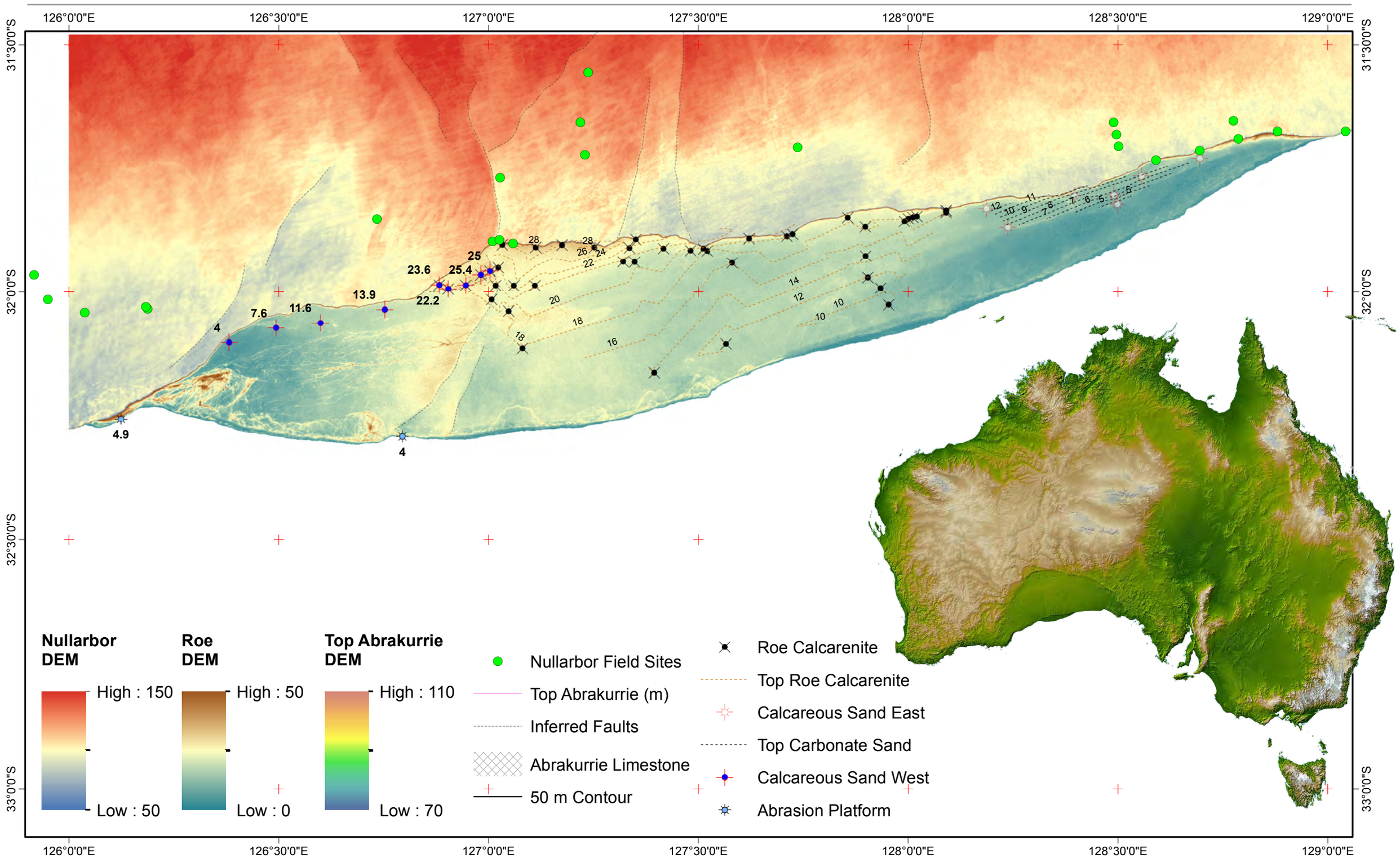
Cenozoic Records of Eustasy, Dynamic Topography, and Neotectonics from the Eucla Basin

Mick O'Leary[1], Milo Barham[2] and Lewis Mounsher[3]

[1]*Department of Environment and Agriculture, Curtin University*
[2]Department of *Applied Geology, Curtin University*
[3]*Woodside Energy, Perth, Western Australia*

Pliocene sea level archives from the Roe Plain

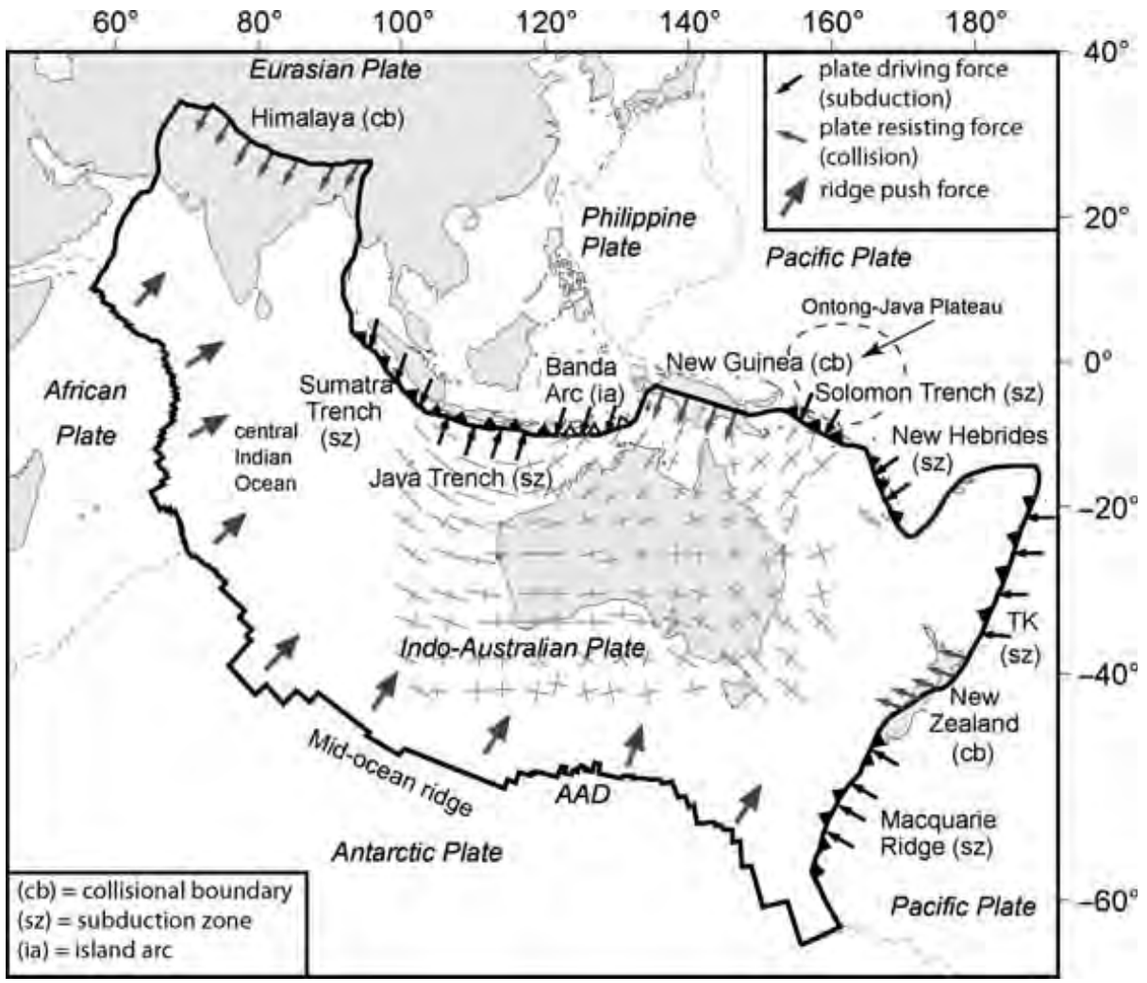
Evidence of former sea levels up to 28 m above present (TECTONIC CONTAMINATION?)



Crustal deformation of the Australian continent during the Cenozoic

- Tectonically Quiescent ✗
- Actively deforming ✓
  - Paucity of onshore data 😕
- Evolution of stress fields?
- Significance of strain structures i.e., seismic hazard/basin evolution?
- Tectonic contamination of palaeoshoreline data?

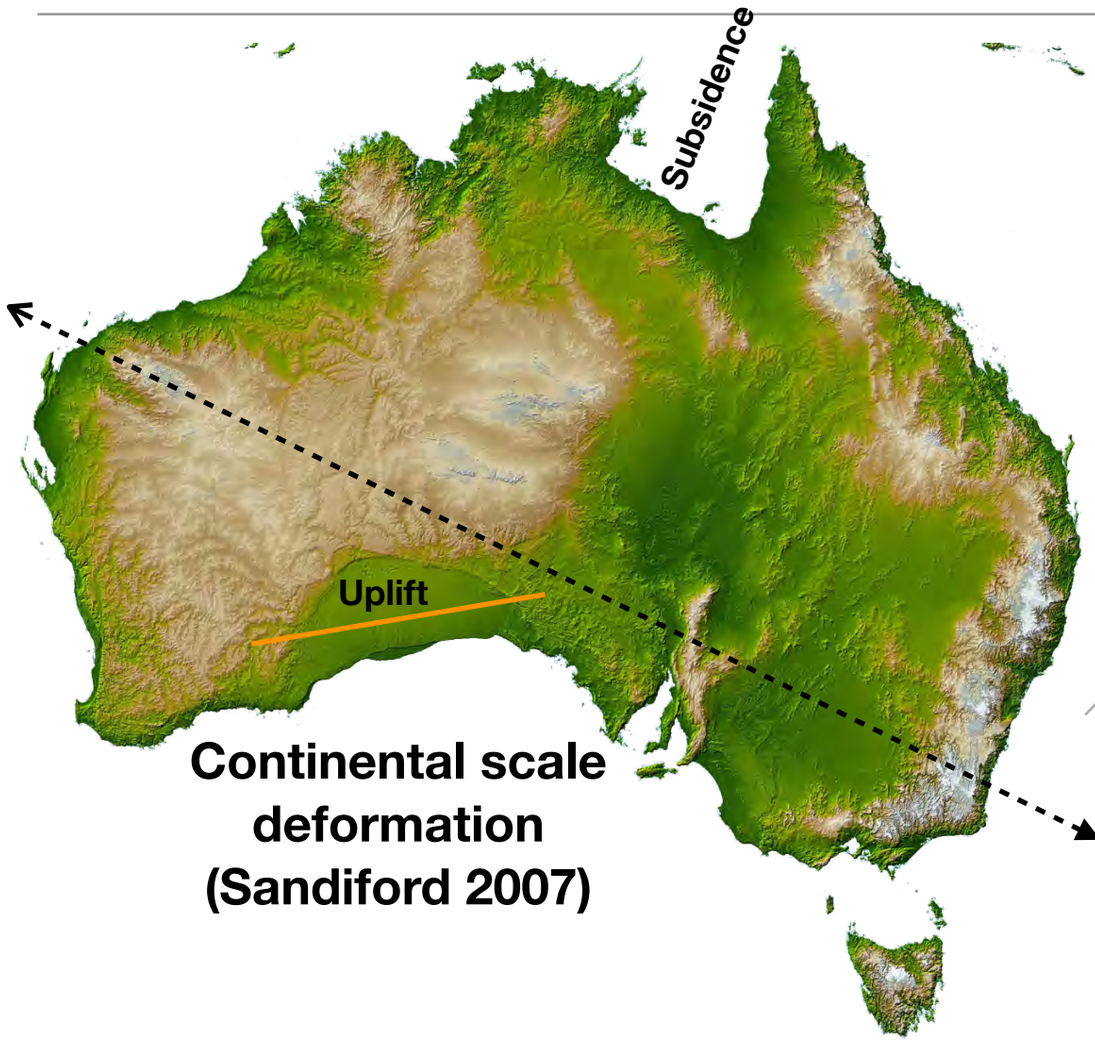
Rapid northward drift of the Australian continental plate

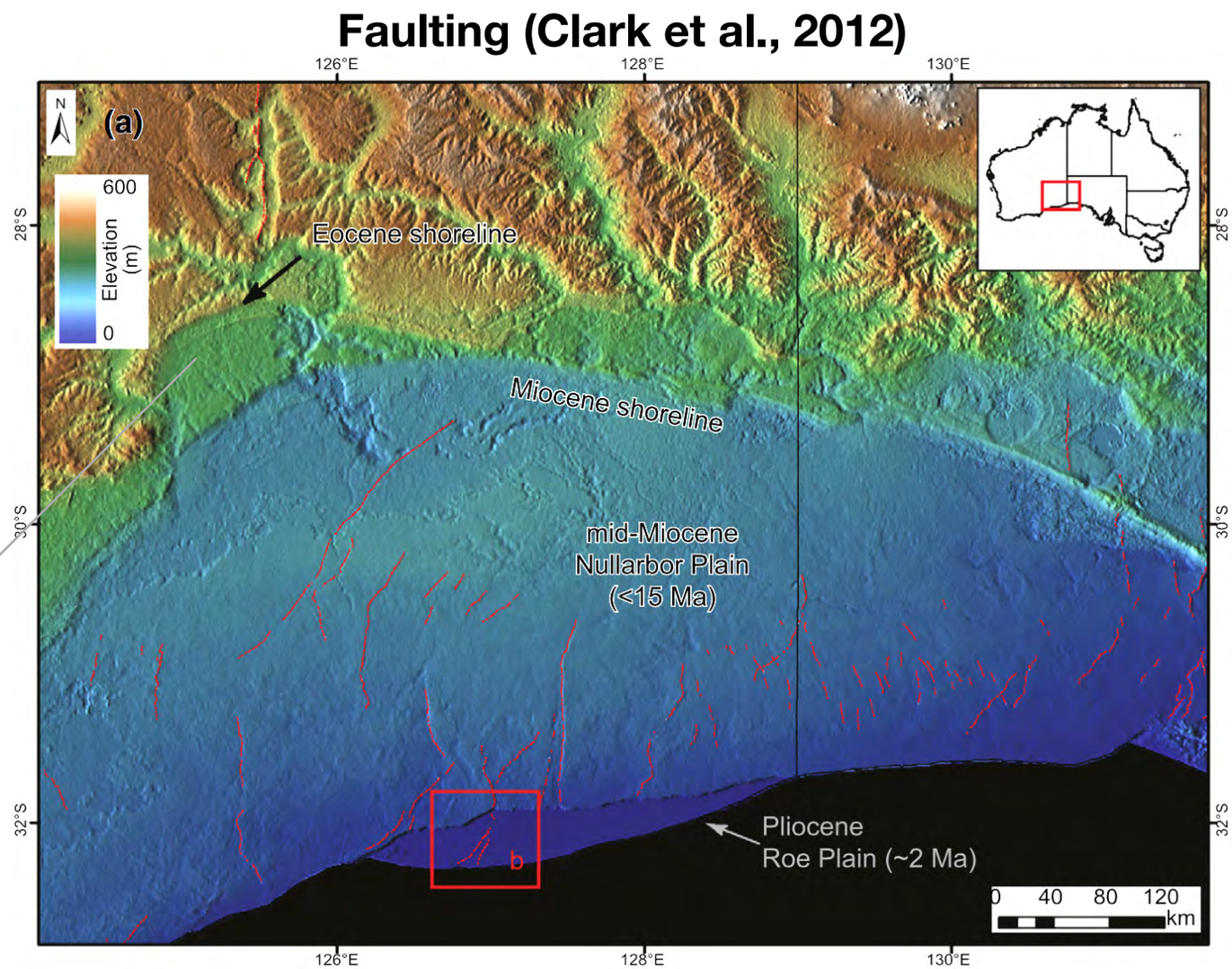


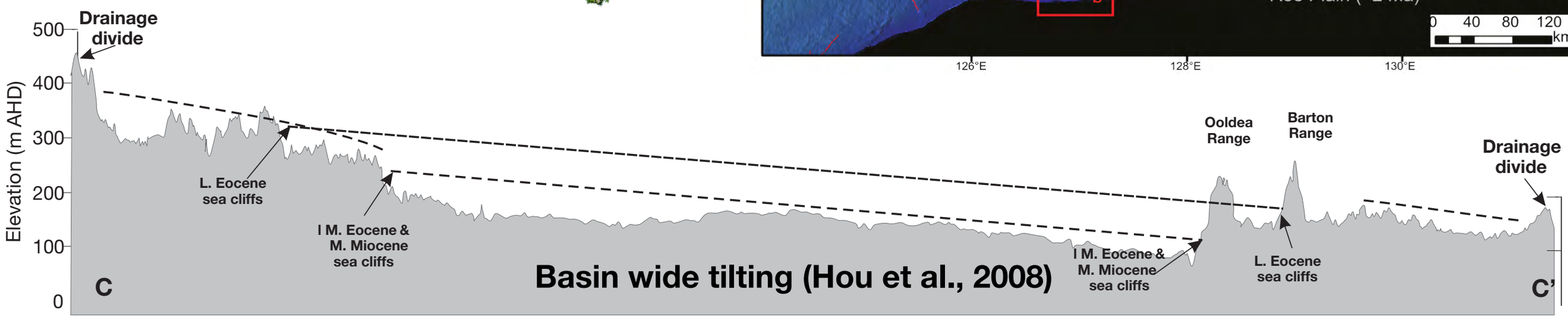
From Reynolds et al. 2003; Hillis et al. 2008

Evidence of dynamic movement on the Nullarbor

(Provided by surface digital elevation models)



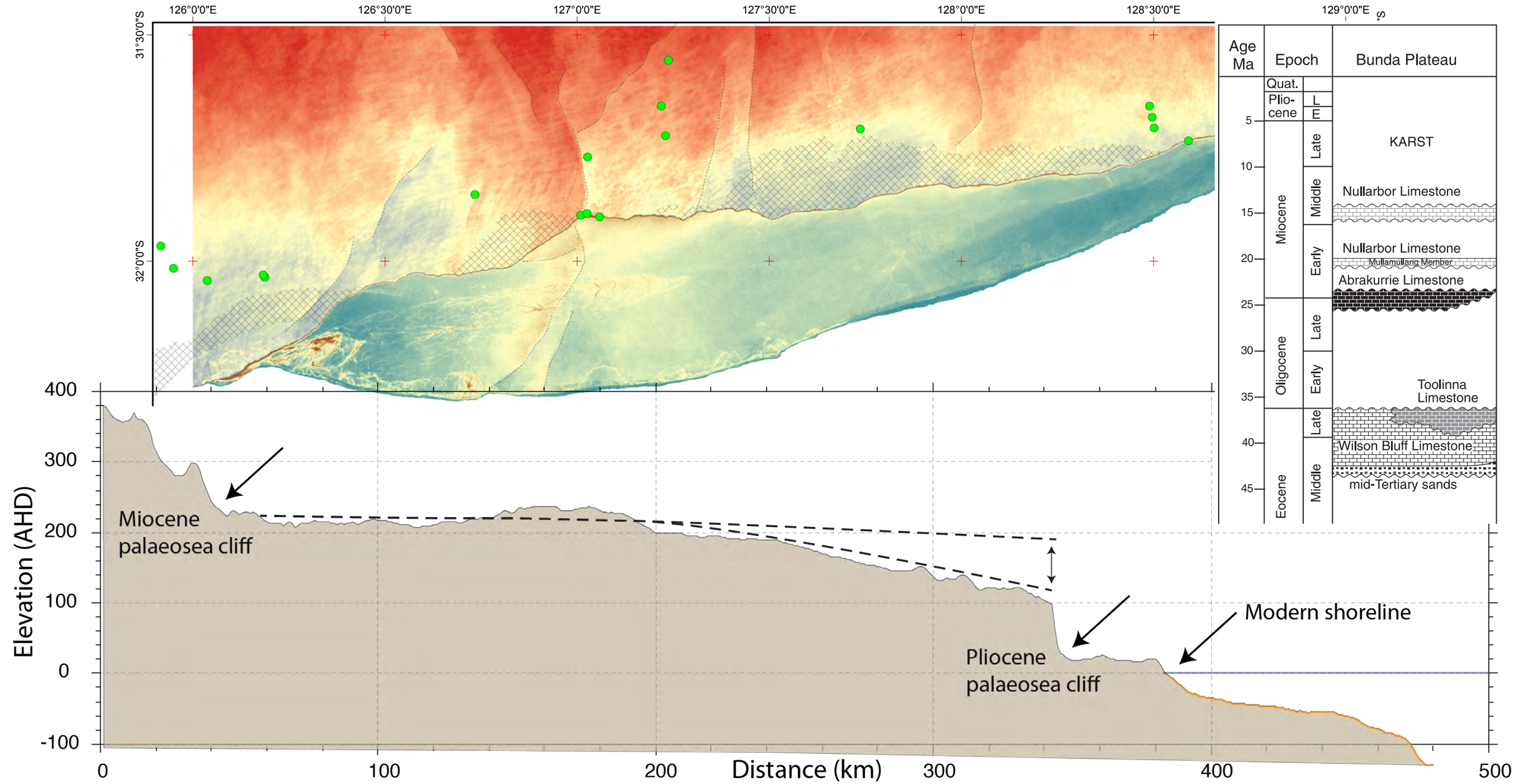




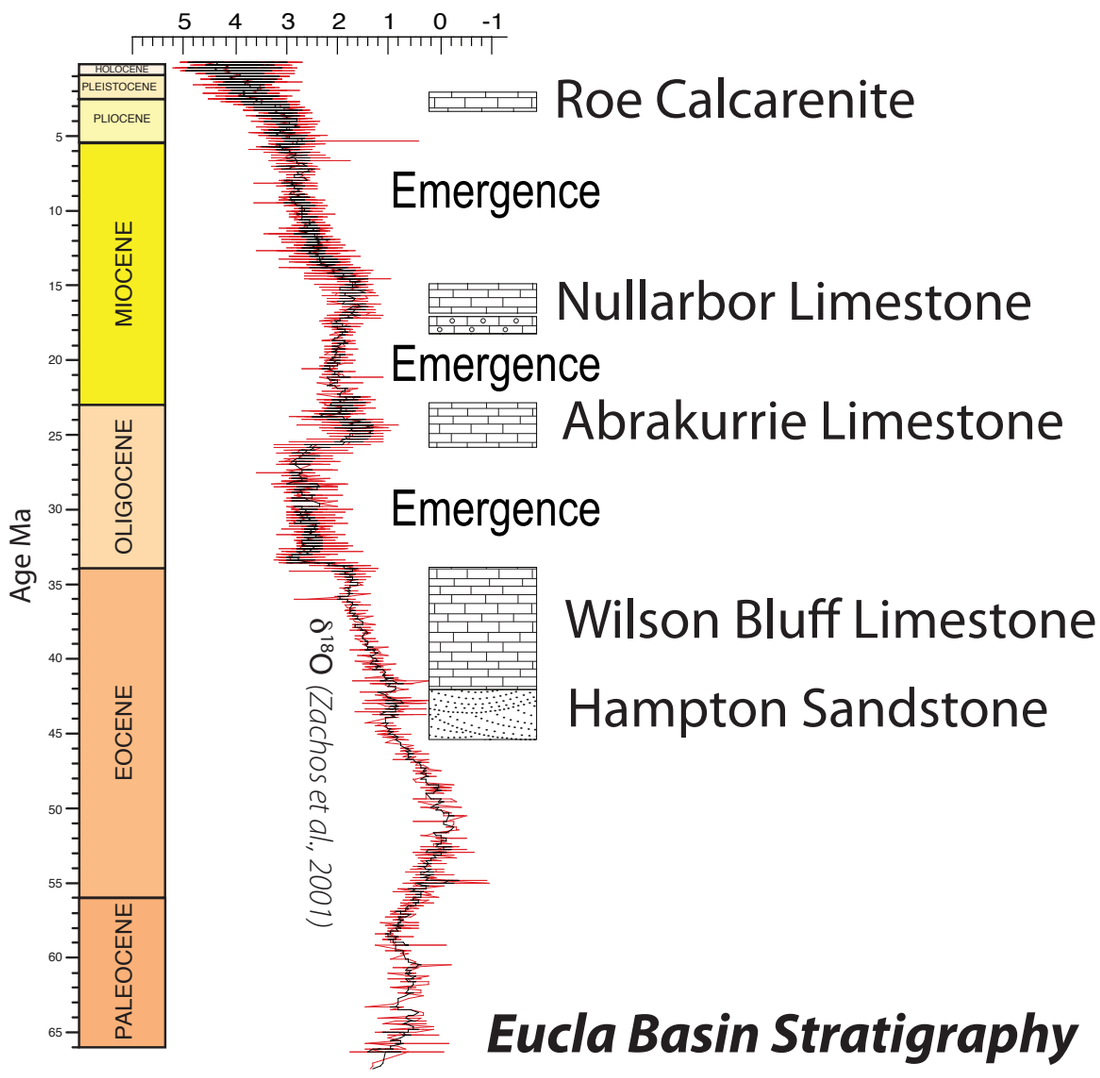
Karst dissolution of Nullarbor Plain

Compounding factor when quantifying dynamic crustal movement

- Nullarbor limestone has been emergent for the past 15 My
- Nullarbor is heavily karst and no longer represents the original depositional surface



Utilise subsurface horizontal bedding surfaces (i.e., shaved shelf morphology) to measure deformation

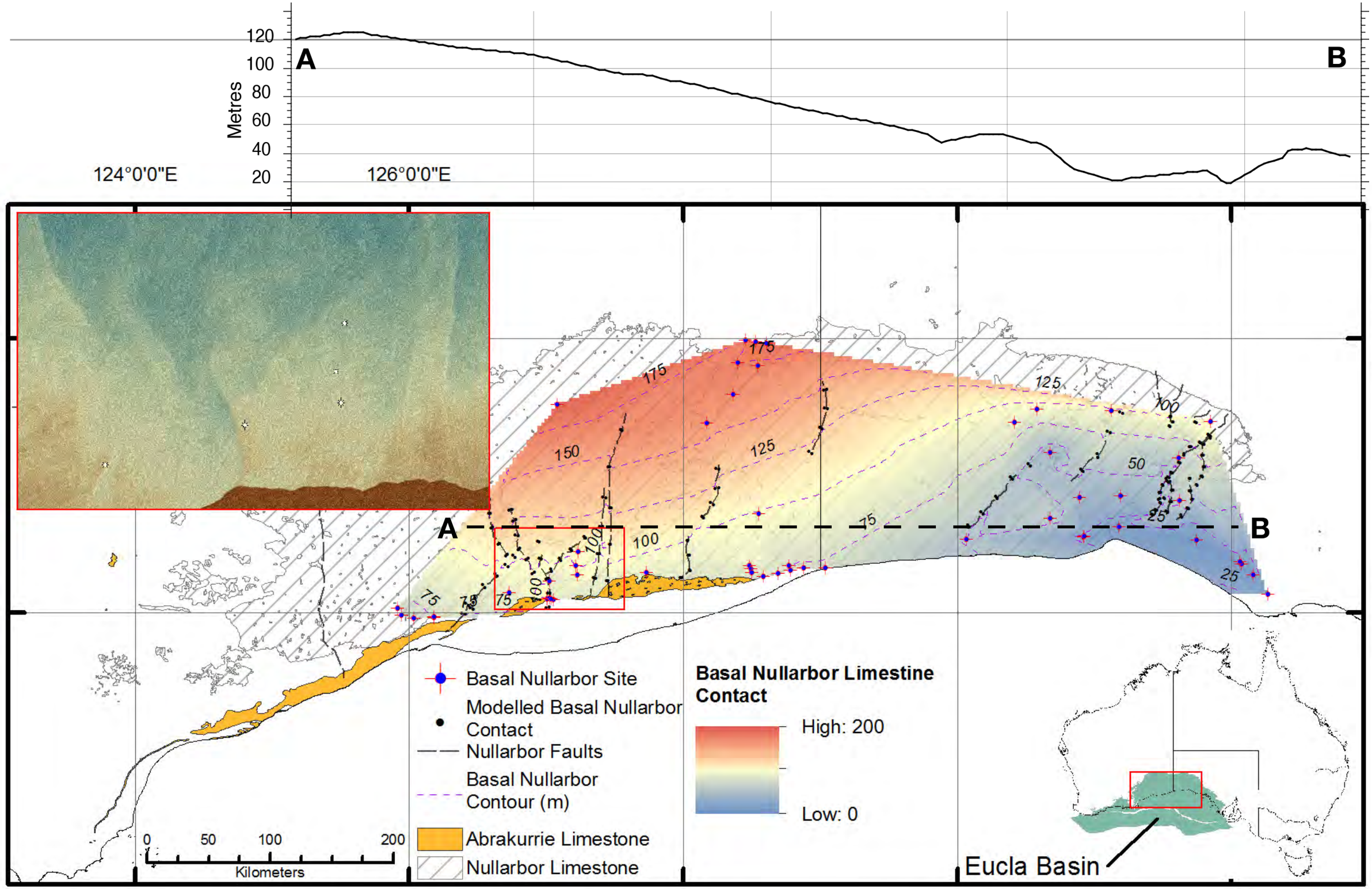


- Here we utilise the “horizontal” erosional unconformities between subsurface limestone formations: **Abrakurrie/Nullarbor**
- These buried contact surfaces provide an initial horizontal datum and should not be affected by karst dissolution

Murra-el-elevyn Cave

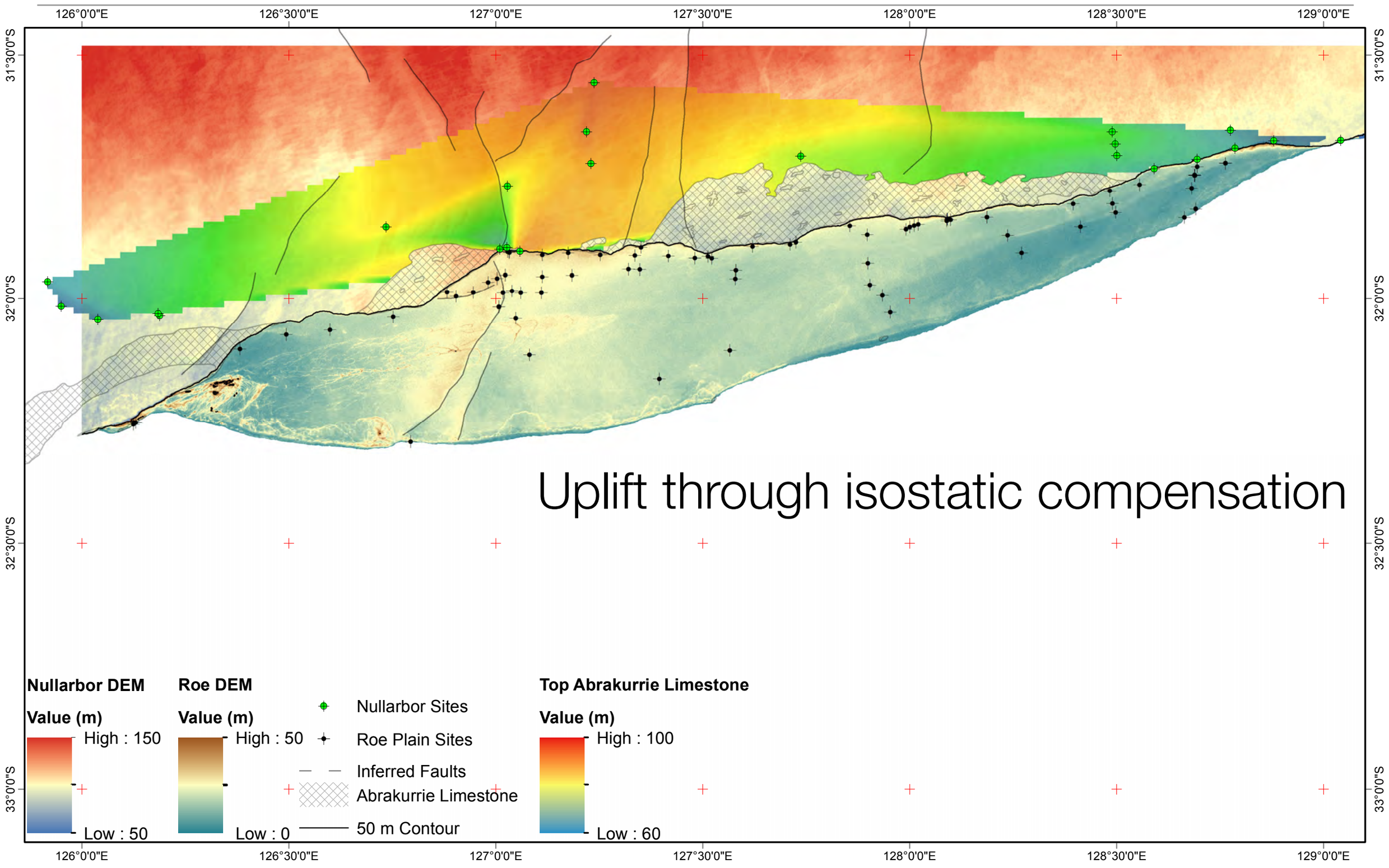
Thylacine Hole

Contact elevation of the basal Nullarbor Limestone



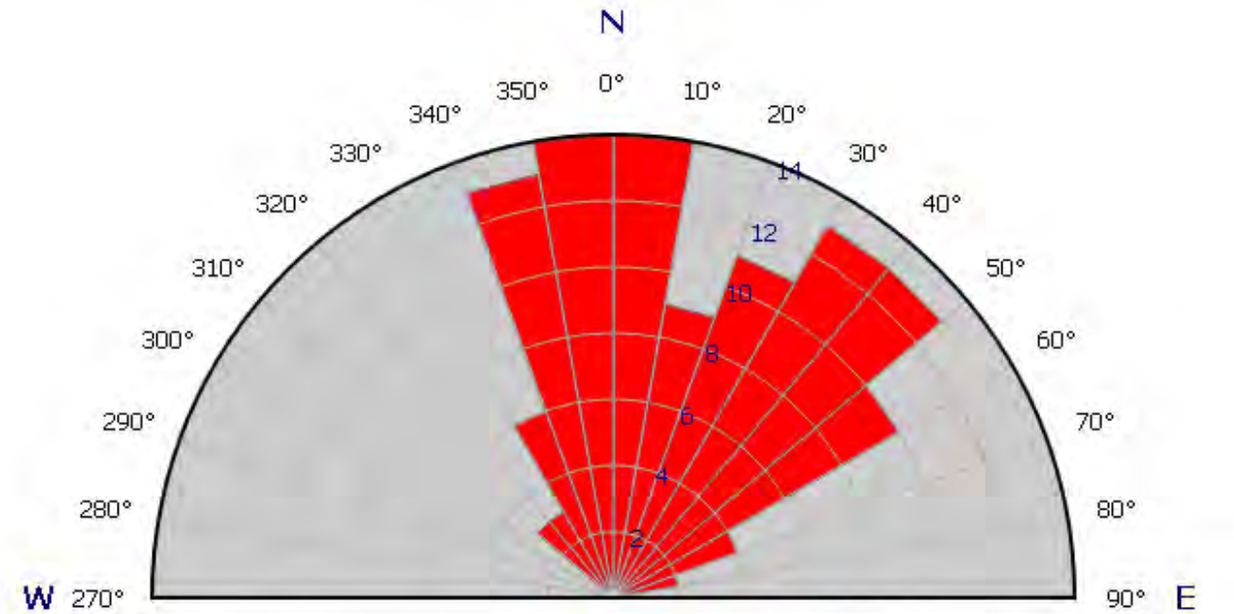
Warping of Nullarbor Plain (1 to 2 m/Mya)

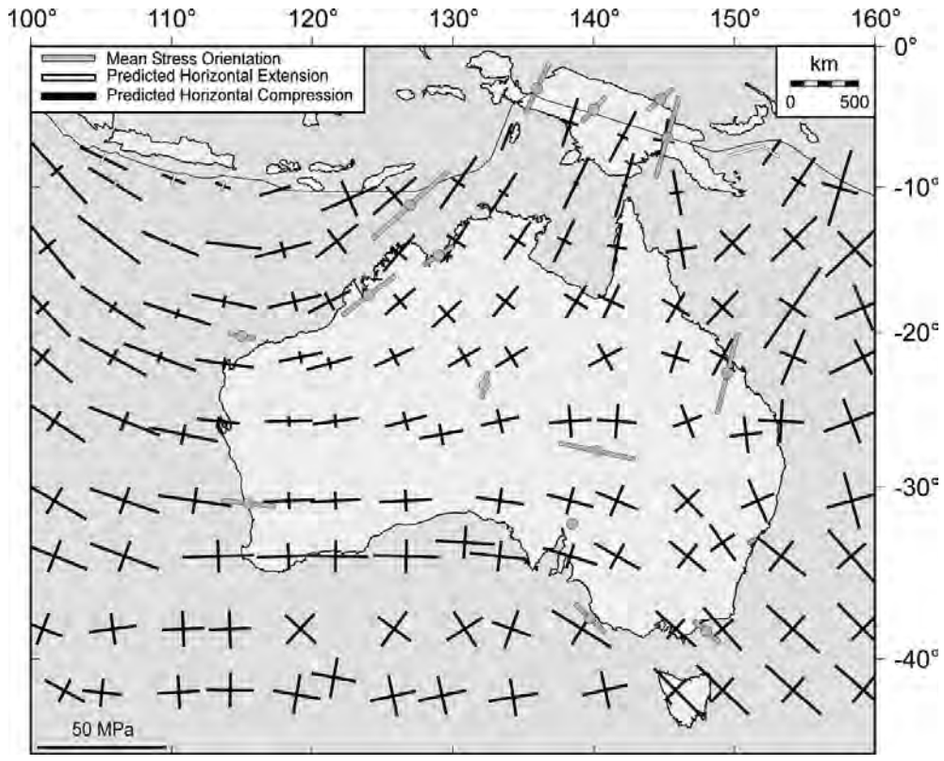
— < 10 m of uplift of Pliocene Roe Plain

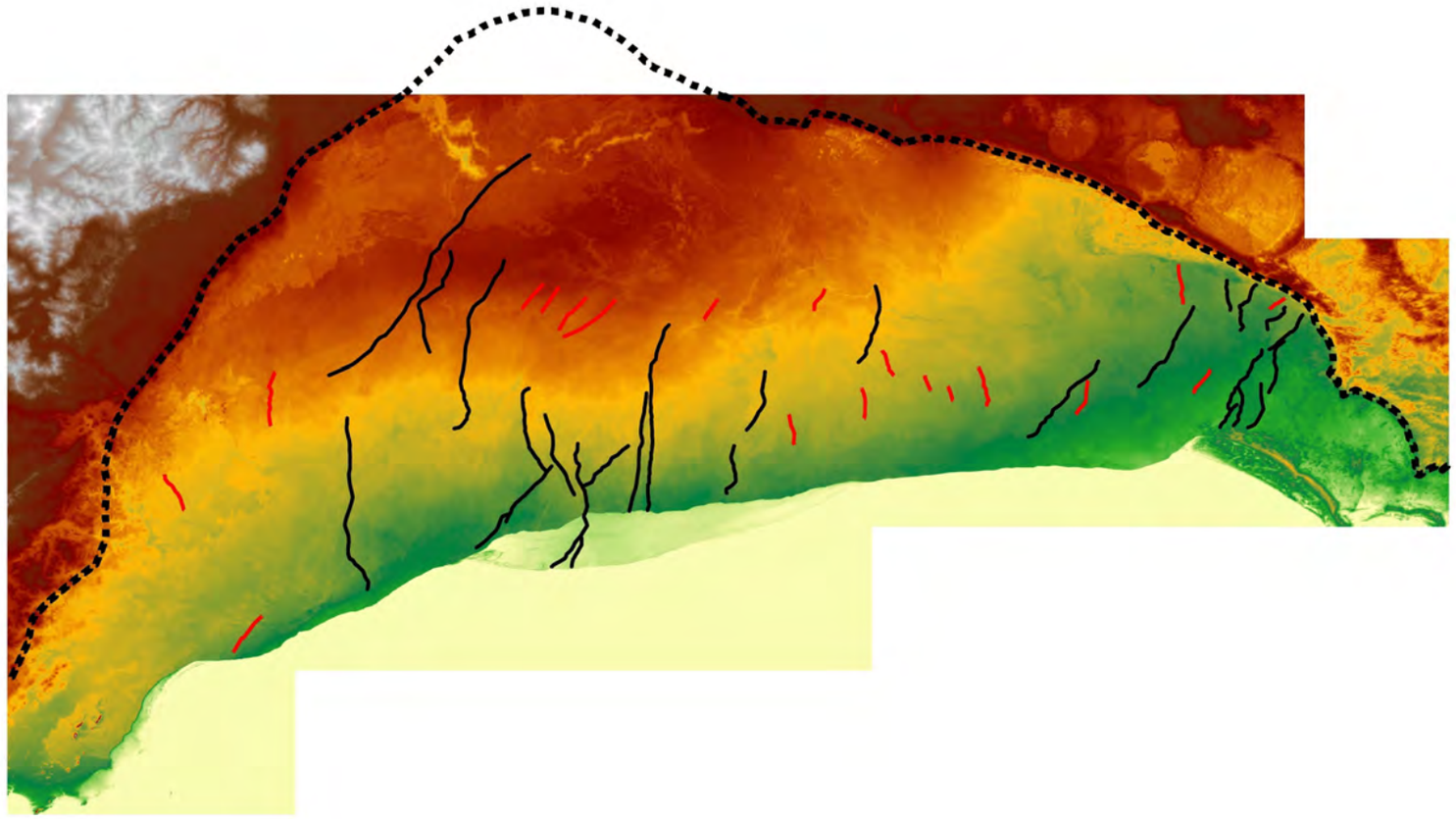


Fault characterisation on the Nullarbor Plain

- Modal strike intervals: 340-010 and 030-050 (i.e. trending ~N-S)
- Neotectonic ‘SHmax’ is E-W oriented in the Eucla Basin region
- Max horizontal stress approximately perpendicular to measured fault traces – infer reverse faulting

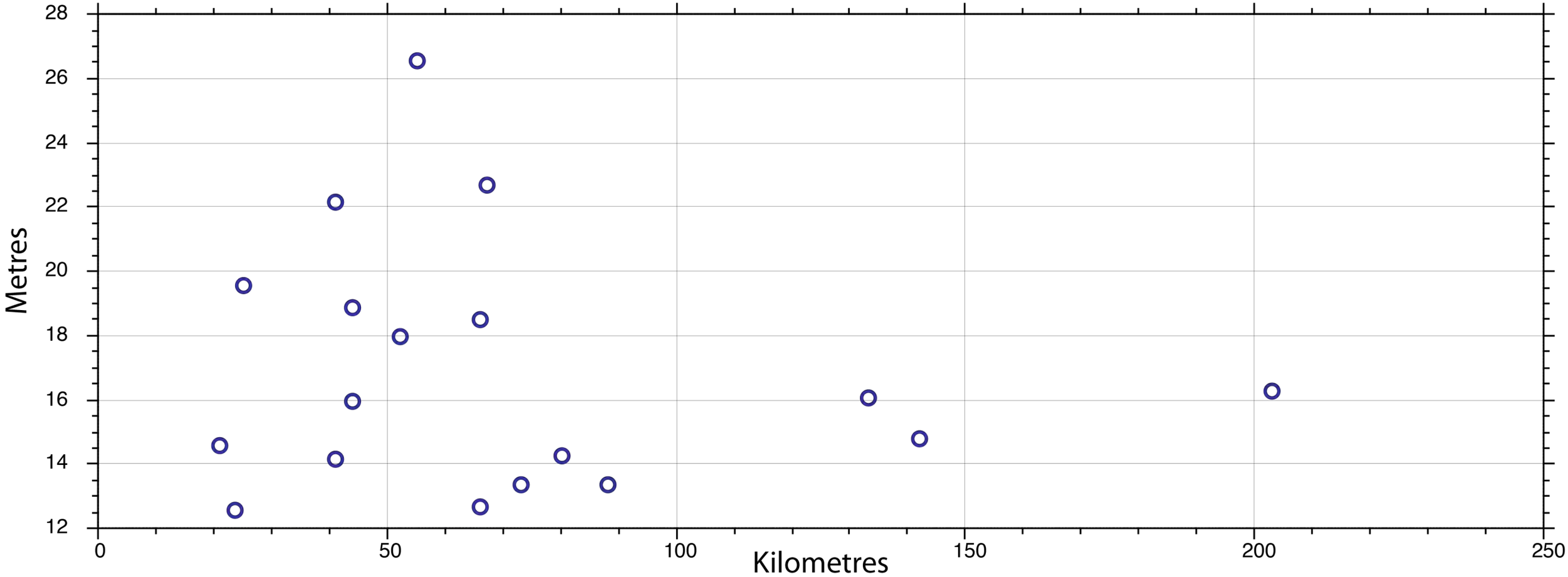






Fault displacement on the Nullarbor Plain

- Fault displacement on the order of 10 to 35 m
- The onshore faults exhibit anomalously low ‘displacement : scarp length’ ratios
- Established fault growth models imply displacements an order of magnitude greater than the observed values
- Possible strike-slip (oblique-slip) component??



Conclusions

- **E/W tilting of the Nullarbor Plain evident in subsurface marine erosional unconformities**
  - *Deformation driven by dynamic topography*
- **Regional scale warping evident along the Roe Plain**
  - *Deformation driven by isostatic compensation*
- **Numerous fault scarps evident on the Nullarbor Plain**
  - *Surficial faults are likely neotectonic (reverse dip slip sense of displacement is probable)*
  - *Anomalously low 'displacement : scarp length' ratios imply strike slip movement (or support an alternative fault growth model!)*