

Interpretation of Albany–Fraser seismic lines 12GA–AF1, 12GA–AF2 and 12GA–AF3: implications for crustal architecture



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Seismic and MT Workshop: April 9th 2014

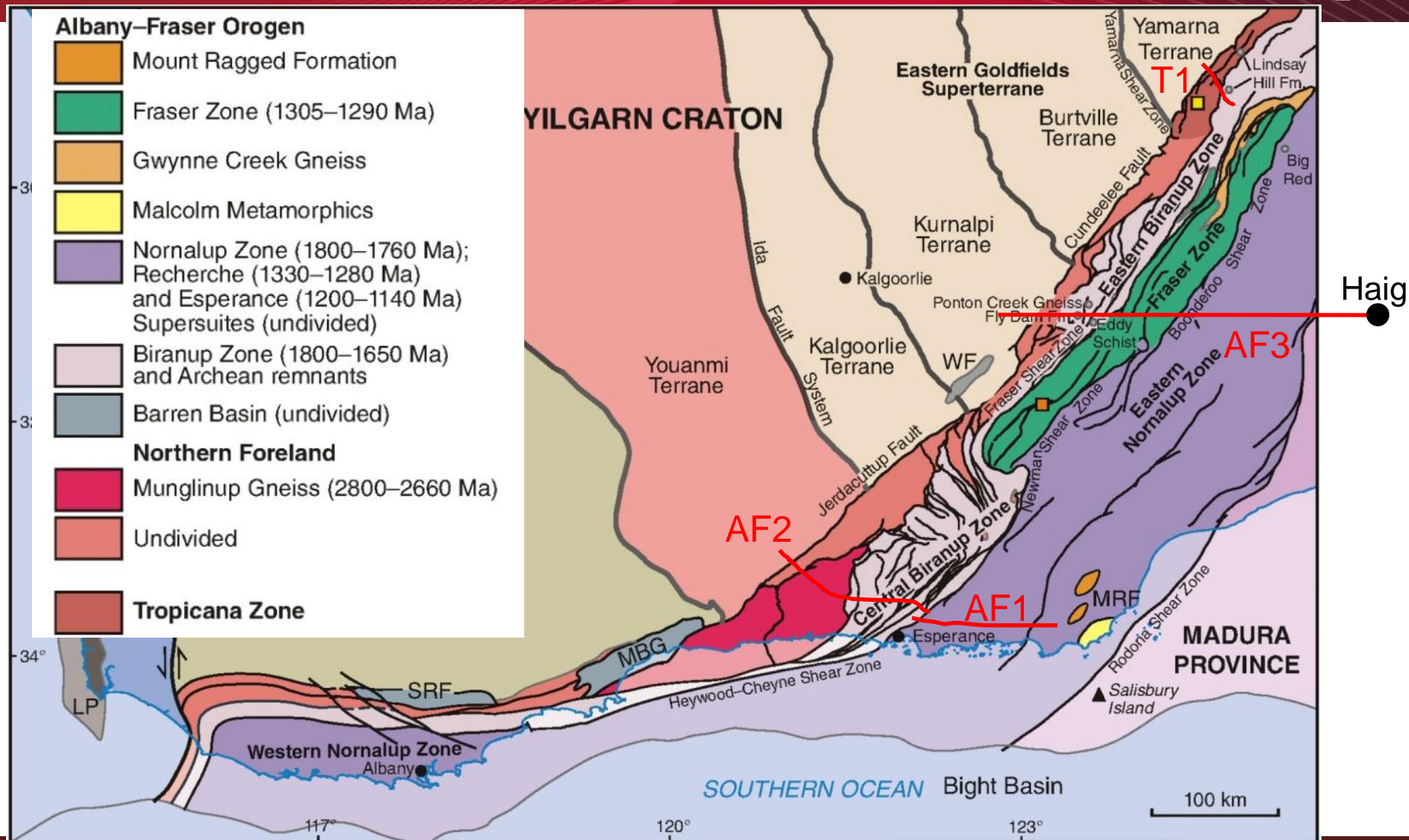


Australian Government
Geoscience Australia

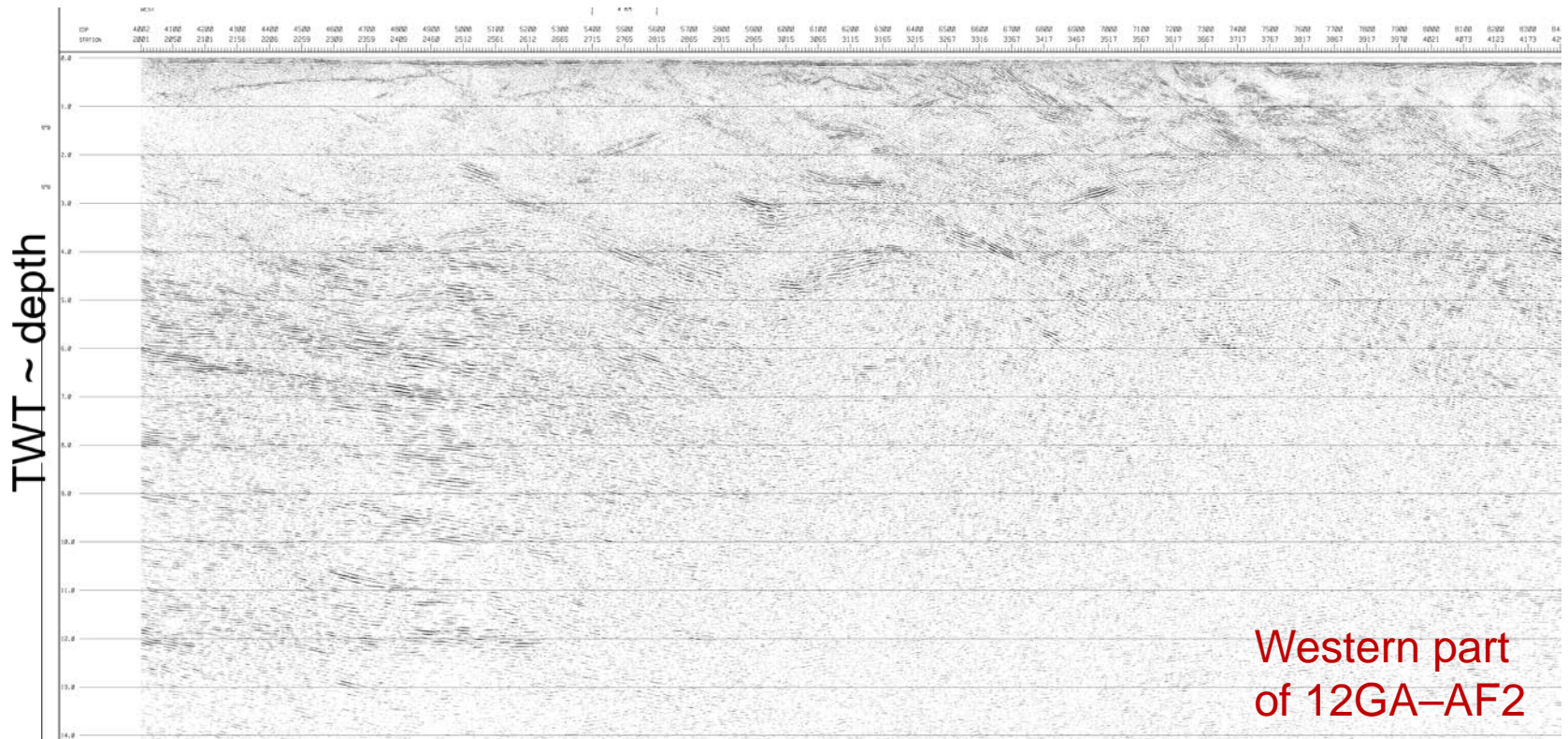
Geological Survey of
Western Australia



Locations of seismic lines

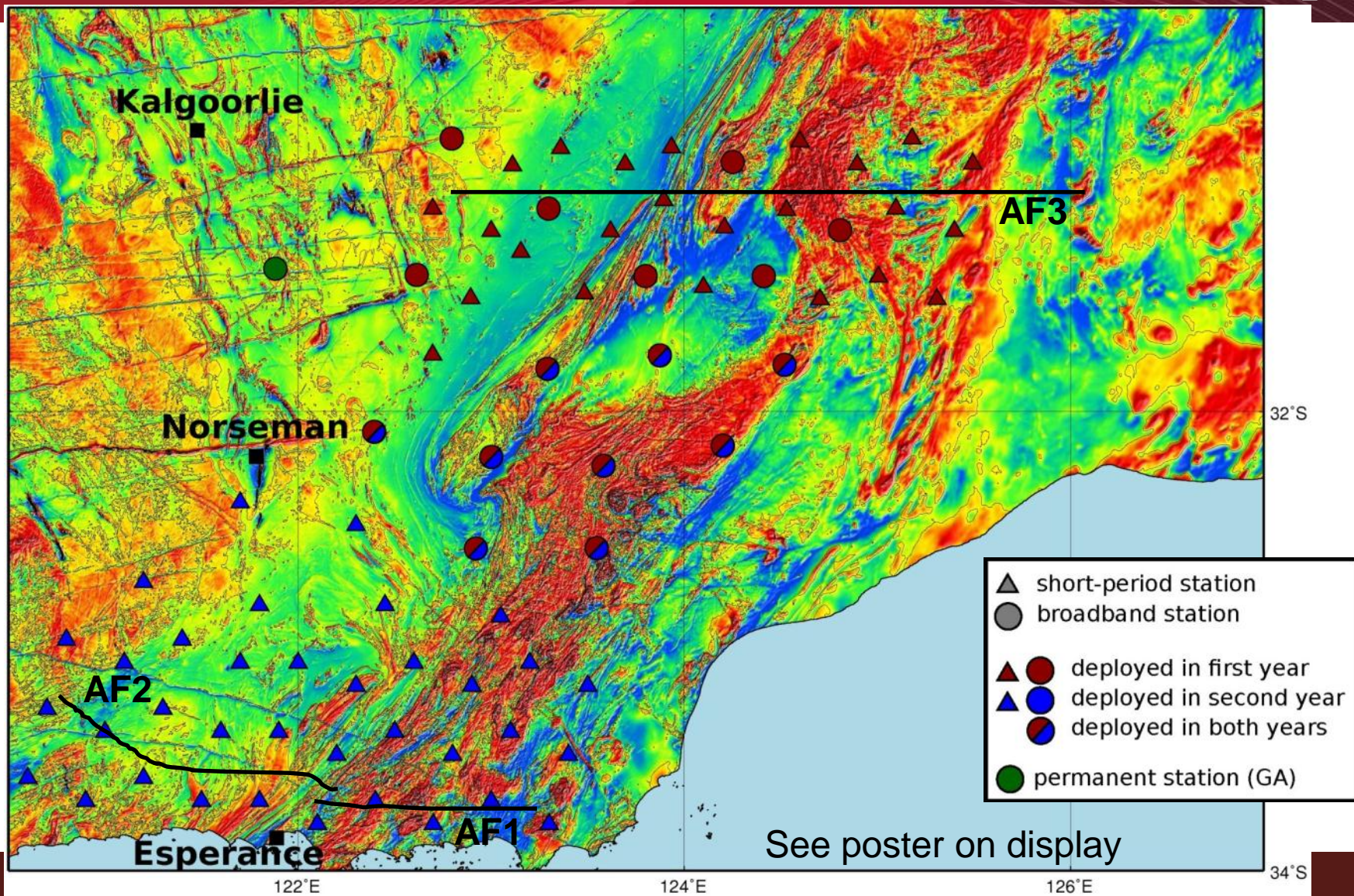


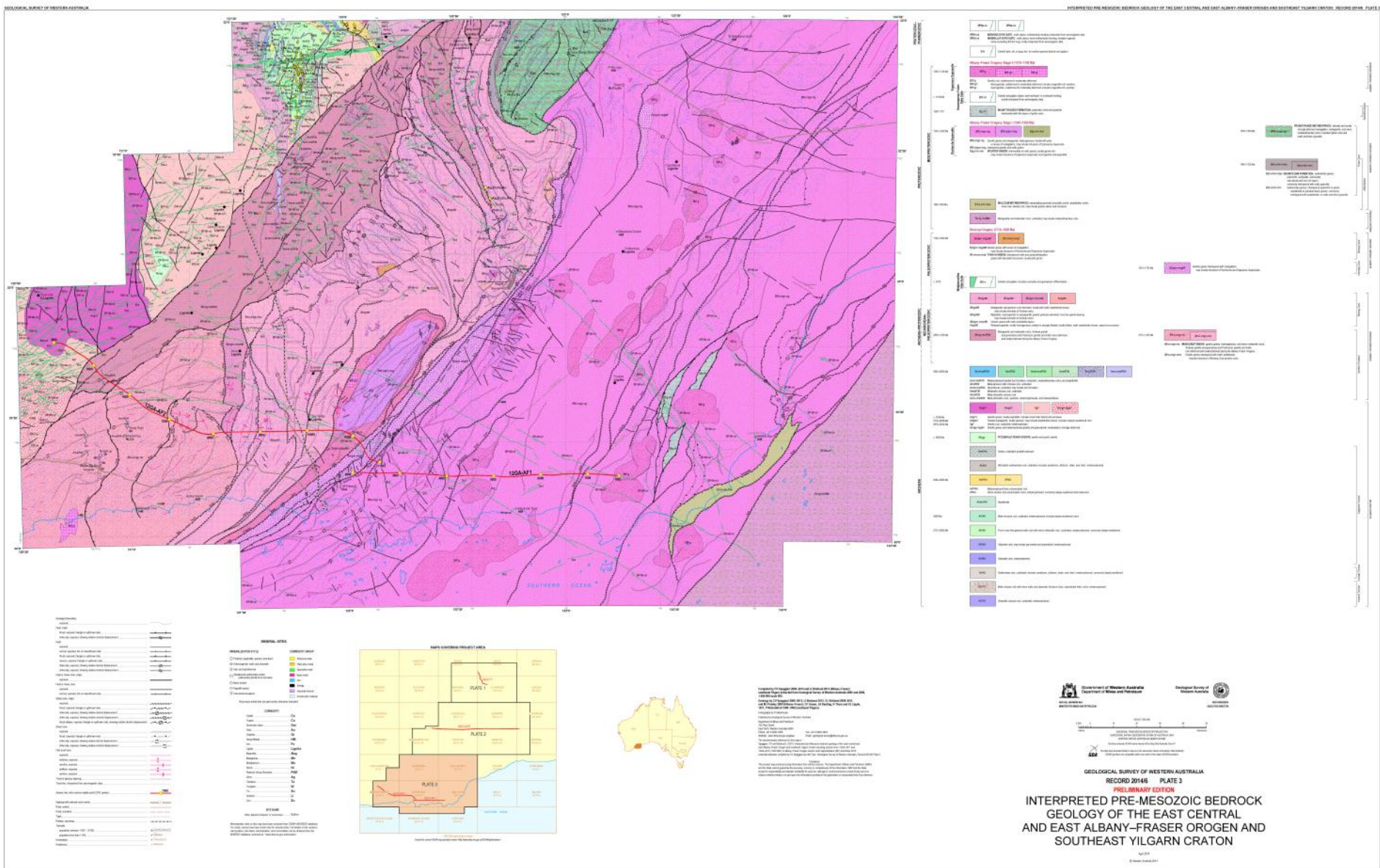
Interpreting seismic images - limitations



- Problems of 2-dimensionality, apparent dip
- Migration
- Large areas of non-reflectivity
- Limited outcrop, and complete cover to the east (Eucla Basin)
- Need to make use of all available geological and geophysical data

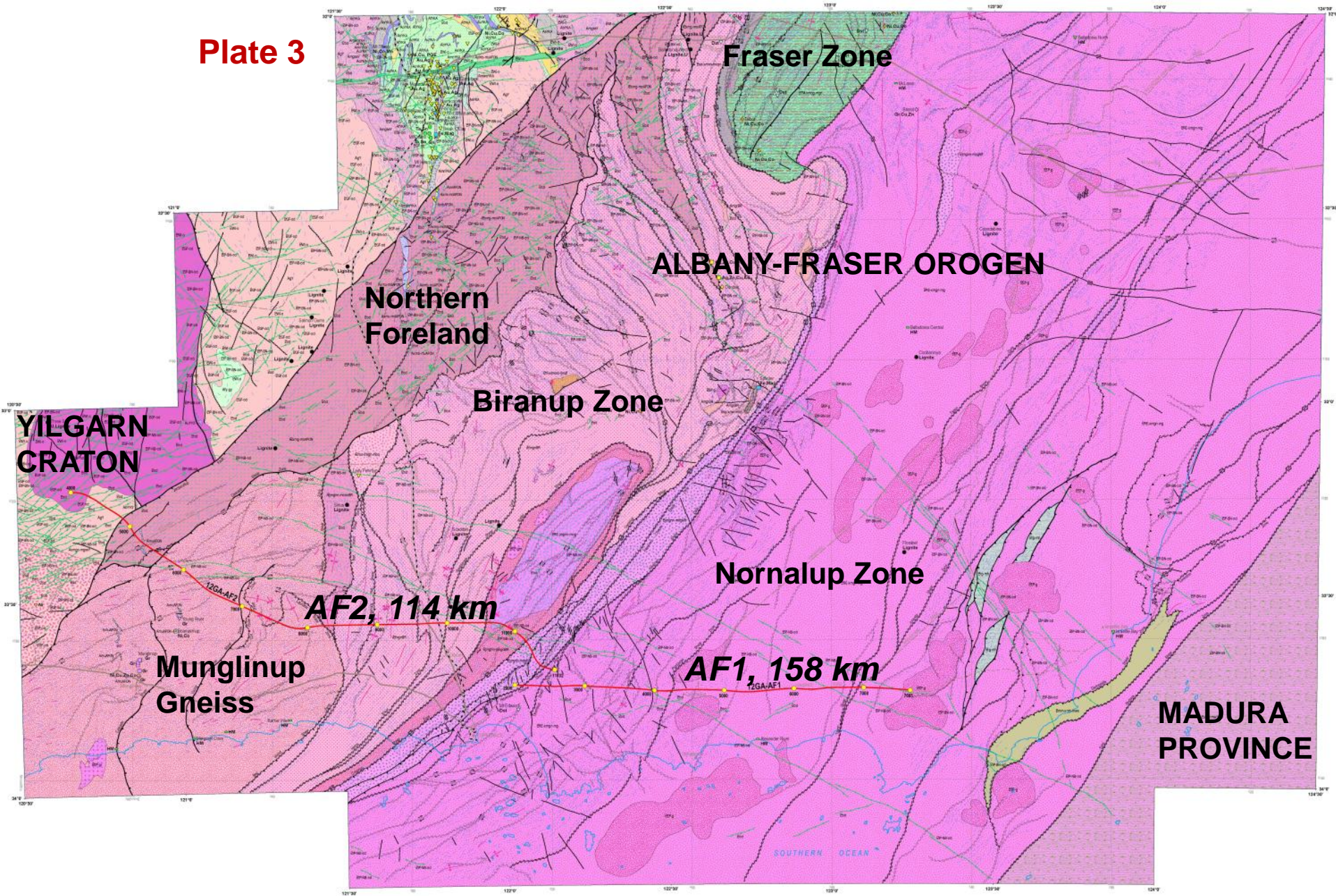
Passive seismic array – ARC linkage with ANU



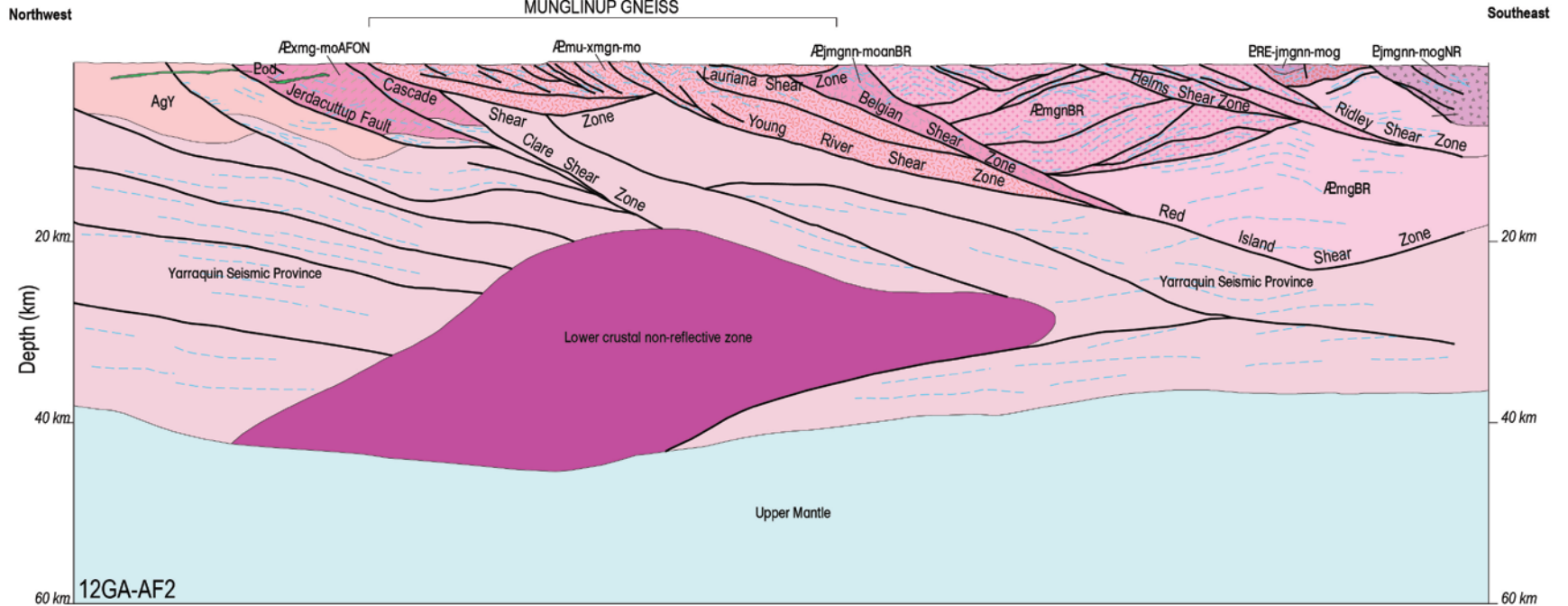
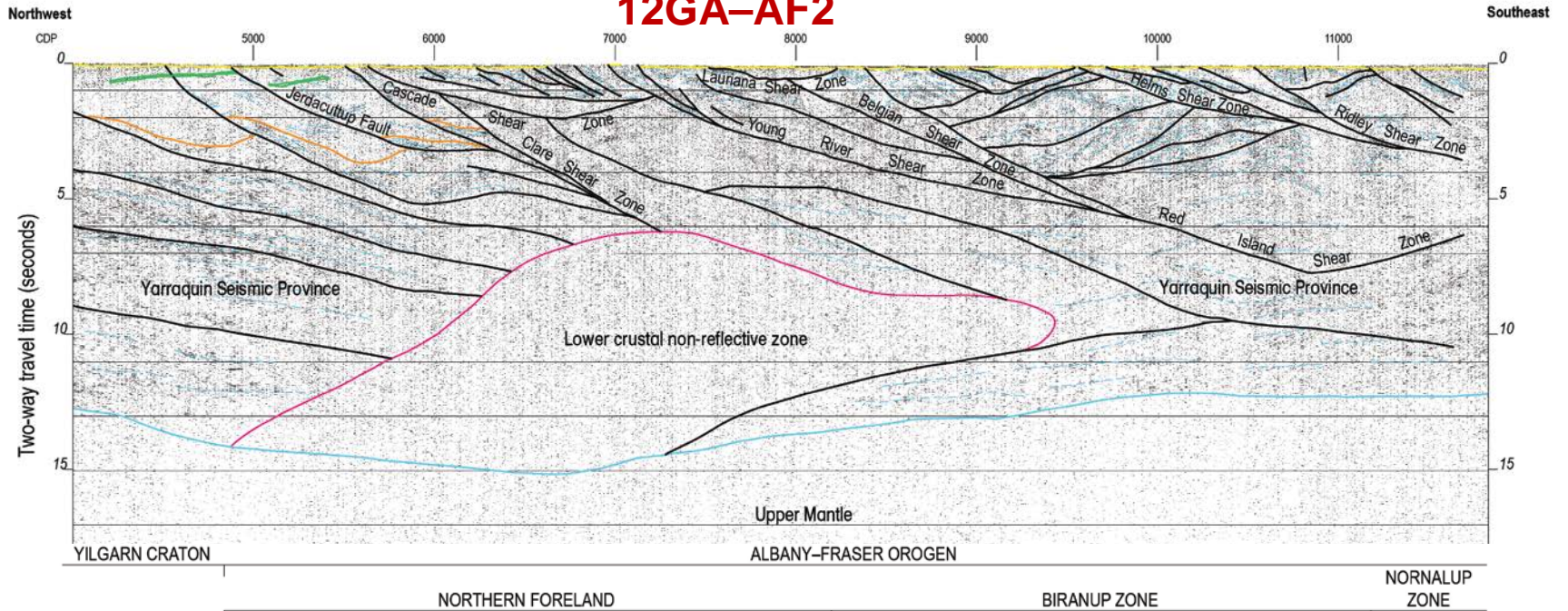


- Utilize interpreted bedrock geology (IBG) maps
- Map and section Plates with abstract volume

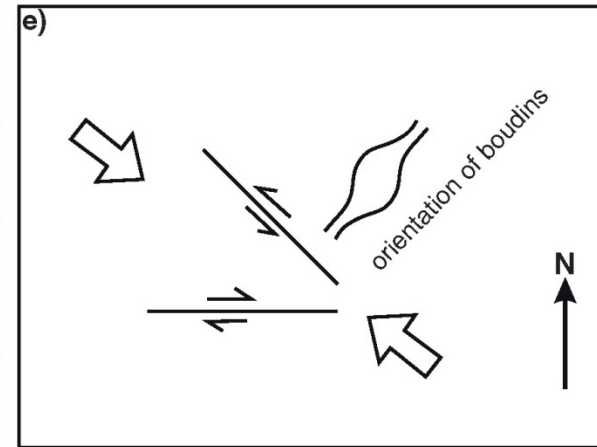
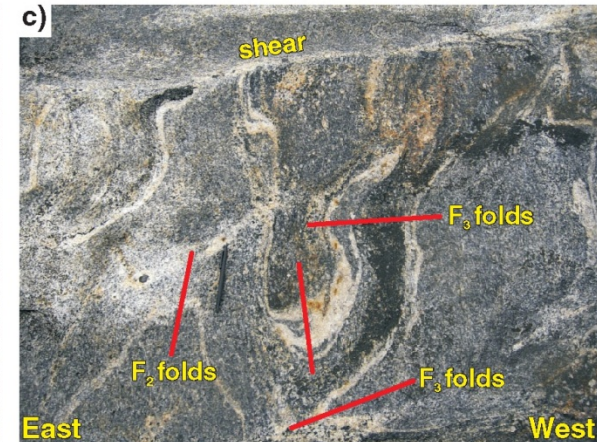
Plate 3



12GA-AF2

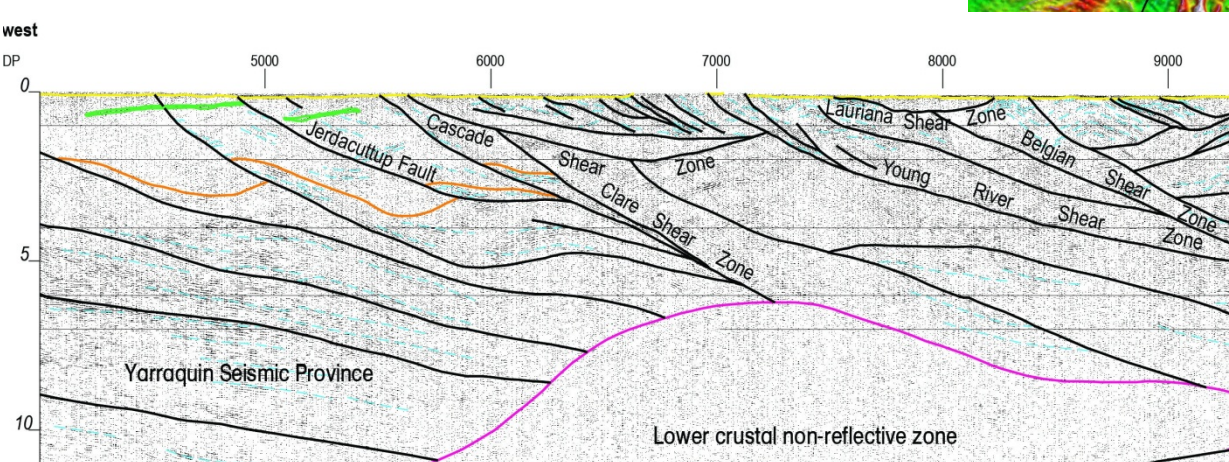
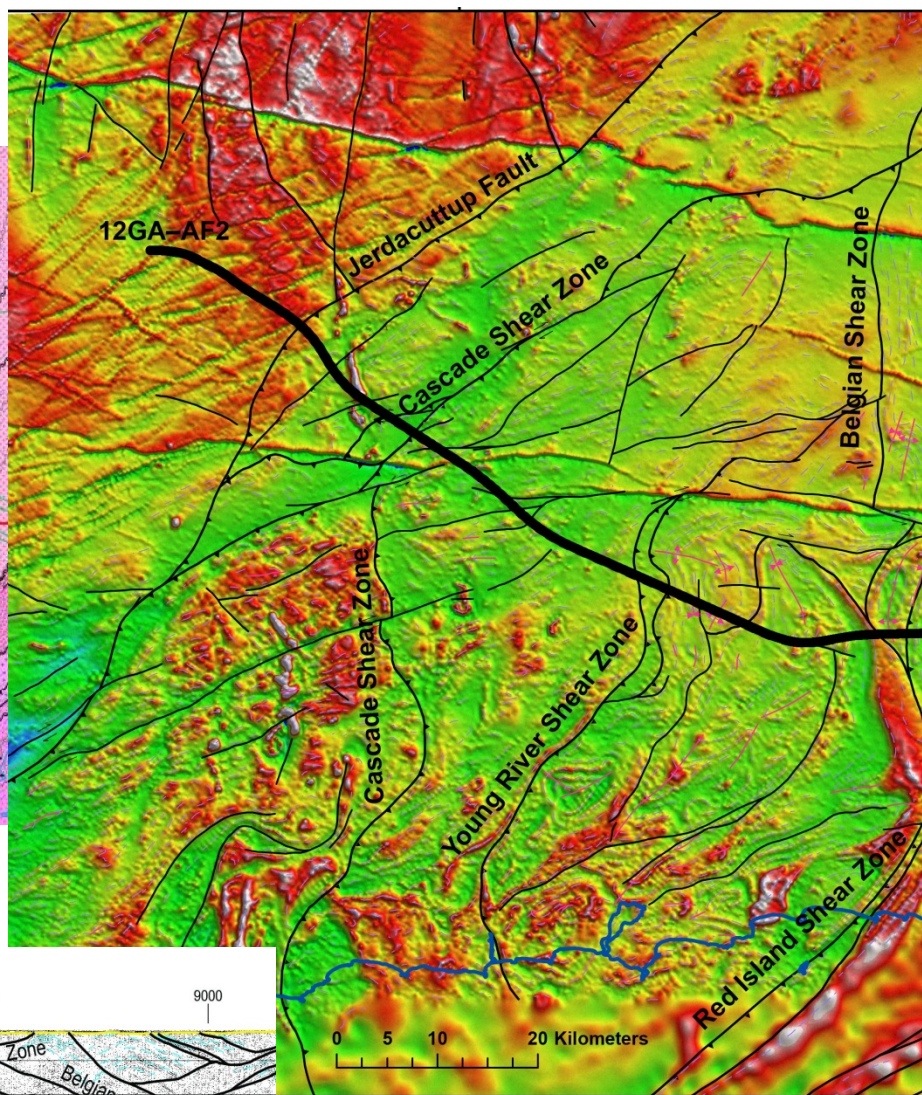
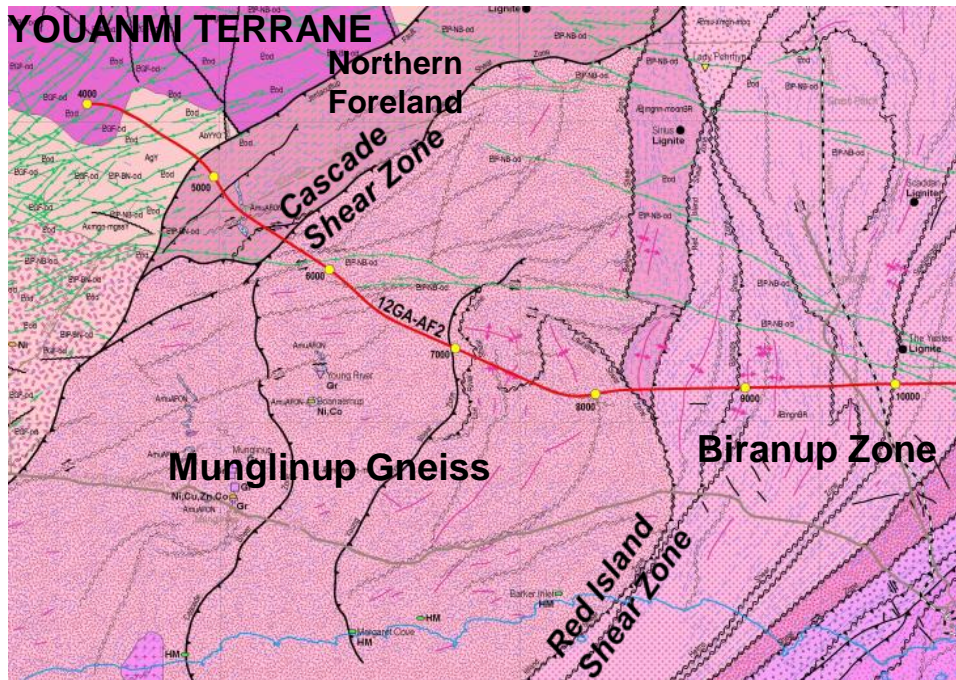


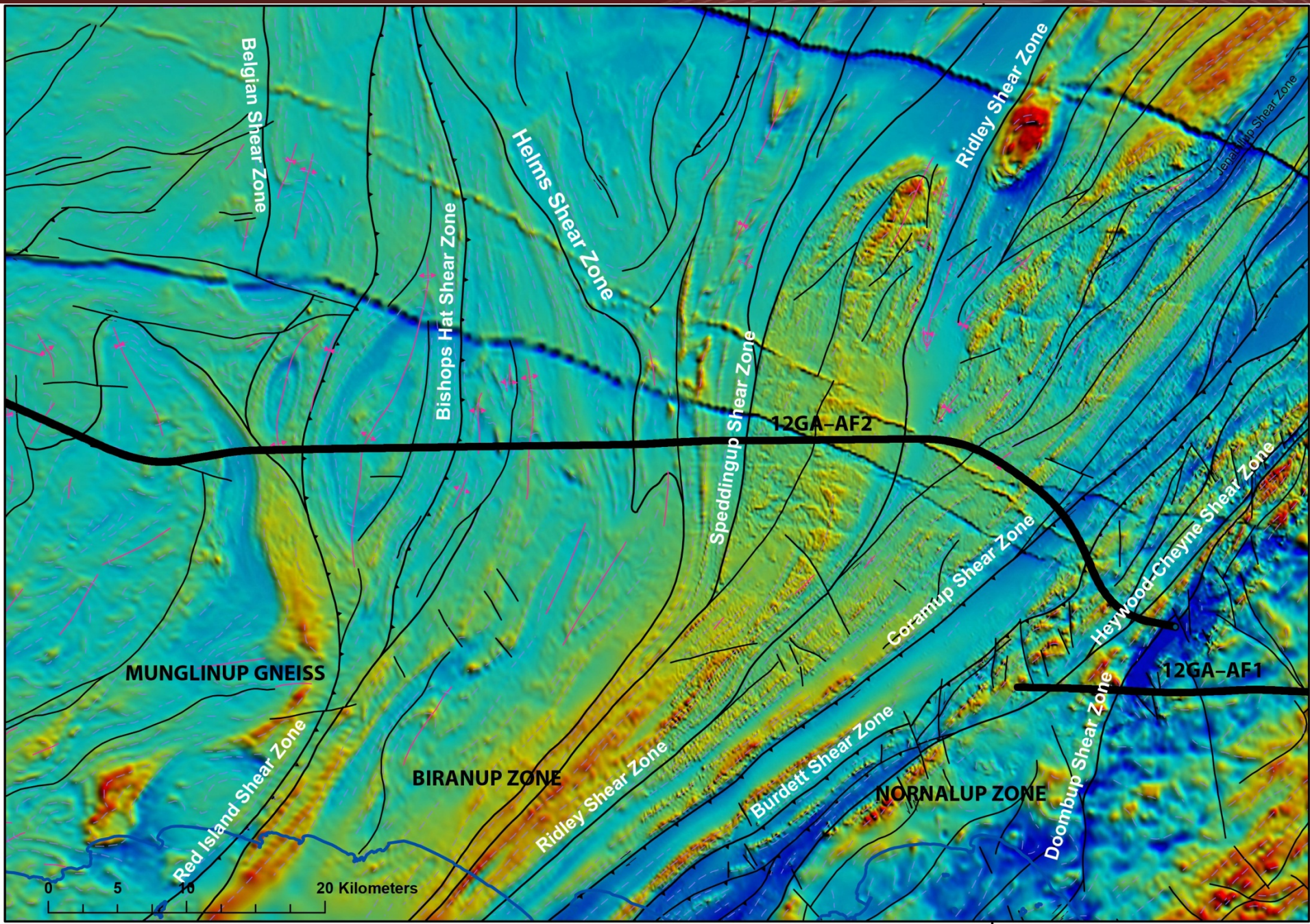
Munglinup Gneiss; Northern Foreland



- Leucocratic orthogneiss with mafic lenses
- Upper amphibolite facies
- Higher metamorphic grade, more deformed Northern Foreland

12GA-AF2





Belgian Shear Zone

Helms Shear Zone

Ridley Shear Zone

Vernal Hill Shear Zone

Bishops Hat Shear Zone

Speddingup Shear Zone

12GA-AF2

Coramup Shear Zone

Heywood-Cheyne Shear Zone

MUNGLINUP GNEISS

12GA-AF1

BIRANUP ZONE

Red Island Shear Zone

Ridley Shear Zone

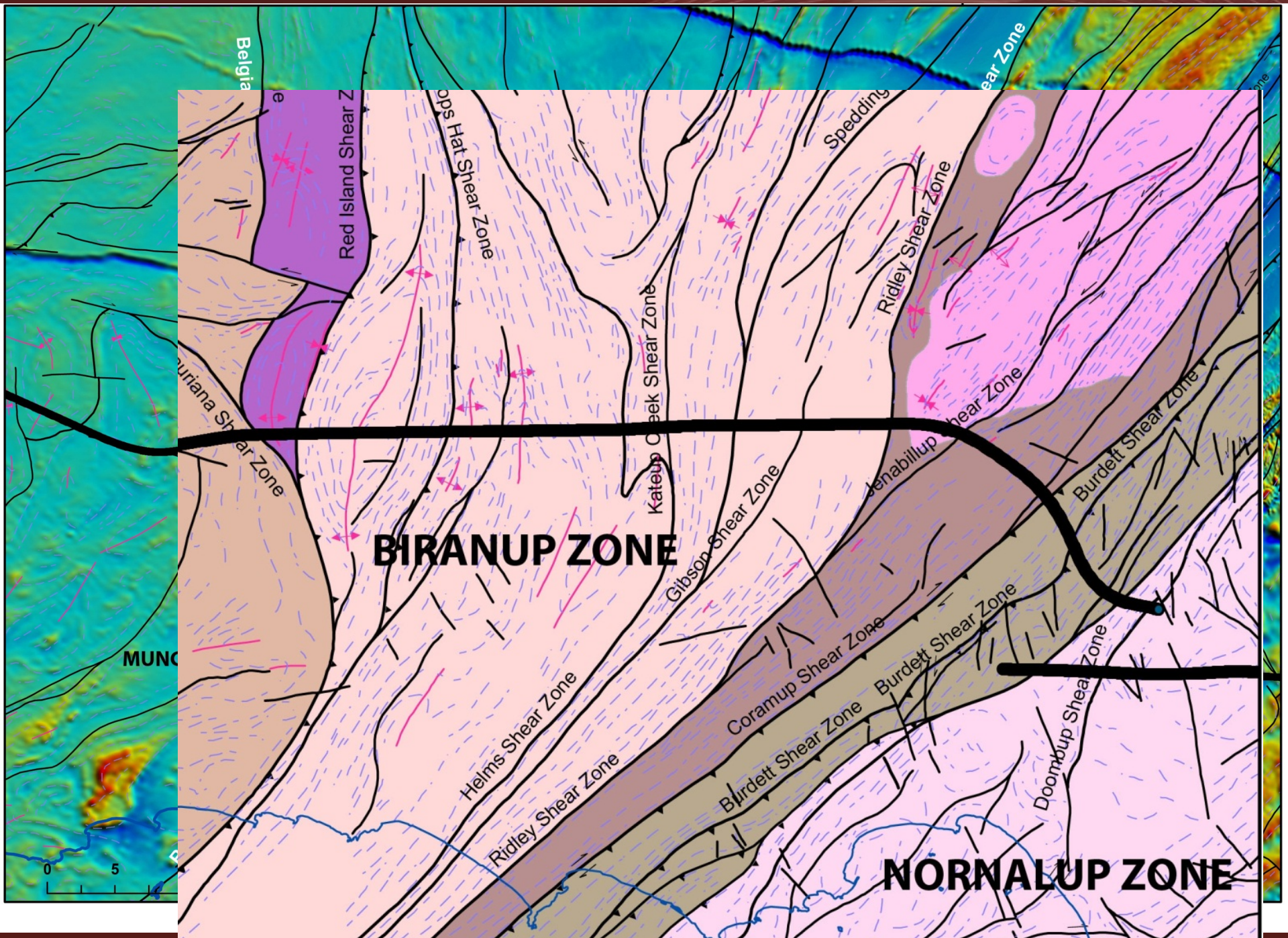
Burdett Shear Zone

NORNALUP ZONE

Doombup Shear Zone

0 5 10 20 Kilometers

122°0'0"E



Belgia

Red Island Shear Zone

Spedding Shear Zone

Ridley Shear Zone

Burdett Shear Zone

Doombup Shear Zone

Helms Shear Zone

Coramup Shear Zone

Doombup Shear Zone

Doombup Shear Zone

Doombup Shear Zone

Doombup Shear Zone

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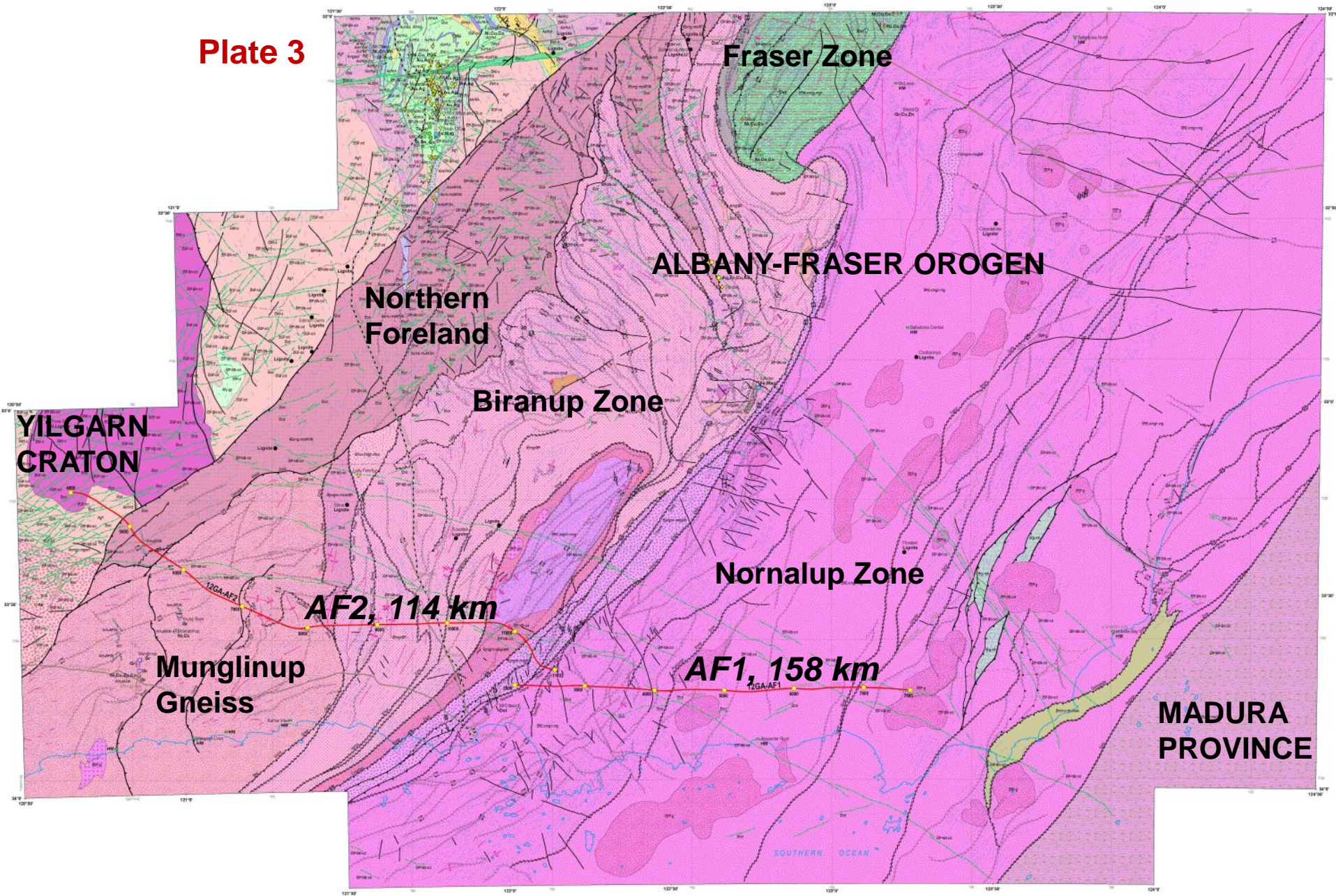
BIRANUP ZONE

NORNALUP ZONE

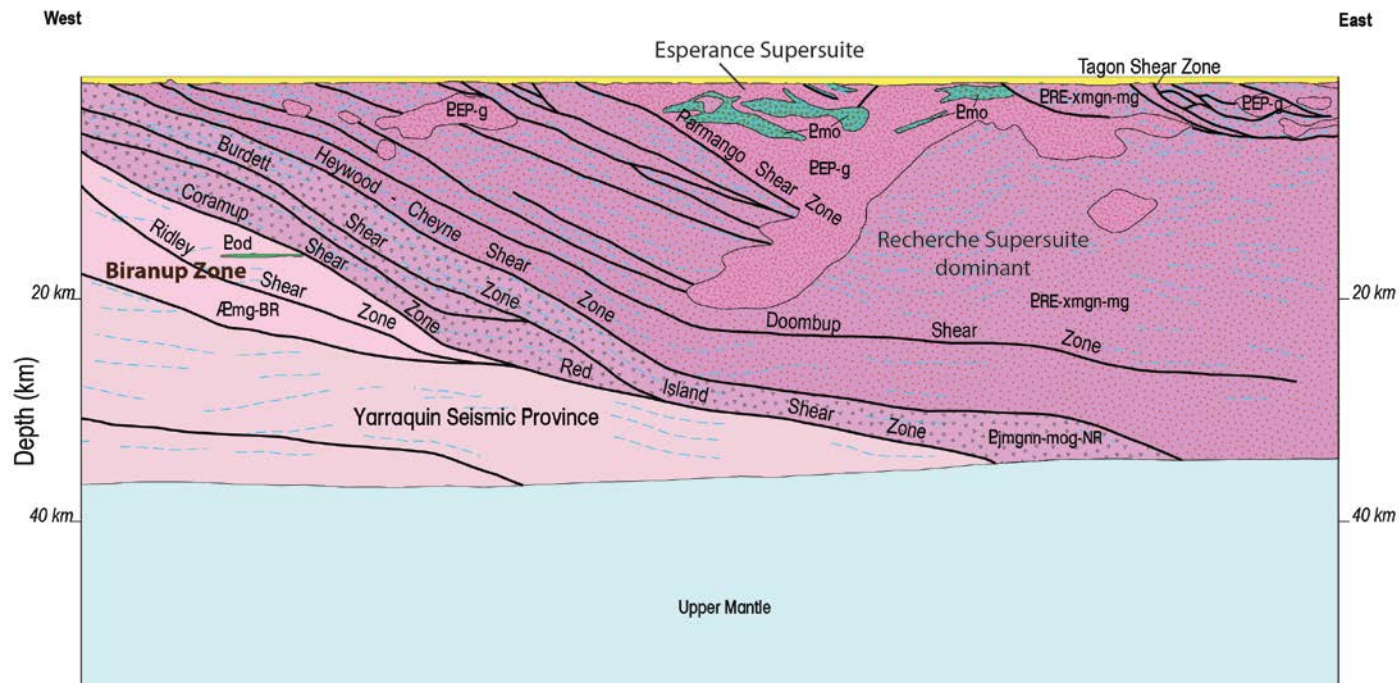
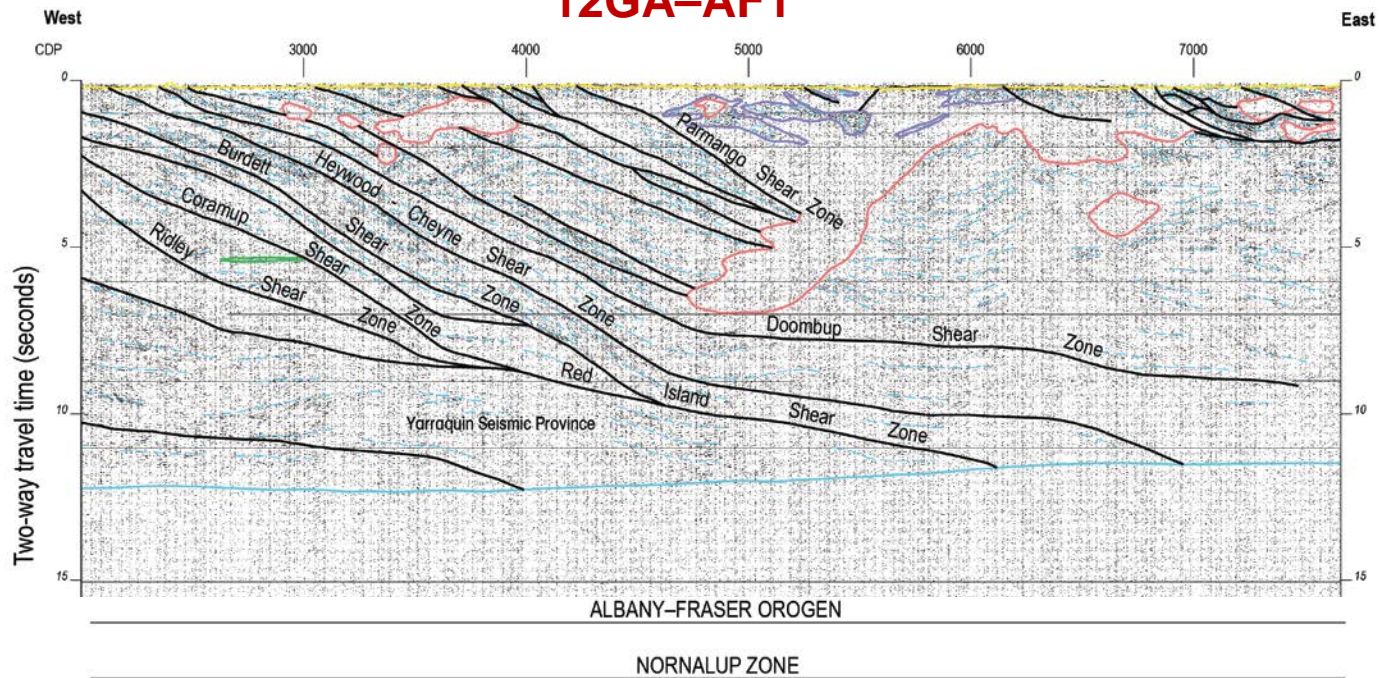
MUNC

0 5

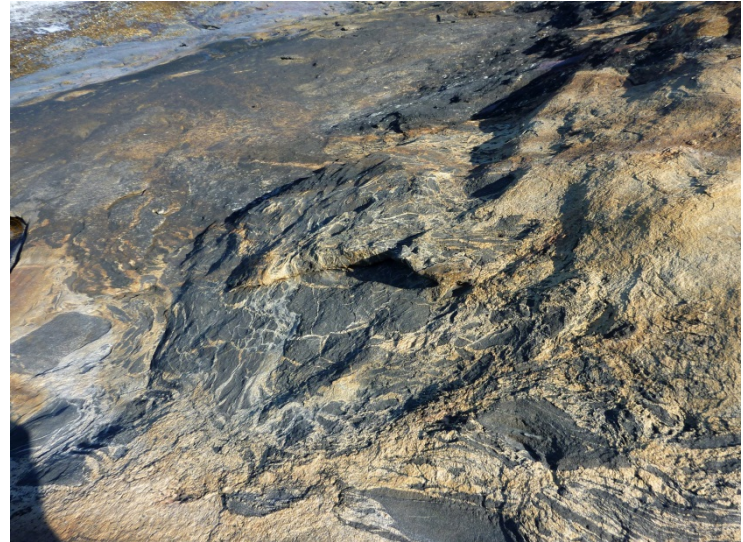
Plate 3

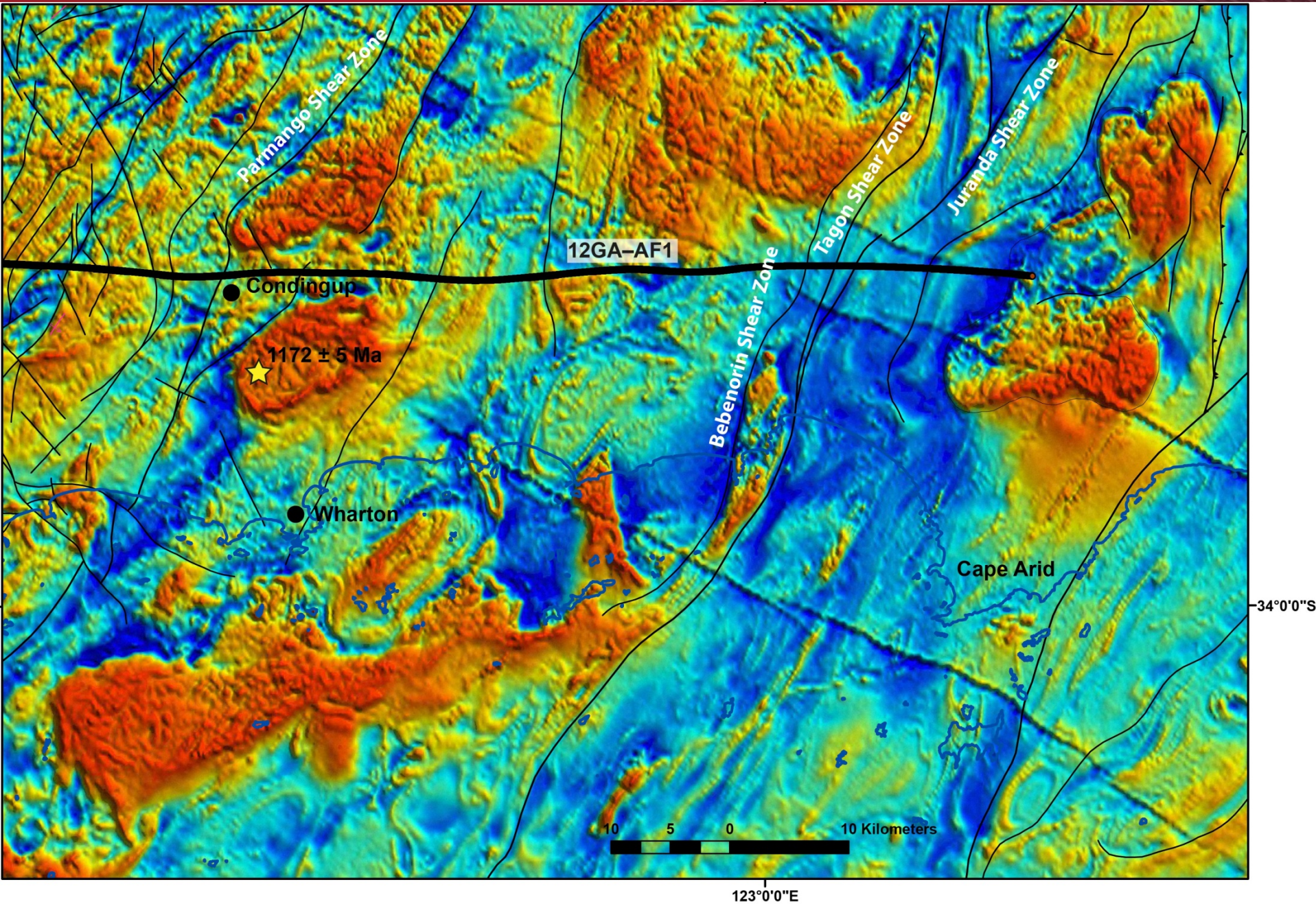


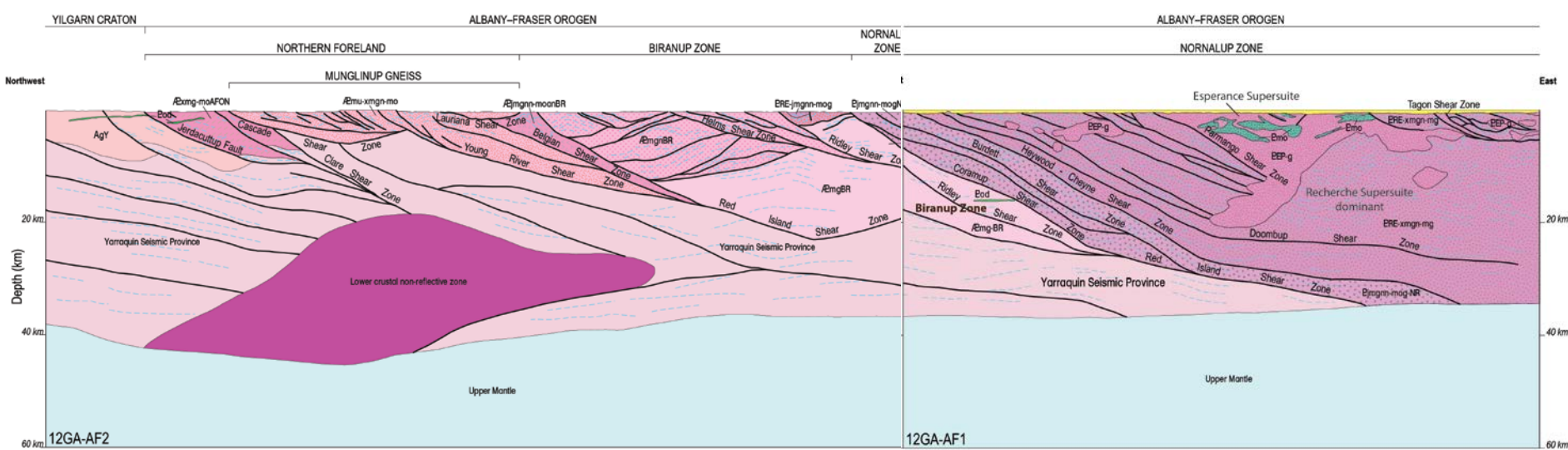
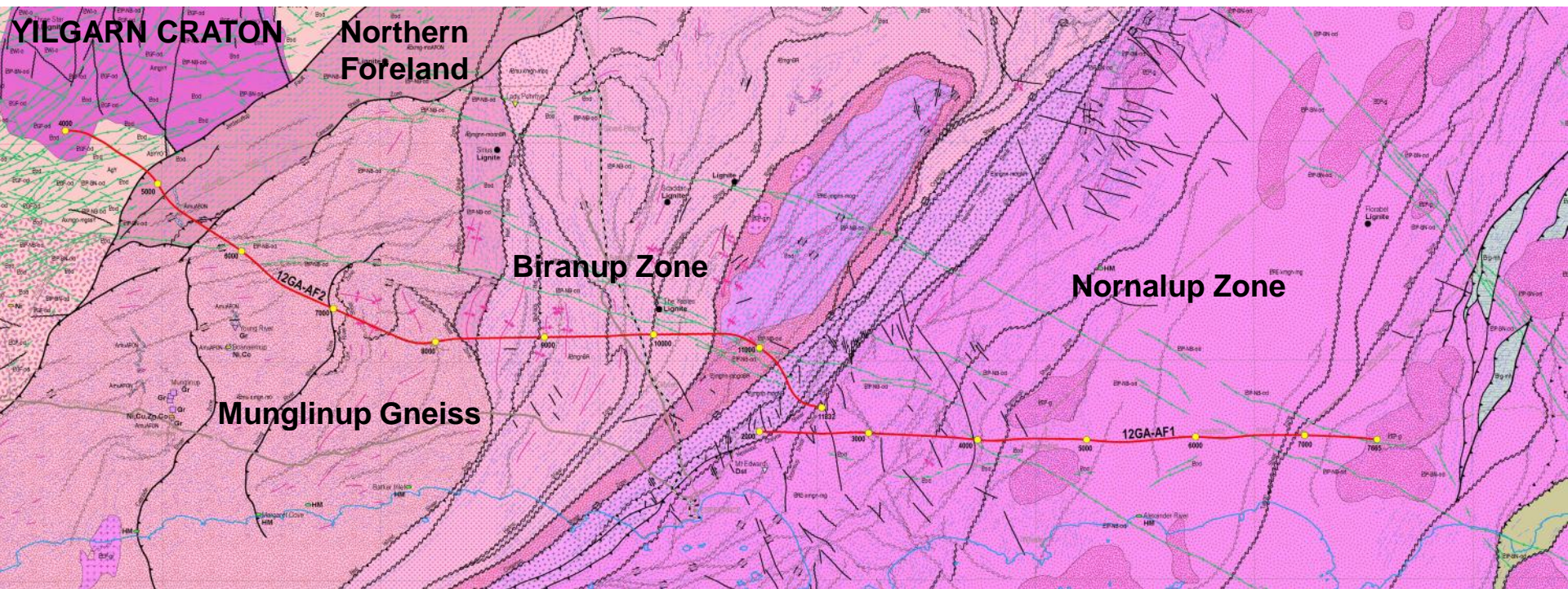
12GA-AF1



Magma chamber





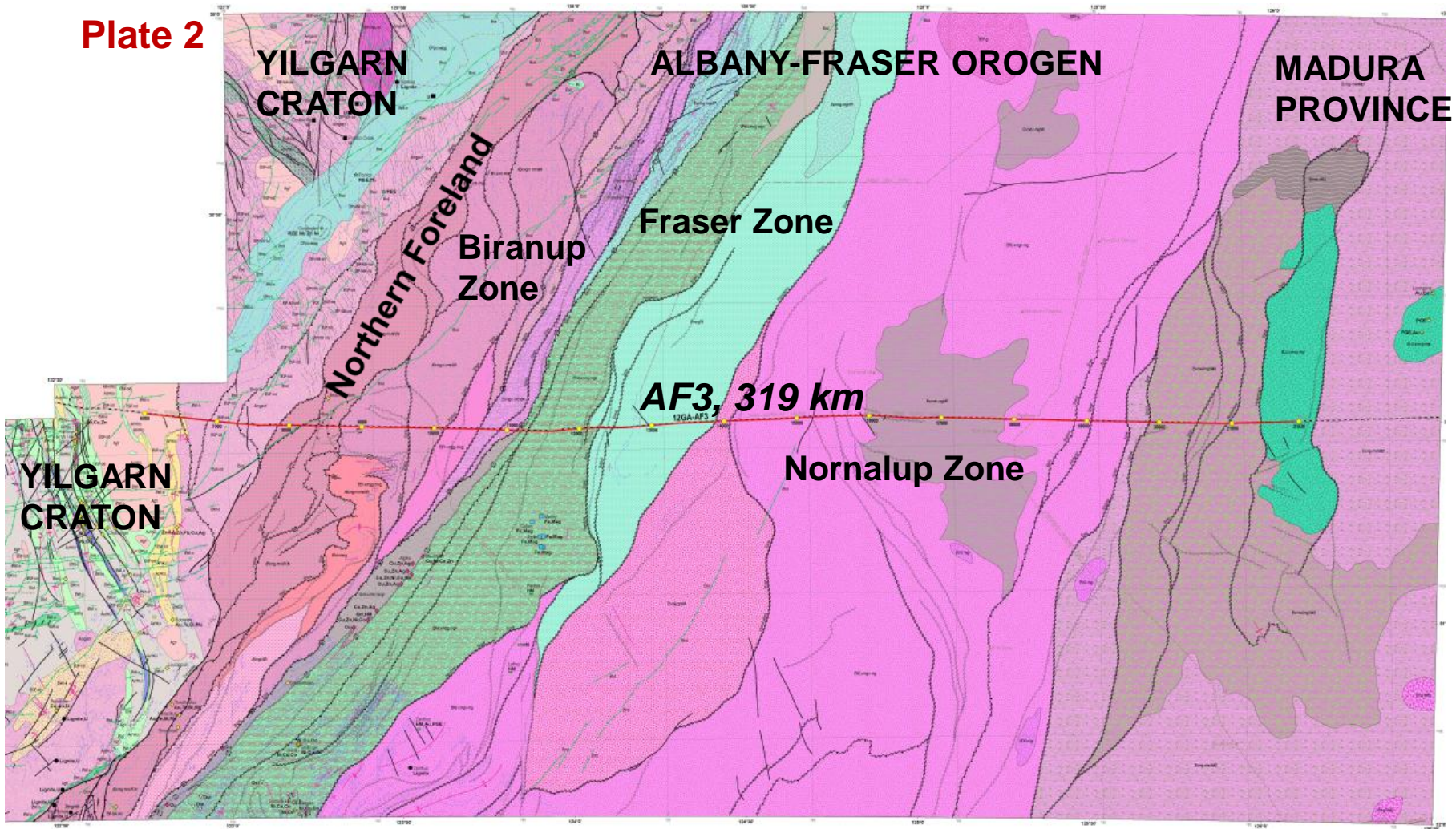


12GA-AF2 and 12GA-AF1 combined

Seismic line 12GA–AF3



Plate 2



12GA-AF3

YILGARN CRATON

ALBANY-FRASER OROGEN

MADURA PROVINCE

Biranup Zone

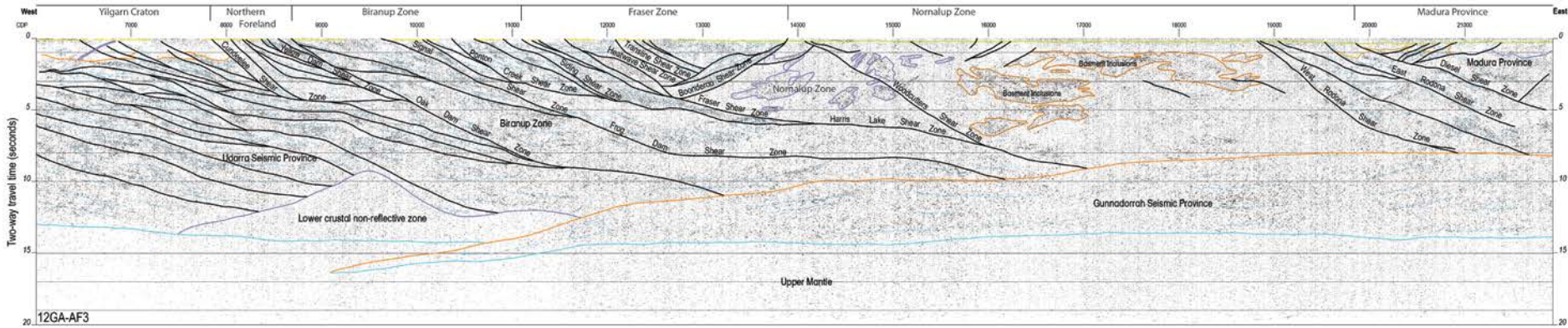
Fraser Zone

Nornalup Zone

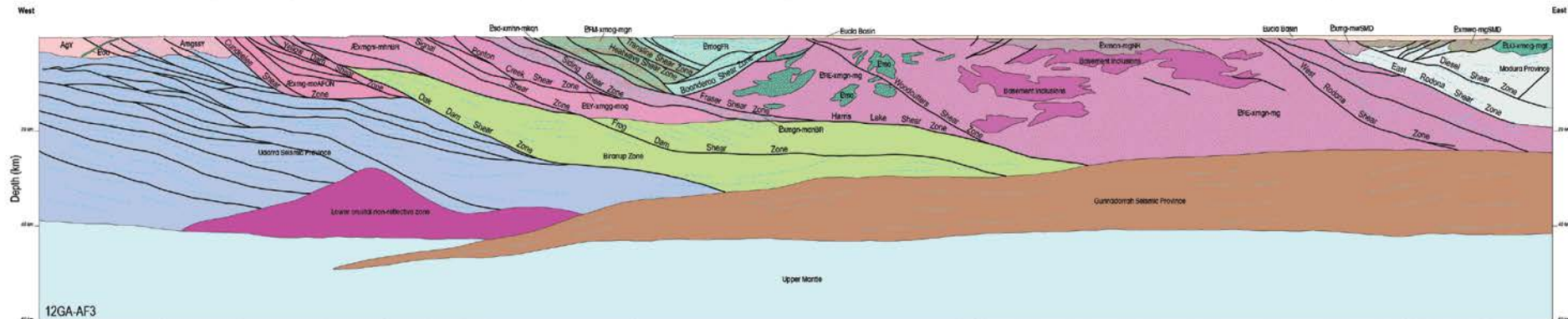
Northern Foreland

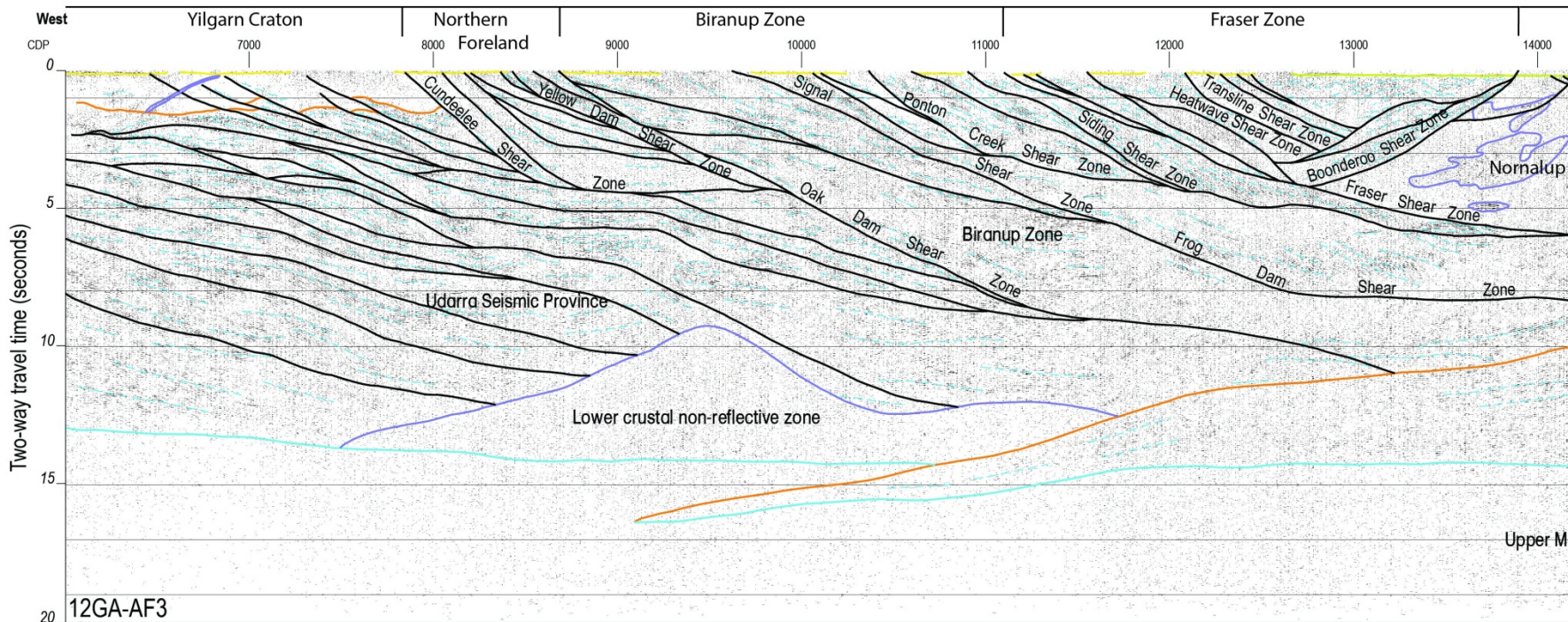
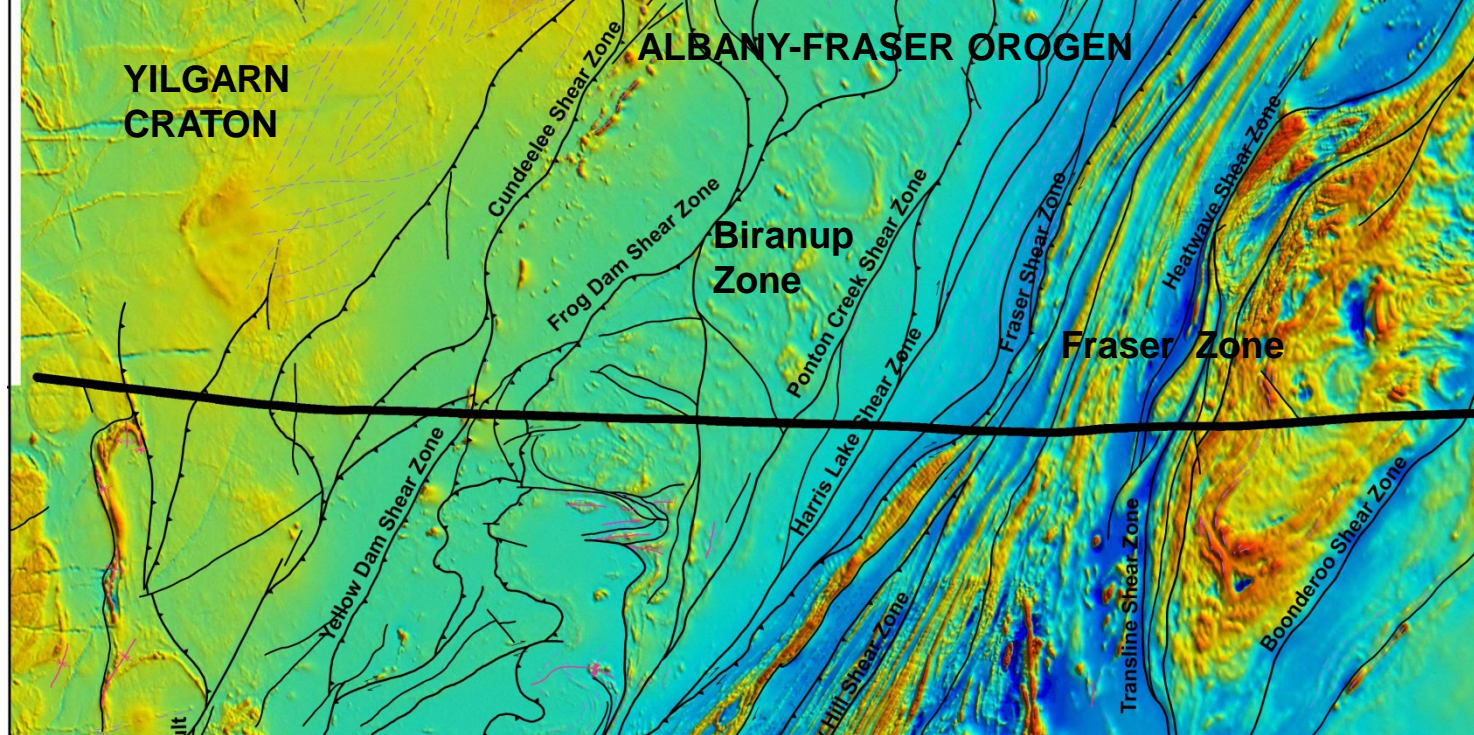


Interpreted Migrated Seismic Sections



NORTHERN FORELAND BIRANUP ZONE FRASER ZONE NORNALUP ZONE







YILGARN CRATON

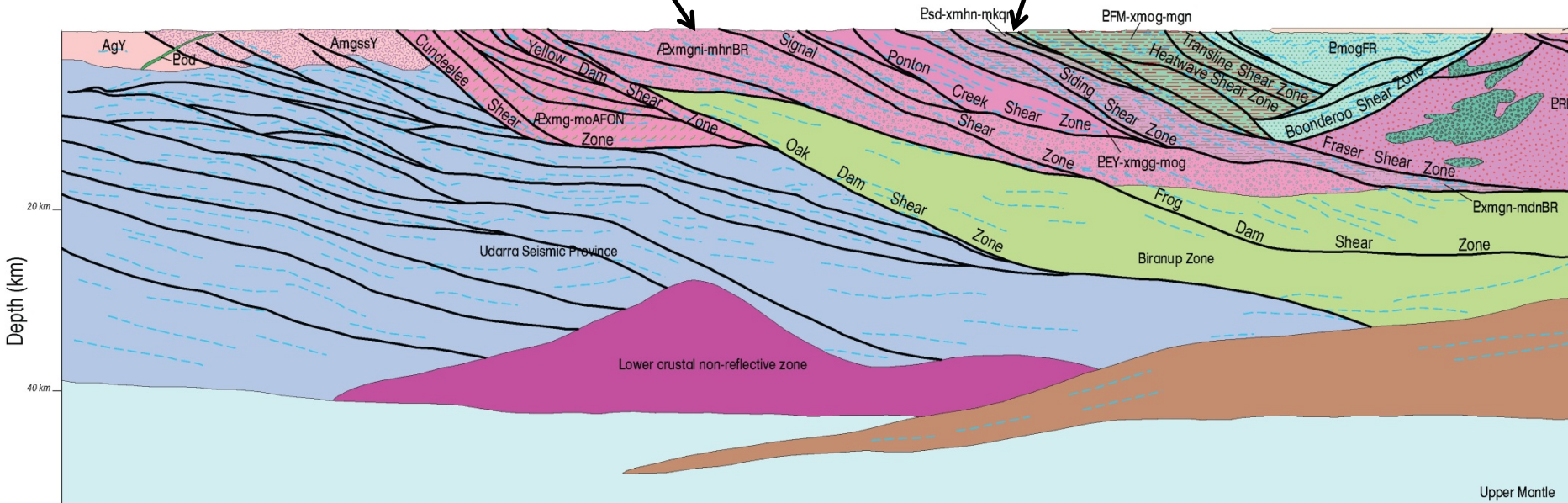
ALBANY-FRASER OROGEN

NORTHERN FORELAND

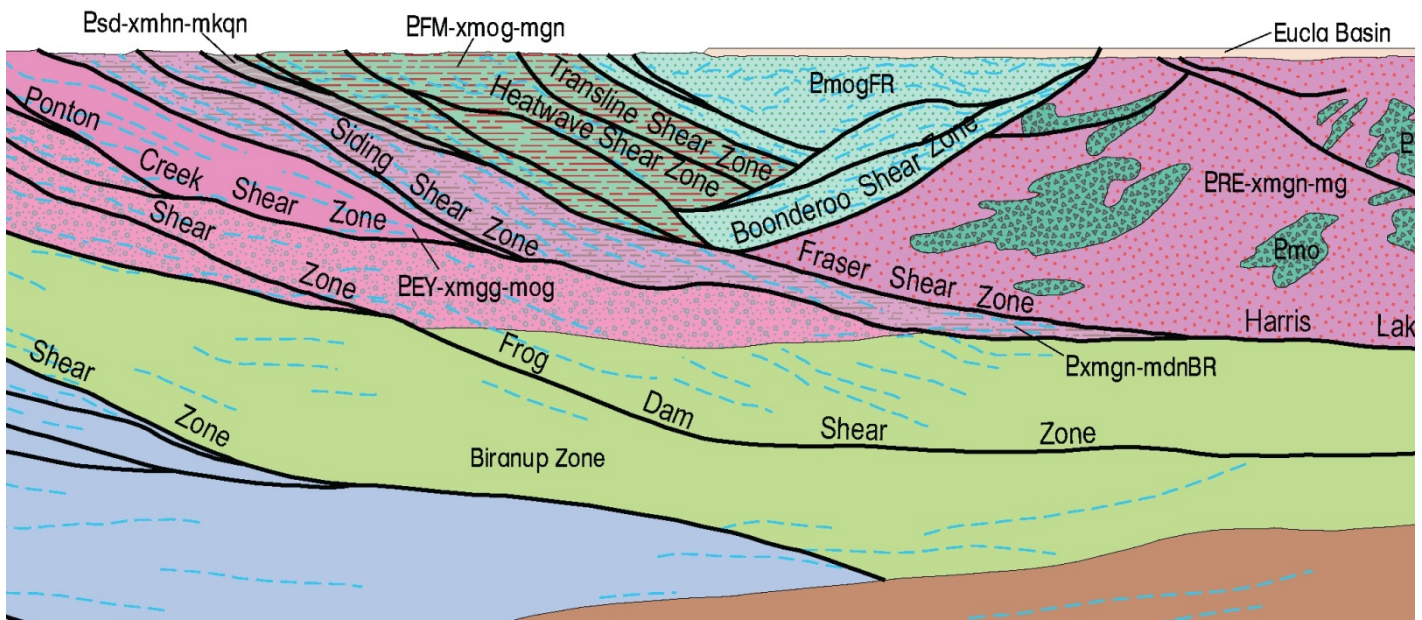
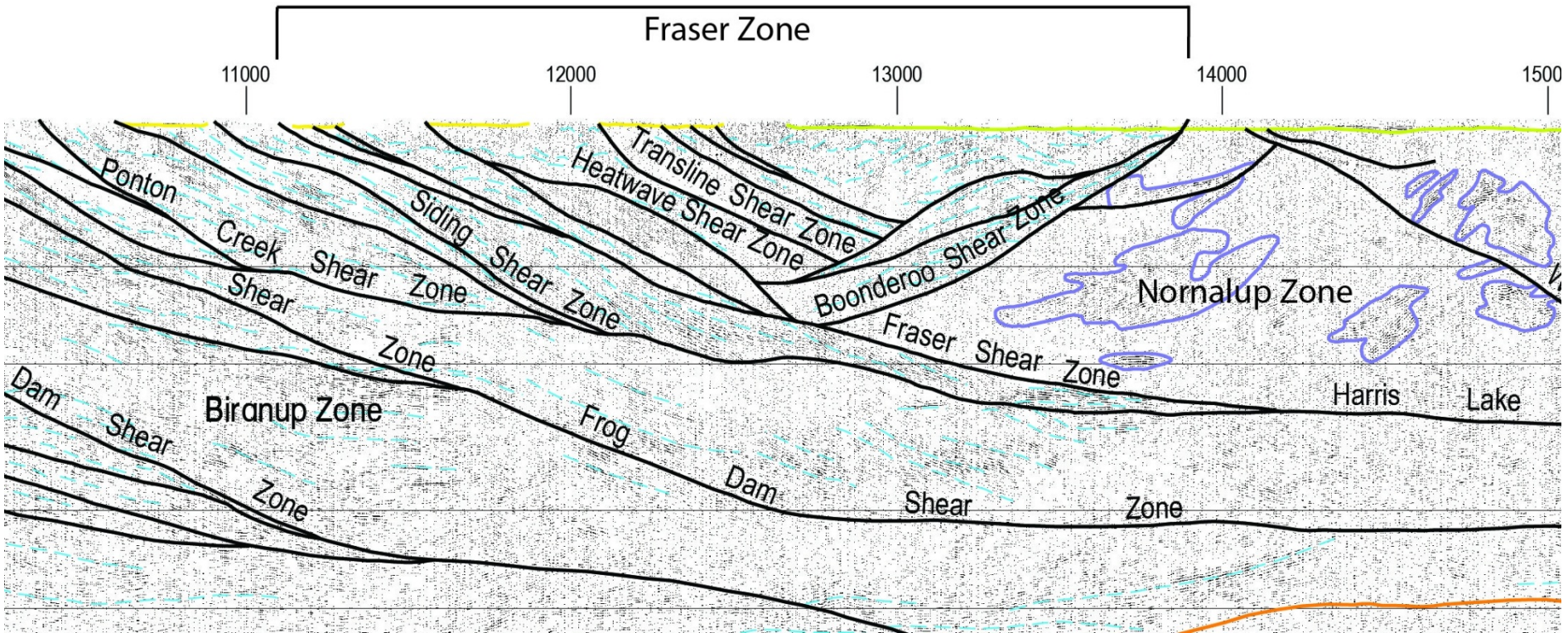
BIRANUP ZONE

FRASER ZONE

West

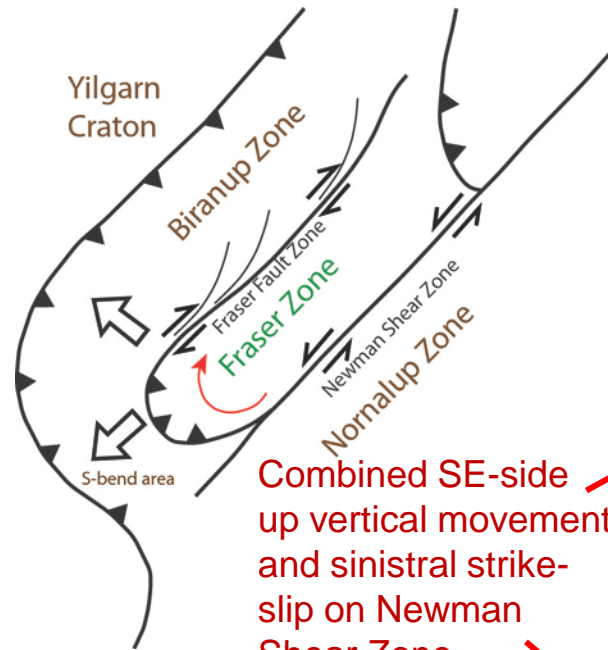


Upper Mantle



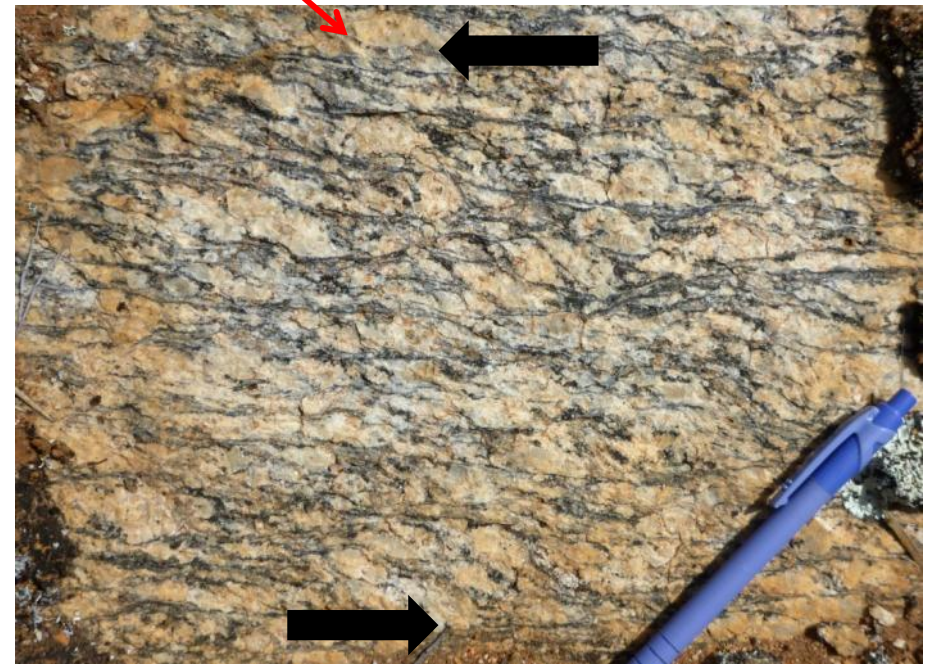
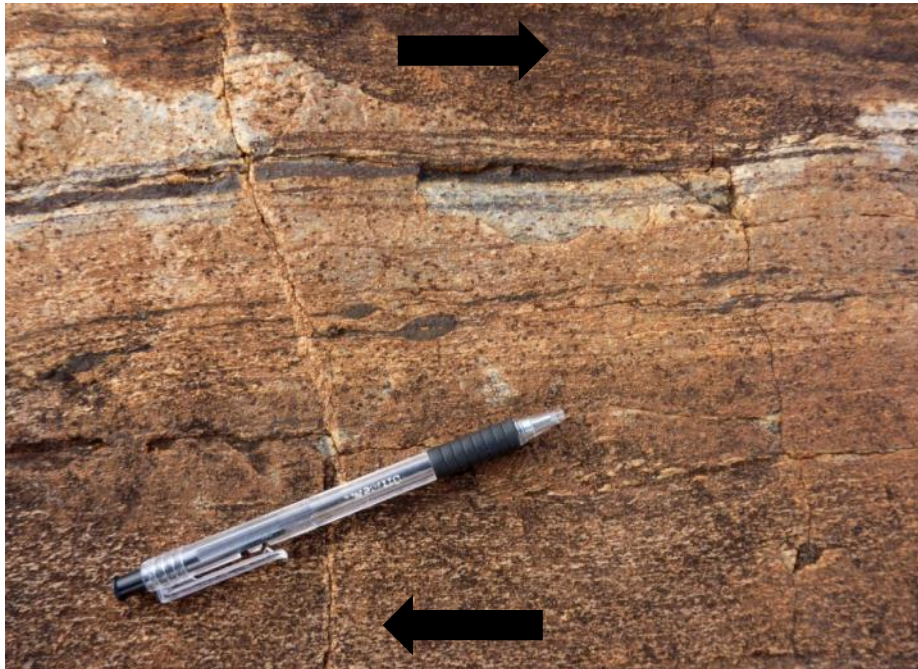
Final emplacement of the Fraser Zone

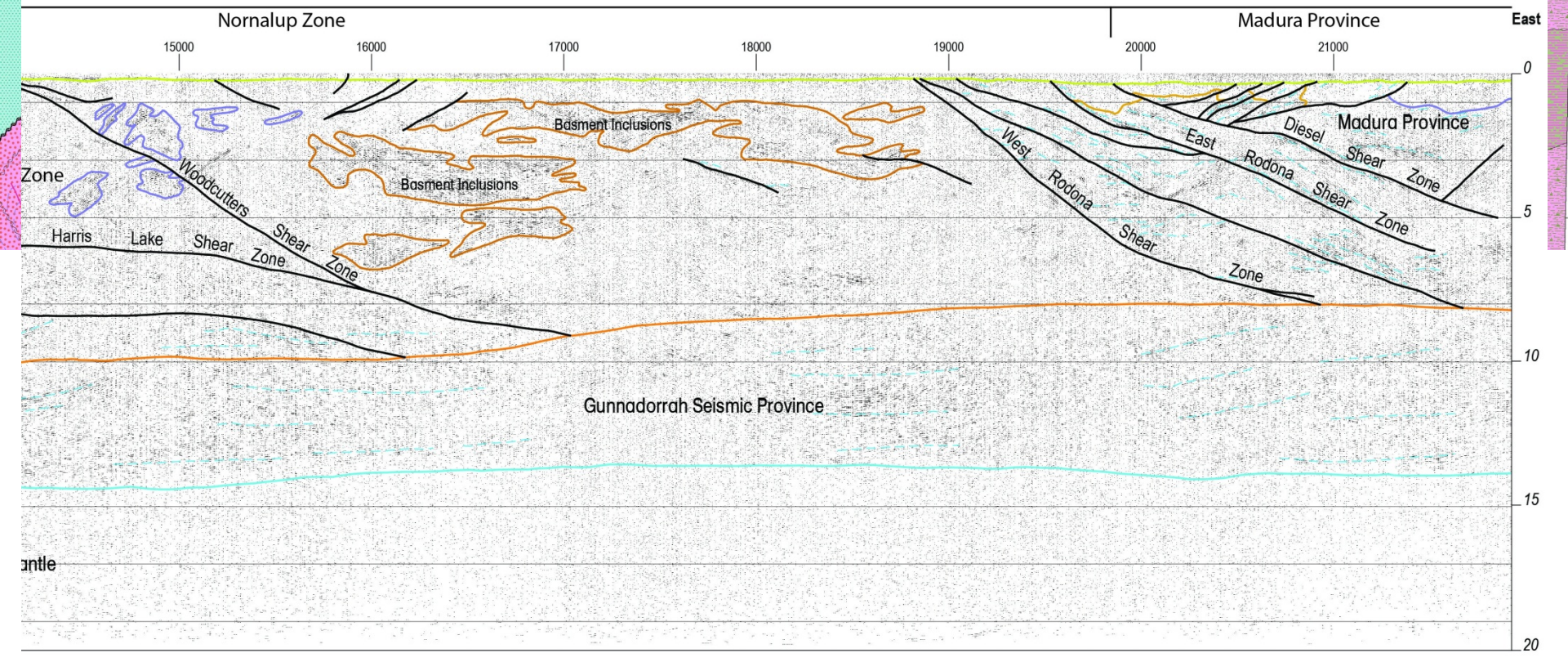
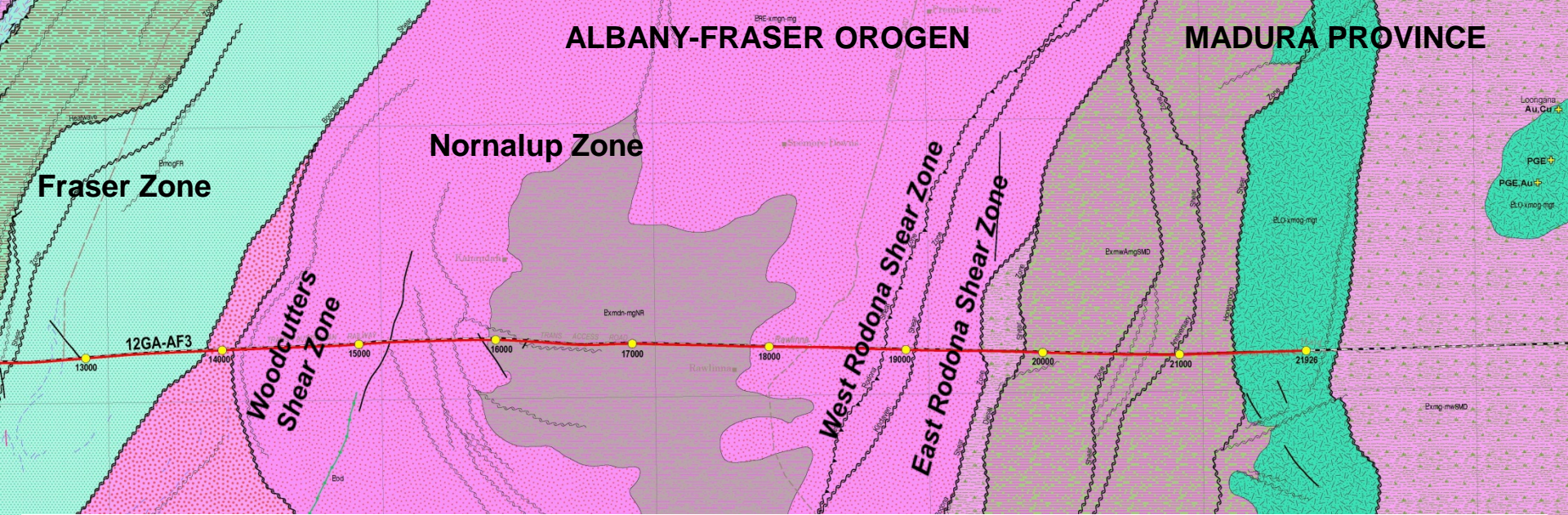
Bounding shear zones
with different kinematics
and lower T deformation
- active during Stage II?

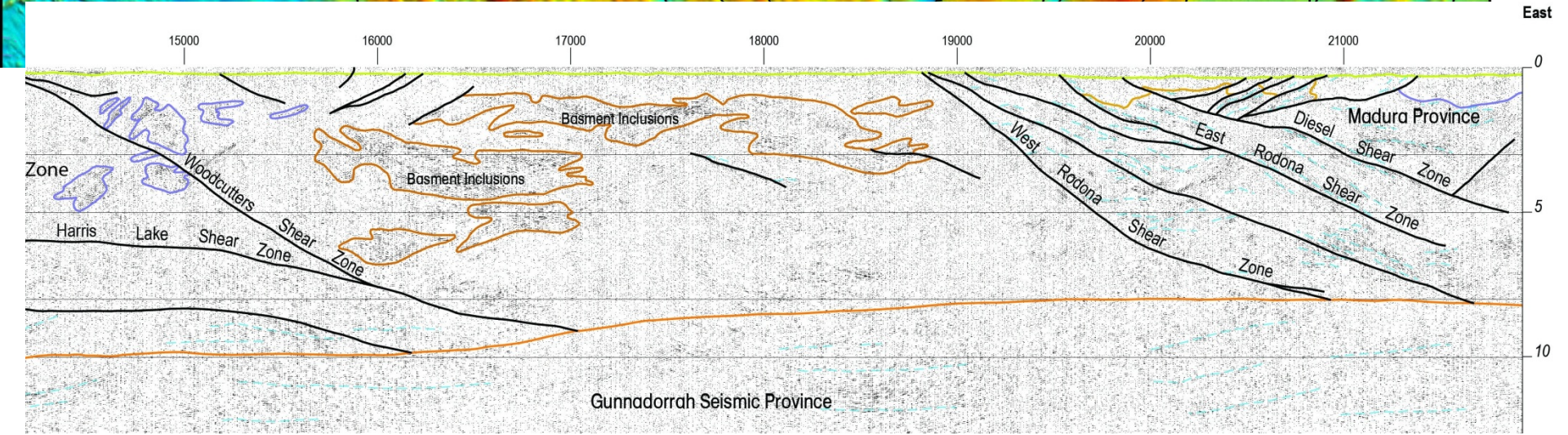
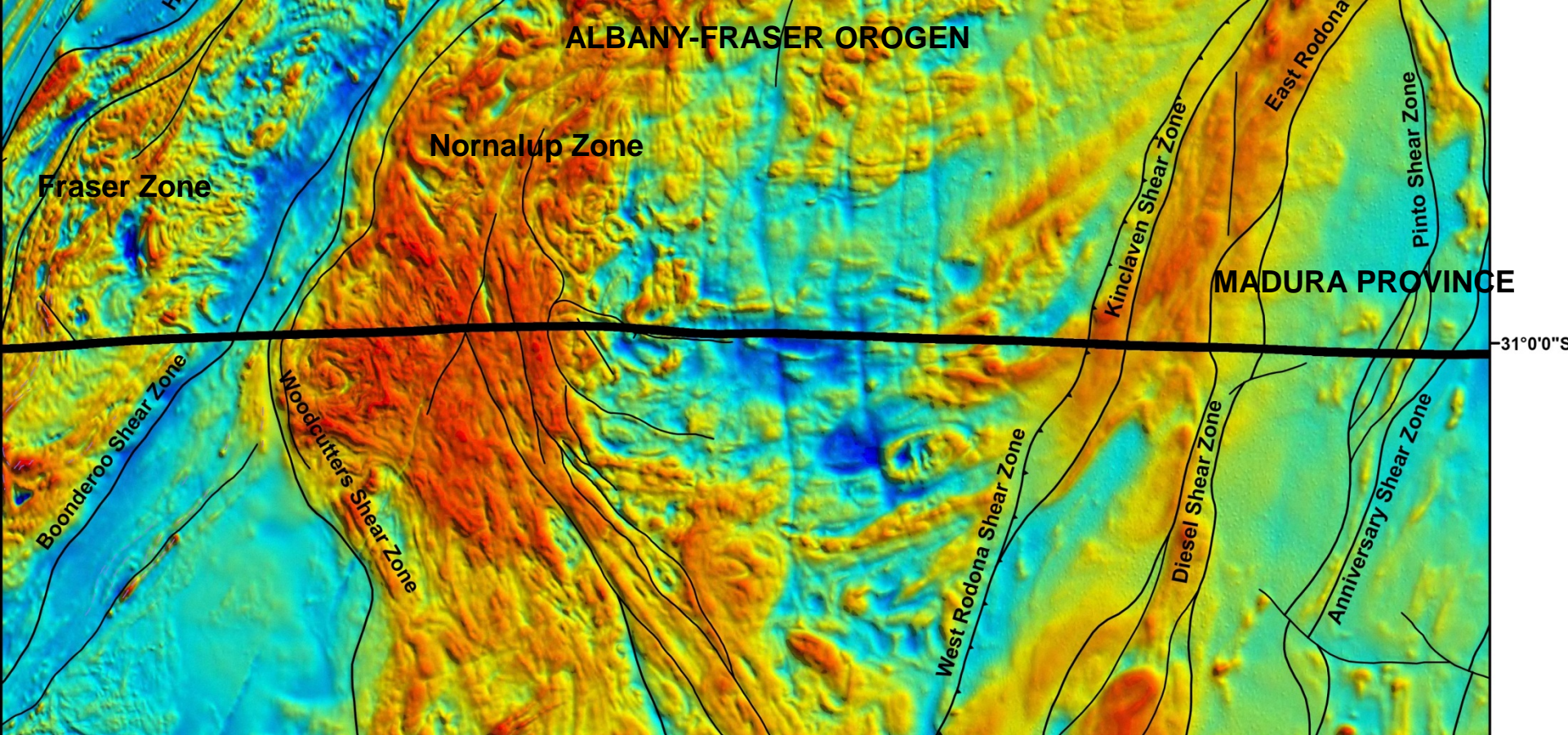


Dextral strike-slip on Fraser Shear Zone

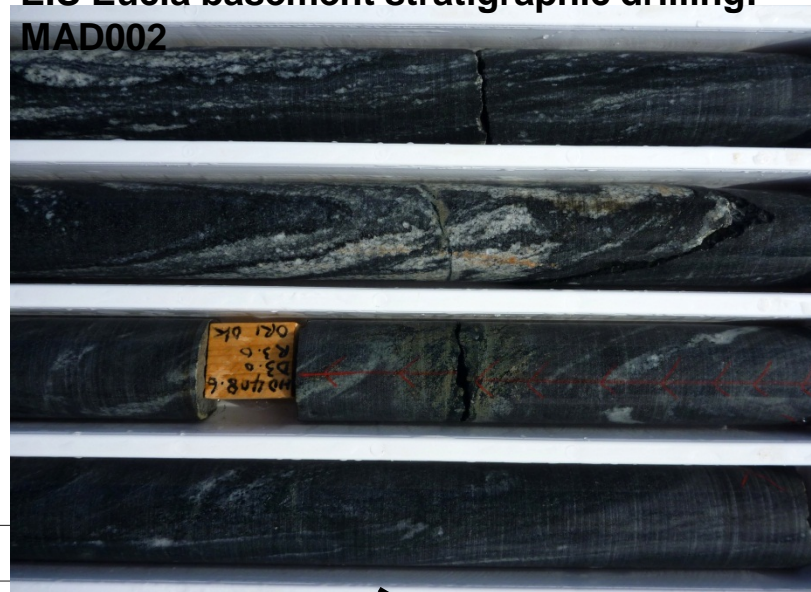
Combined SE-side
up vertical movement
and sinistral strike-
slip on Newman
Shear Zone



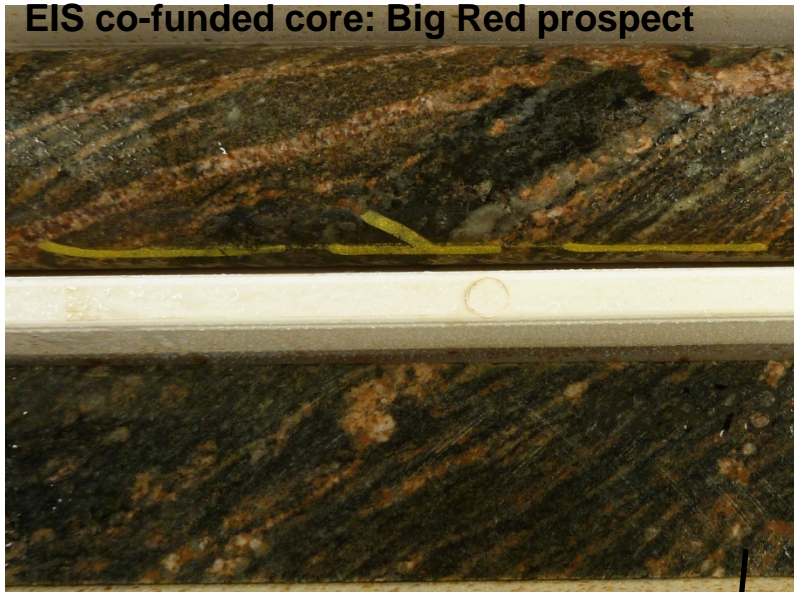




EIS Eucla basement stratigraphic drilling: MAD002



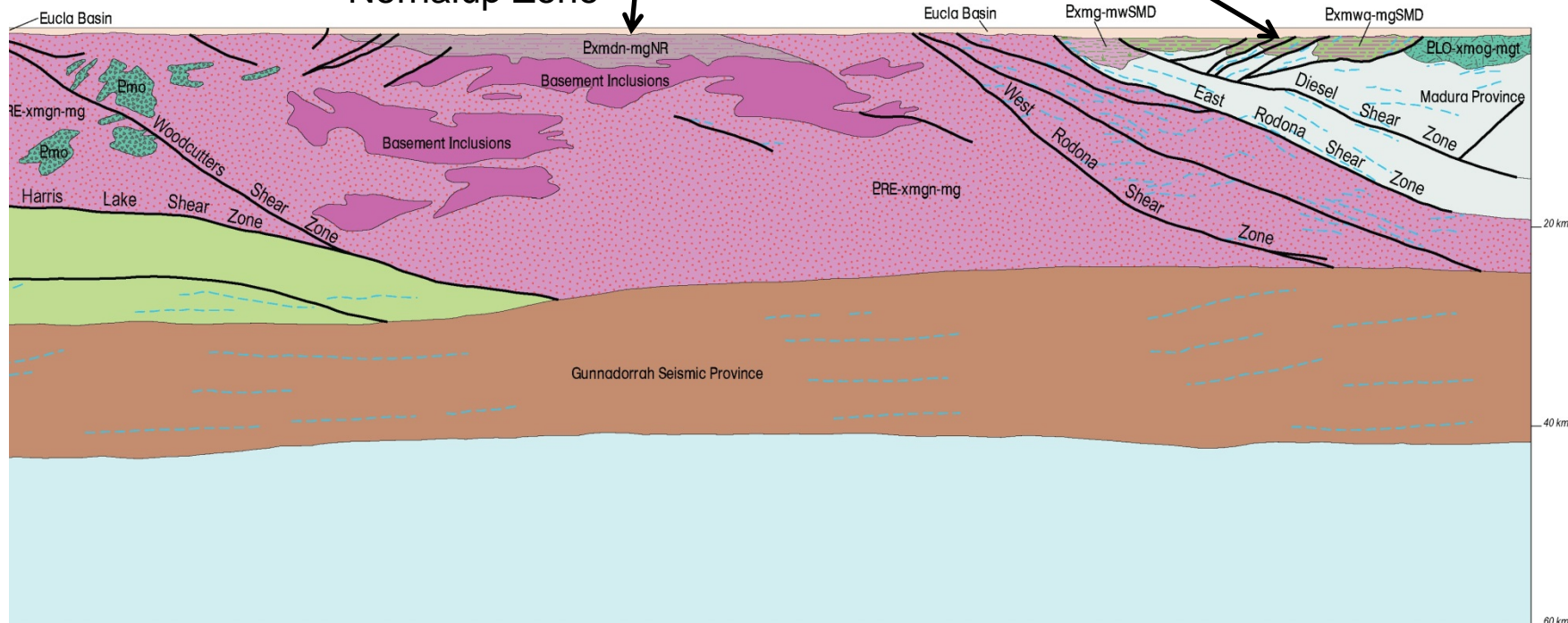
EIS co-funded core: Big Red prospect



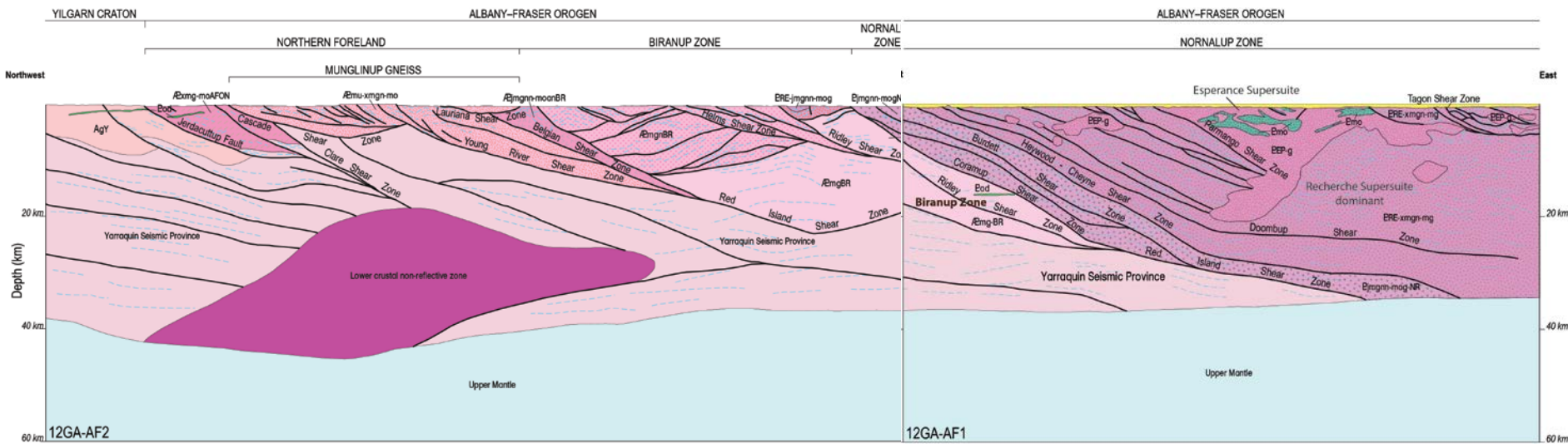
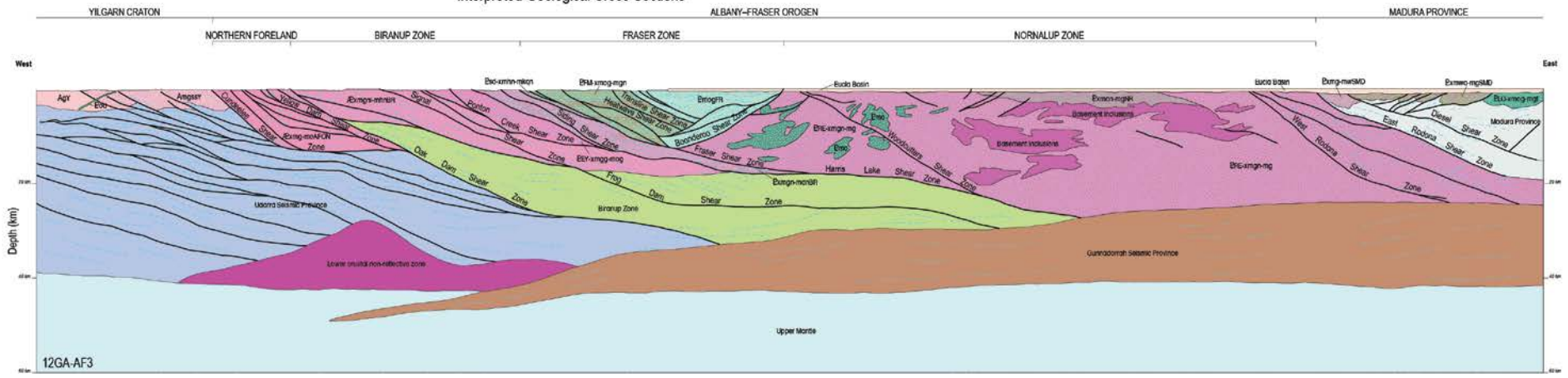
Nornalup Zone

Madura Province

East



Interpreted Geological Cross Sections



Conclusions



- The 3 seismic lines provide 2D cross-sections across the entire orogen
- The orogen has a predominant southeast dip, and shear zones generally have listric form
- Interpreted as largely due to craton-vergent thrusting – probable inverted structures
- The largest structures are the shear zones associated with the Biranup-Nornalup Zone boundary – extend to the Moho, but some difference along-strike
- The Fraser Zone has a V-shaped geometry – modified pop-up structure
- Three seismic provinces are recognised – the Yarraquin, the Udarra, and the Gunnadorrah Seismic Provinces
- Large areas of non-reflective crust – reflectivity possibly masked by magmatic processes, which were prevalent during AFO evolution
- The only suture recognised so far is the Rodona Shear Zone – Eucla-Gawler line in progress