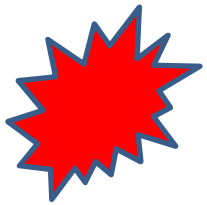
CHILLAGOE DISTRICT MINERALISATION

A TECTONIC MODEL

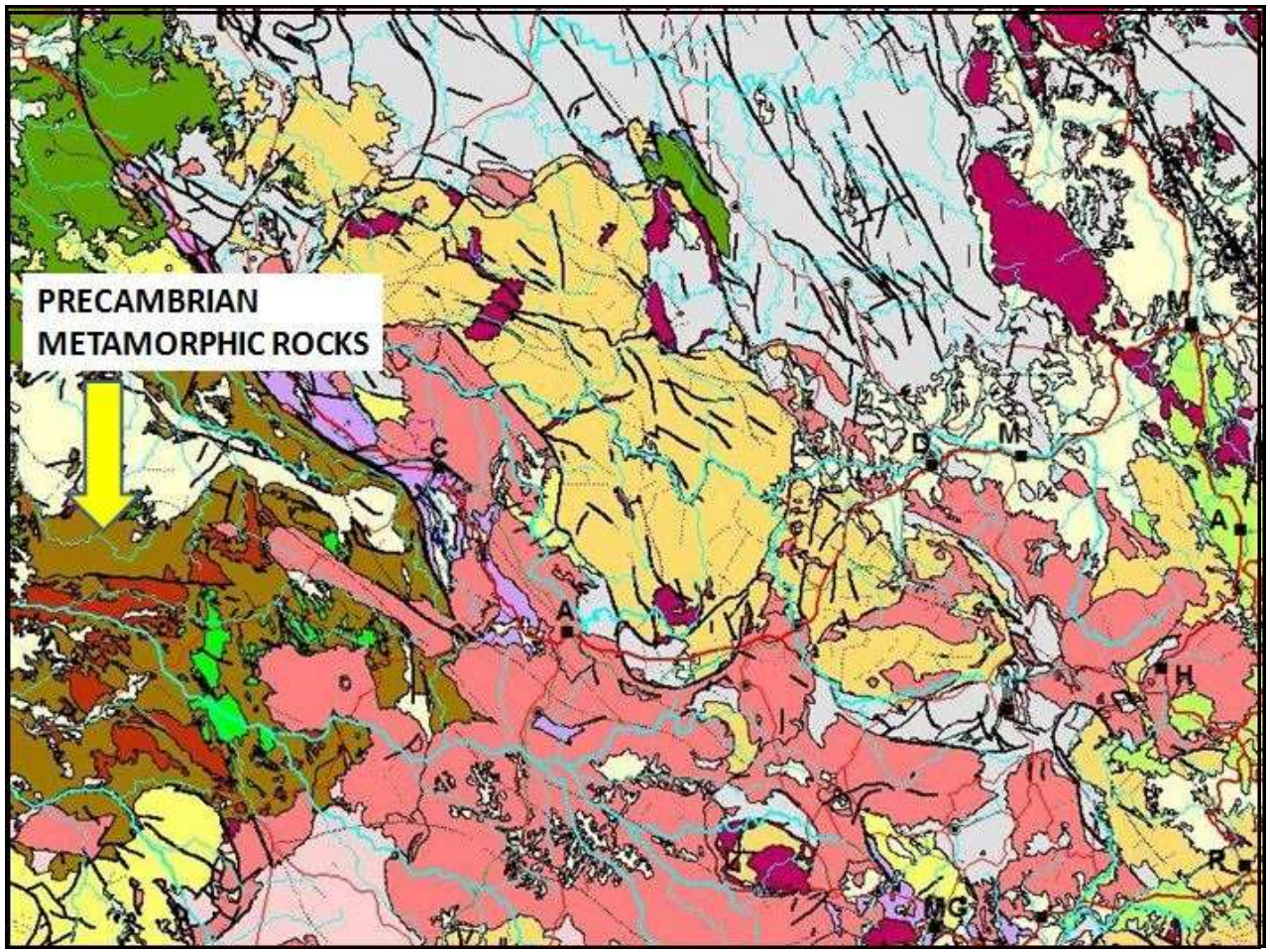
John Nethery - Nedex P/L (August 2015)
independently from public arena data

EXPLORATION UPSIDE

- Mature base metal exploration. Potential for more shoots (e.g. Red Dome, Mungana, King Vol, Redcap).
- Mature gold exploration as shallow skarn breccia porphyry deposits hosted by limestone & marble (e.g. Red Dome).
    - Potential for porphyry gold deposits hosted by volcanic / sedimentary rocks (e.g. Mt Redcap) and deep extensions beneath breccia pipes (e.g. Girofla, Lady Jane, Red Hill, Harpers).



GEOLOGICAL SETTING



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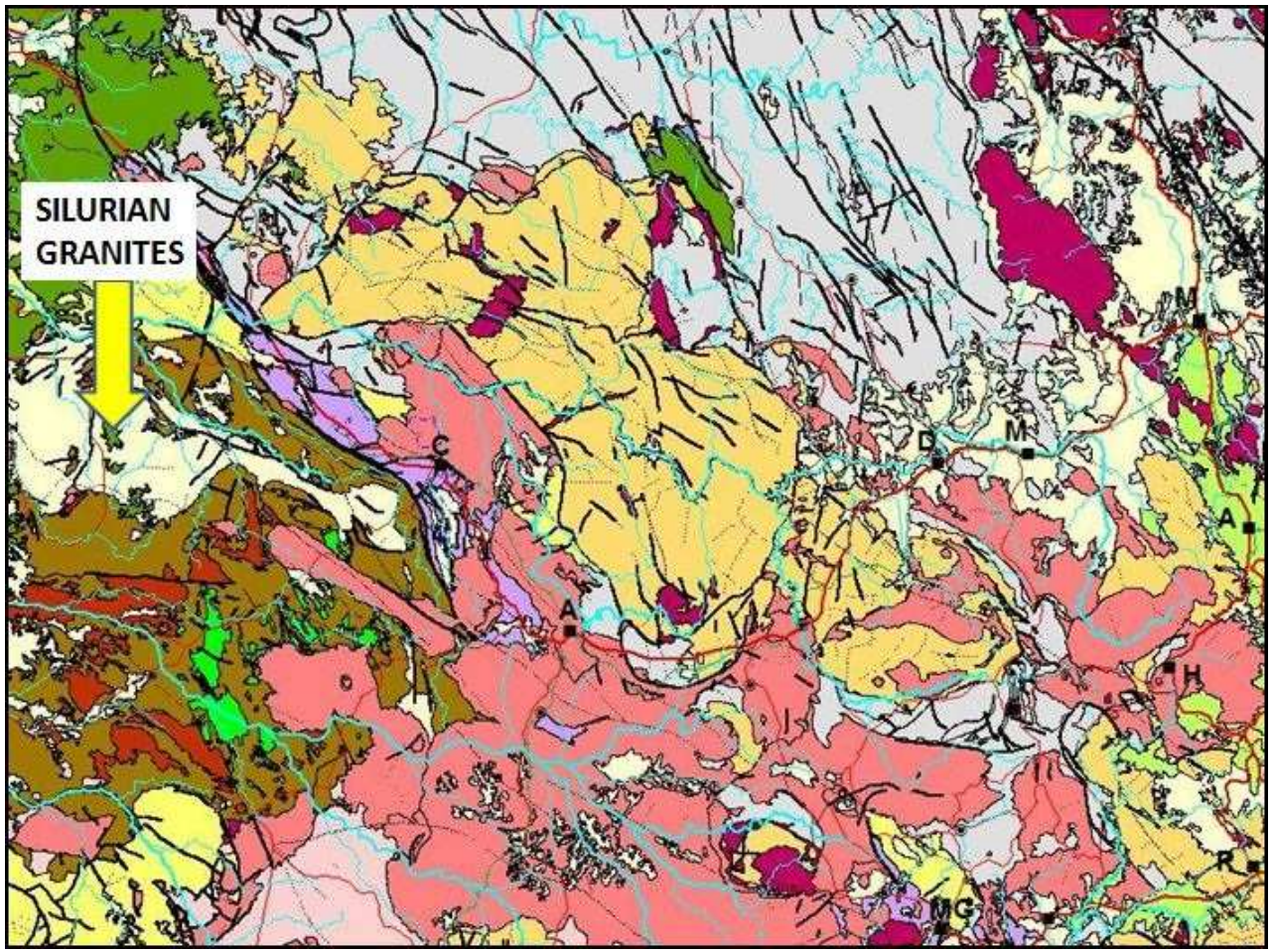

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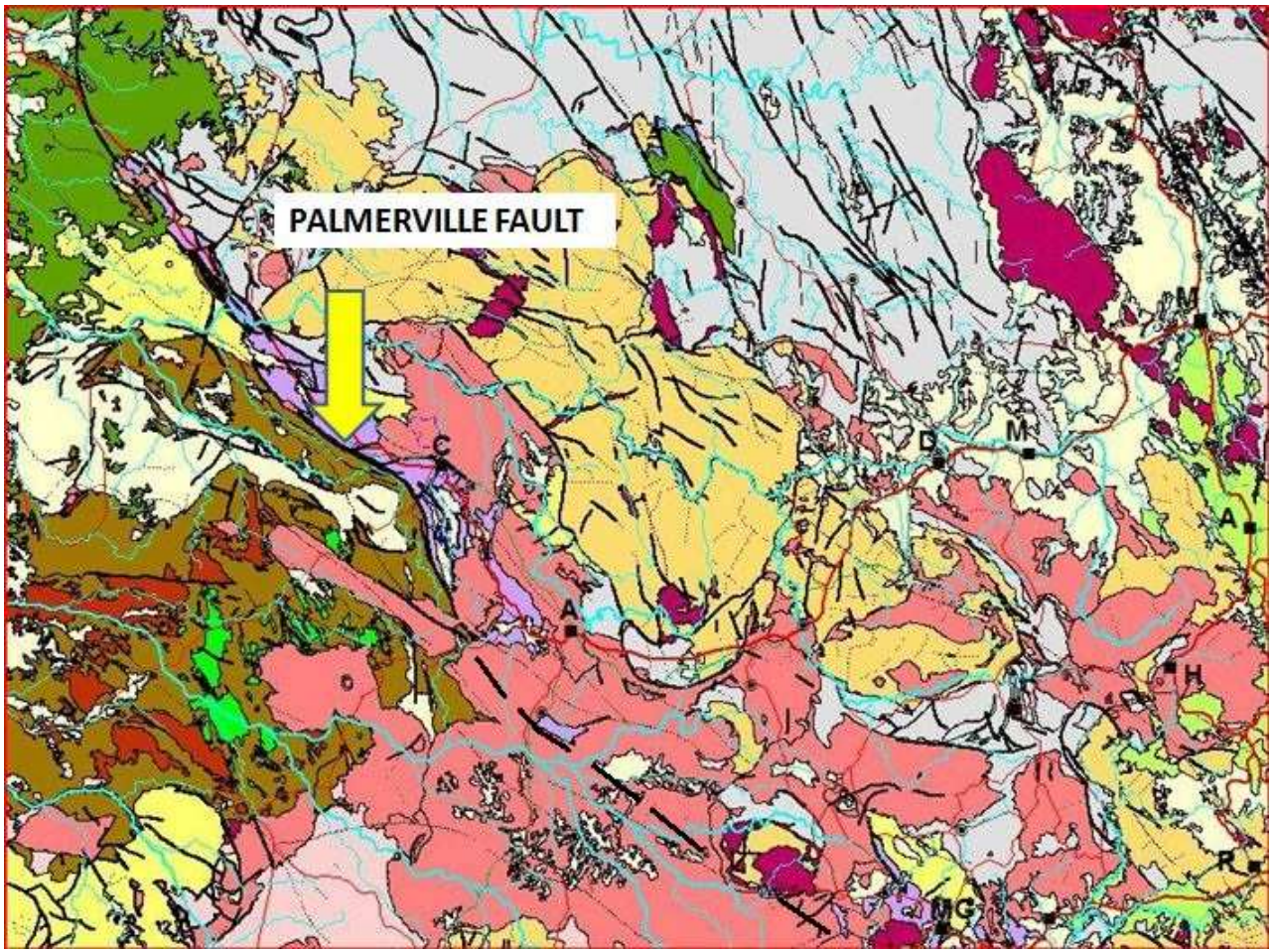

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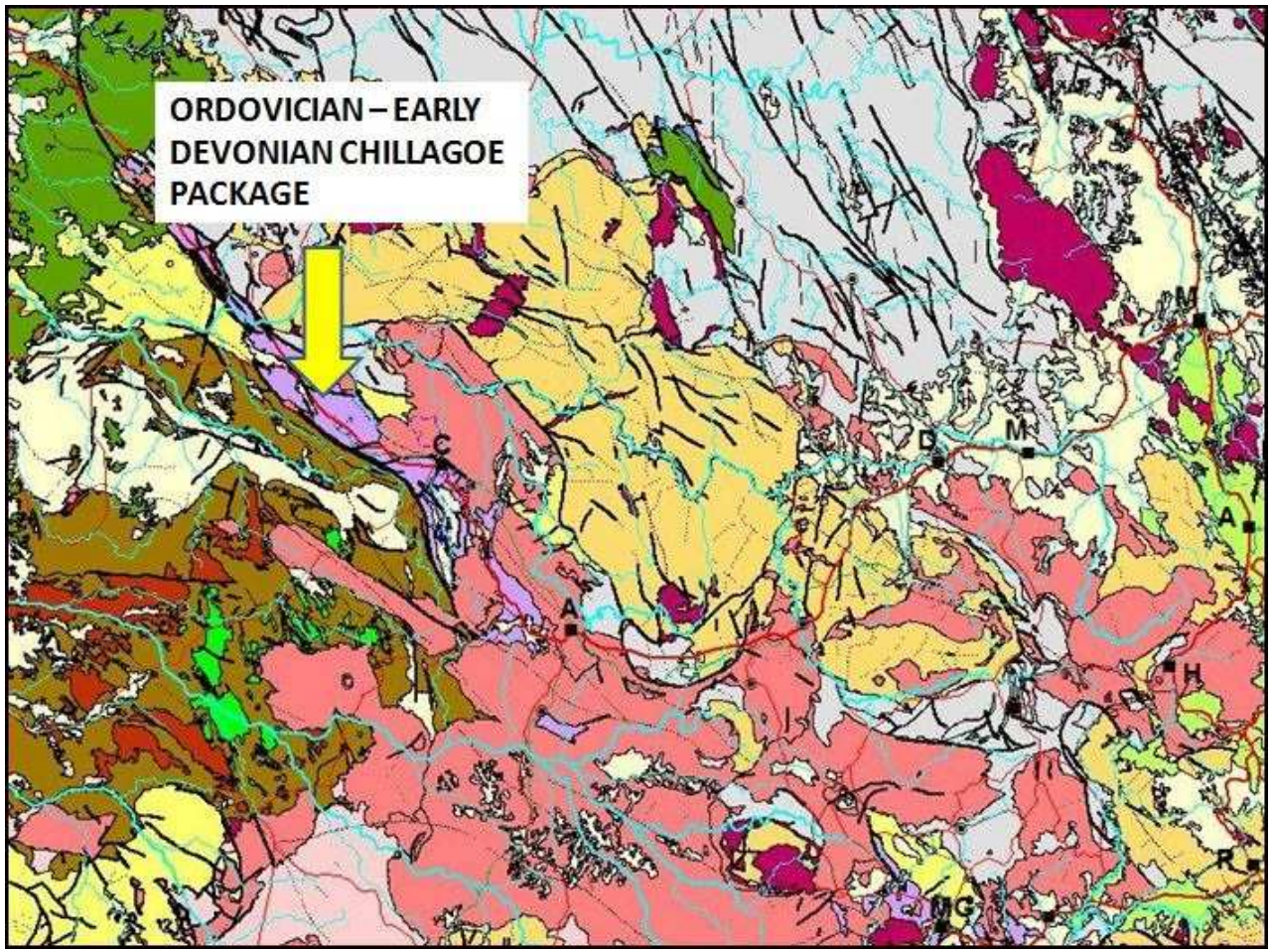

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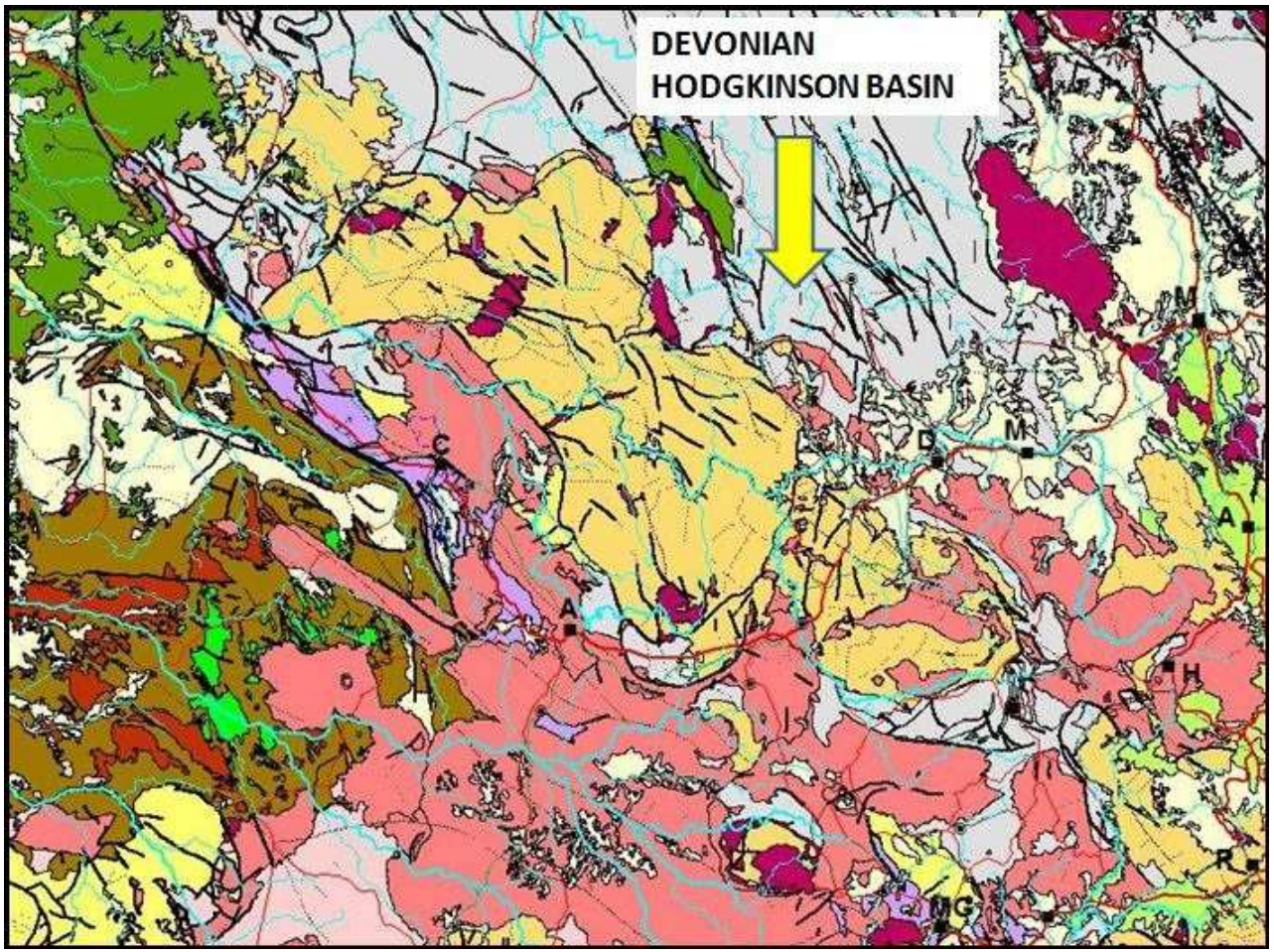

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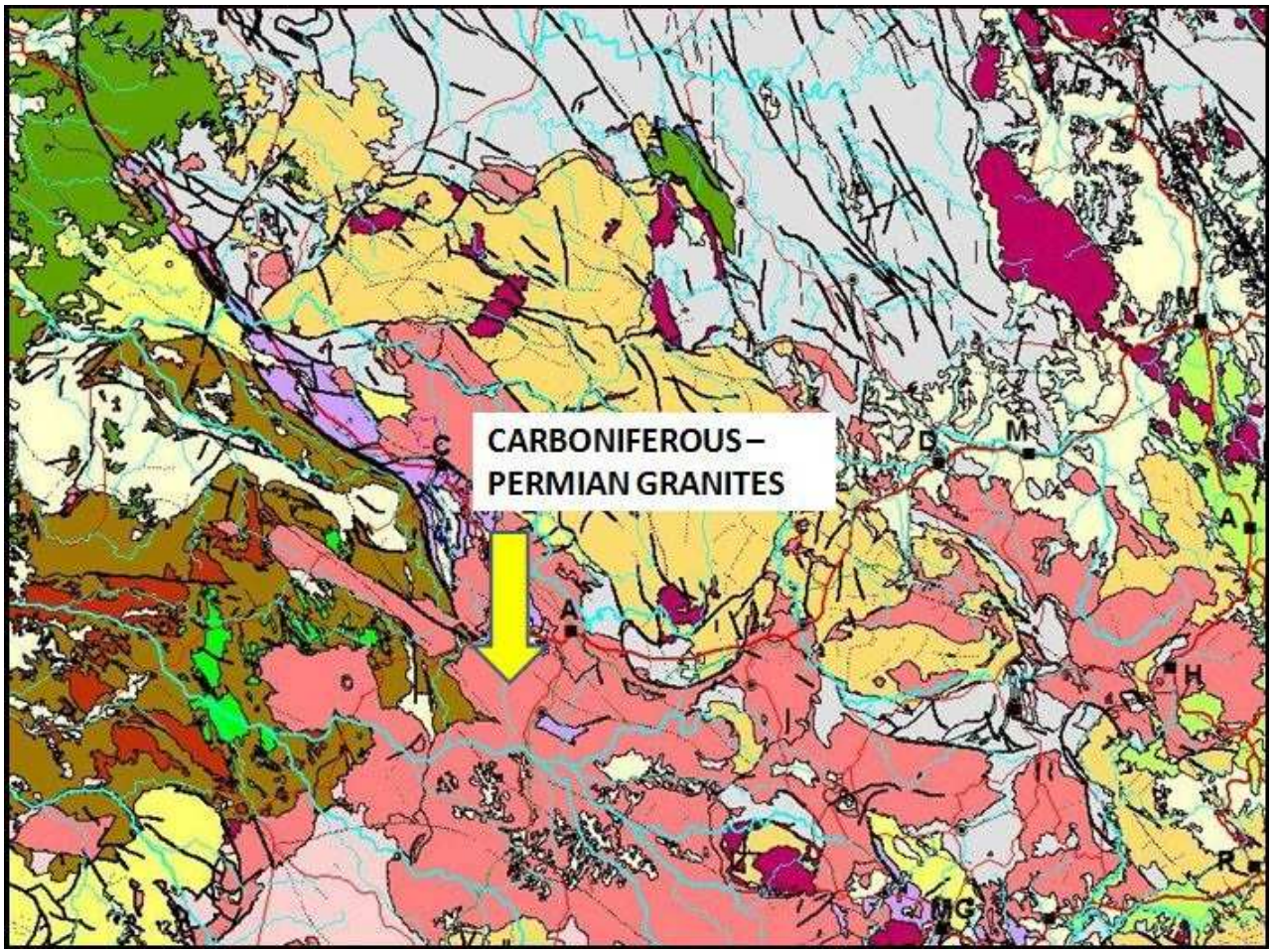
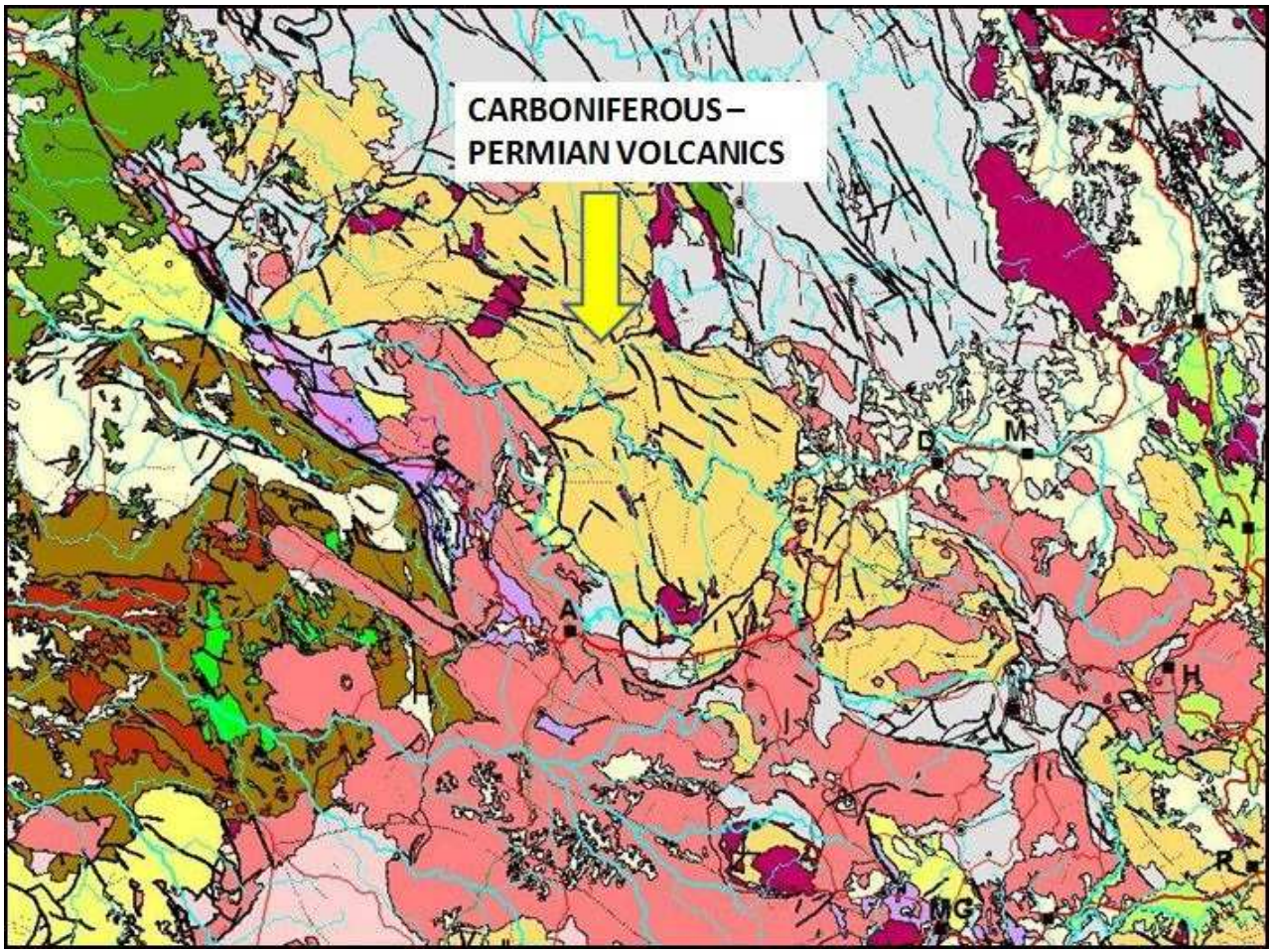


GEOLOGICAL SETTING



TECTONIC MODEL

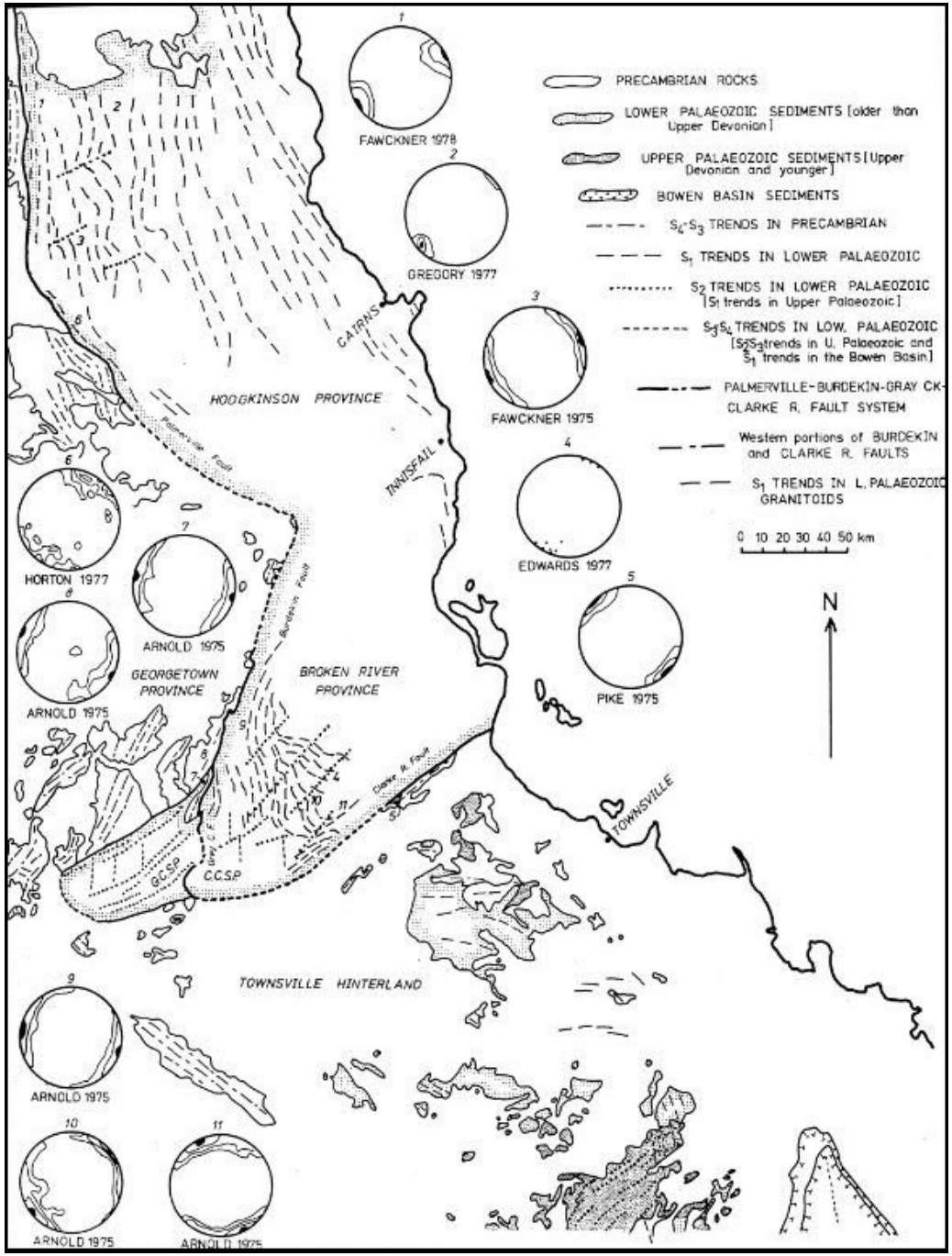
- Well established recognition of Late Devonian to Early Carboniferous Tabberabberan Orogeny circa 370Myr to 340Myr. INVERSION
- Produced a series of steep thrust horses, and multiple repetition of the Chillagoe Formation host to most mineralisation.
- Complex structural development not well understood. ARE WE MISSING SOMETHING?

TECTONIC MODEL

- What about the Alice Springs Orogeny circa 330Myr to 315Myr????
- Wells, A.T., Forman, D.J., Ranford, L.C., & Cook, P.J. (1970). Geology of the Amadeus Basin, central Australia. *APEA Journ. 28, 267– 282.*
- Infamous Chorus: *Who the XXXX is Alice?*

THE BIG BEND MEGAFOLD

- Tim Bell 1980
- Large scale oroclinal folding of Devonian – Carboniferous foliation
- Varying orientation of other early Palaeozoic and Proterozoic plutons & foliations
- E to NE oriented oroclinal axes
- Associated thrust faulting



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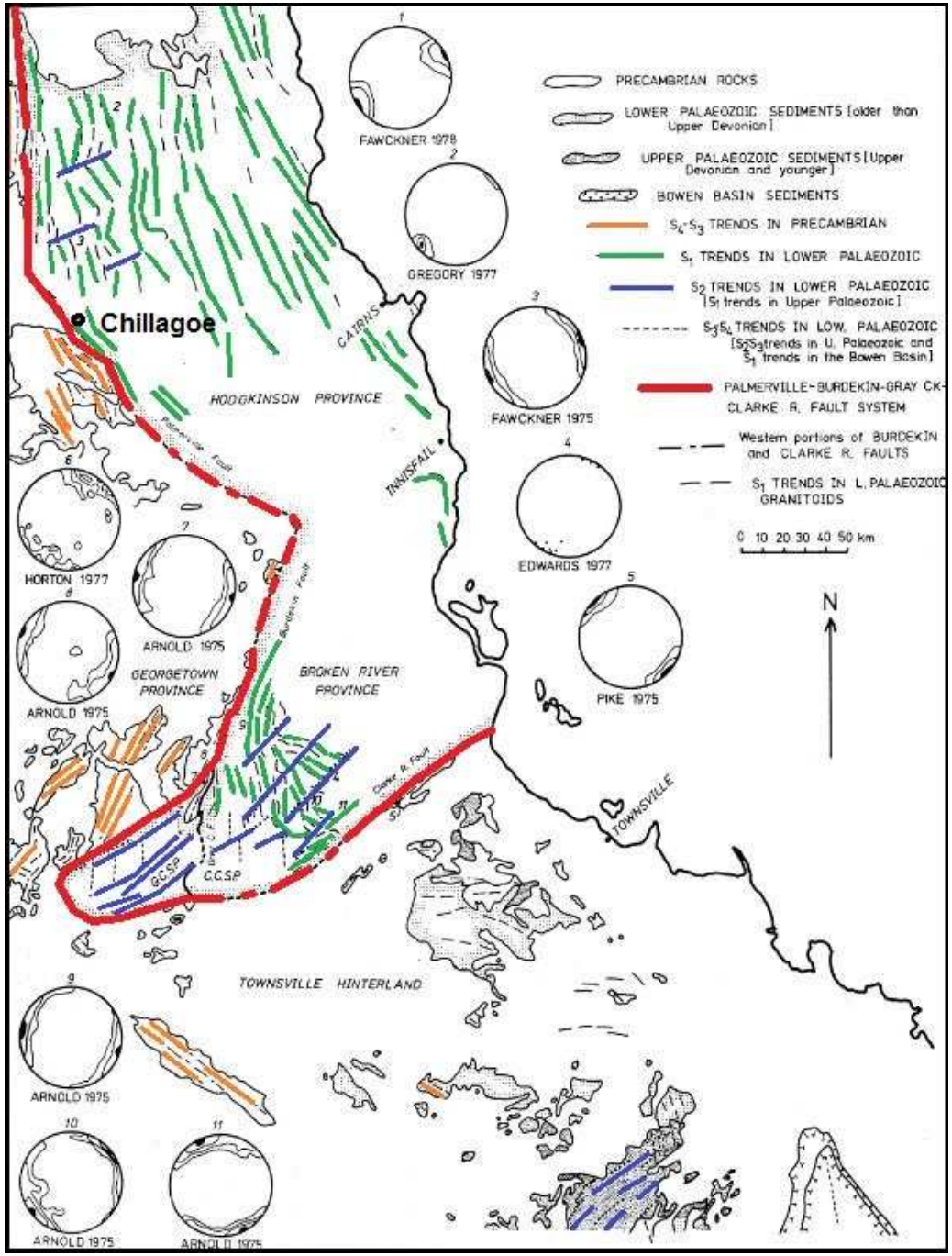


Chris Powell (1984) Powell, Cole & Cudahy 1985

- Alice Springs Orogeny
- 330 - 315Myr
- North - South compression
- Tasmanides megakinking

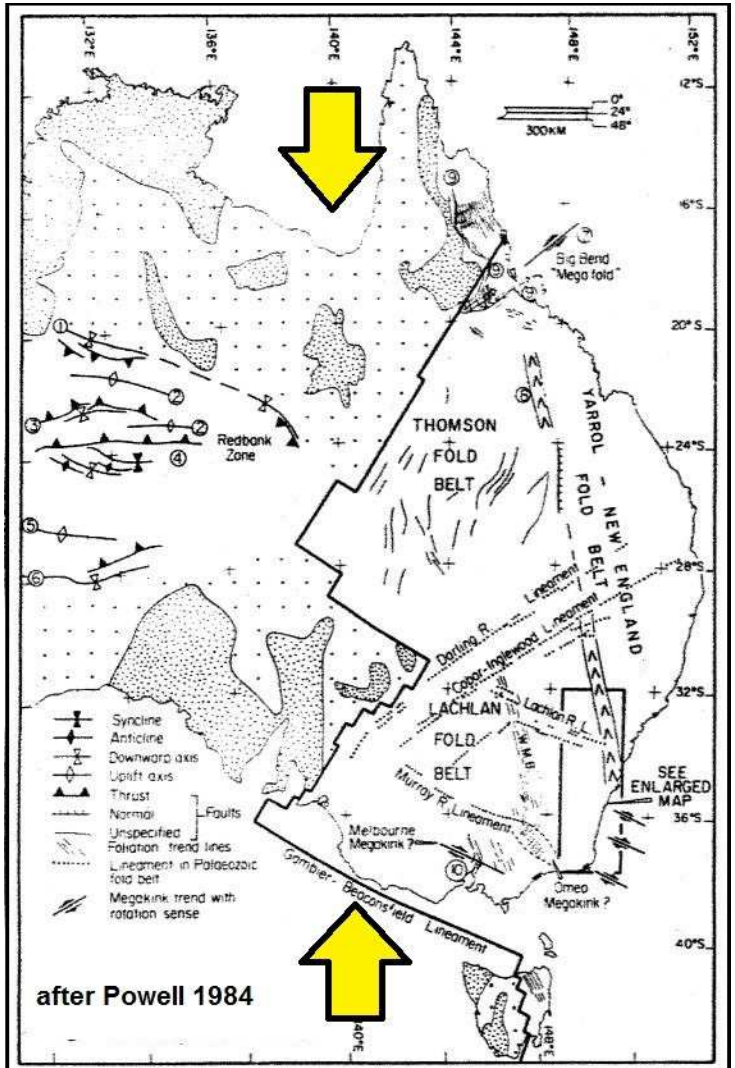
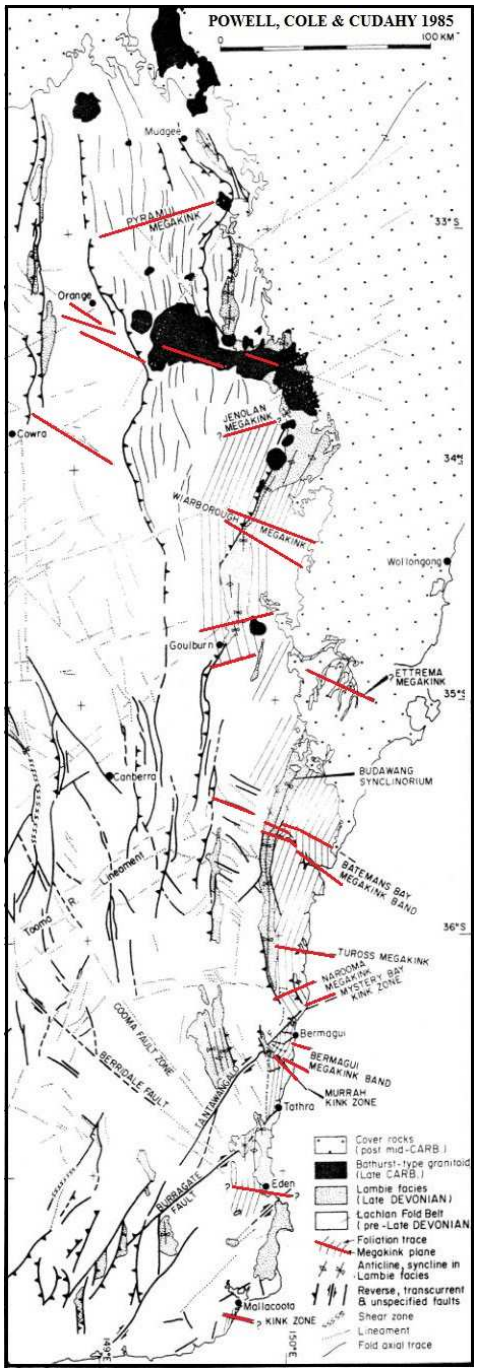
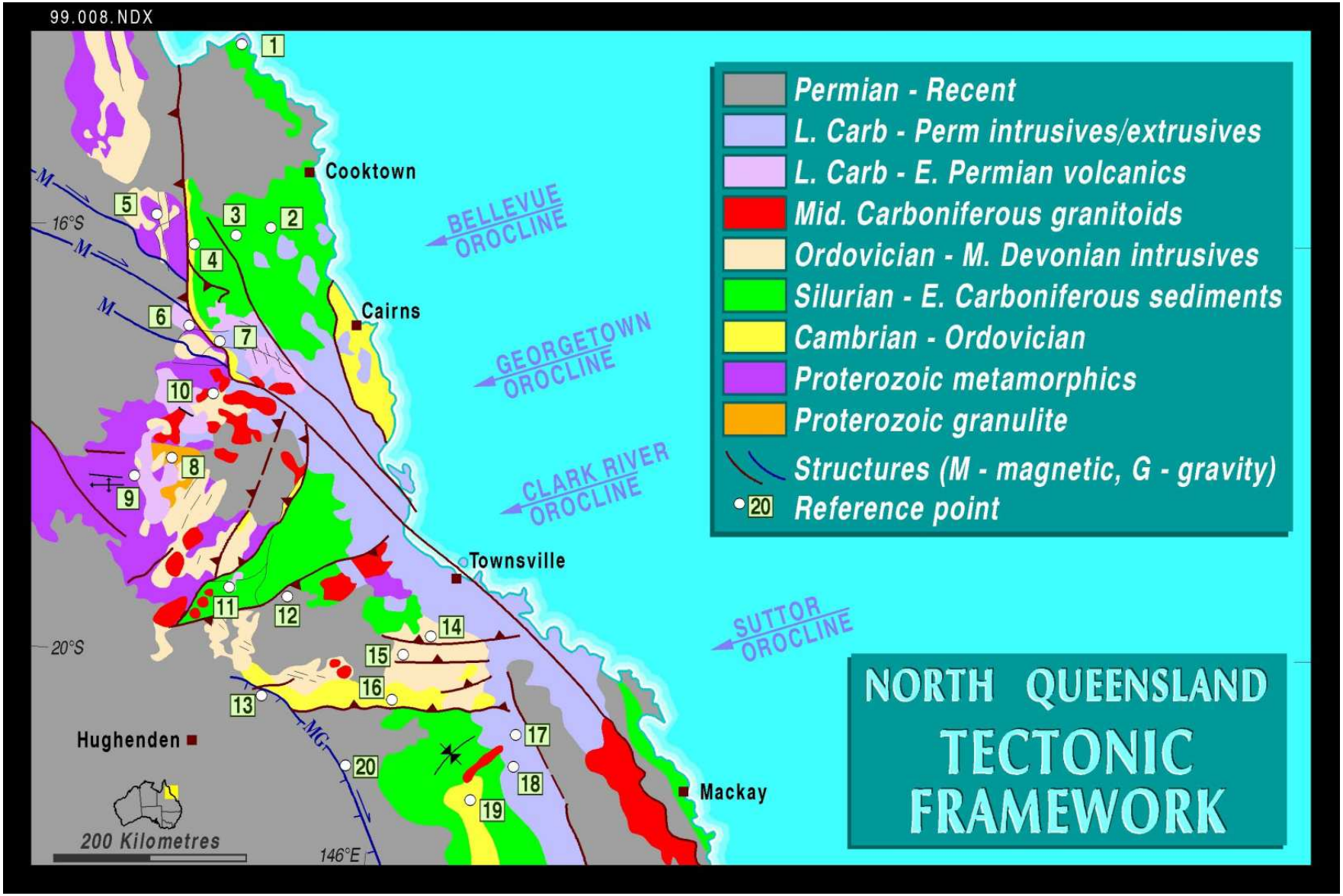


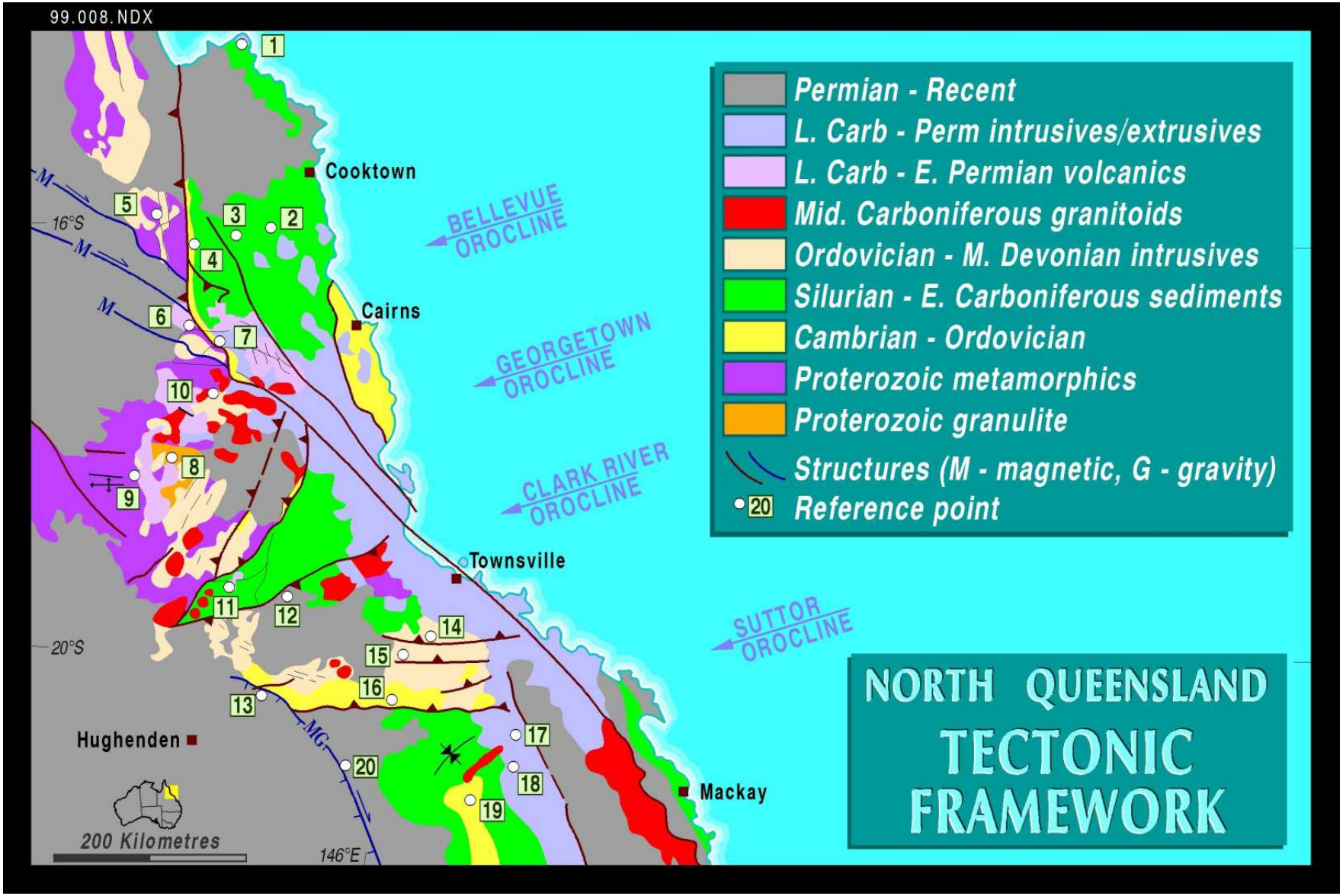
Fig. 1. Mid-Carboniferous structural sketch map of the eastern two-thirds of Australia based on the Tectonic Map of Australia (Geological Society of Australia 1971). Heavy line marking the edge of the proven Precambrian basement is the Tasman Line. The Yarrol–New England Fold Belt was a continental slope-to-trench terrane at the time. Numbered structures: 1, Lander Trough and Toko Syncline; 2, Arunta Block; 3, Thrust-faulted northern edge of the Ngalia Basin; 4, Amadeus Basin; 5, Musgrave Block; 6, Officer Basin; 7, Big Bend Megafold; 8, Anakie Inlier; 9, Palmerville–Burdekin–Clarke River Fault; 10, Steiglitz area. WMB, Wagga Metamorphic Belt. Modified from Powell (1984, fig. 4).



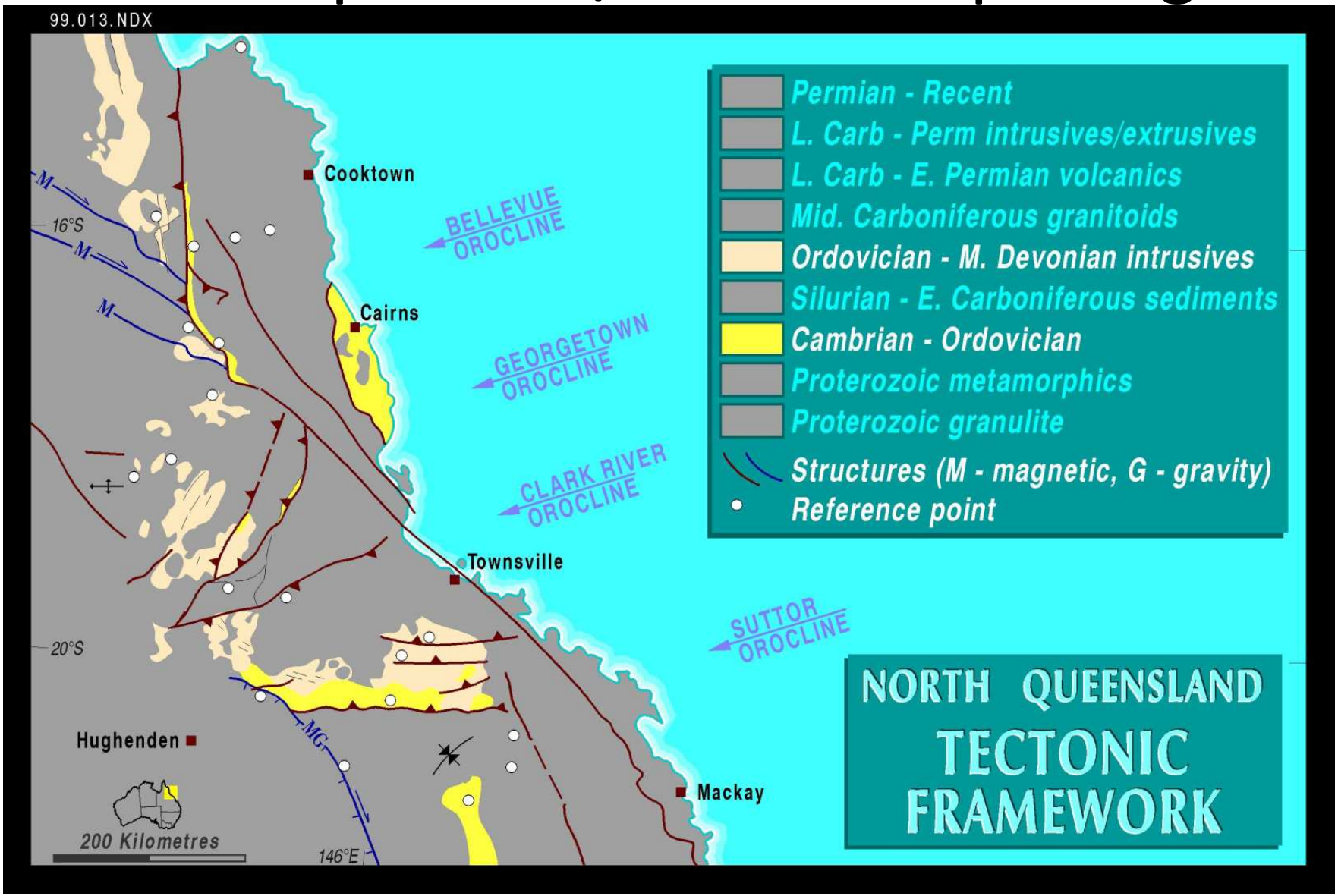
NORTH QUEENSLAND – Region from Cape Melville to Mount Coolon – 4 Oroclines



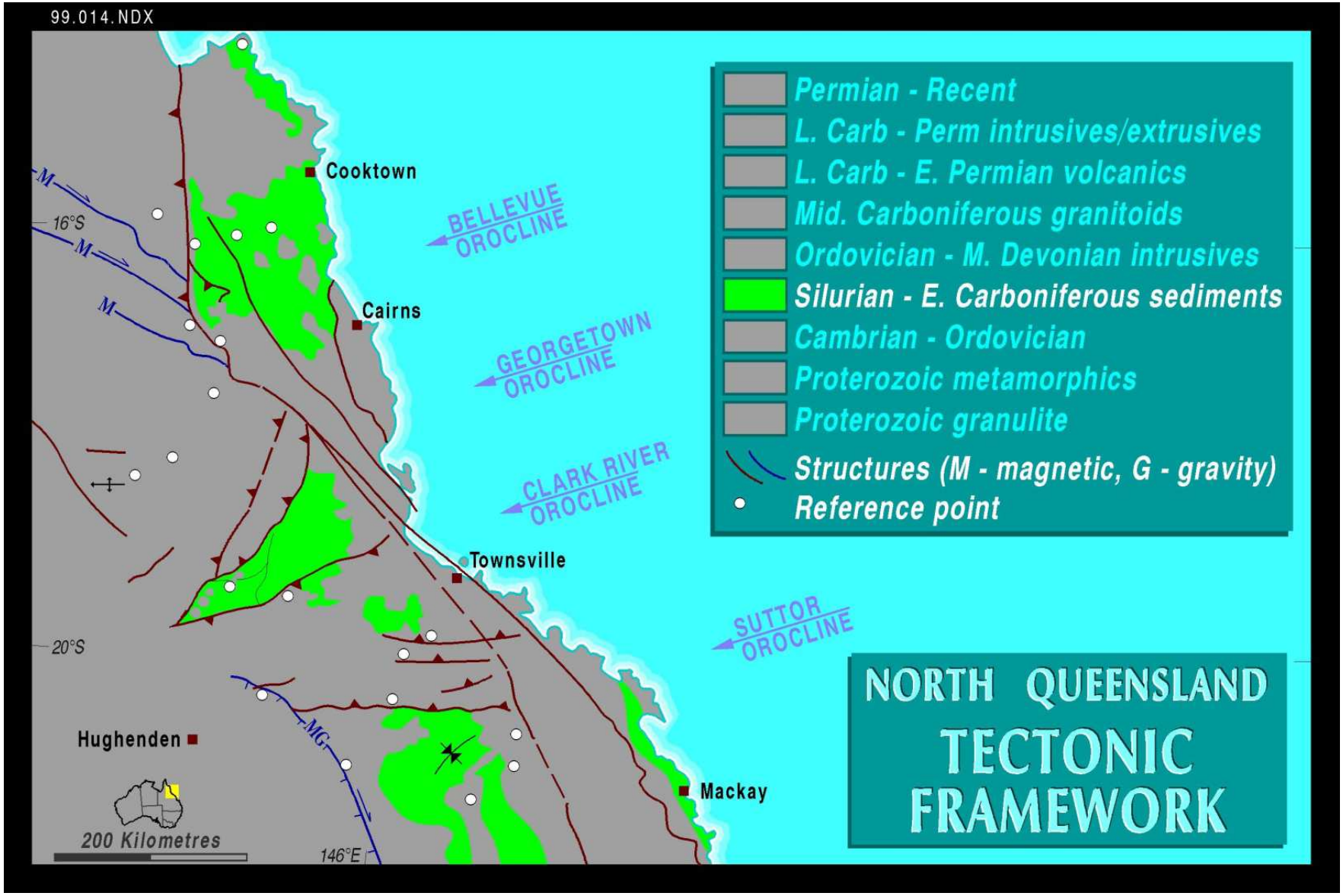
COMPONENTS: Georgetown Block – Central metamorphic dome / Late E folding



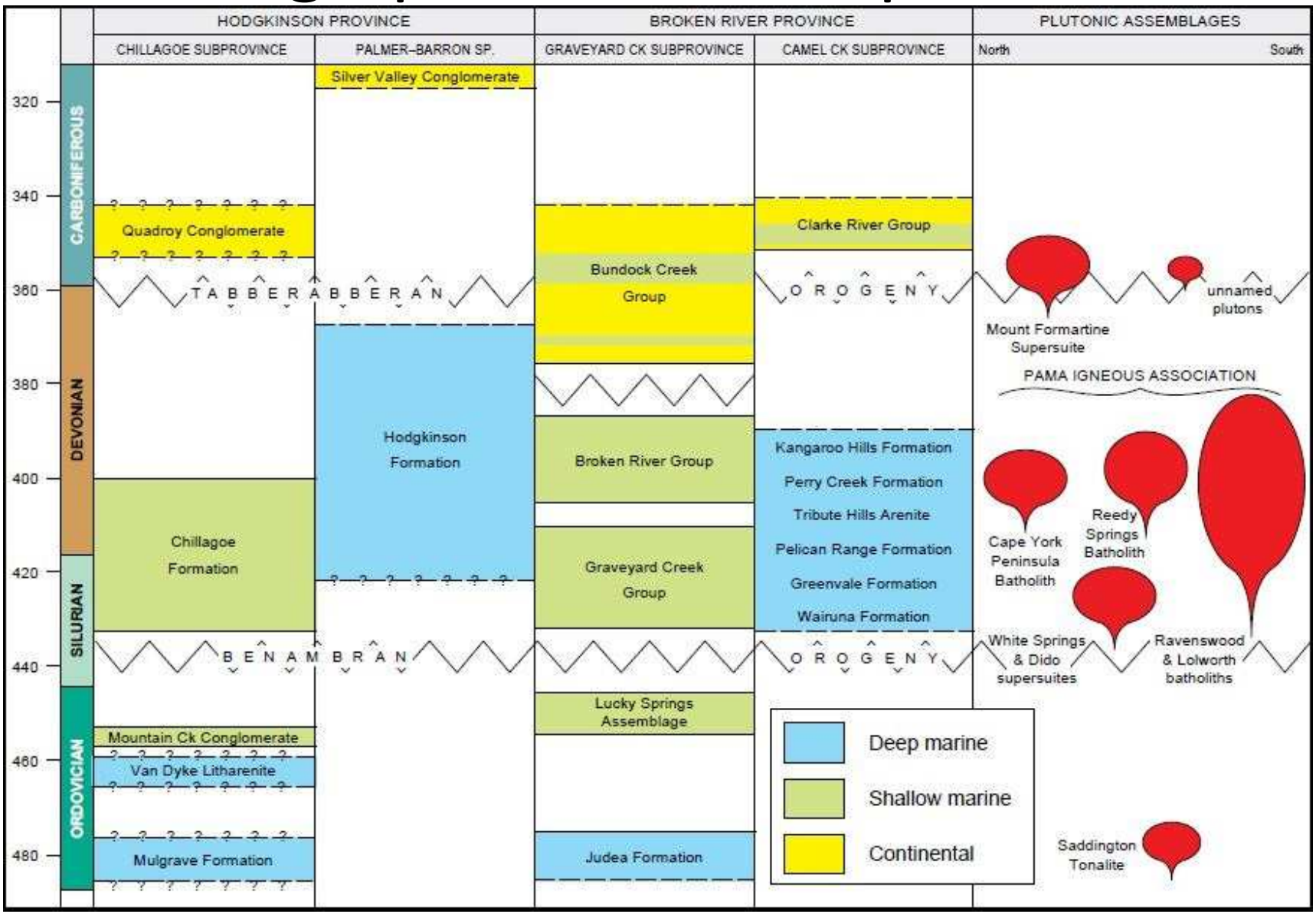
COMPONENTS: Early Palaeozoic – Sinuous trend of plutons / sediment packages



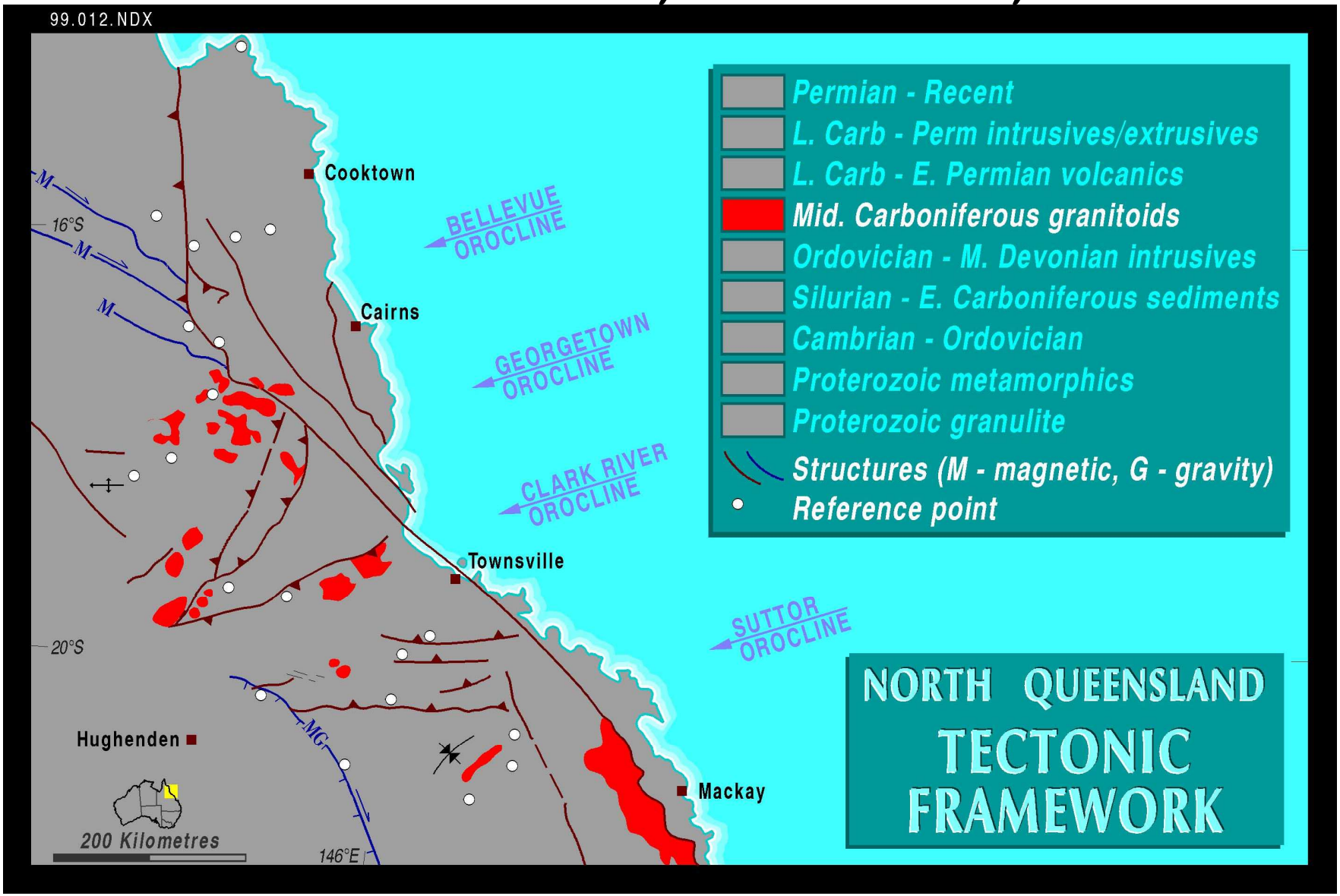
COMPONENTS: Hodgkinson & Broken River linked under cover / Drummond Basin later



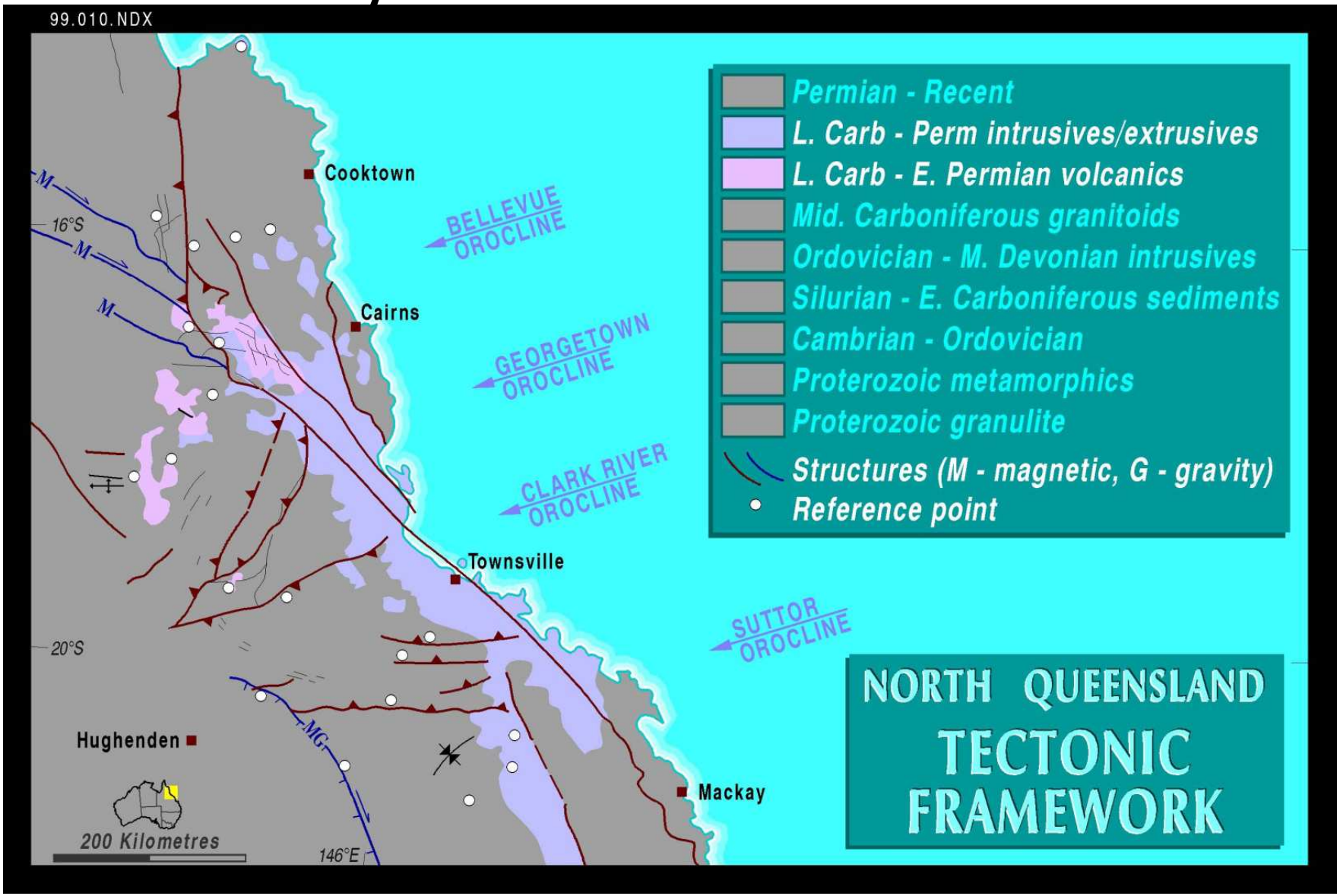
Hodgkinson – Broken River stratigraphic column equivalence



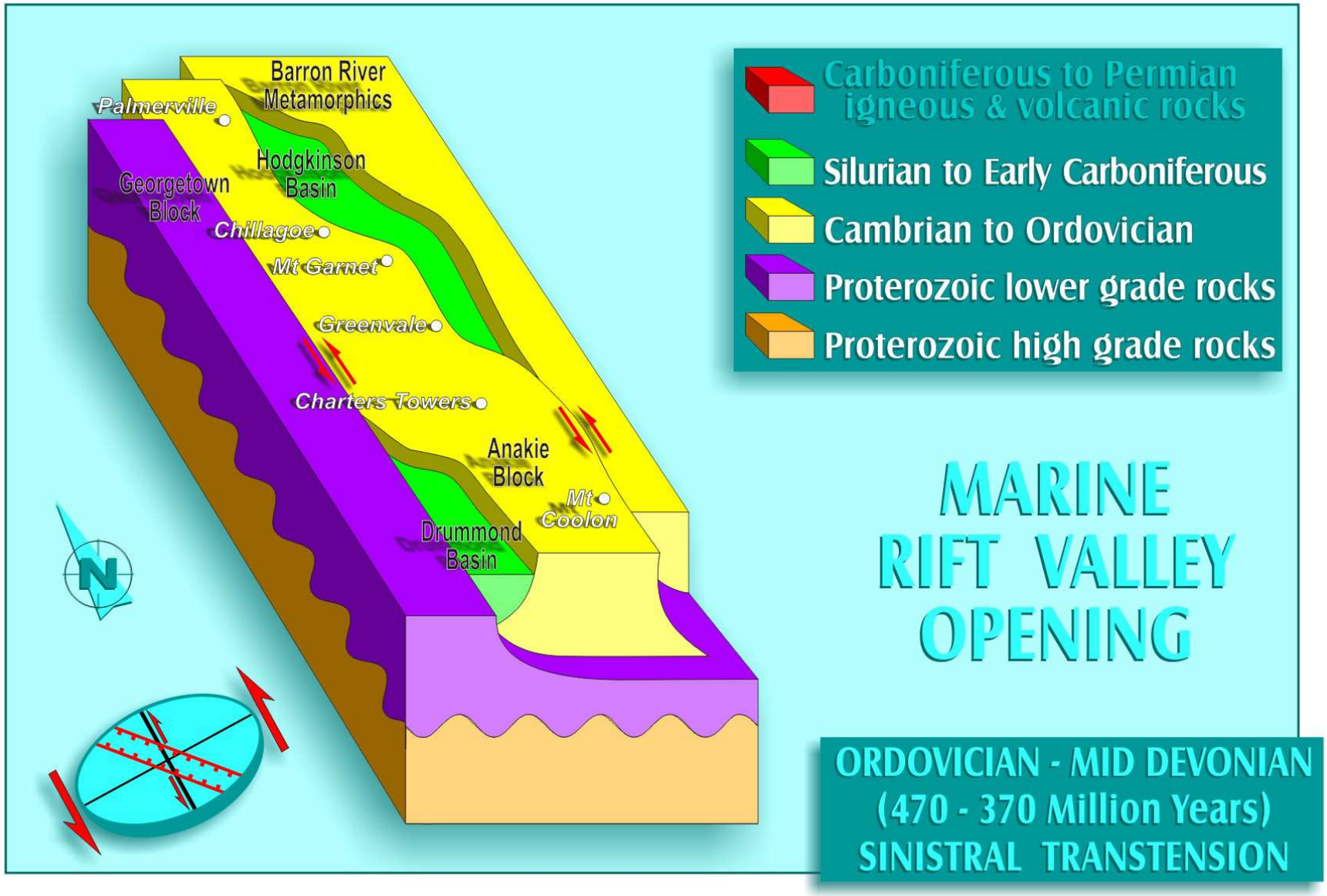
COMPONENTS: 1ST Phase Carb intrusives trend ENE – O'Brien's, Oweenee, Ukalunda



COMPONENTS: Kennedy Assoc'n - Late Carb – Early Permian intrusives trend SE

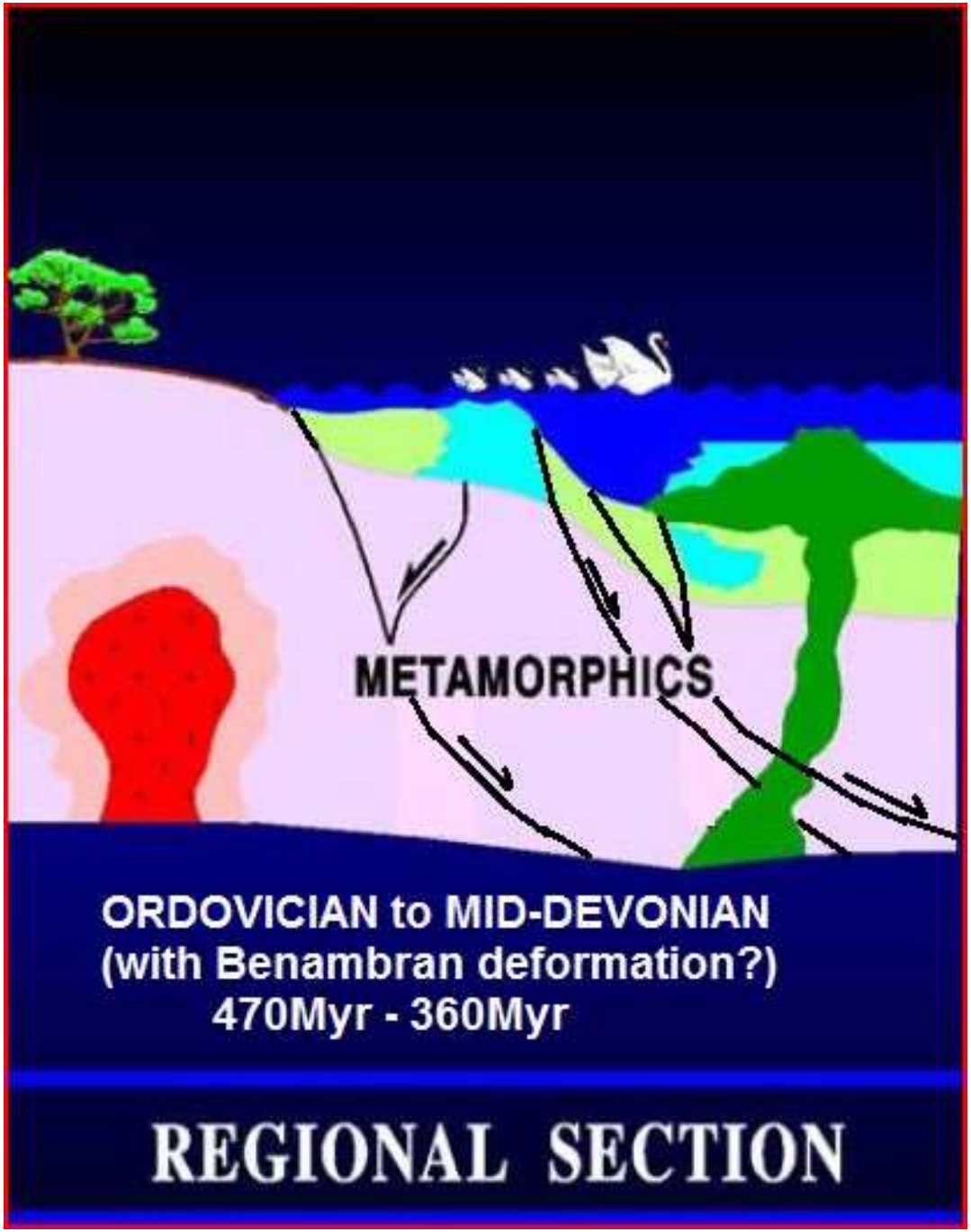


SCHEMATIC BLOCK MODEL – RIFT PHASE

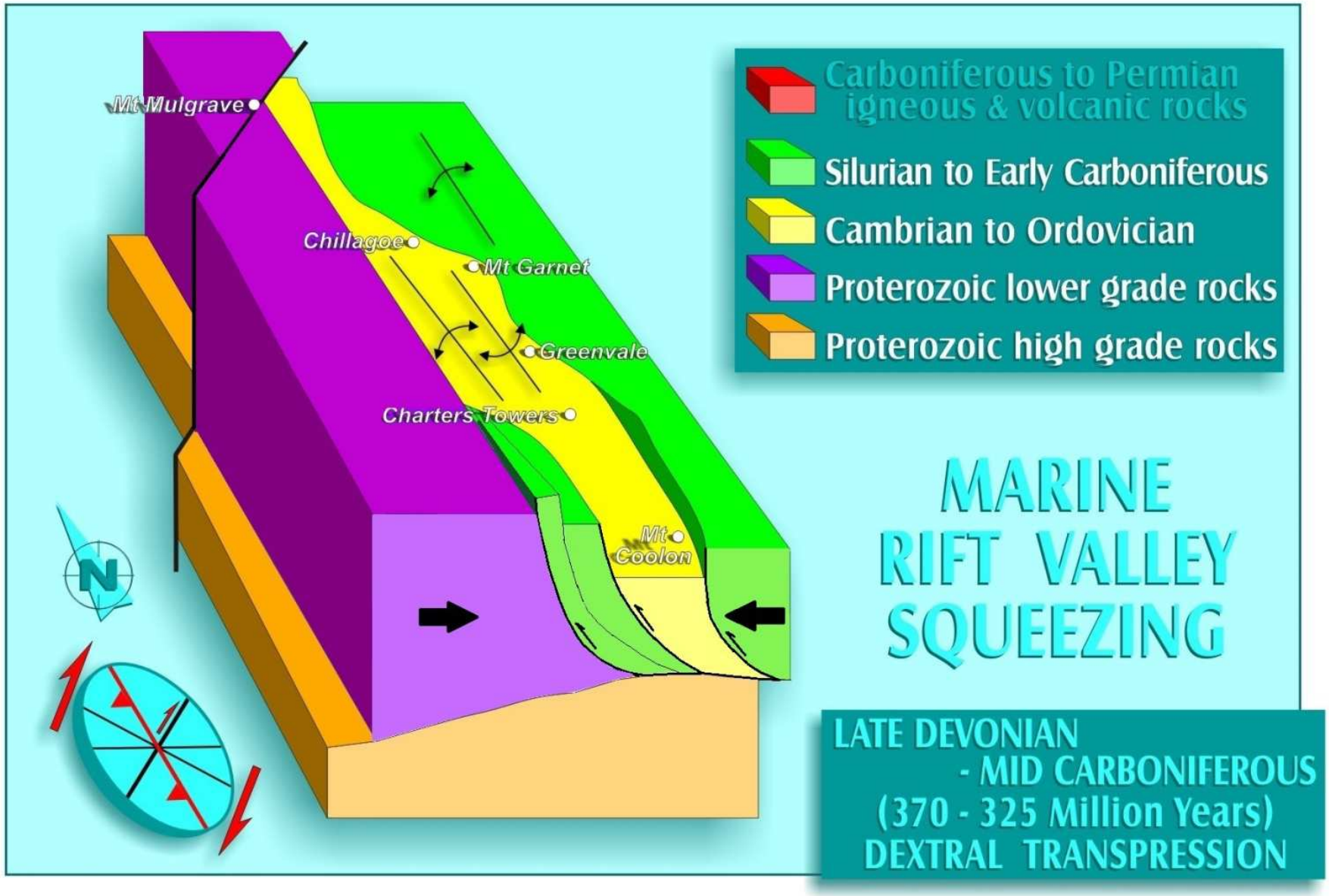


SCHEMATIC SECTION

- Back Arc / Rift
- Marine sediments
- Sediments, Limestones, Marls, Mafic volcanics
- Proterozoic basement

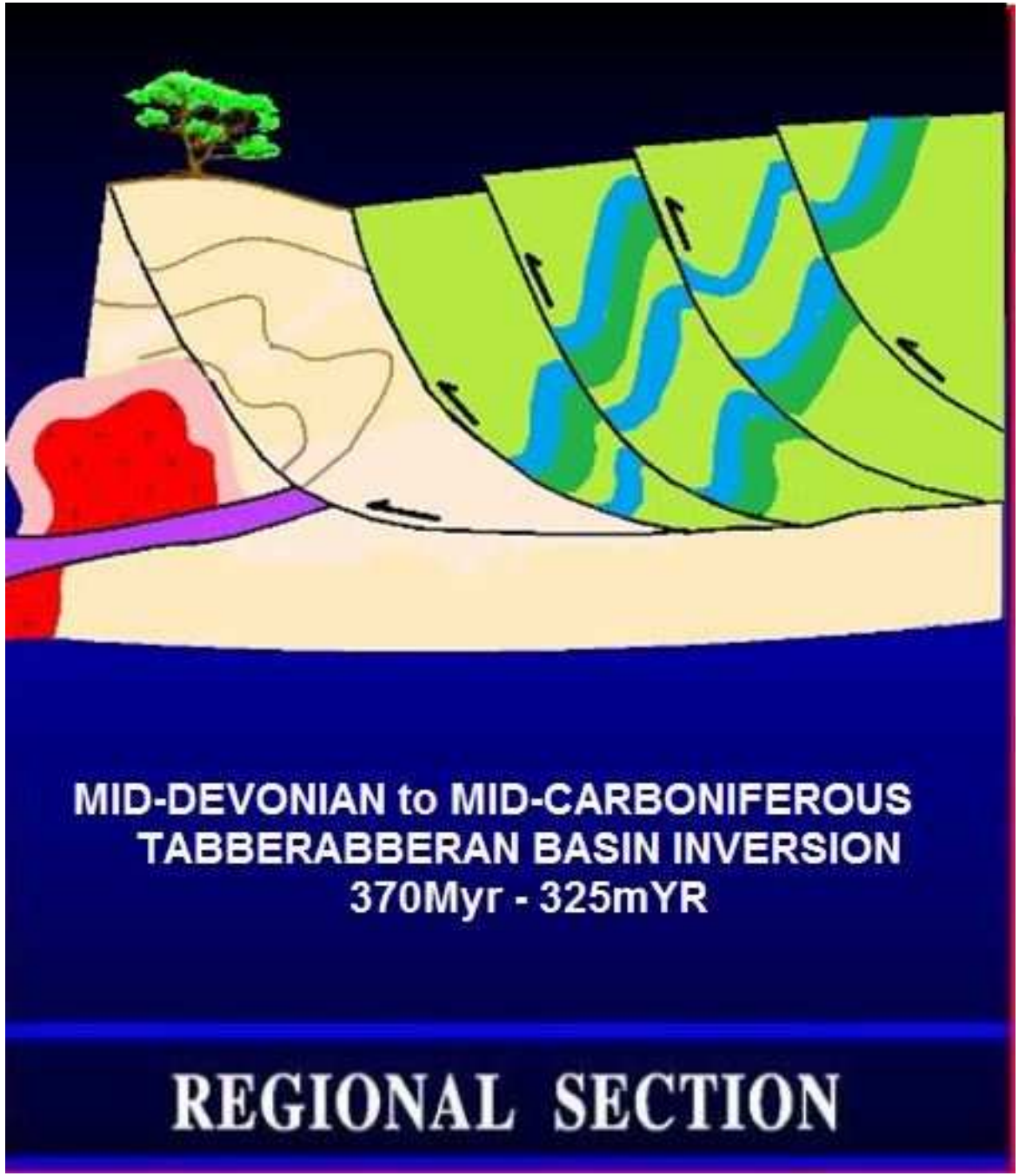


SCHEMATIC BLOCK MODEL –INVERSION

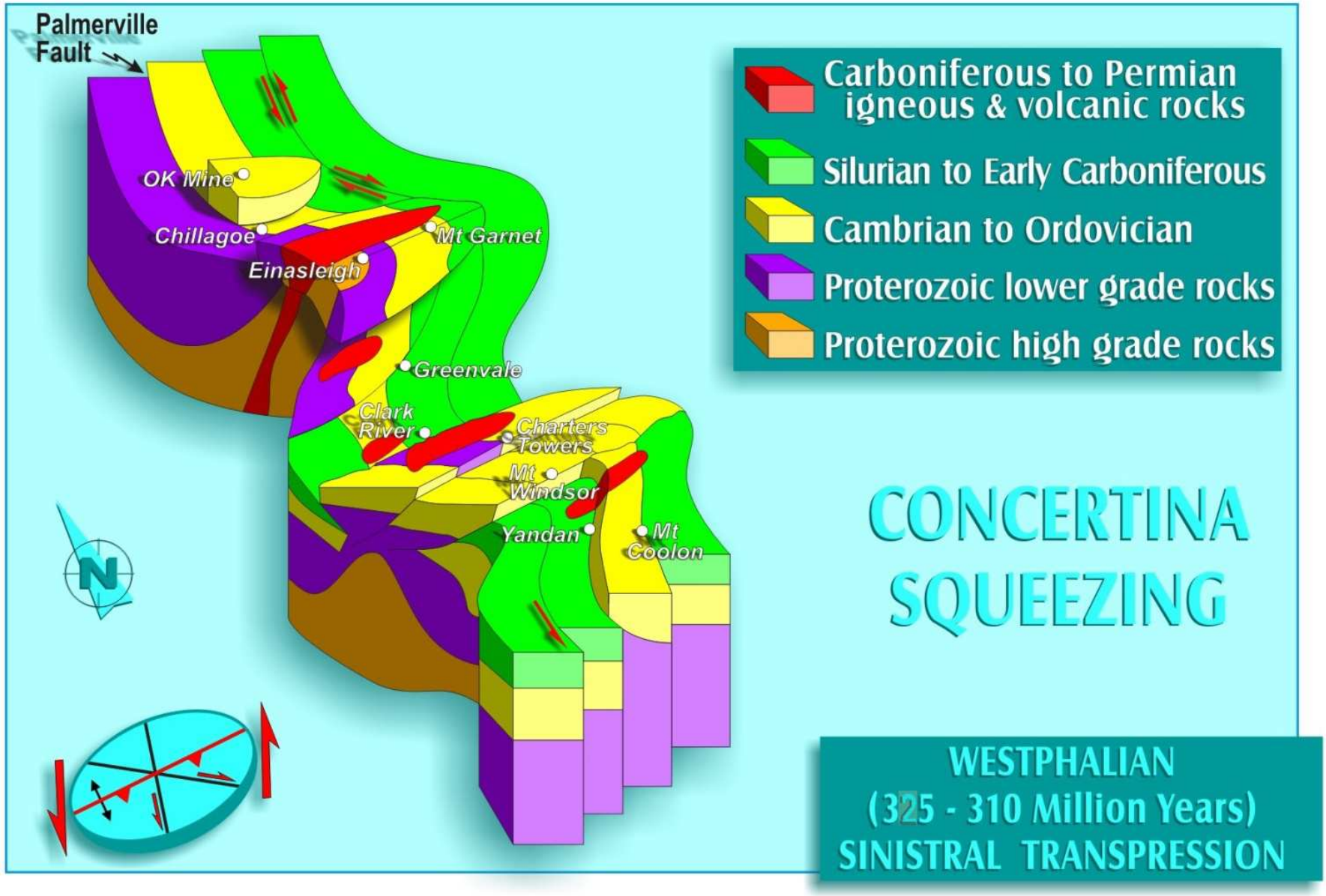


SCHEMATIC SECTION

- Inversion
- Steep west-verging thrusts
- Generally west-younging bedding

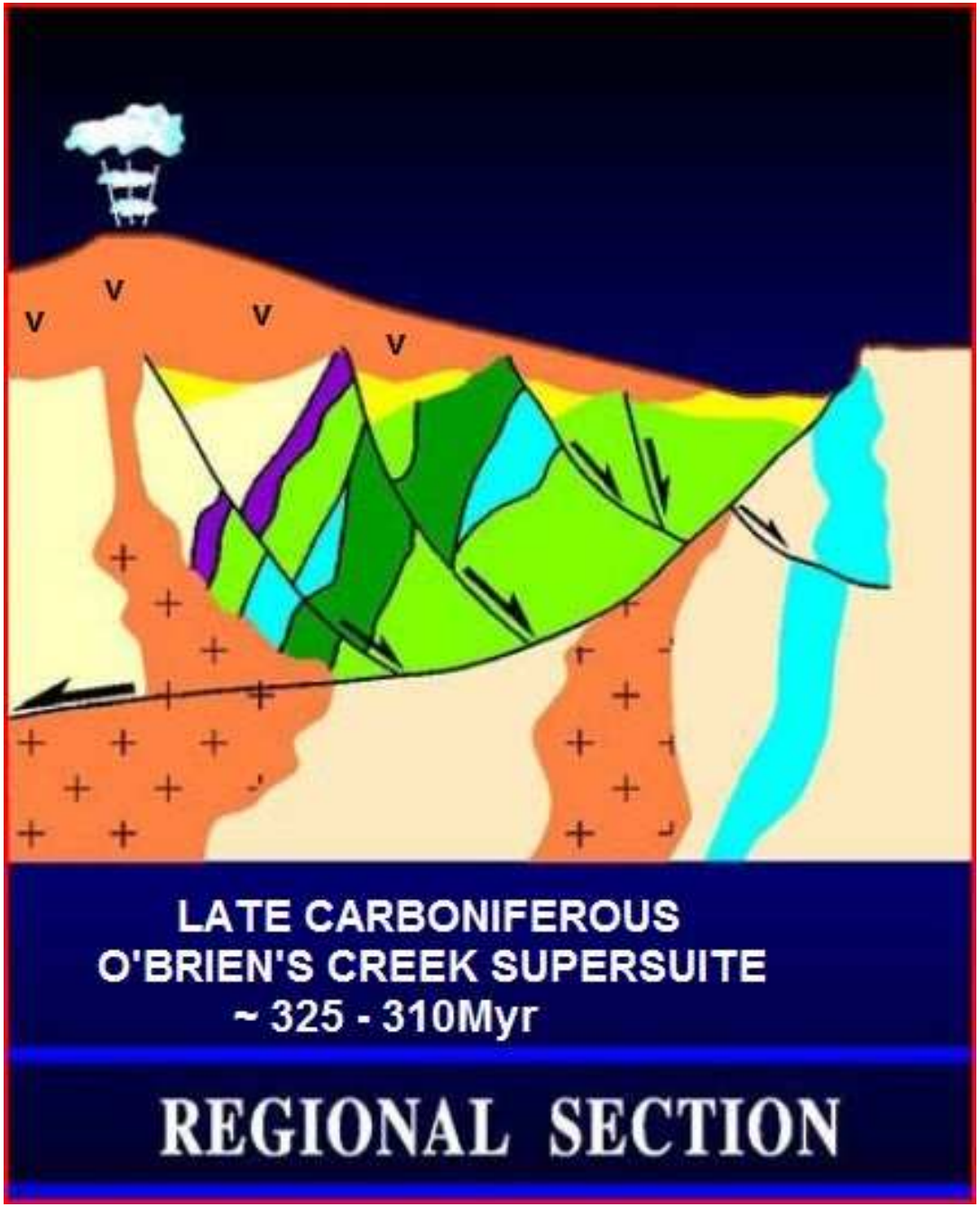


SCHEMATIC BLOCK MODEL - OROCLINAL



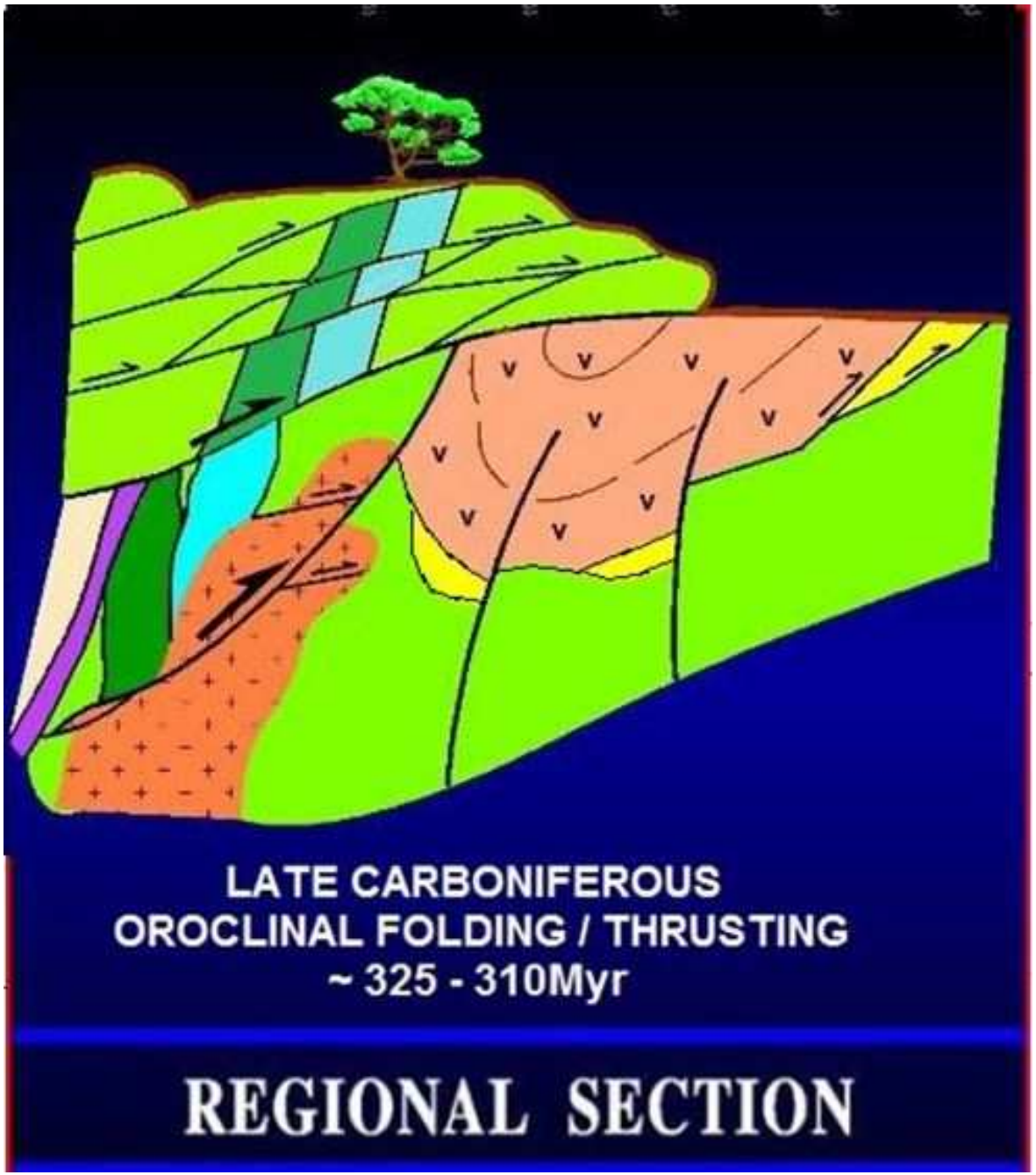
SCHEMATIC SECTION

- Extension
- 1st Phase Carb volcanics & intrusives
- Listric faulting on Inversion thrusts

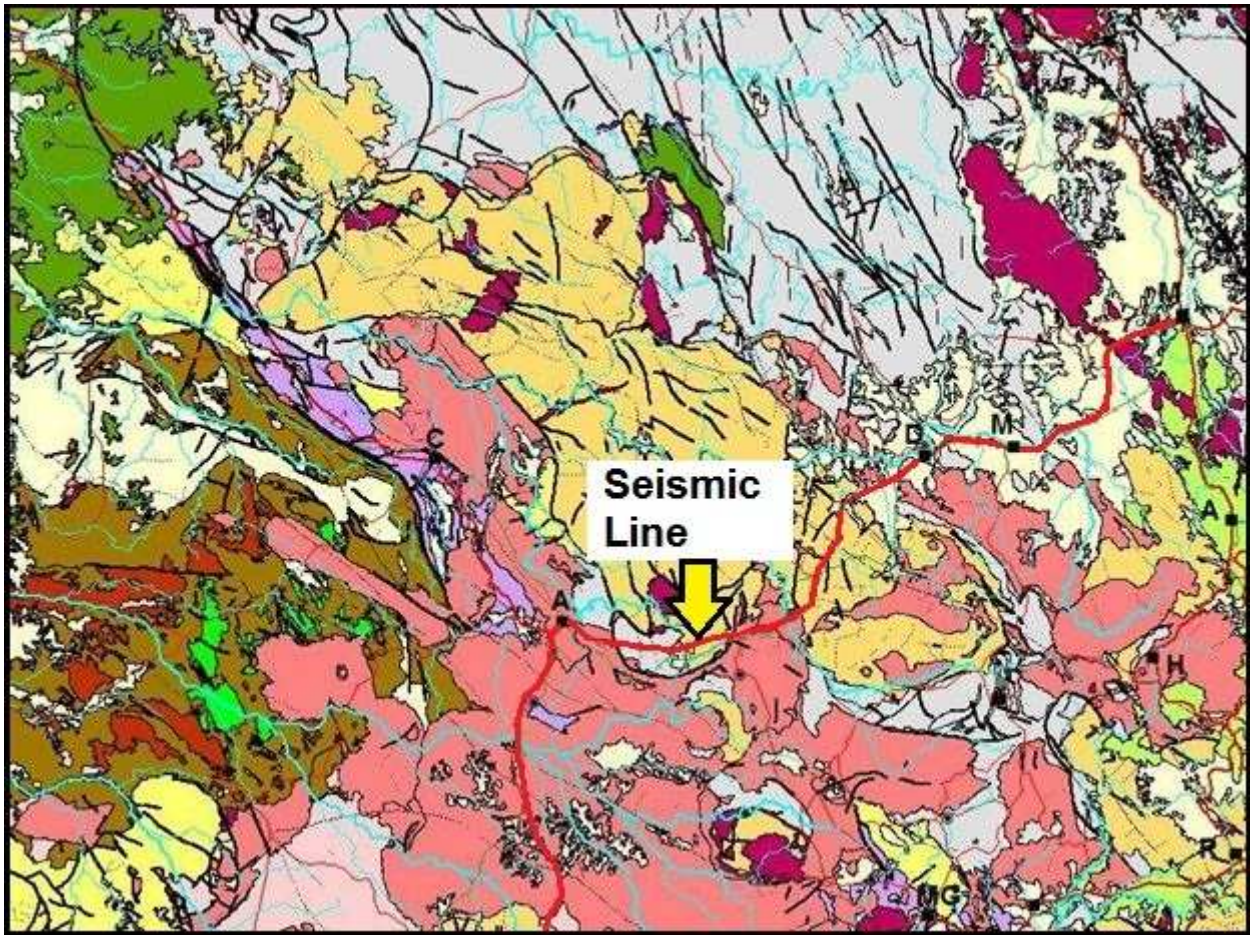


SCHEMATIC SECTION

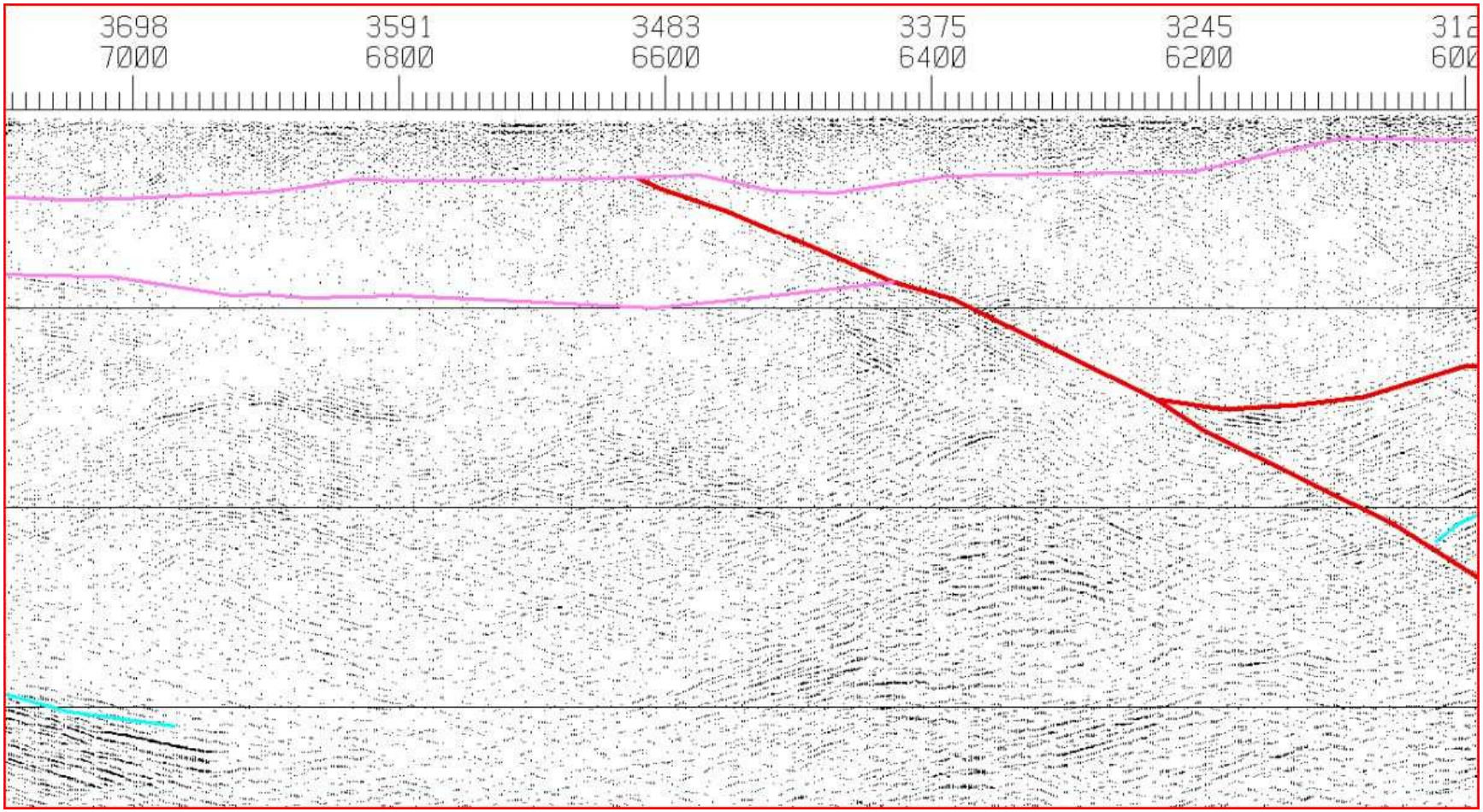
- NS Compression
- Folding of 1st Phase Carb volcanics
- Shallow NE-verging back thrusts
- Incremental thrust displacement



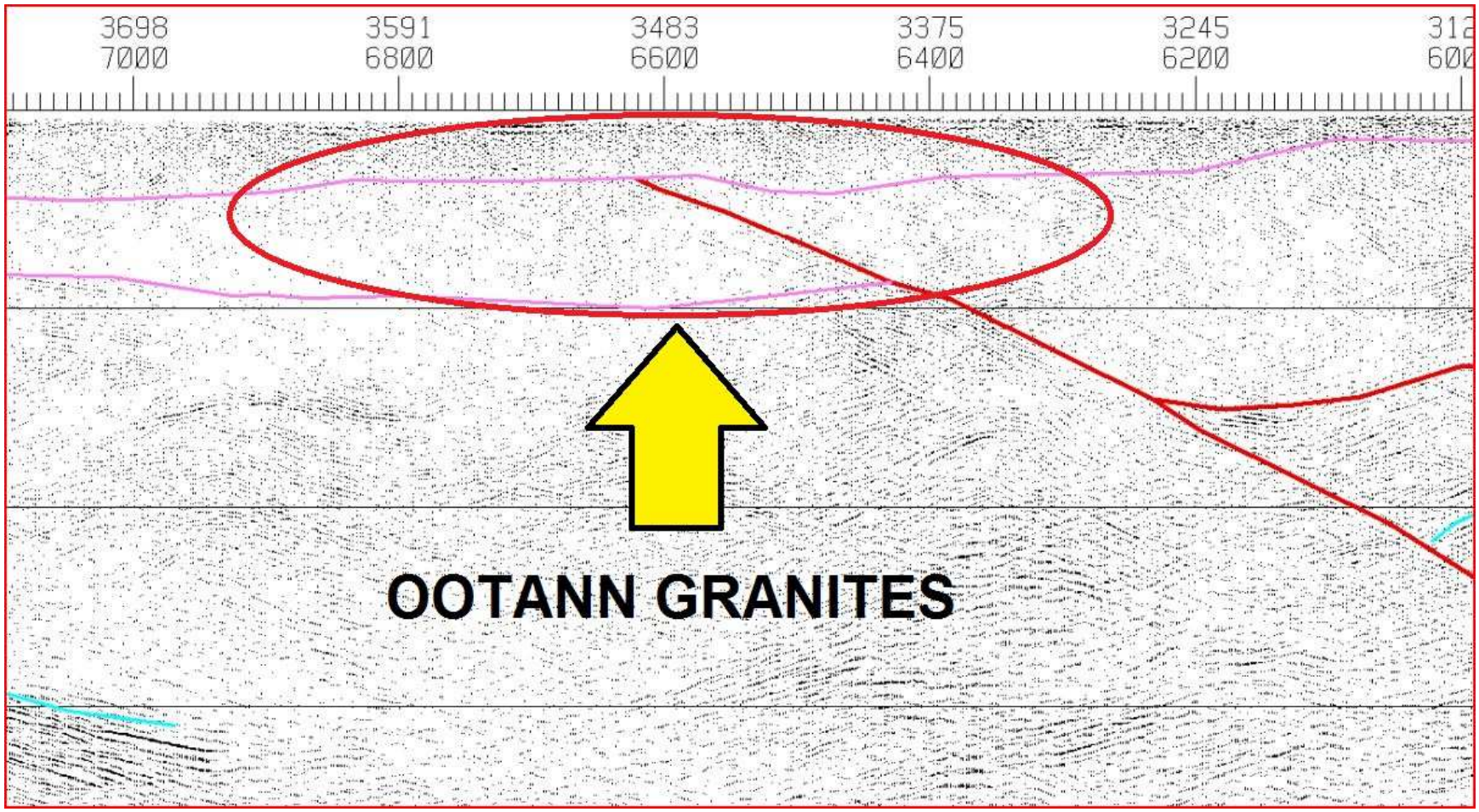
Palmerville Fault response to Mareeba – Mount Surprise Seismic Line ????



DEEP SEISMIC LINE
Palmerville Fault - Henderson et al 2009

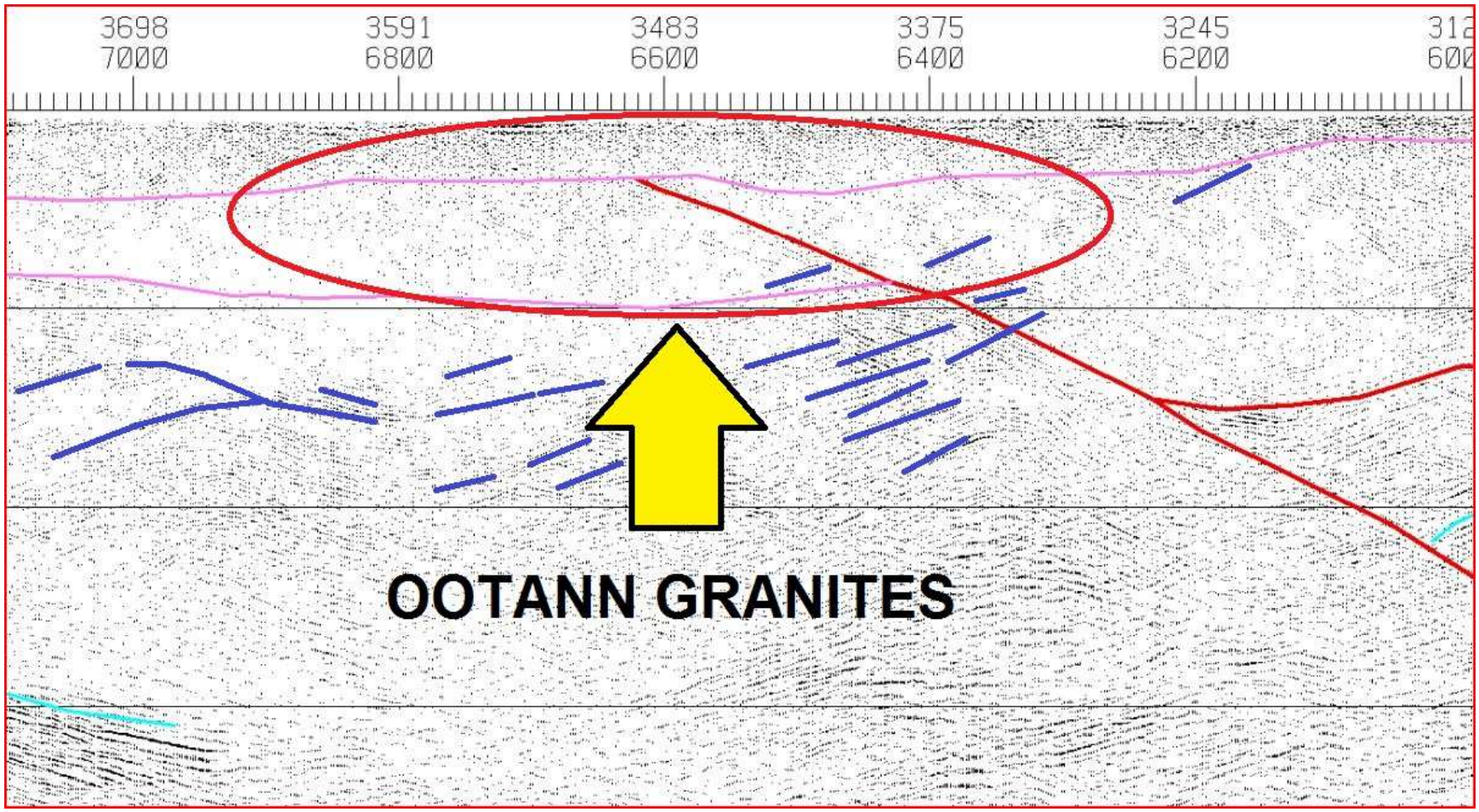


But uncertainty due to major granite stitching through seismic section line

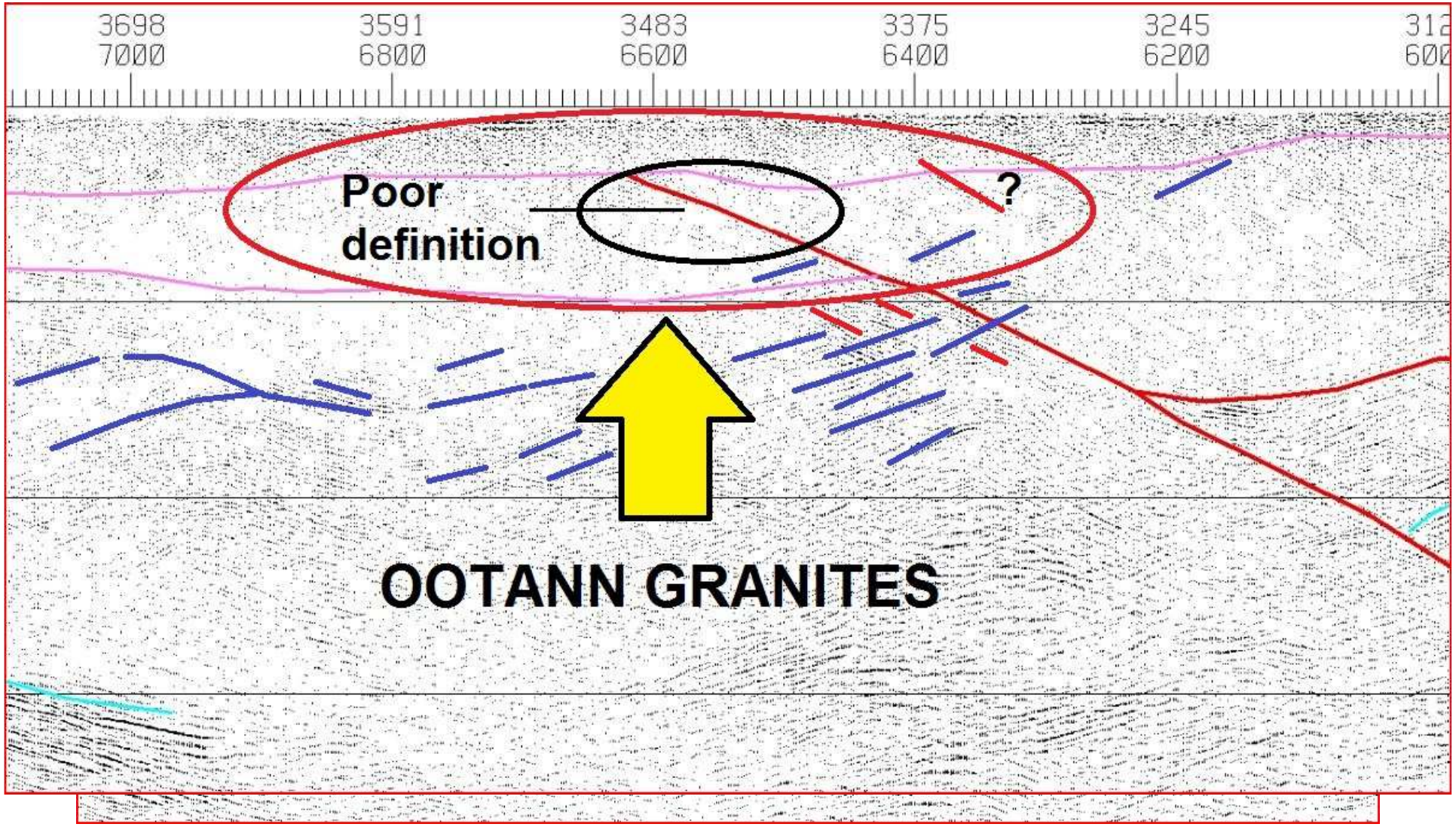


Agree with North-dipping structure – YES

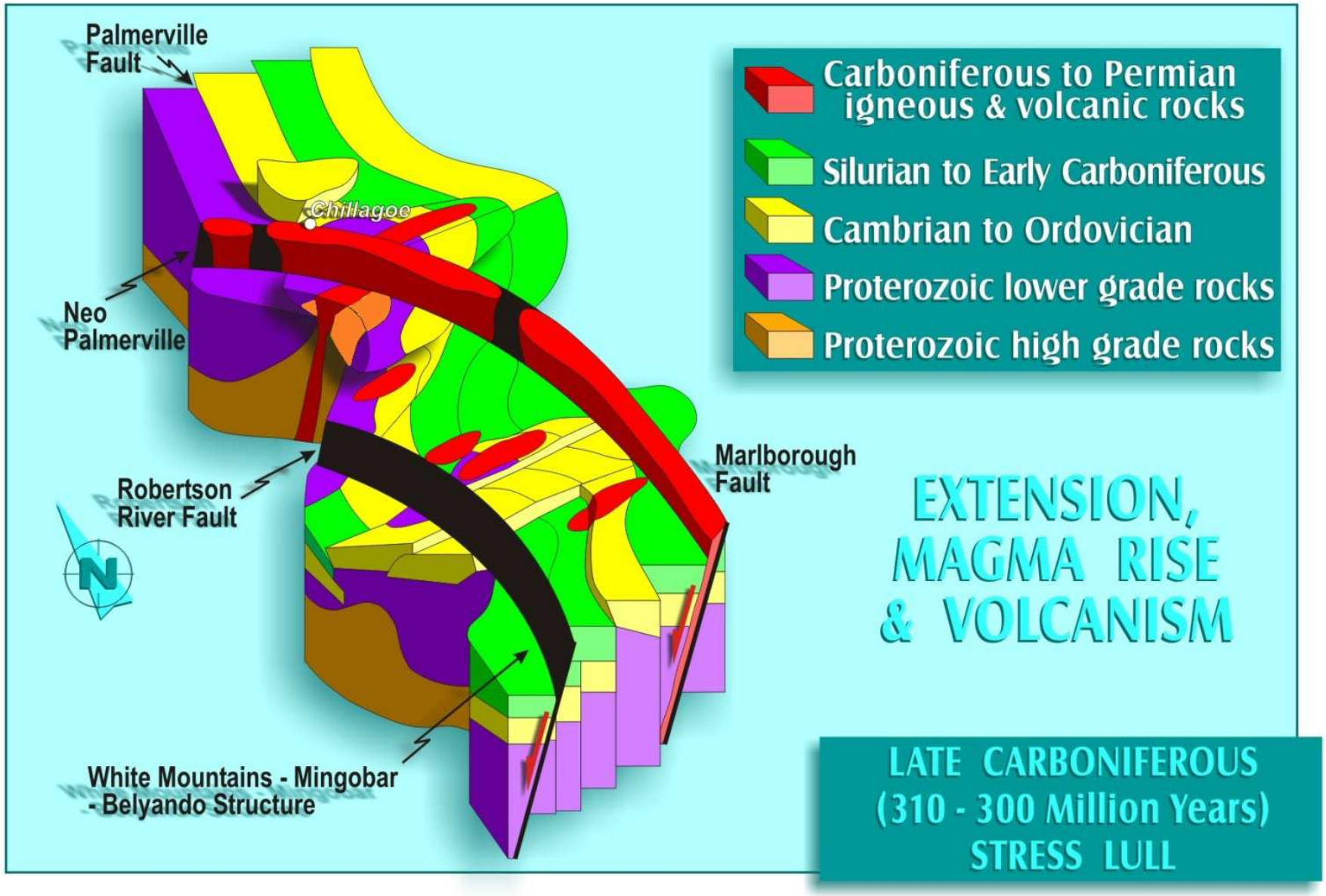
But much stacked South-dip structure also.



Henderson et al XXXX – E dipping thrust

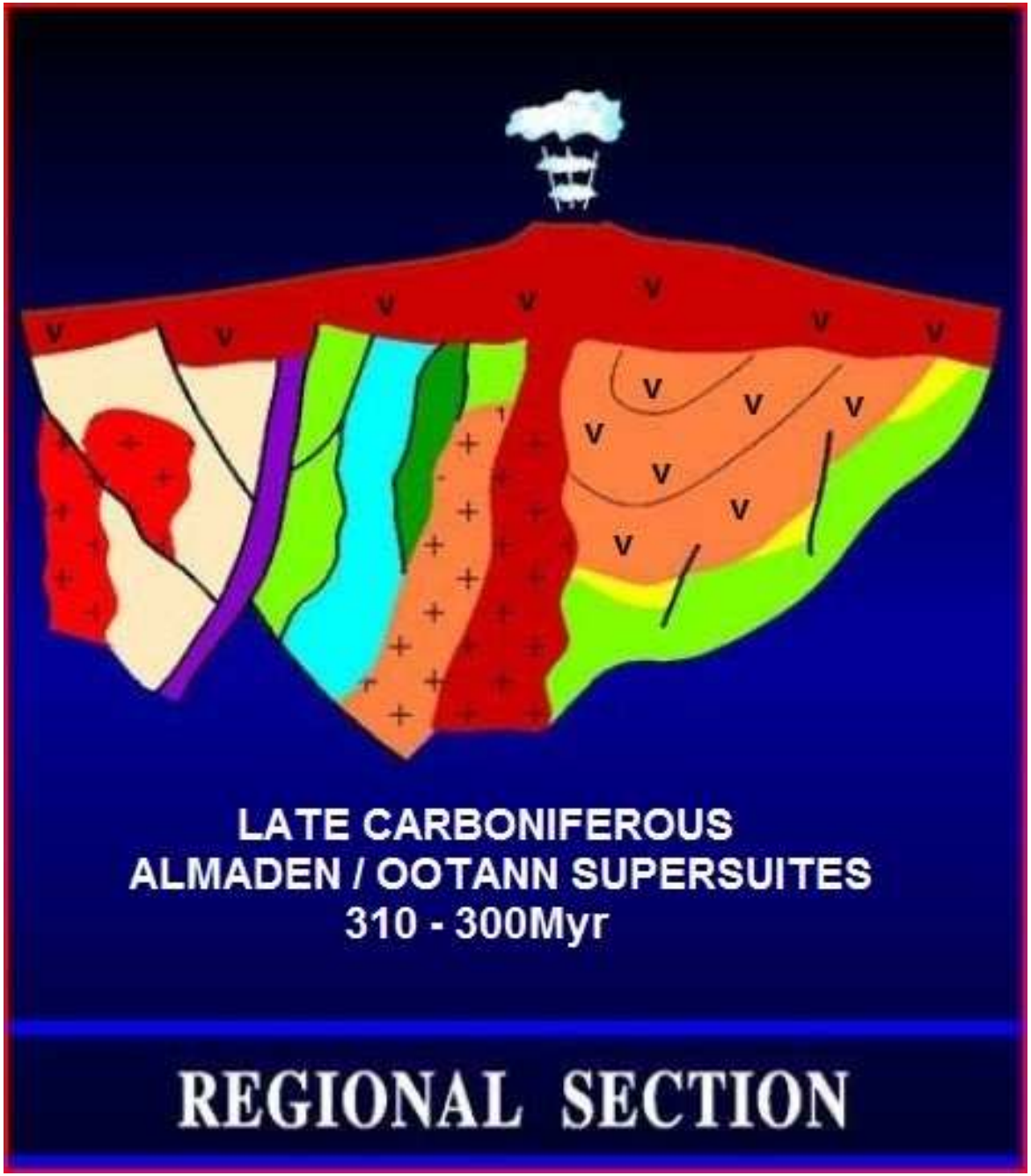


SCHEMATIC BLOCK MODEL –EXTENSION

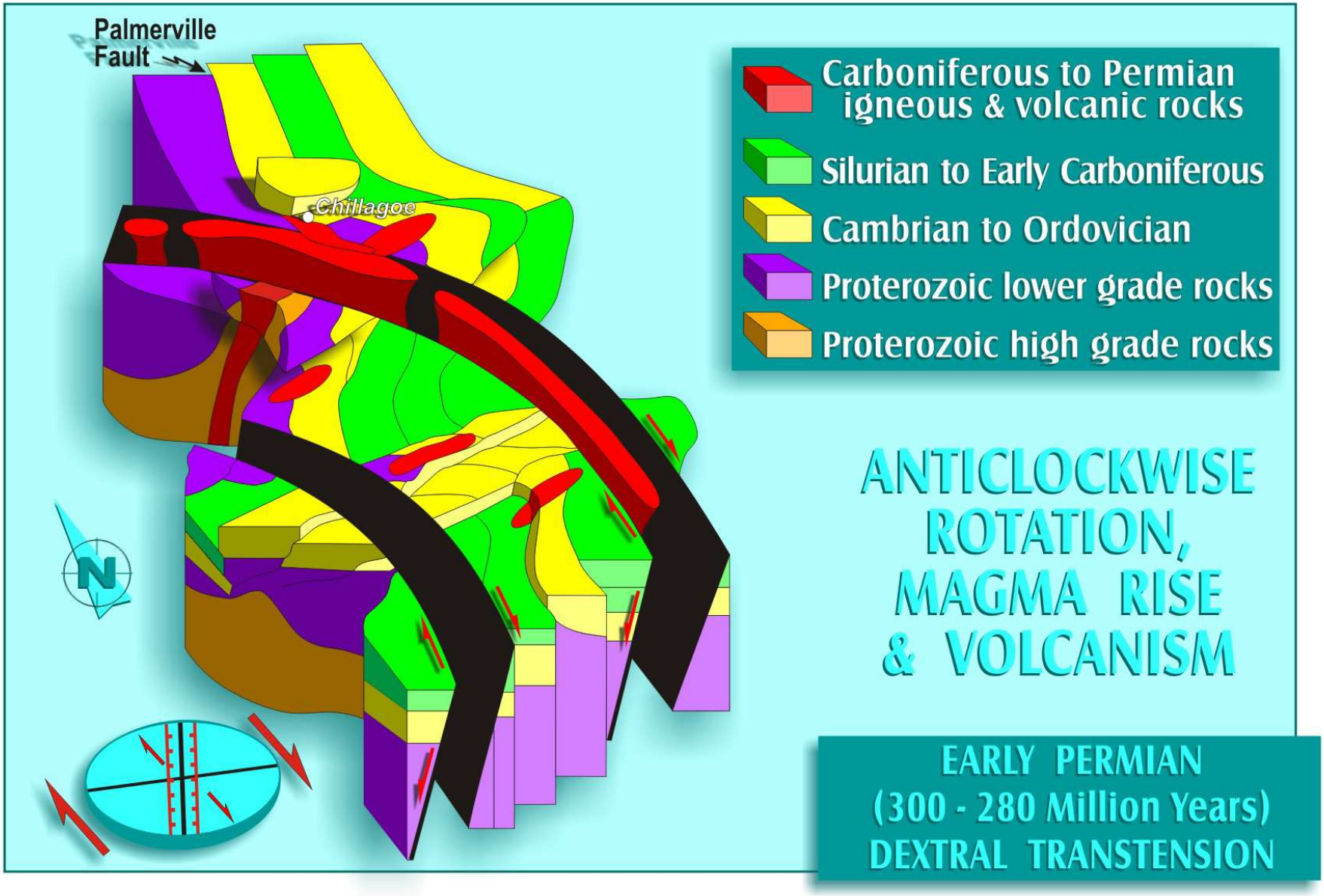


SCHEMATIC SECTION

- Extension
- 2nd Phase Carboniferous volcanics & intrusives
- Intrusives stitch thrusts

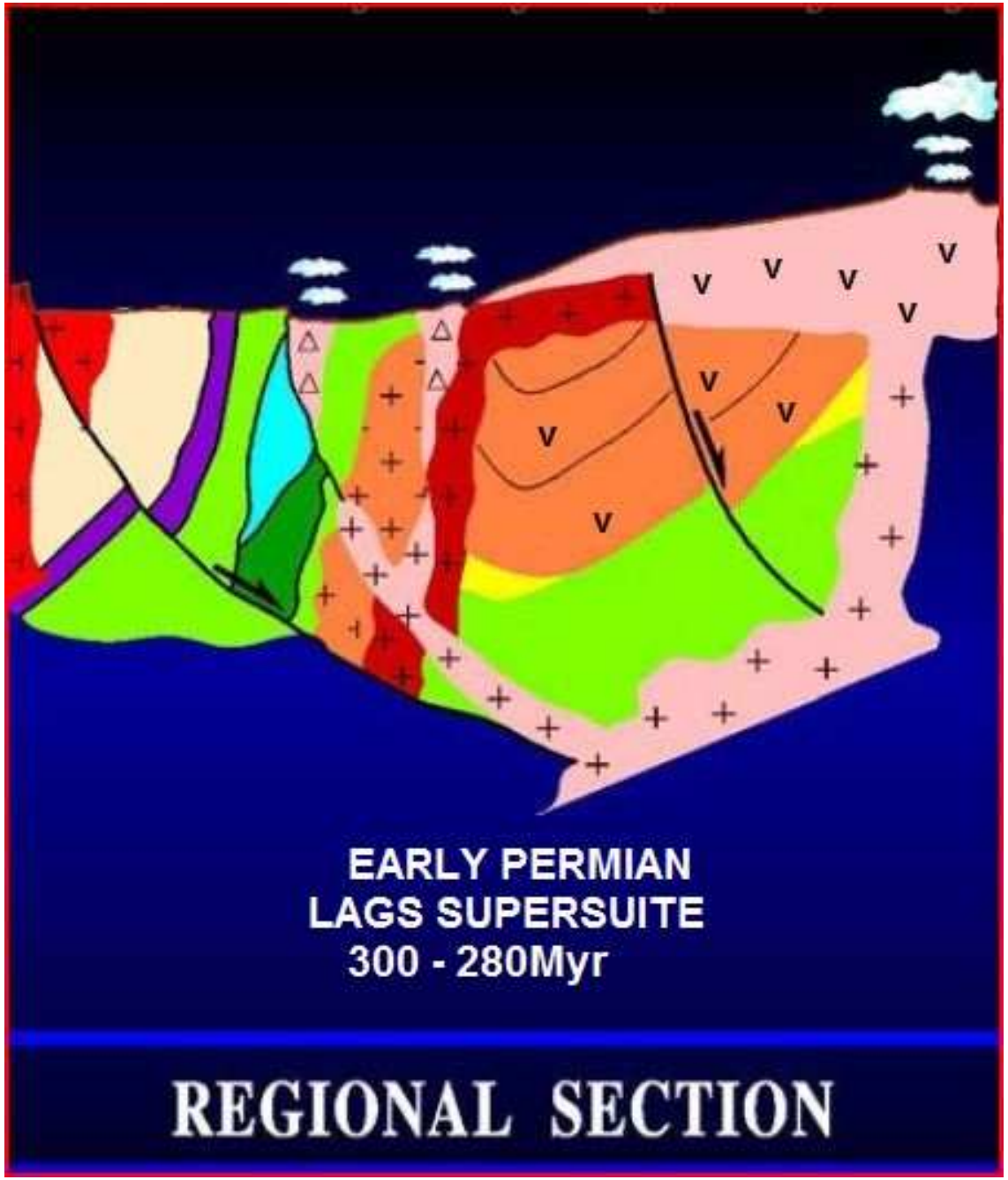


SCHEMATIC BLOCK MODEL – DEXTRAL SLIP



SCHEMATIC SECTION

- Dextral transpression
- Erosion of ~ 2km
- 3rd Phase Early Permian volcanics & intrusives
- Palaeosurface currently preserved
- Hot spring mud pots & sinters



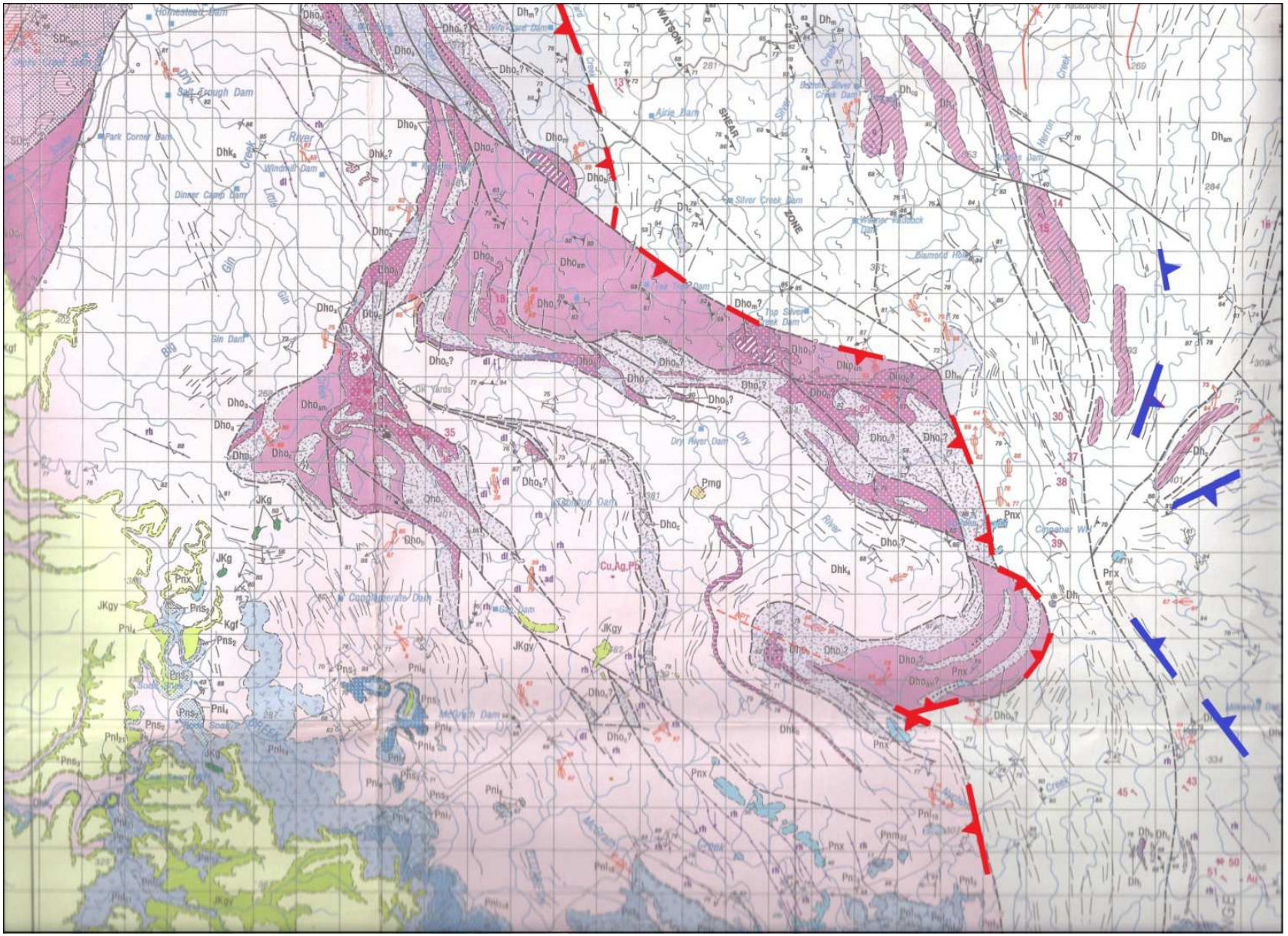
HODGKINSON BASIN

- DNRM airborne Ternary U-Th-K radiometrics shows very different pattern to 1:100K mapping

HODGKINSON BASIN

- Palmerville Fault & inverted basin sediments west-verging oroclinal structures
- Overprinted by shallow east-verging highly contorted back thrusts

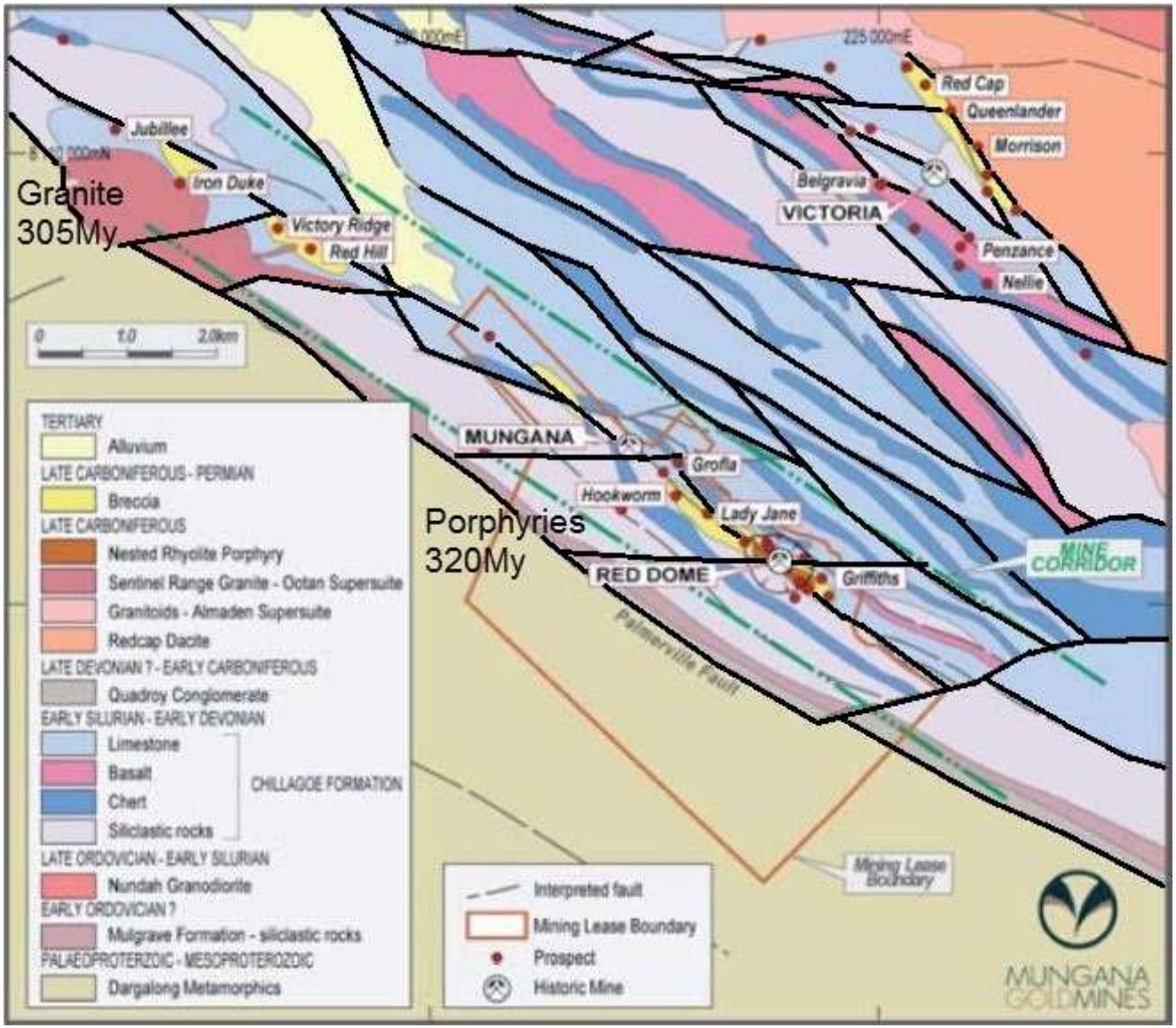
Bellevue Orocline axis – opposing vergence



RED DOME MINE CORRIDOR

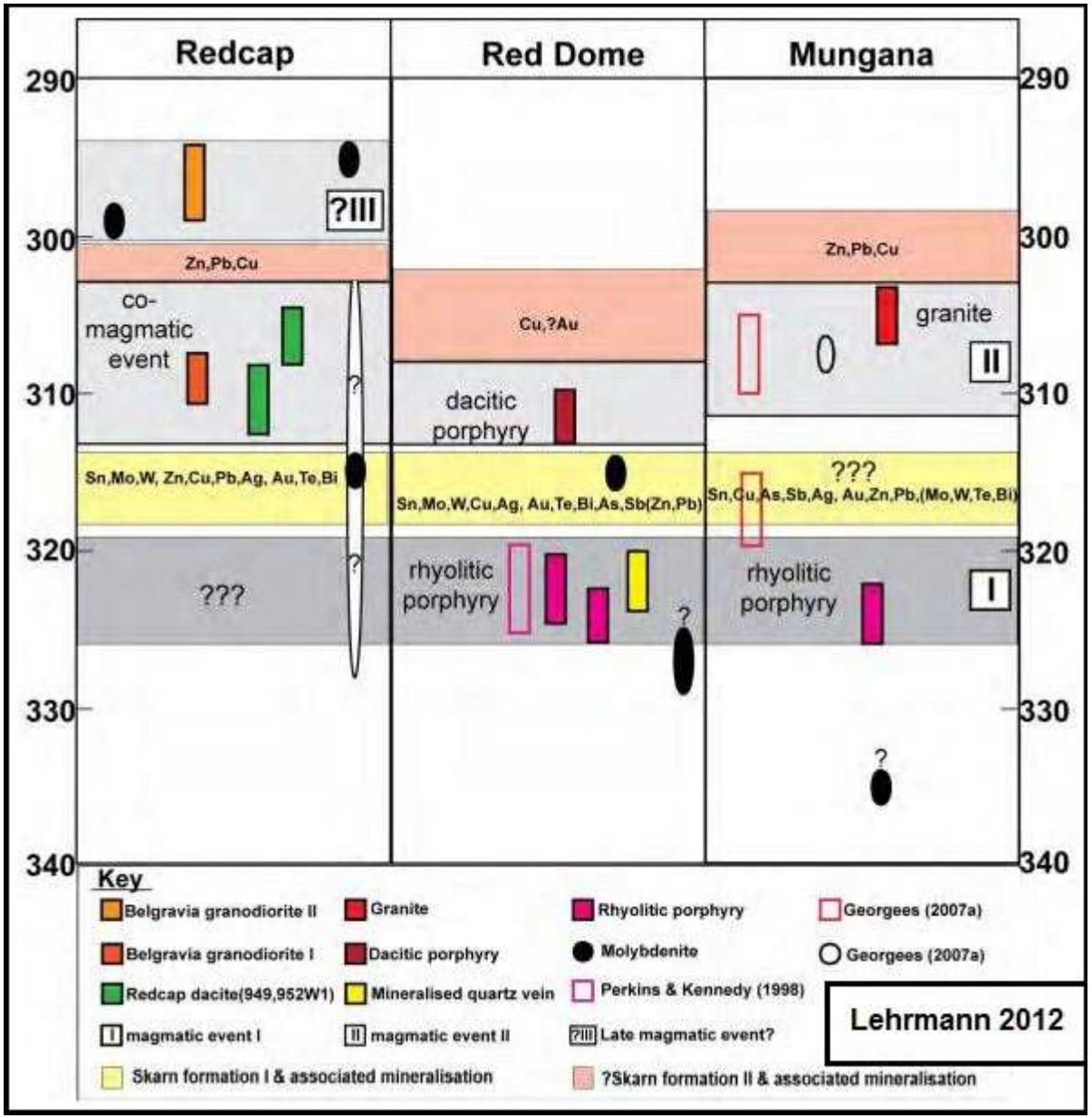
Parallel to Palmerville Fault.

9km between Red Dome and Jubilee at NW end

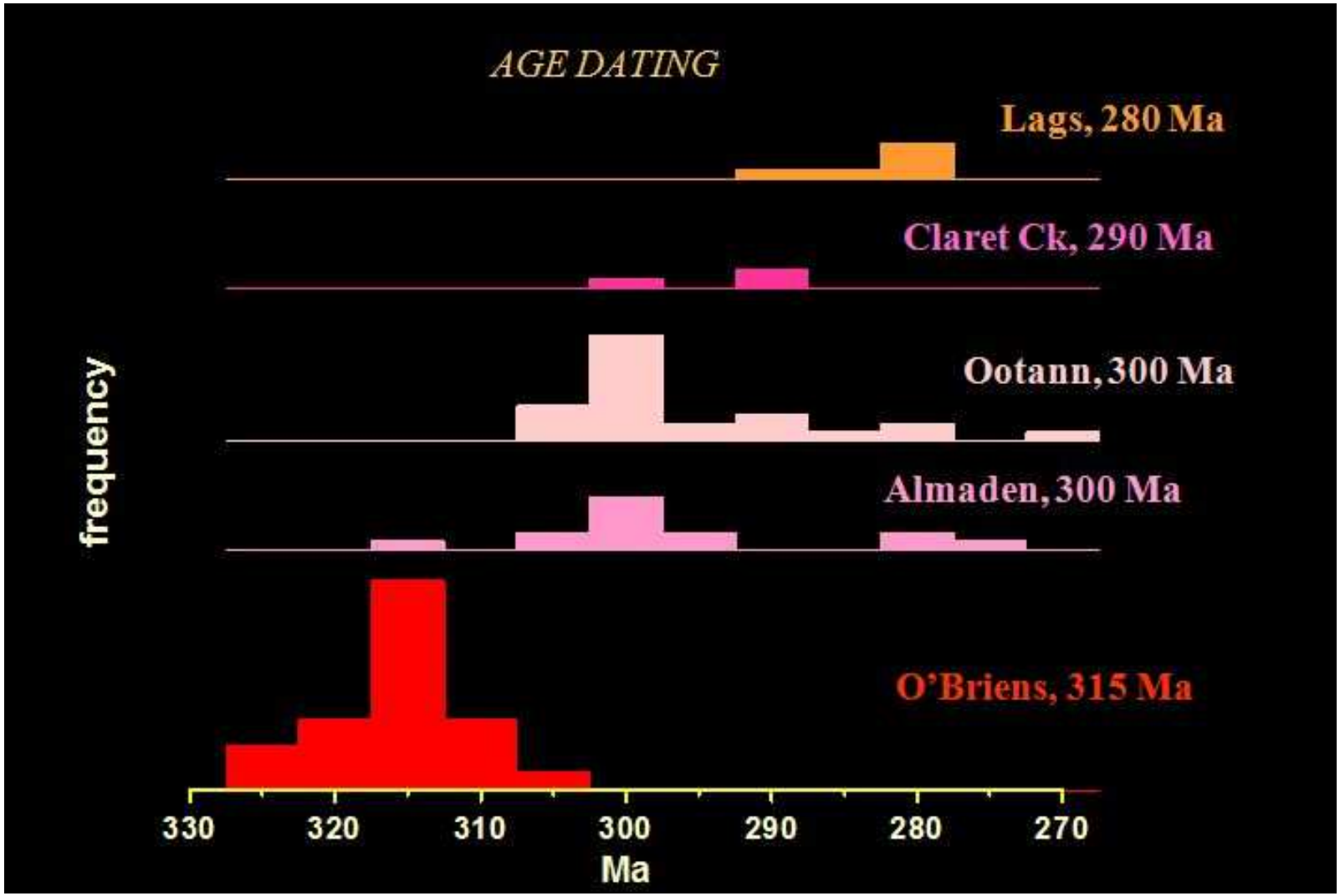


AGE DATING COMPILATION

- U-Pb SHRIMP & Laser Ablation
- Perkins & Kennedy 1998
- Georgees 2007
- Lehrmann 2012



REGIONAL MAGMATIC SUPERSUITES AGE DATING COMPILATION



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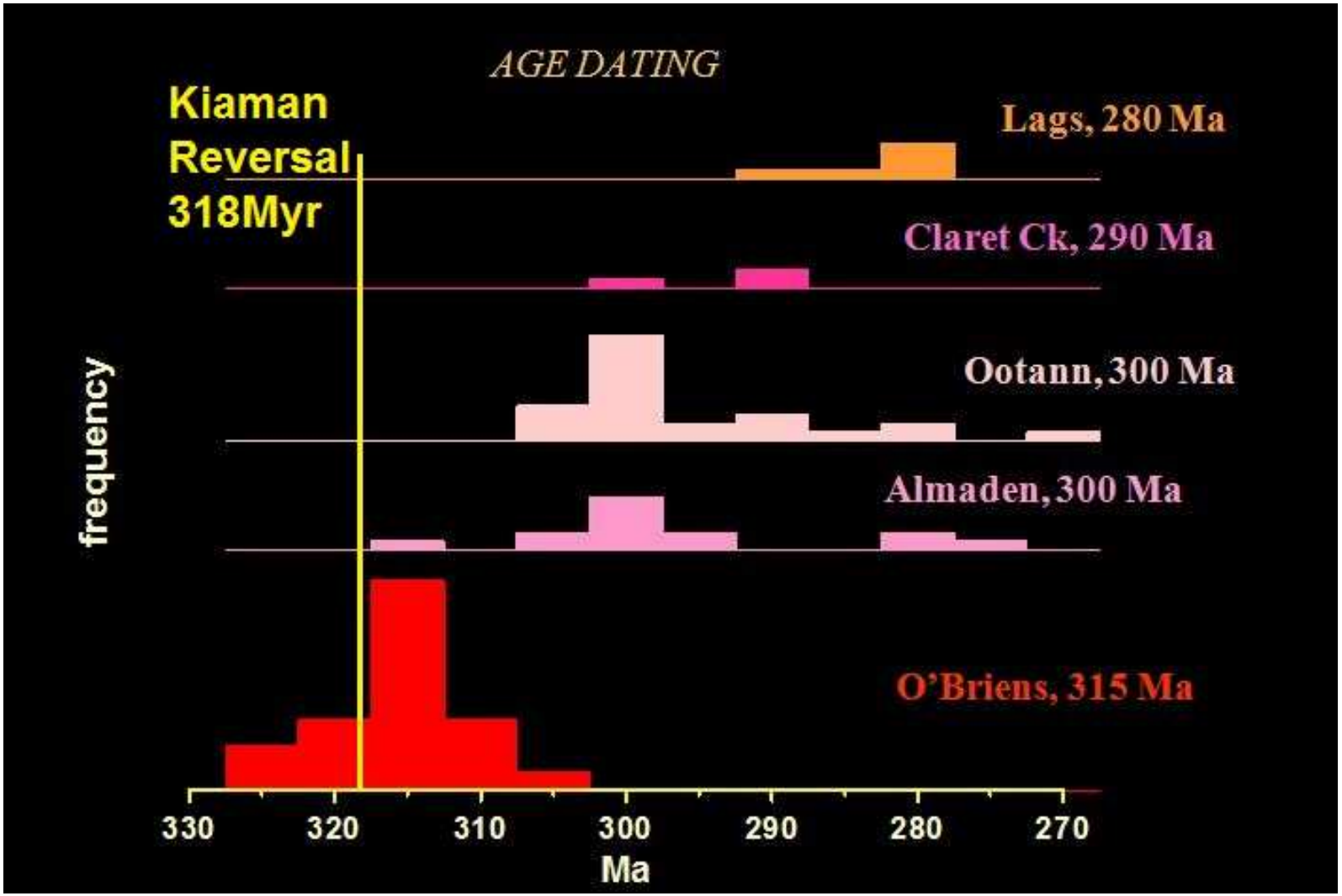

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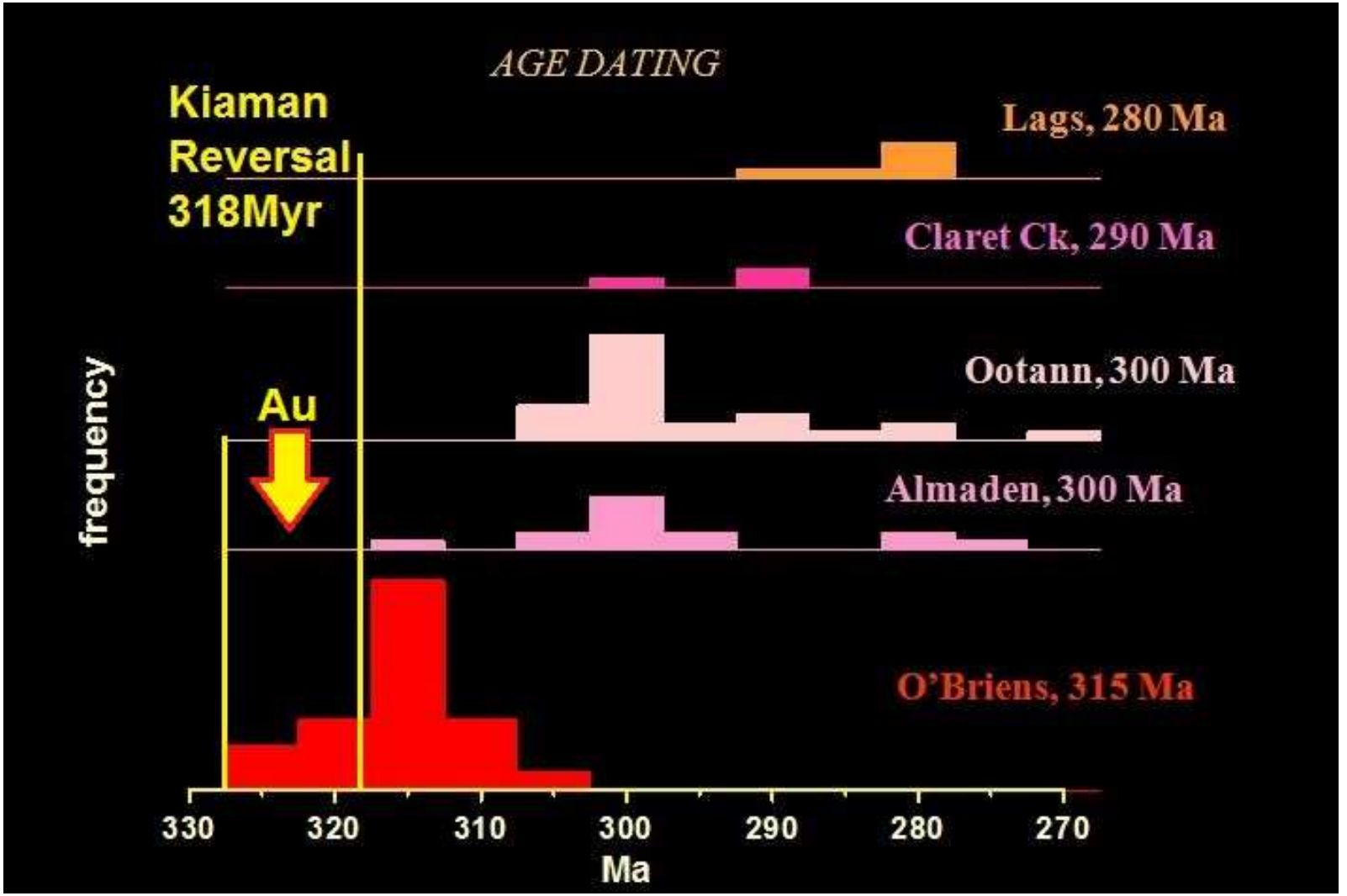
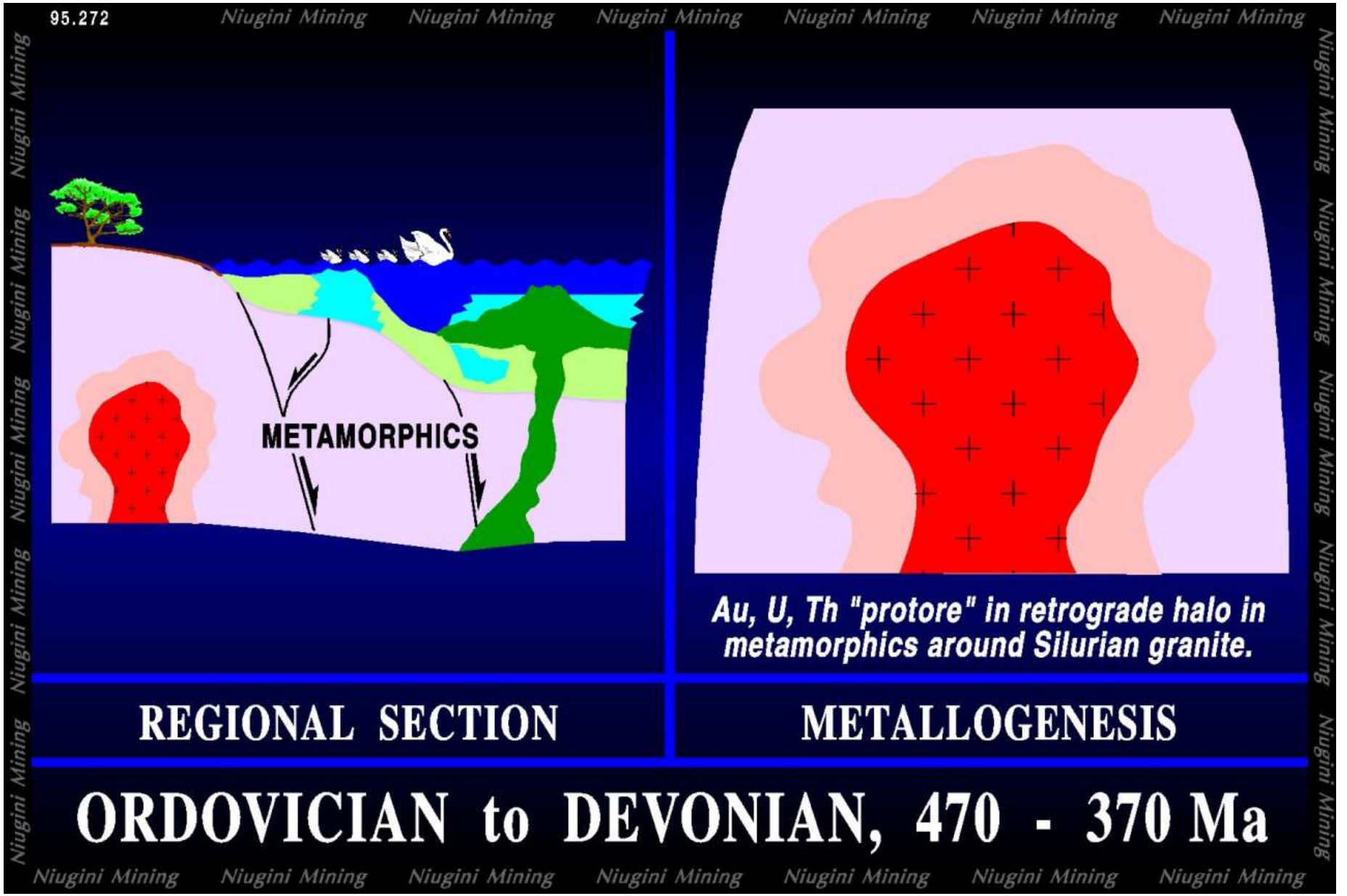
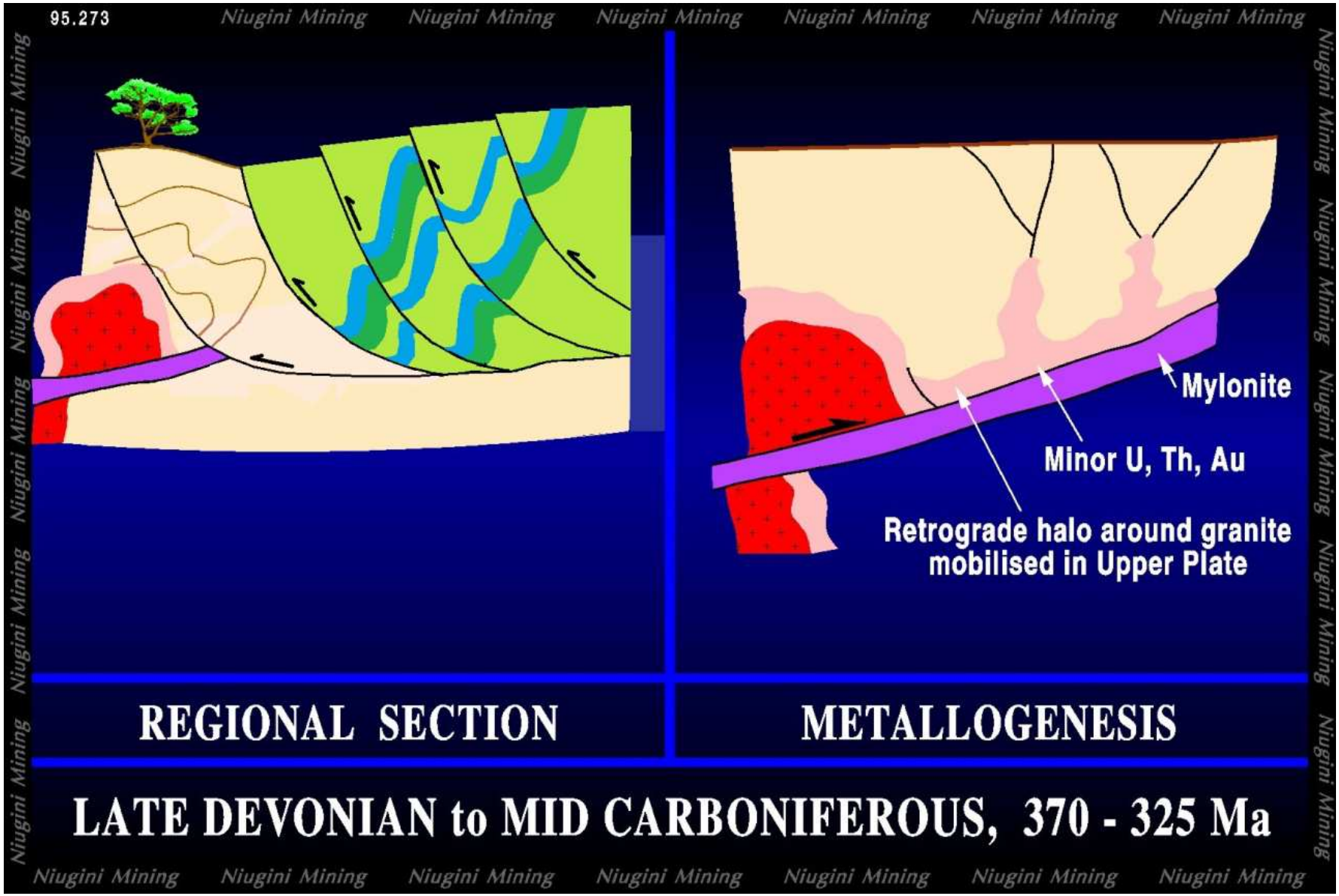


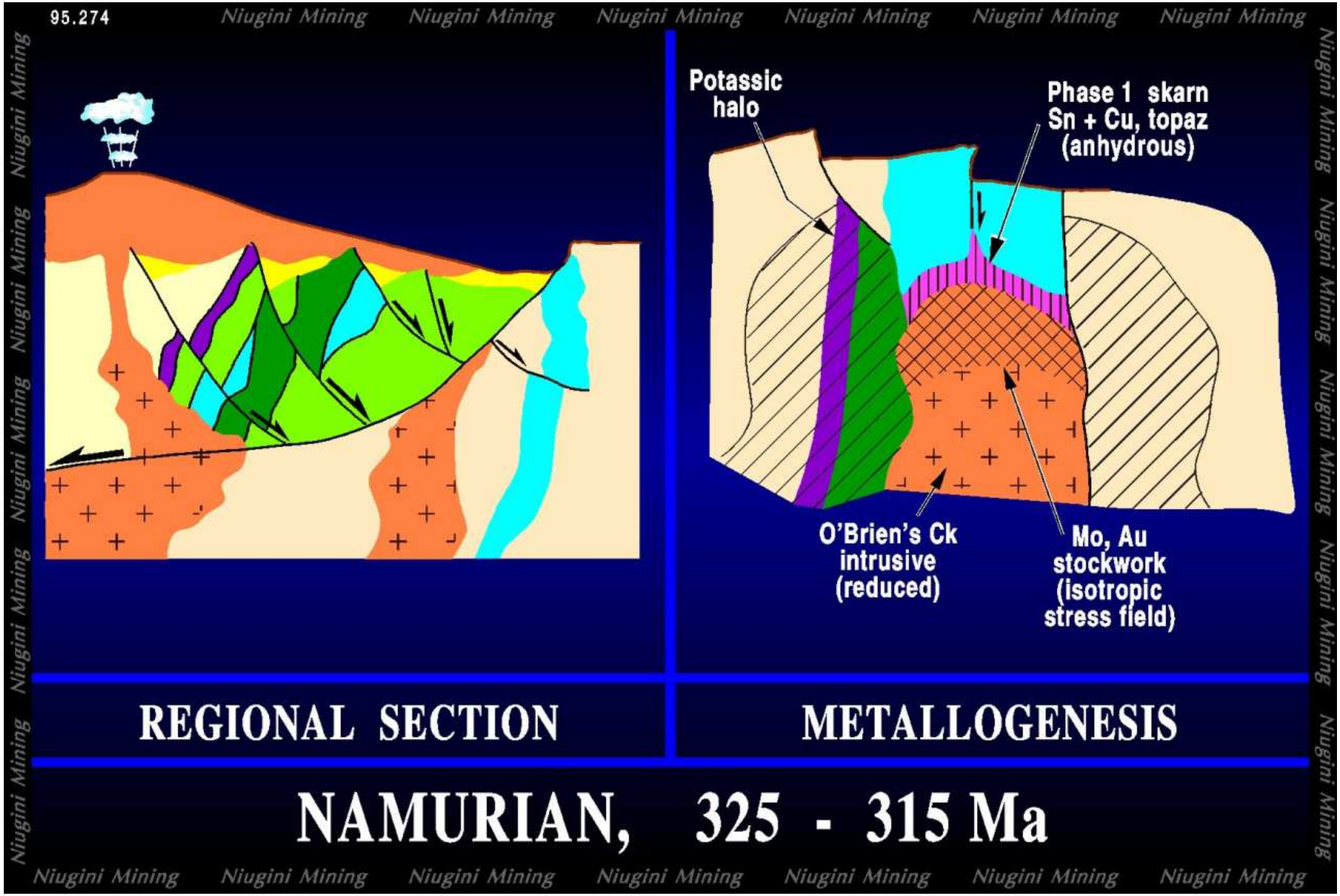
Besshi base metals with mafics???



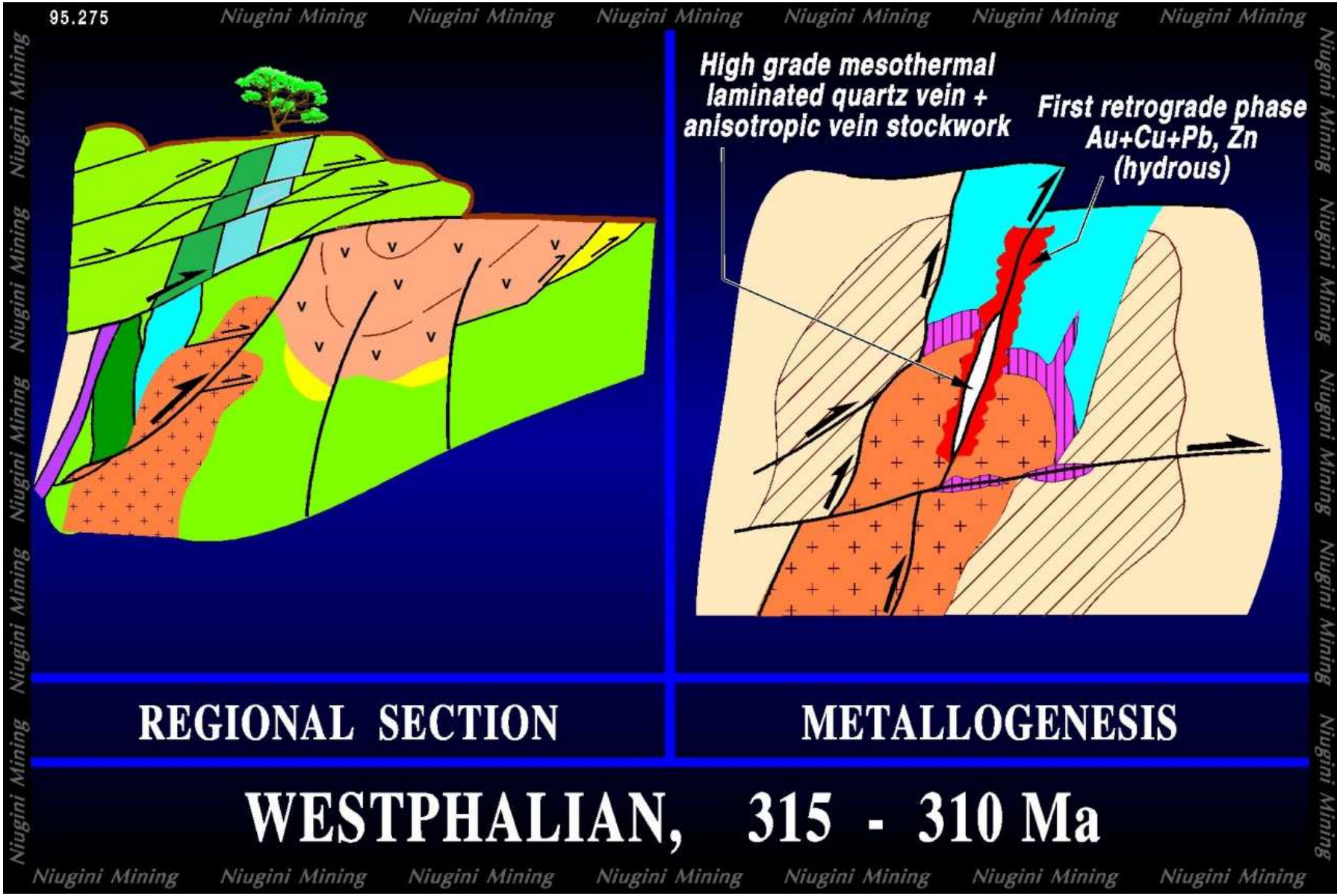
Remobilisation of granite & mafic related mineralisation



Phase 1 Carboniferous magmatic event

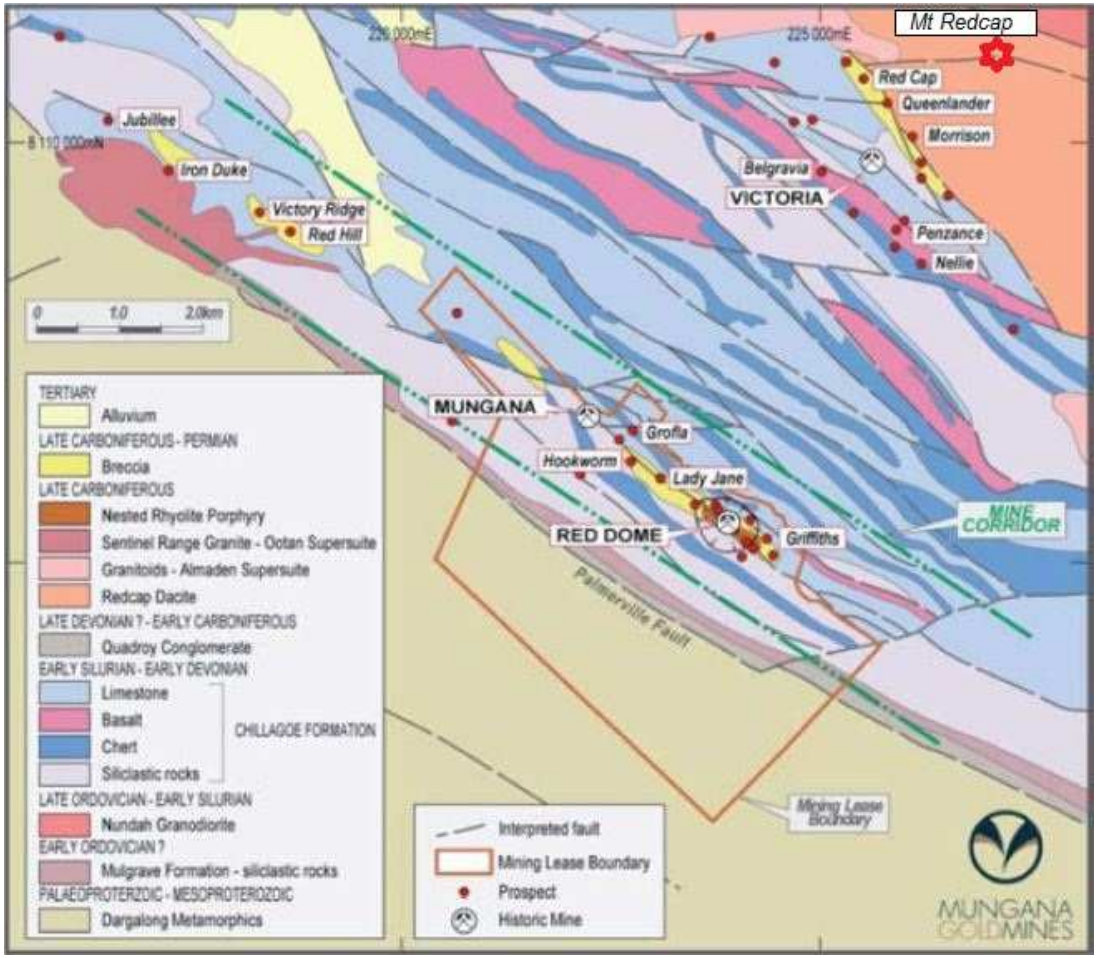


Thrust related retrograde gold

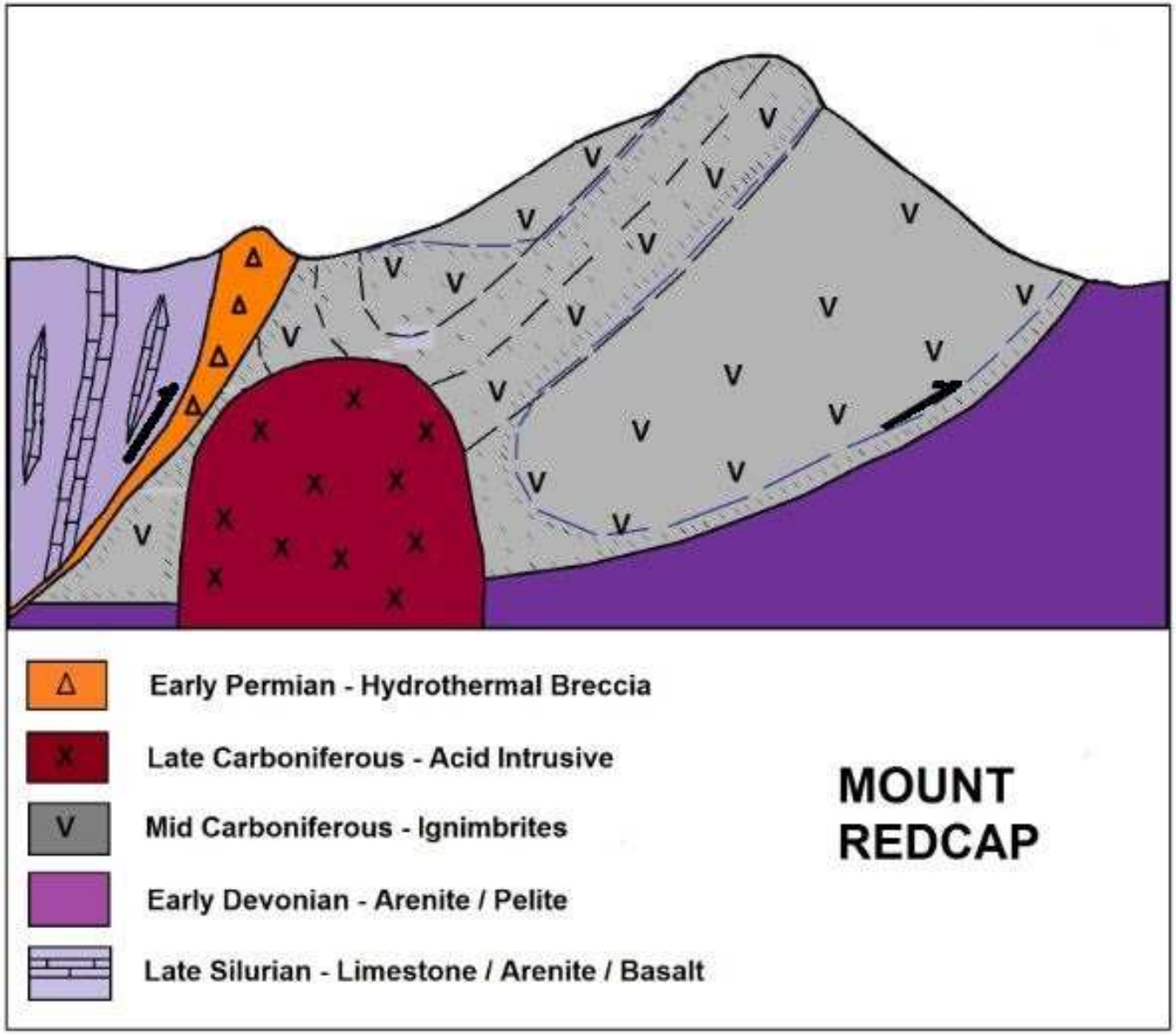


MOUNT REDCAP

- Critical timing constraints
- 7km NNE of Mungana
- Hosted by 320Myr Redcap Volcanics, folded with thrust boundaries

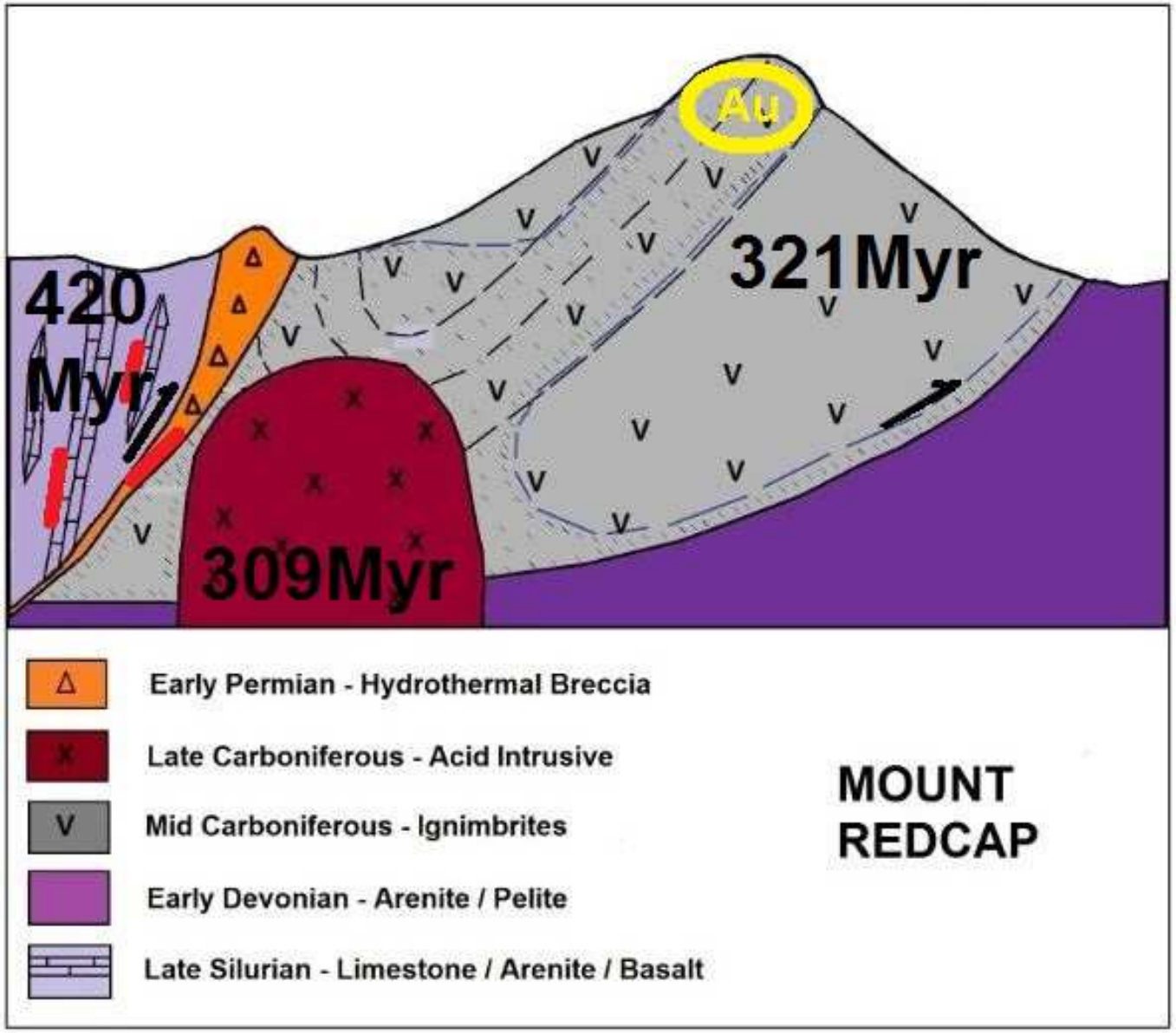


REDCAP – MT REDCAP



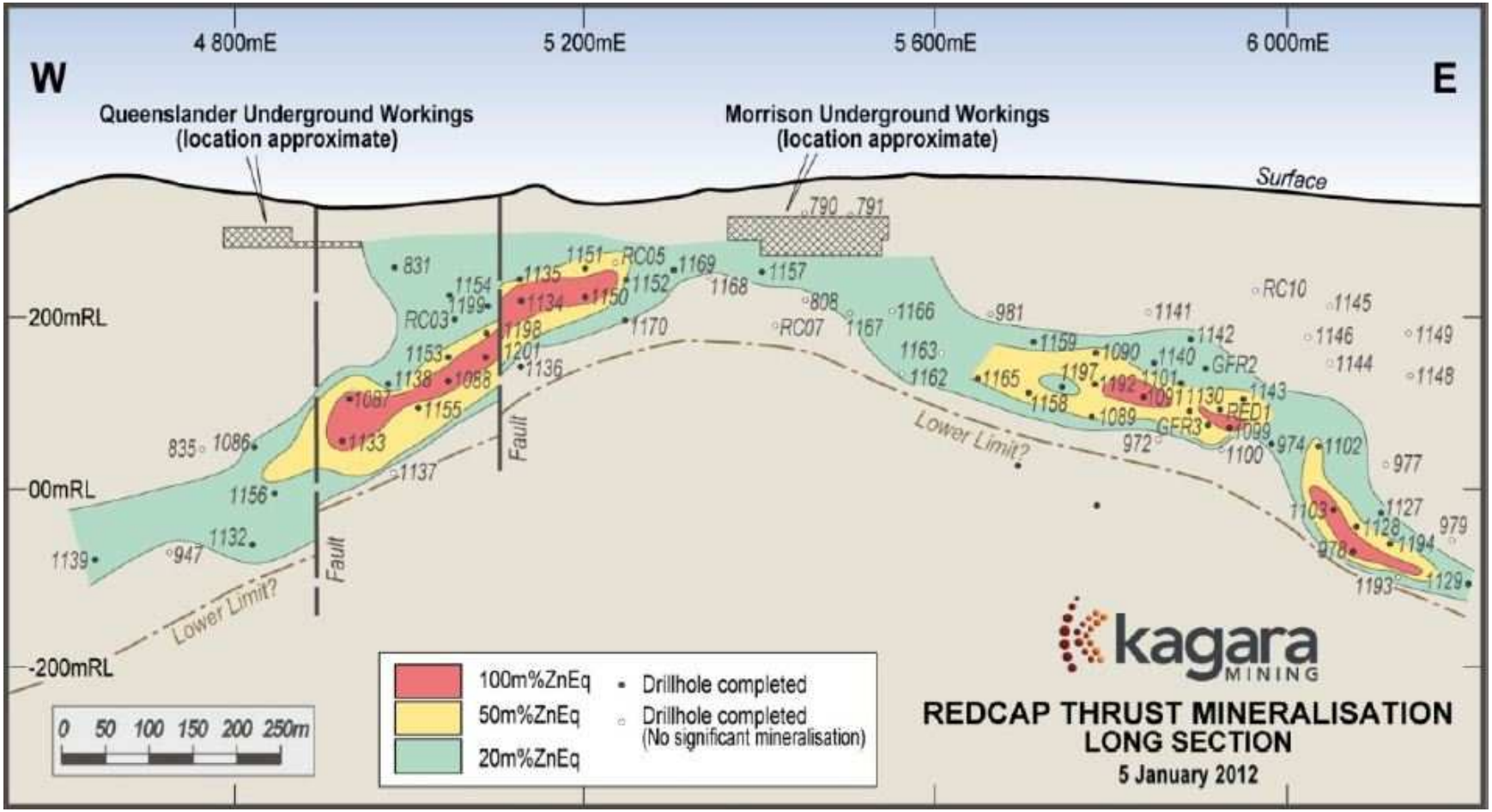
REDCAP – MT REDCAP

- Good timing constraints



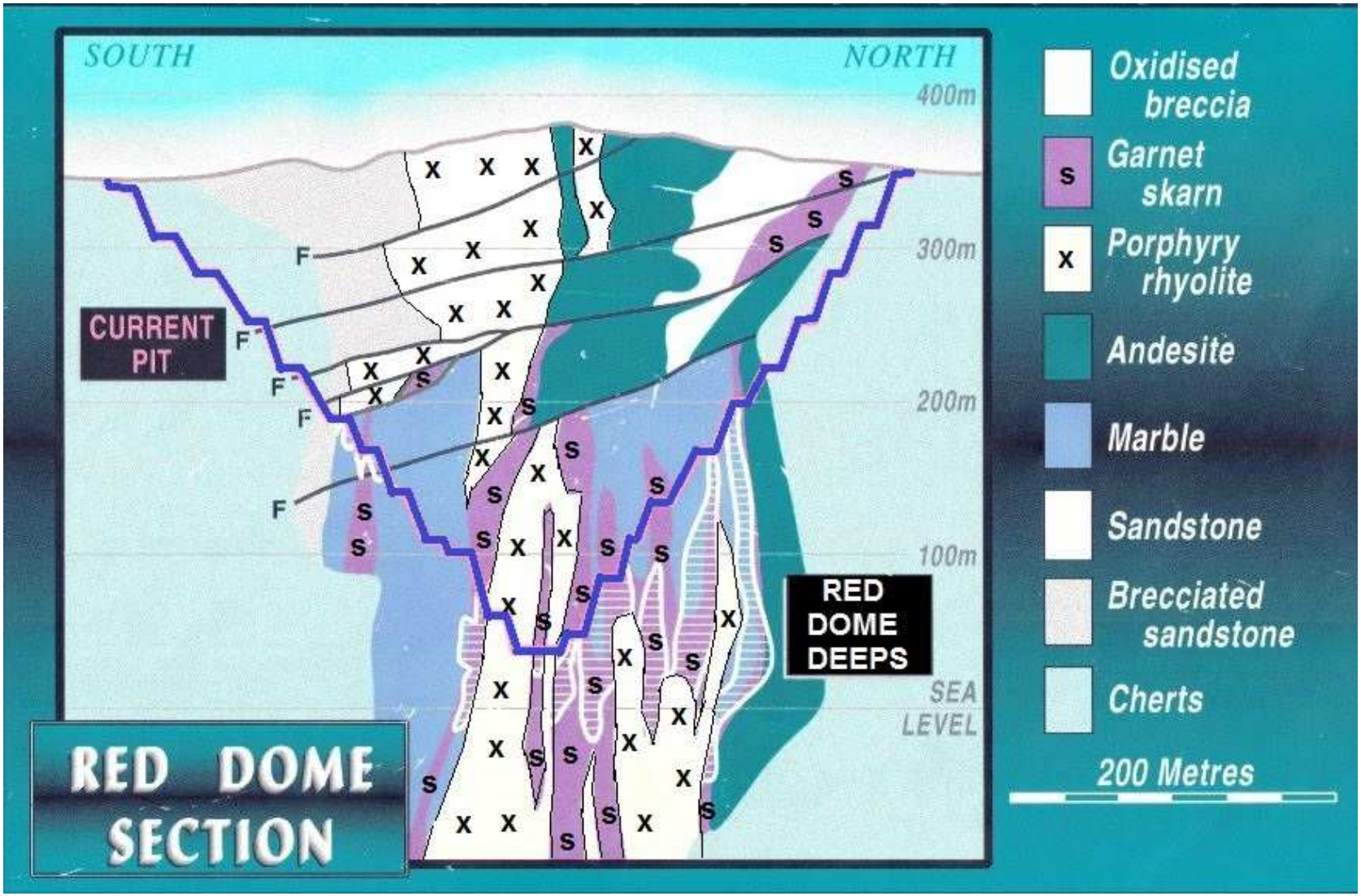
REDCAP – MORRISON'S LINE

Shallow plunge due to NE-directed thrusting on 45 degree SW-dipping thrust (Looking NE)



Stage 1 steep thrusting ~ 350Myr

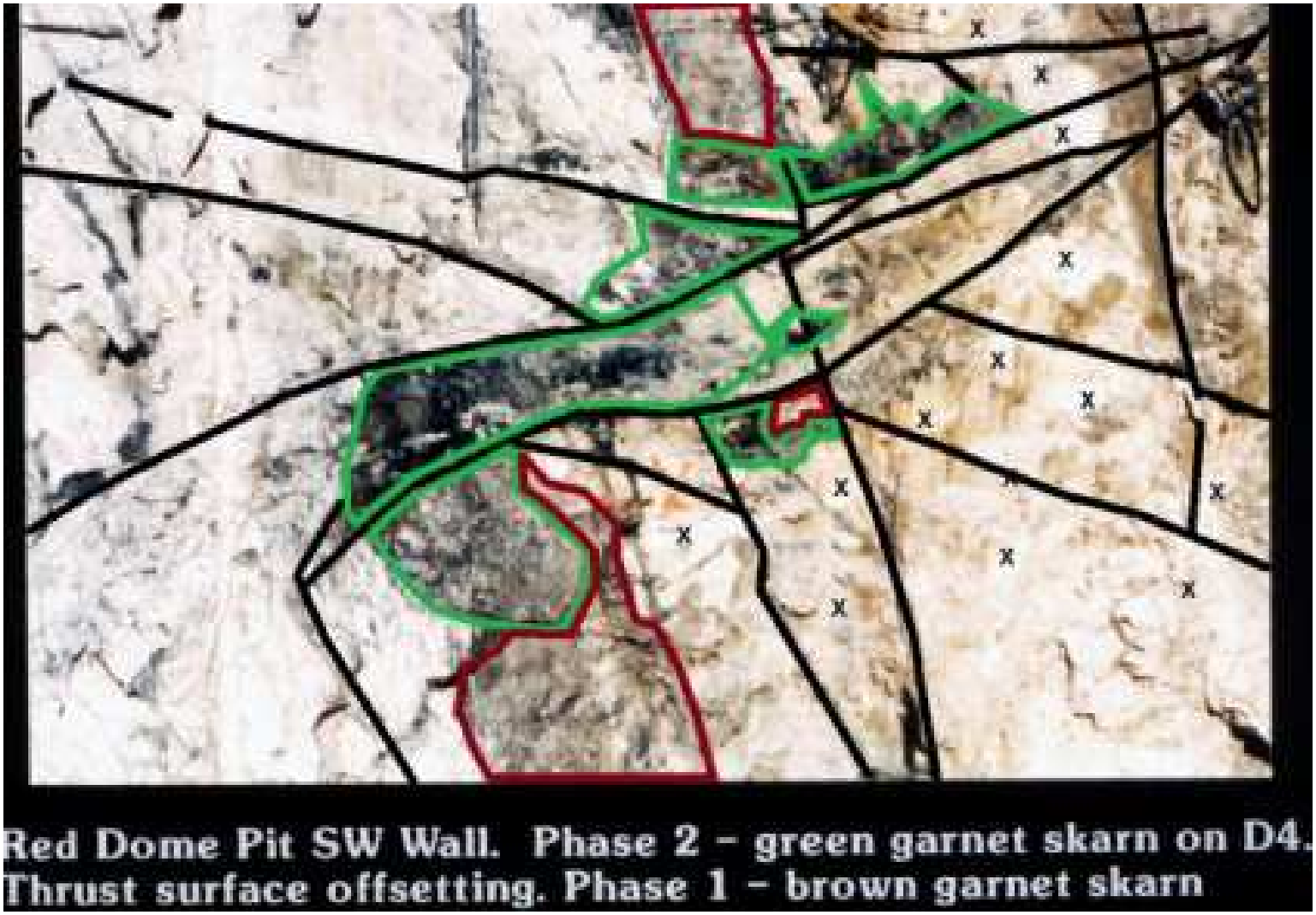
Stage 2 shallow thrusting ~ 320Myr



Red Dome Pit – 300m level

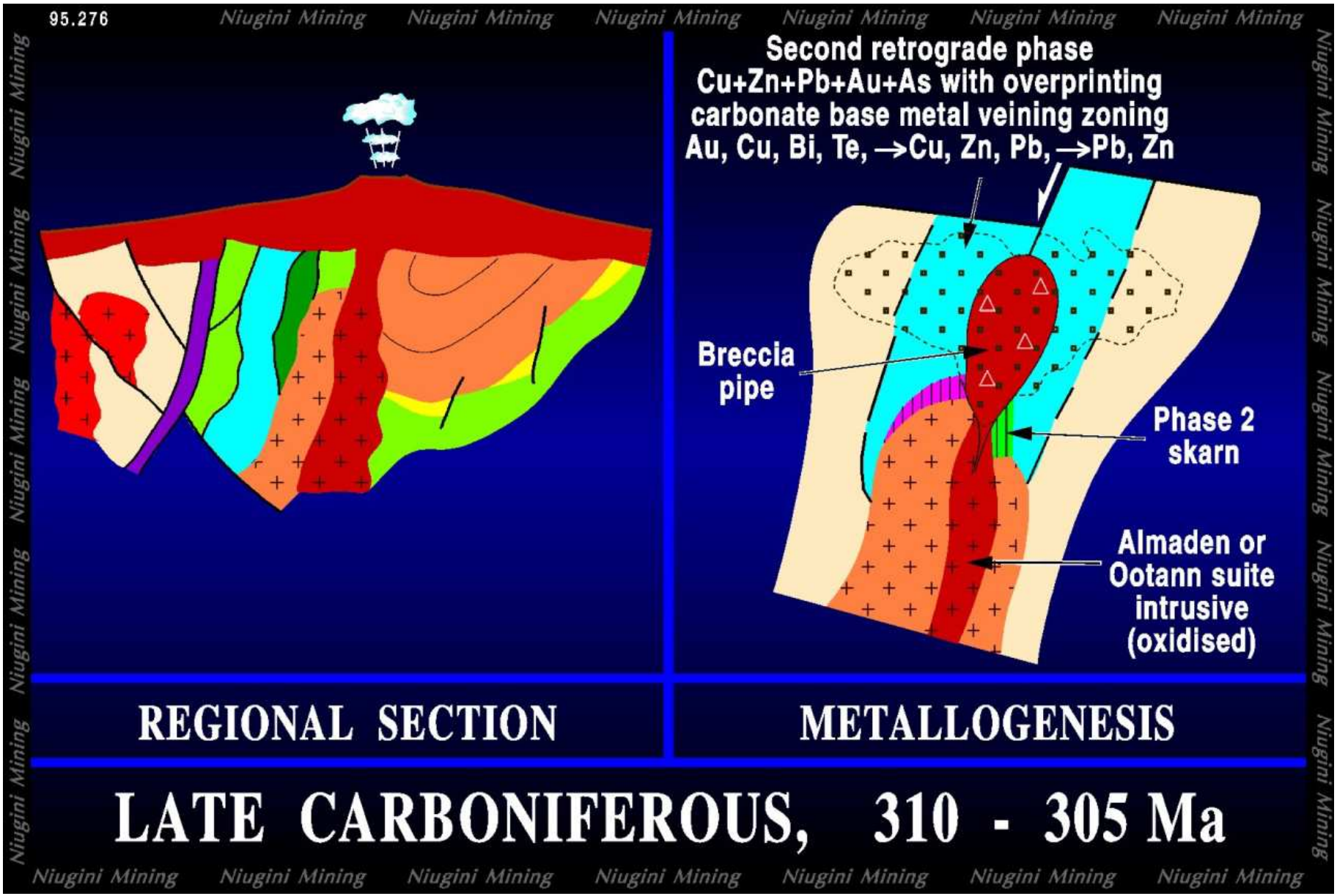
Red Dome Pit SW Wall. Phase 2 – green garnet skarn on D4.
Thrust surface offsetting. Phase 1 – brown garnet skarn

Red Dome Pit – 300m level

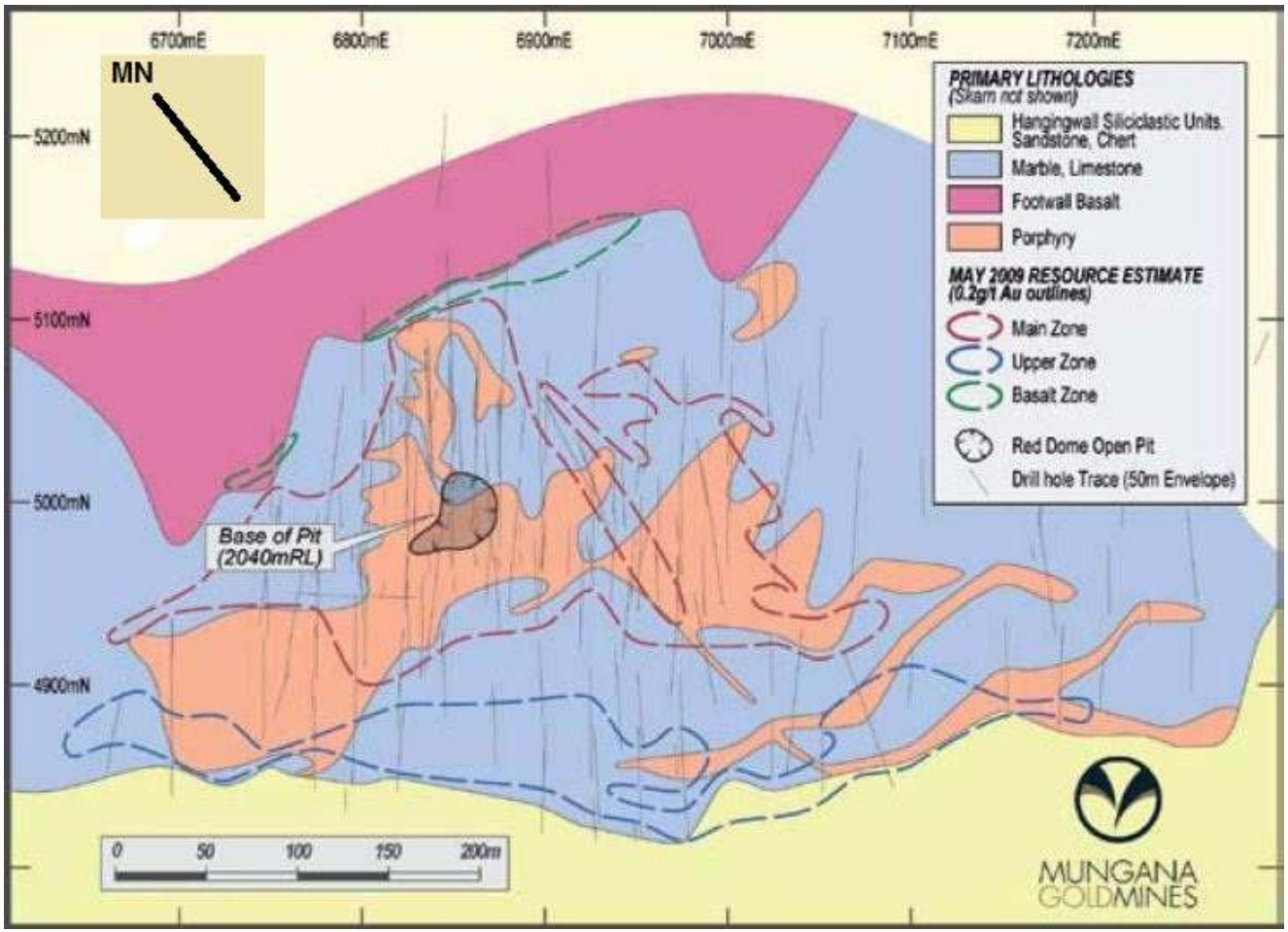


Red Dome Pit SW Wall. Phase 2 – green garnet skarn on D4. Thrust surface offsetting. Phase 1 – brown garnet skarn

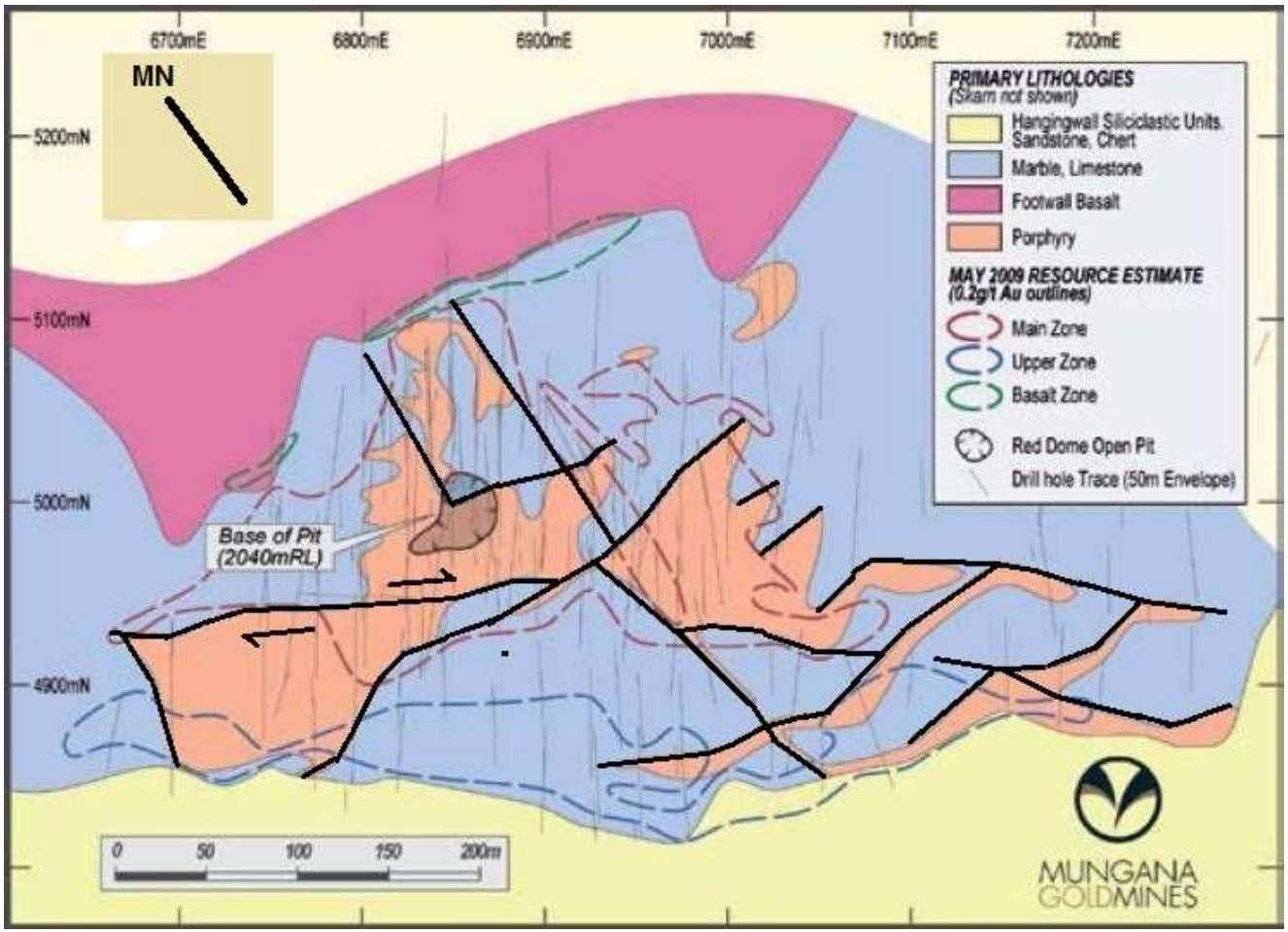
Phase 2 Carboniferous Magmatic event



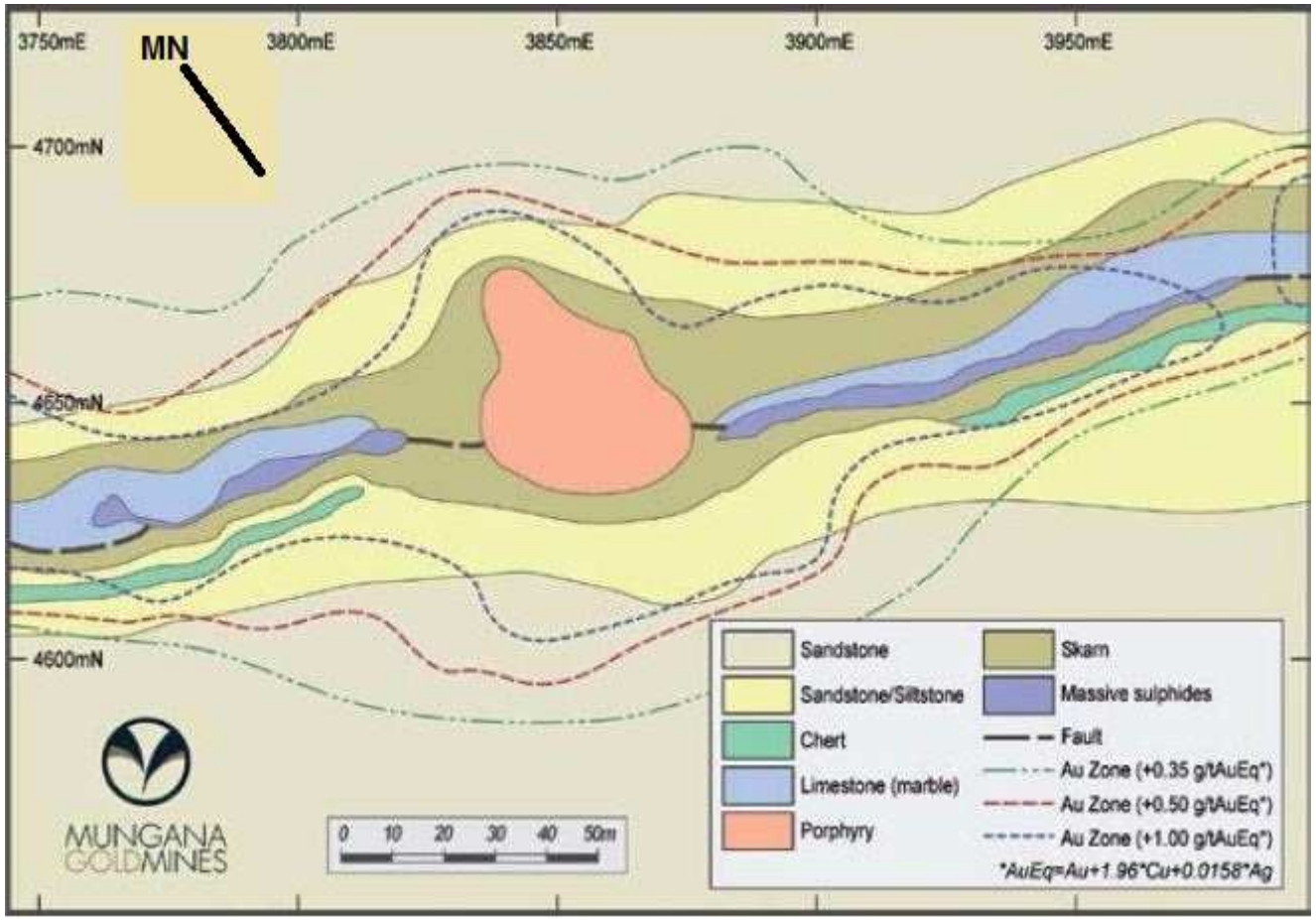
RED DOME – Porphyry shapes irregular



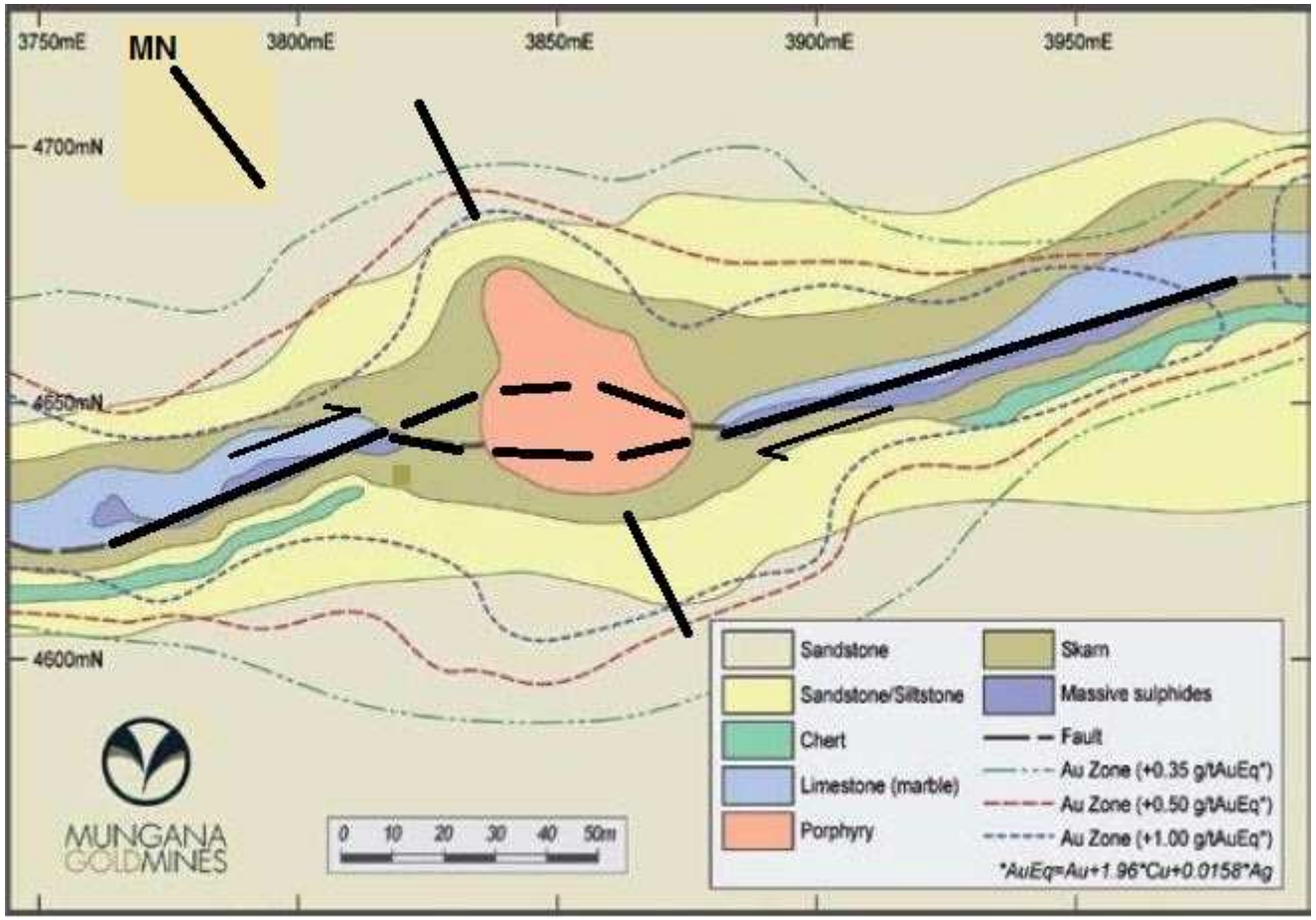
Strike-slip & normal faulting control



MUNGANA – Porphyry 50m diameter

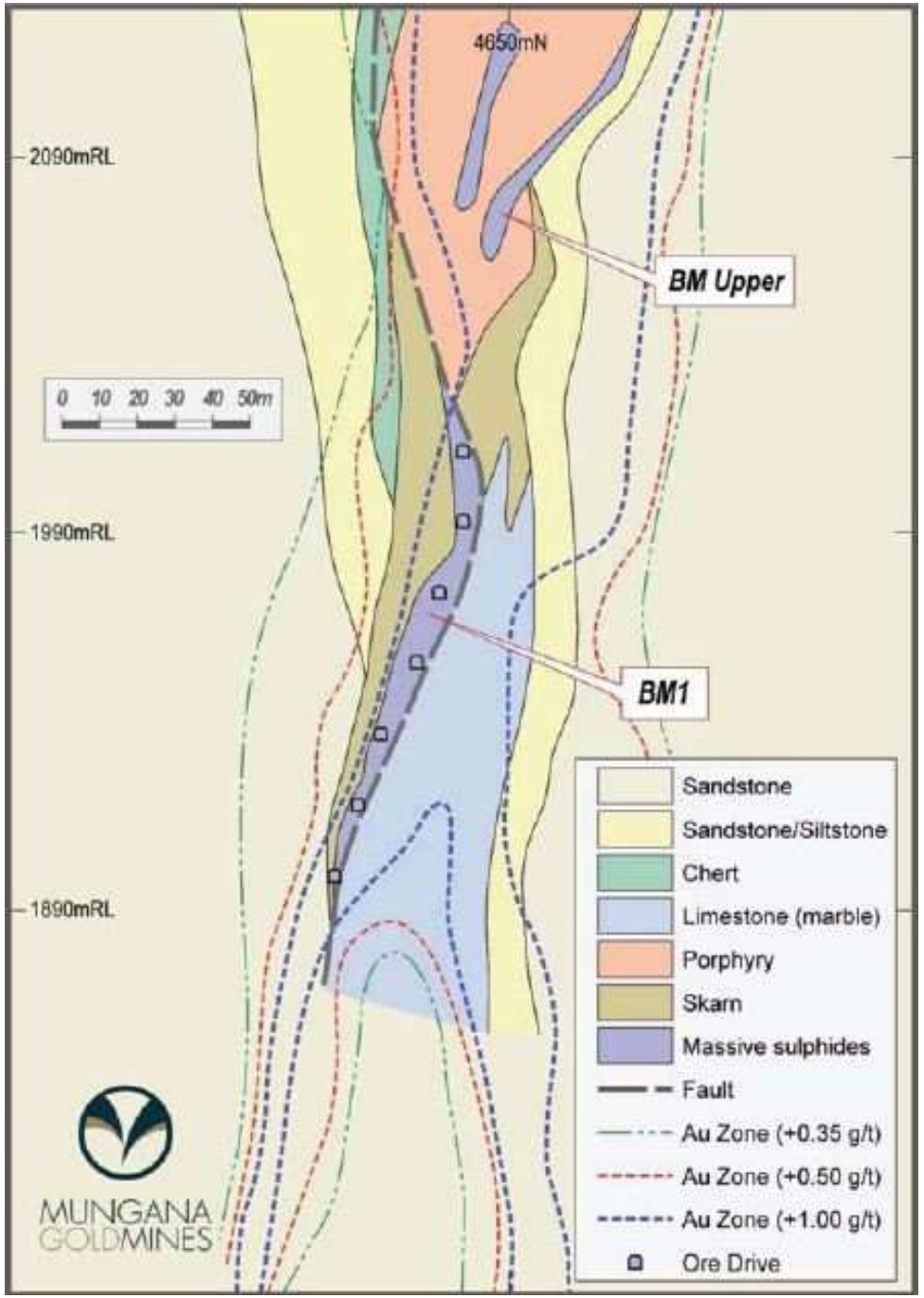


Elongate vertically – dextral dilational jog



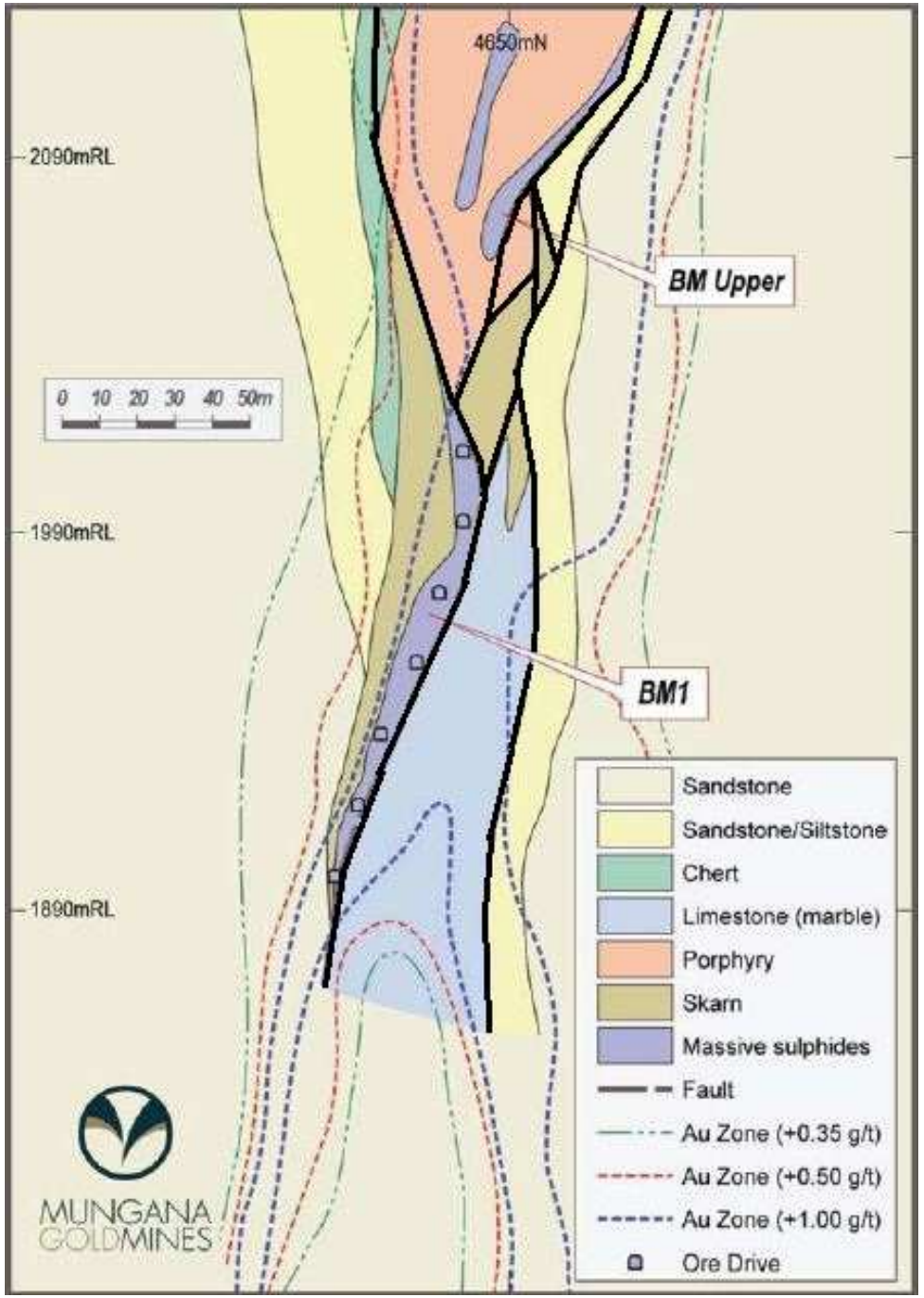
MUNGANA PORPHYRY

- Base metal lenses are elongate laterally along strike slip fault directions.
- BM also elongate vertically with steep dip to south.
- BM developed on faulted boundaries of marble with sandstone
- Clasts of banded sheared base metals enclosed by unstrained porphyry
- Porphyry pods are commonly fault bounded.
- Skarns also seem fault bounded.



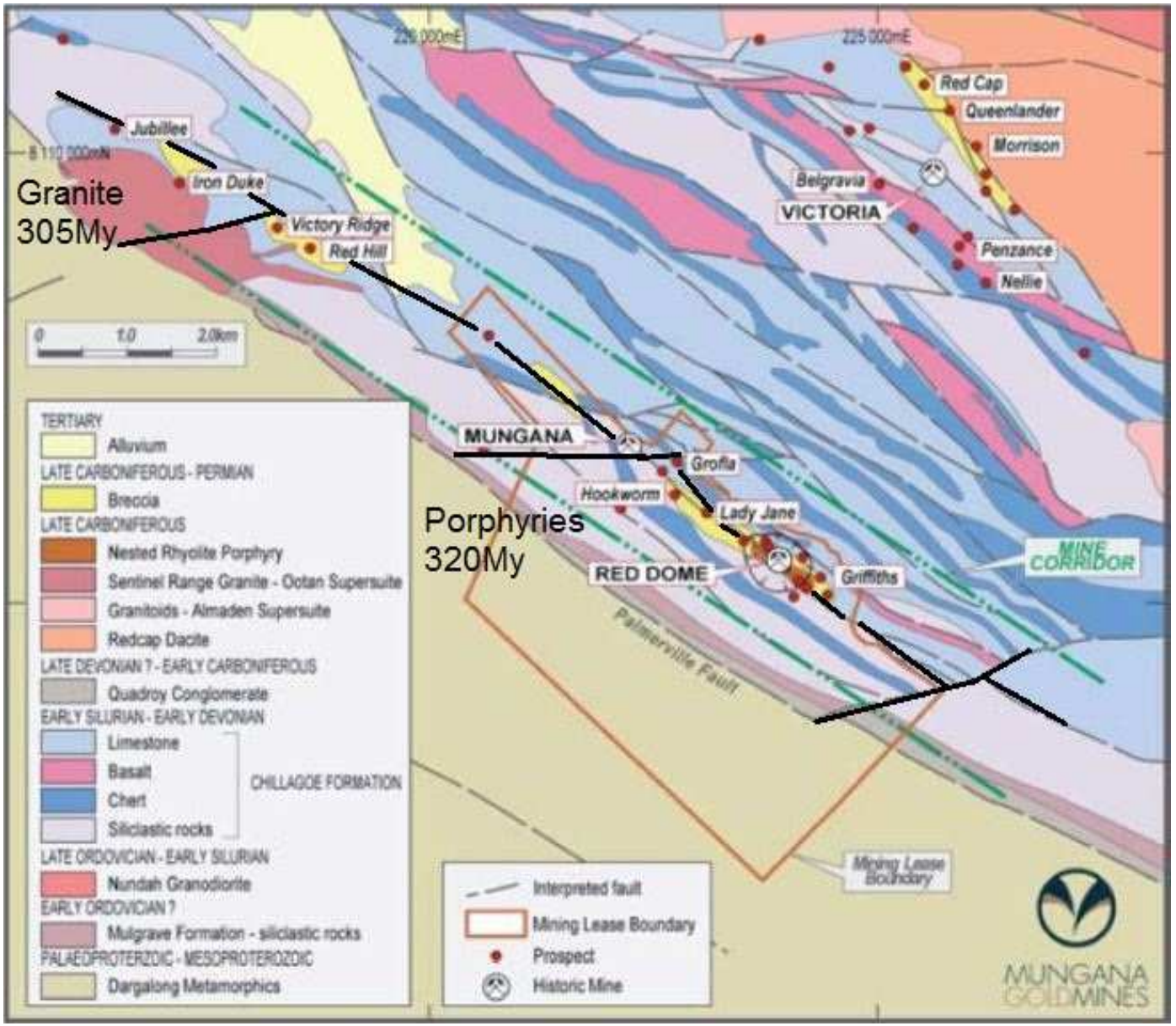
MUNGANA PORPHYRY FAULT-CONTROLLED

- Phase 1: Banded sheared BM controlled by faults and steep thrusts pre-320Myr porphyry.
- Phase 2: Porphyry / Skarn 1
- Phase 3: Hydrous retrograde phyllic and propylitic alteration with main gold channelled by later faulting and shallowly-dipping late thrust surfaces.
- Phase 4: Skarn 2, base metal-rich, superimposed on early phase and probably related to 305 Myr coarse equigranular granite intersected at depth.
- Phase 5: Breccias, sinters, strike-slip faulting post-mineral events from 300 Myr onwards.



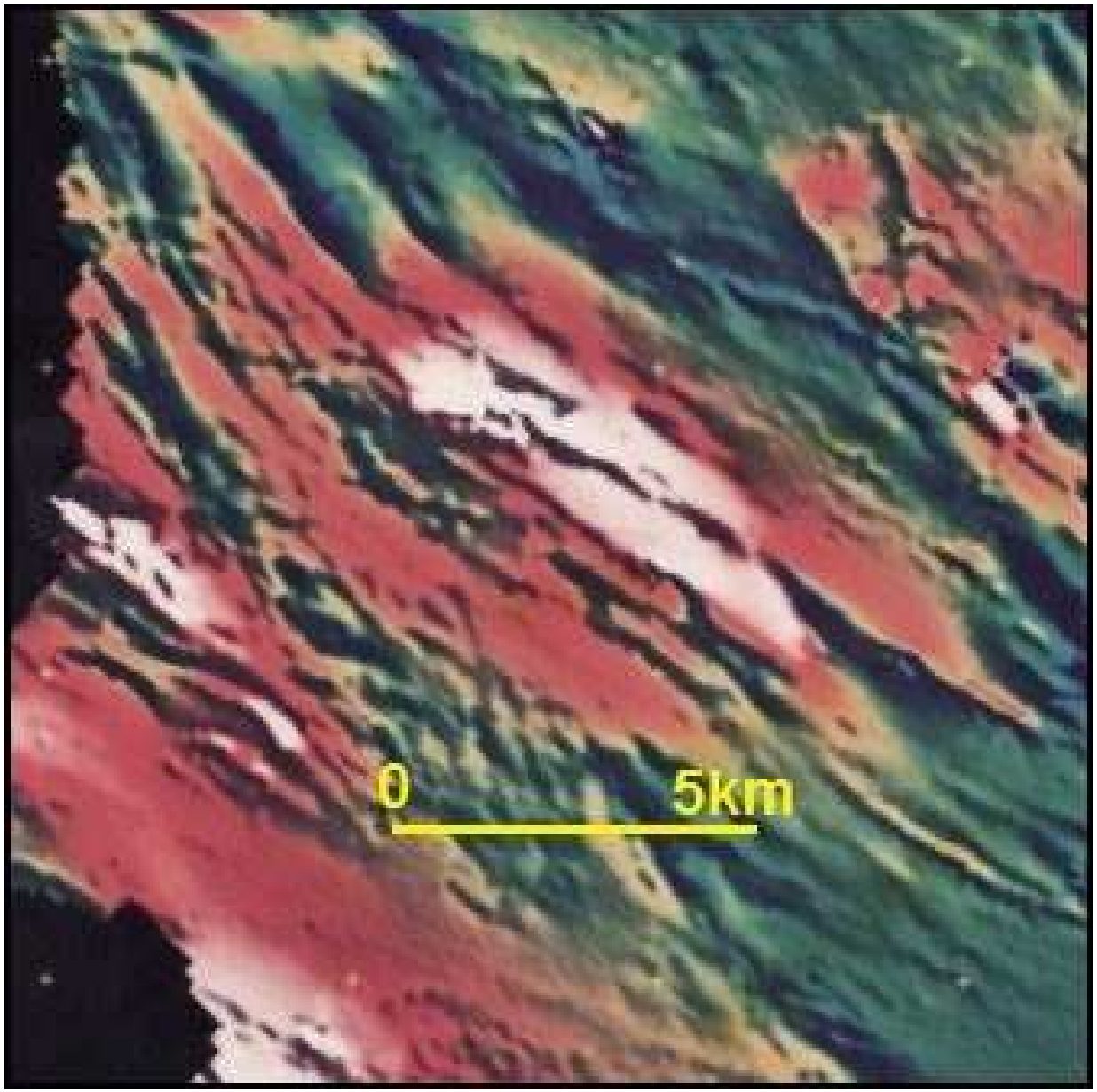
MINE CORRIDOR

- 7 km recessive NW fault system



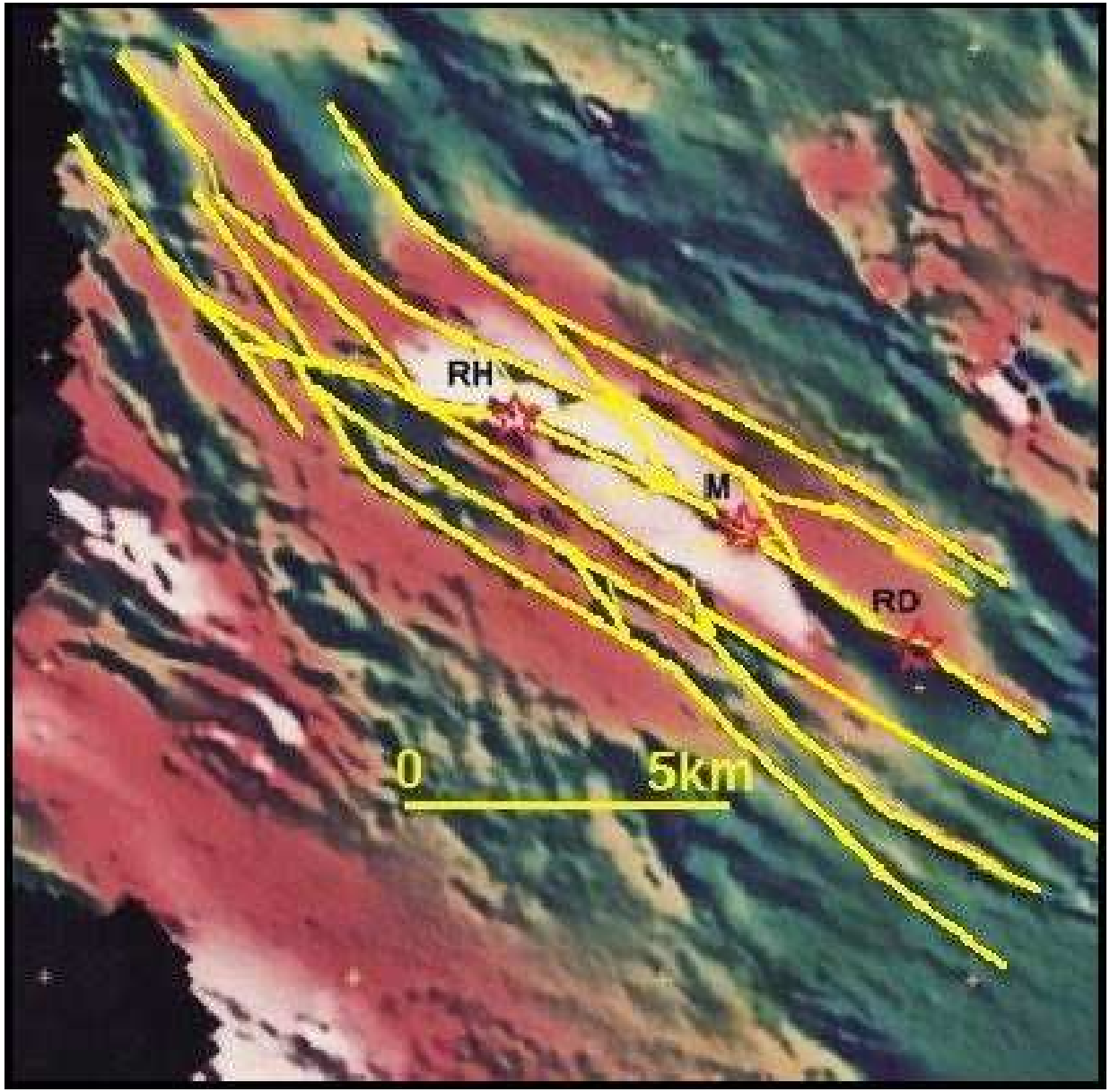
TMI, 1st VD, RTP (AMOCO 1983 – Preprocessed Niugini 1992)

- Total Magnetic Intensity (TMI), First Vertical Derivative (1st VD), Reduced to Pole (RTP)
- District is sliced like “a pack of cards”
- Clear indication of dextral strike slip pattern



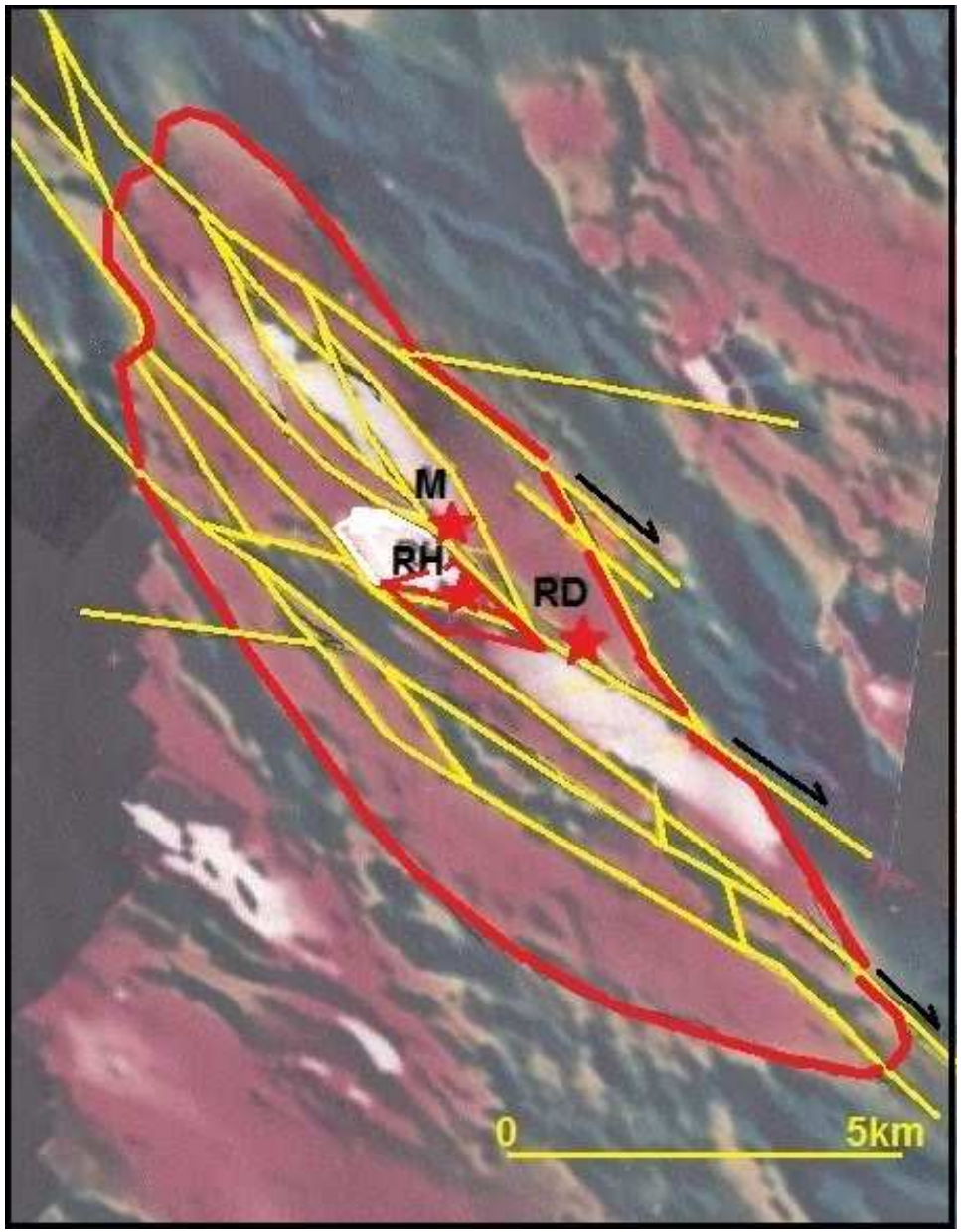
TMI, 1st VD, RTP (AMOCO 1983 – Preprocessed Niugini 1992)

- 5km of NW dextral slip.
- Other sub-parallel dextral strike-slip faults
- EW sinistral linkage faults
- Some NS linking normal faults
- Red Dome – RD, Mungana – M, Red Hill – RH.



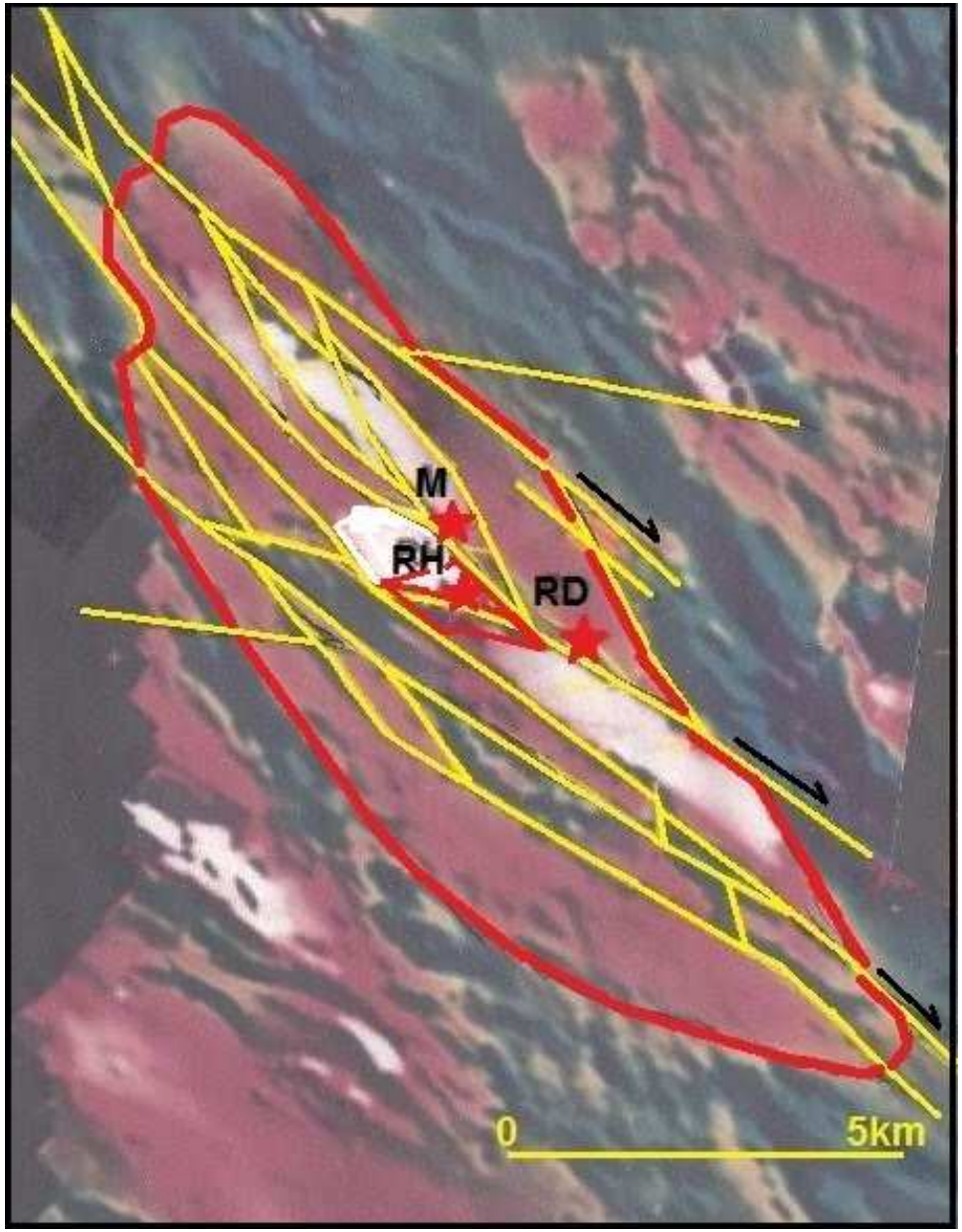
TMI, 1st VD, RTP (AMOCO 1983 – Preprocessed Niugini 1992)

- High TMI zone at Red Hill coincides with skarn and potassic magnetite – bearing altered rims to Sentinel Range Igneous Complex.
- Suggests sub-surface mushroom-shaped pluton.
- Pluton confirmed at 1500m depth at Mungana



TMI, 1st VD, RTP (AMOCO 1983 – Preprocessed Niugini 1992)

- Elliptical 15km x 6km magnetic 305 – 310Myr
- At least 5 NW-trending dextral slip faults
- Mine corridor has clear indication of 5km of slip
- Fault bound slivers of porphyry at Red Dome and at Mungana have clear indications of dextral slip.
- Could all these slivers fit together as a single 2 sq km gold porphyry system?
- There may be more gold porphyry slivers between Red Dome and Red Hill.



VIEW NE FROM PUB

Chillagoe looking NE. Shallow N dipping & E ramping thrust surfaces (D4) displacing steep mylonite fabric (?D3)

VIEW OF THRUST RAMP FROM PUB AFTER IMBIBING RED WINE

Chillagoe looking NE. Shallow N dipping & E ramping thrust surfaces (D4) displacing steep mylonite fabric (?D3)