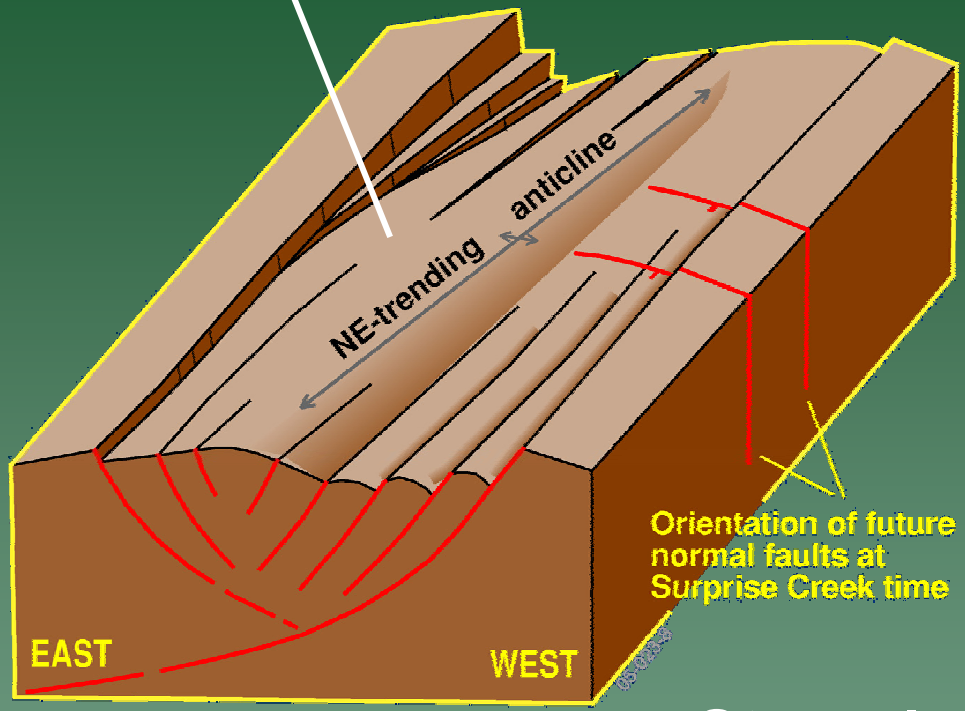
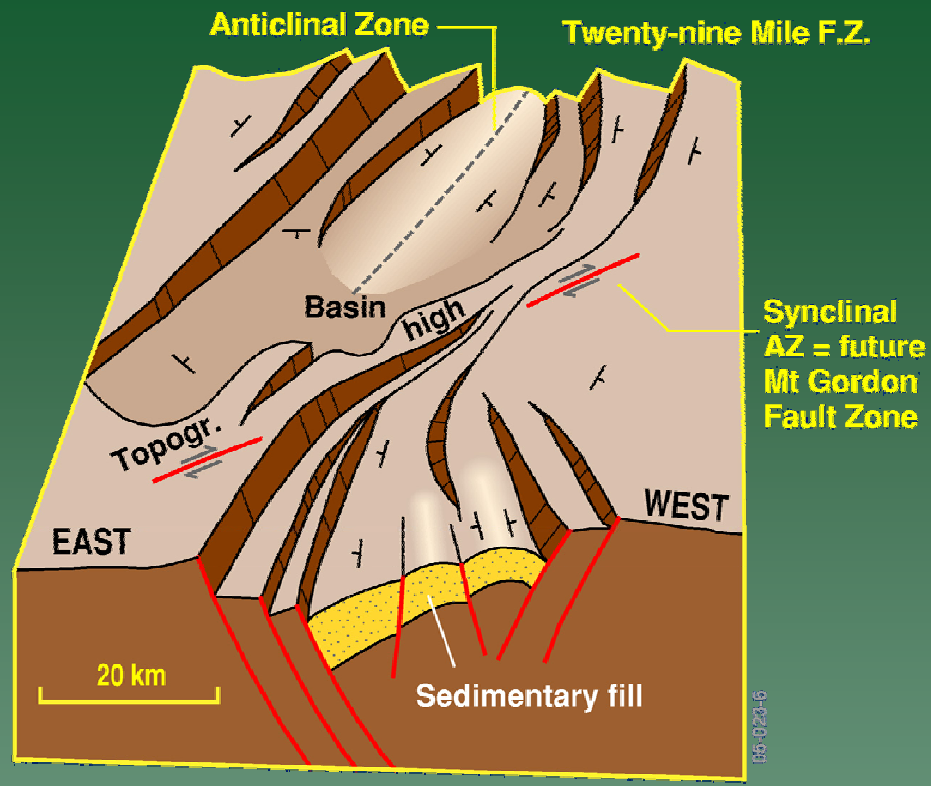
Accommodation Zones



Element 1: Mt Gordon Arch

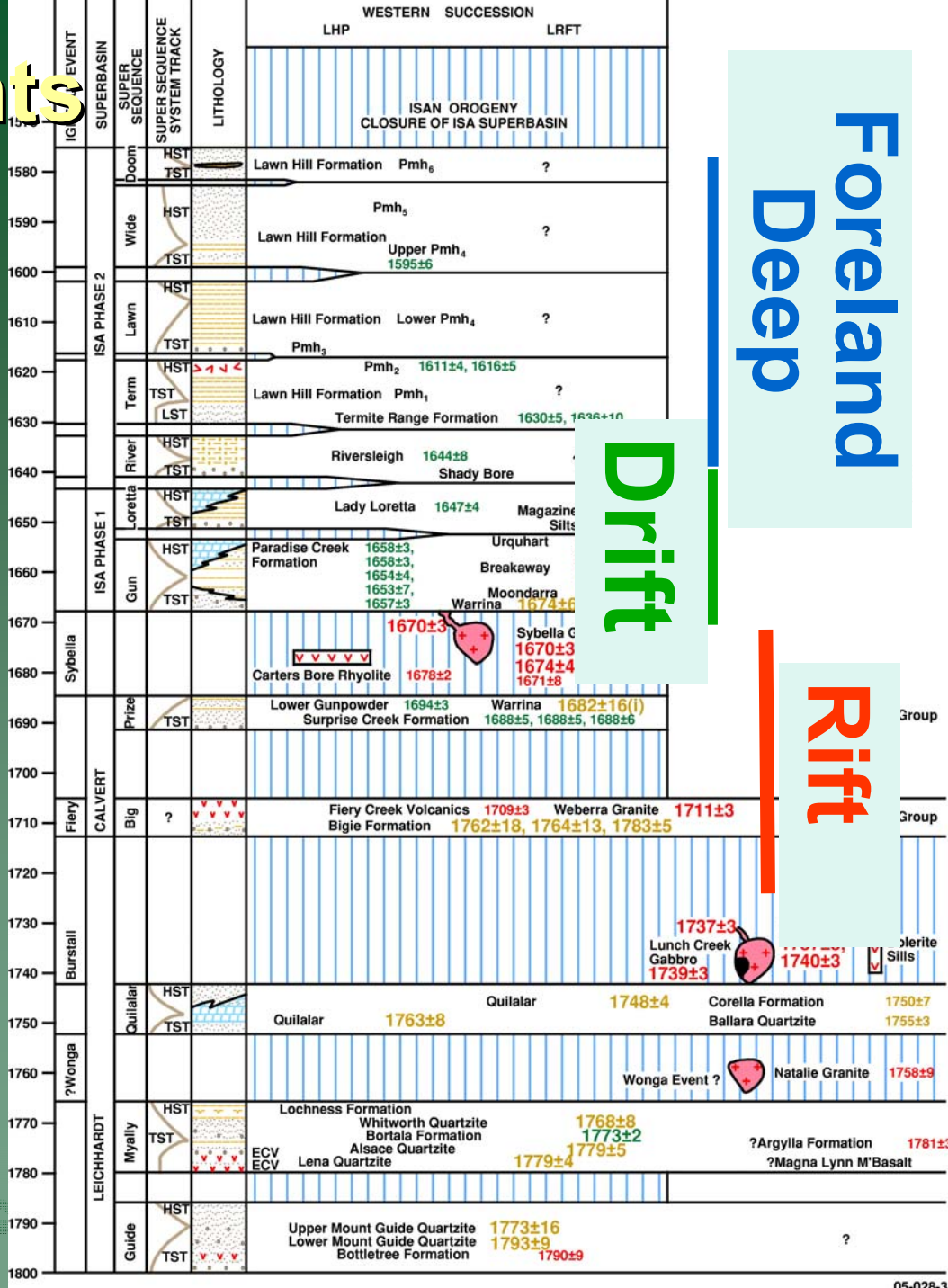




- Strongly overlapping half-graben
- Original syn-rift origin (not D2 age)
- Long-lived (ECV → Myally time)
- East & west sub-basins
- Influenced siting of future MGFZ

Post-Quilalar Events

- Rift rejuvenation (1730 Ma?)
- Bimodal magmatism (1730 - 1710 Ma)
- East-west growth faults
- N-S faults reactivated
- Clastic sedimentation (Big thro' Prize) & formation of NE-thickening wedge
- Extensional unroofing of high-grade metamorphics (1690 - 1670 Ma)
- Onset of passive margin sedimentation from ca. 1670Ma
- Foreland basin in North after 1640 Ma (upper McNamara Group)



predictive mineral discovery

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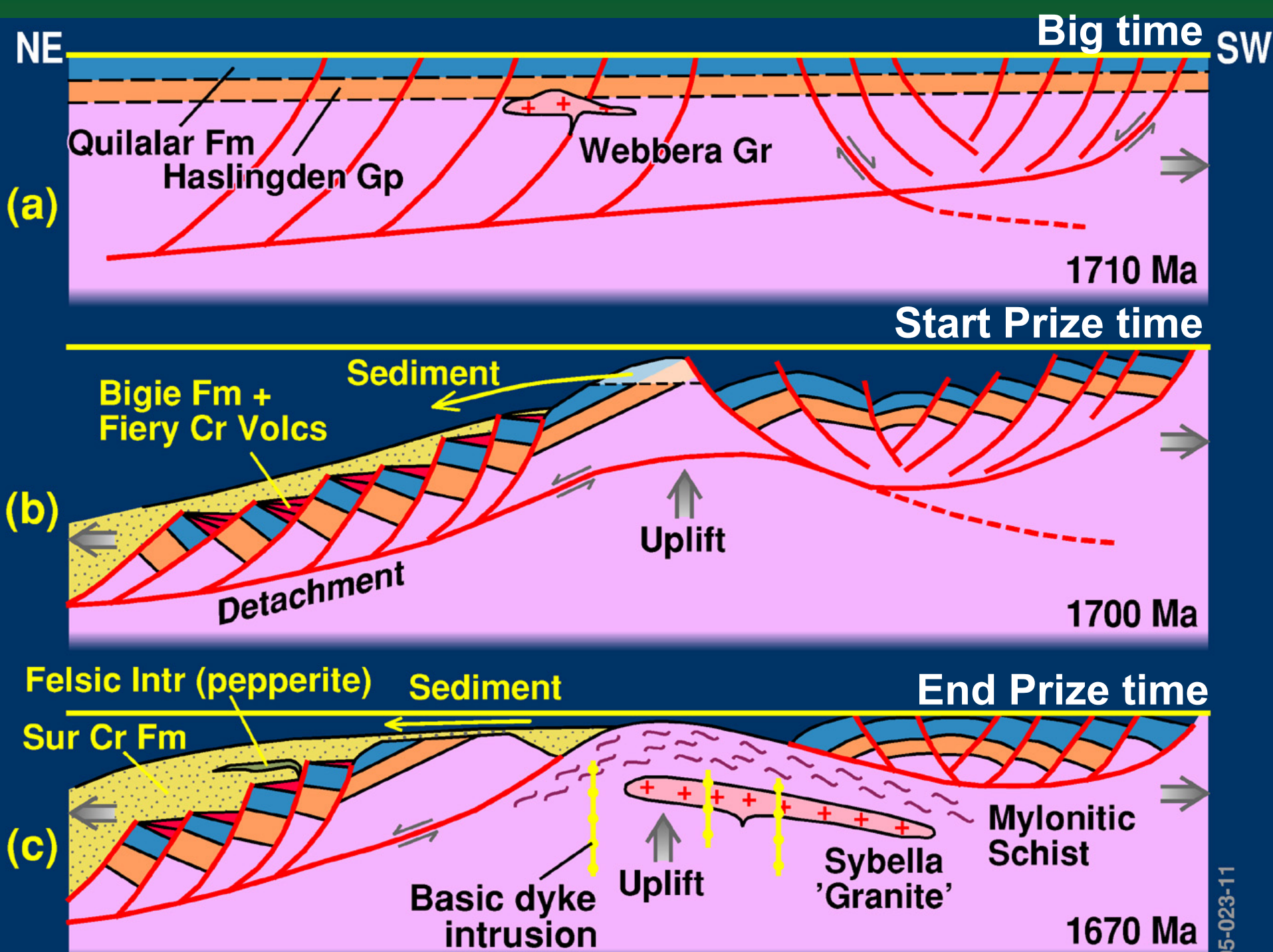
NE
SW
Big time
Quilalar Fm
Haslingden Gp
Webbera Gr
(a)
1710 Ma
Start Prize time
Sediment
Bigie Fm +
Fiery Cr Volcs
(b)
Uplift
Detachment
1700 Ma
Felsic Intr (pepperite)
Sediment
End Prize time
Sur Cr Fm
(c)
Mylonitic
Schist
Sybella
'Granite'
Uplift
Basic dyke
intrusion
1670 Ma
5-023-11

Exploration Implications

- Elevated geotherm and bimodal magmatism during extension creating ideal conditions for metamorphism, fluid generation & metal leaching (two cycles)
- Peak metamorphism in basement rocks at 1670-1690 Ma (Prize/Surprise Ck time)
- Potential for Irish-style Pb-Zn deposits in Quilalar carbonates adjacent to growth faults (western basin)
- Potential source of oxidising fluids/metals in basement &/or Myally Subgroup (L Ness)
- Carbonaceous components of Surprise Ck Fm (Prize) underexplored for Pb-Zn deposits adjacent to E-W (& N-S?) growth faults?