



Università di Trieste
LAUREA MAGISTRALE IN GEOSCIENZE
Curriculum Geofisico
Curriculum Geologico Ambientale

Anno accademico 2017 – 2018

Geologia Marina

Parte V

Modulo 5.4 Geologia marina delle aree polari

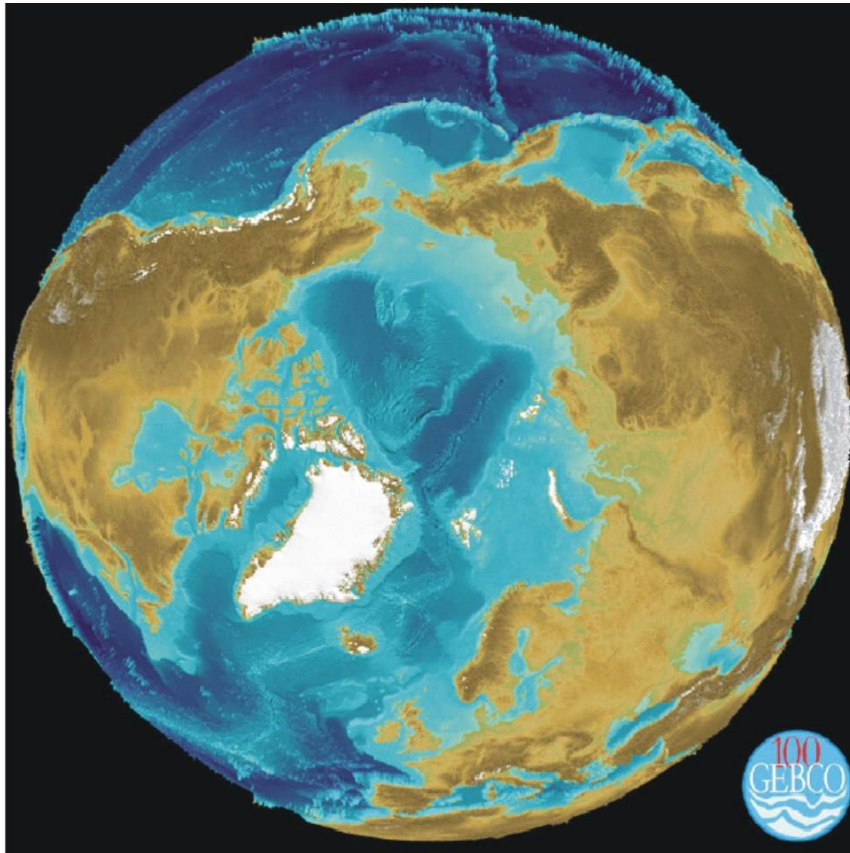
Docente

Laura De Santis

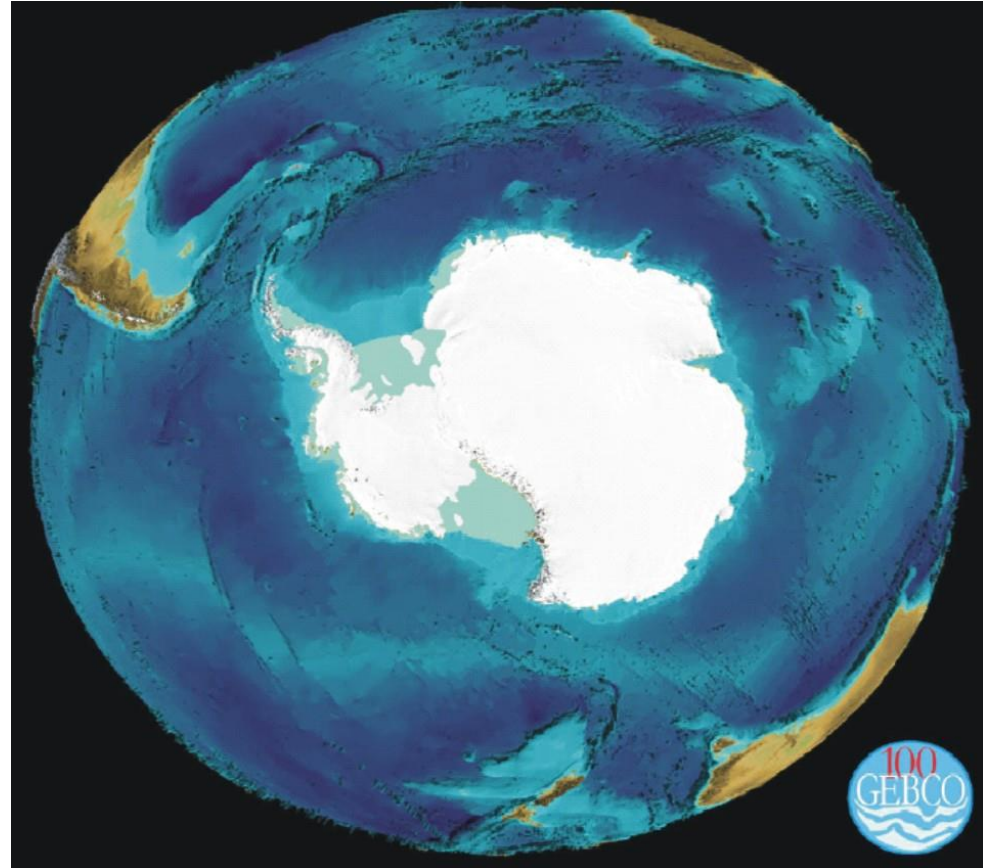
ARGOMENTI

- **Gondwana fragmentation and geological evolution.**
- **Oceanic gateways formation and climate evolution.**
- **Subglacial topography and paleogeographic evolution.**

Break-up of Gondwana. Origin of present day continents and Location of Antarctica and of the Arctic Ocean

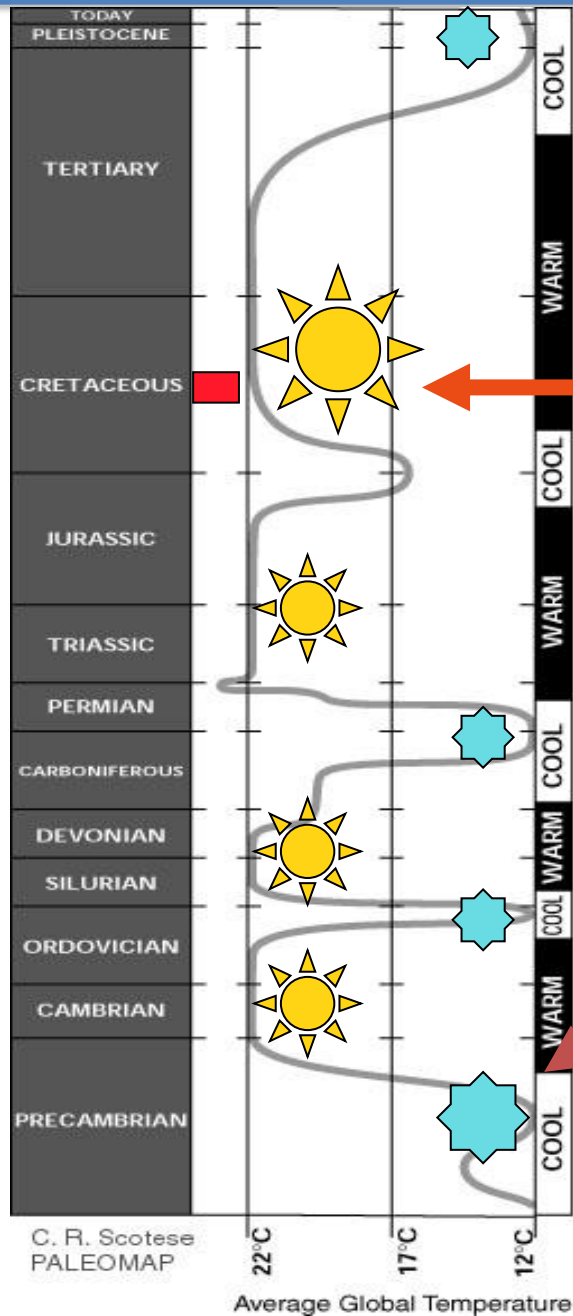


CALOTTA ARTICA



CALOTTA ANTARTICA

Extreme climates throughout the geological time



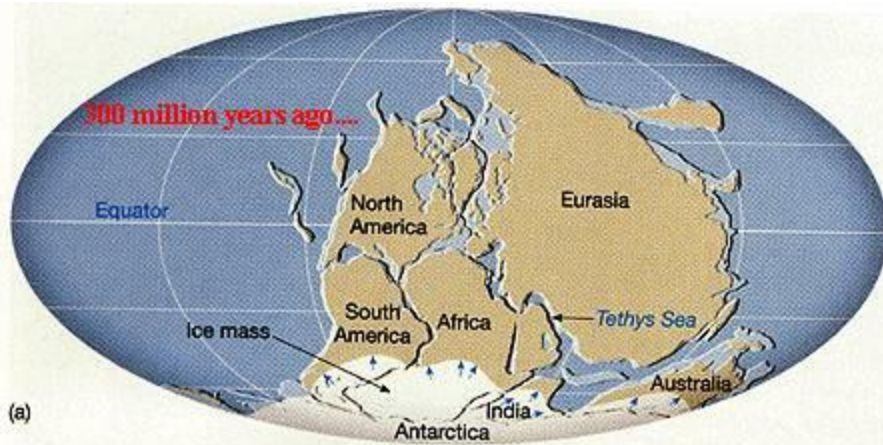
SUPER-GREENHOUSE (Cretaceous)



SNOWBALL EARTH (NeoProterozoic)

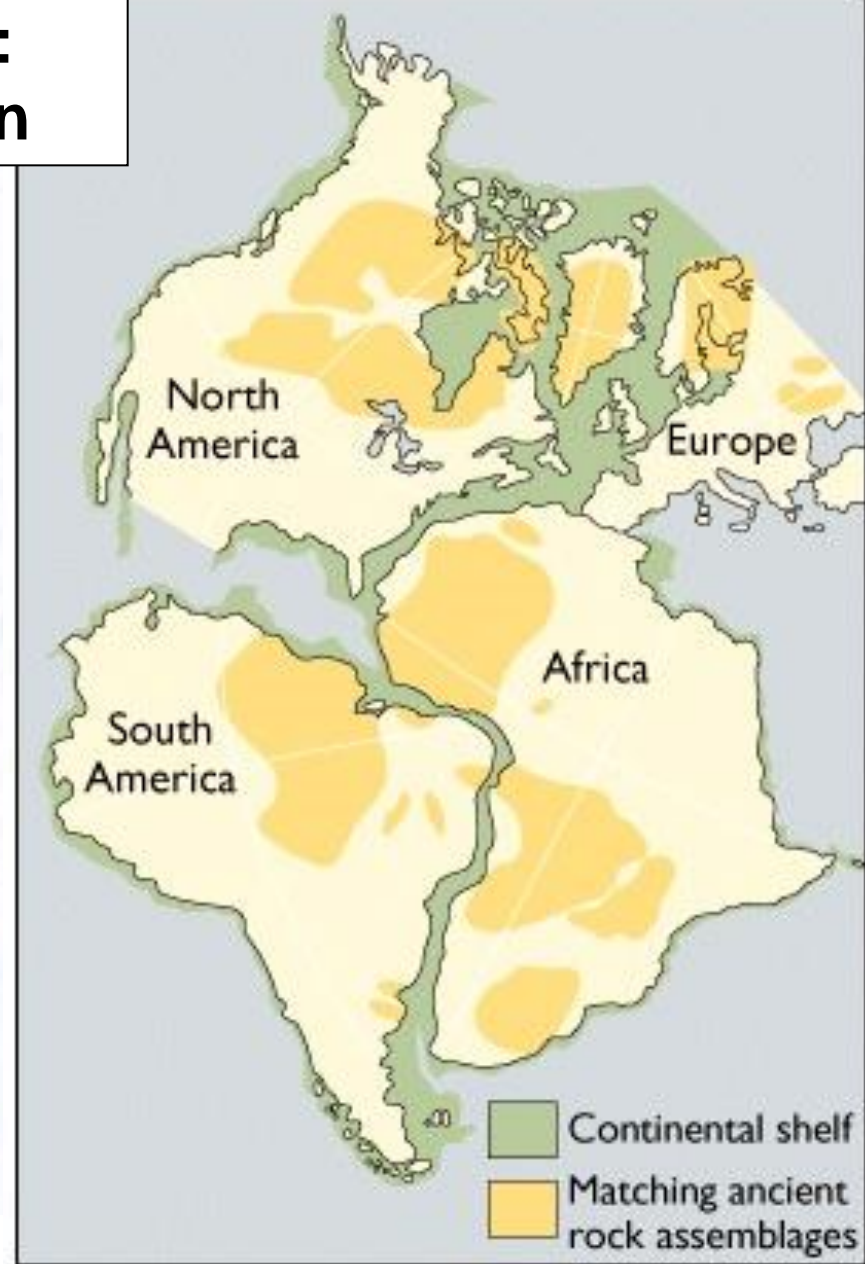
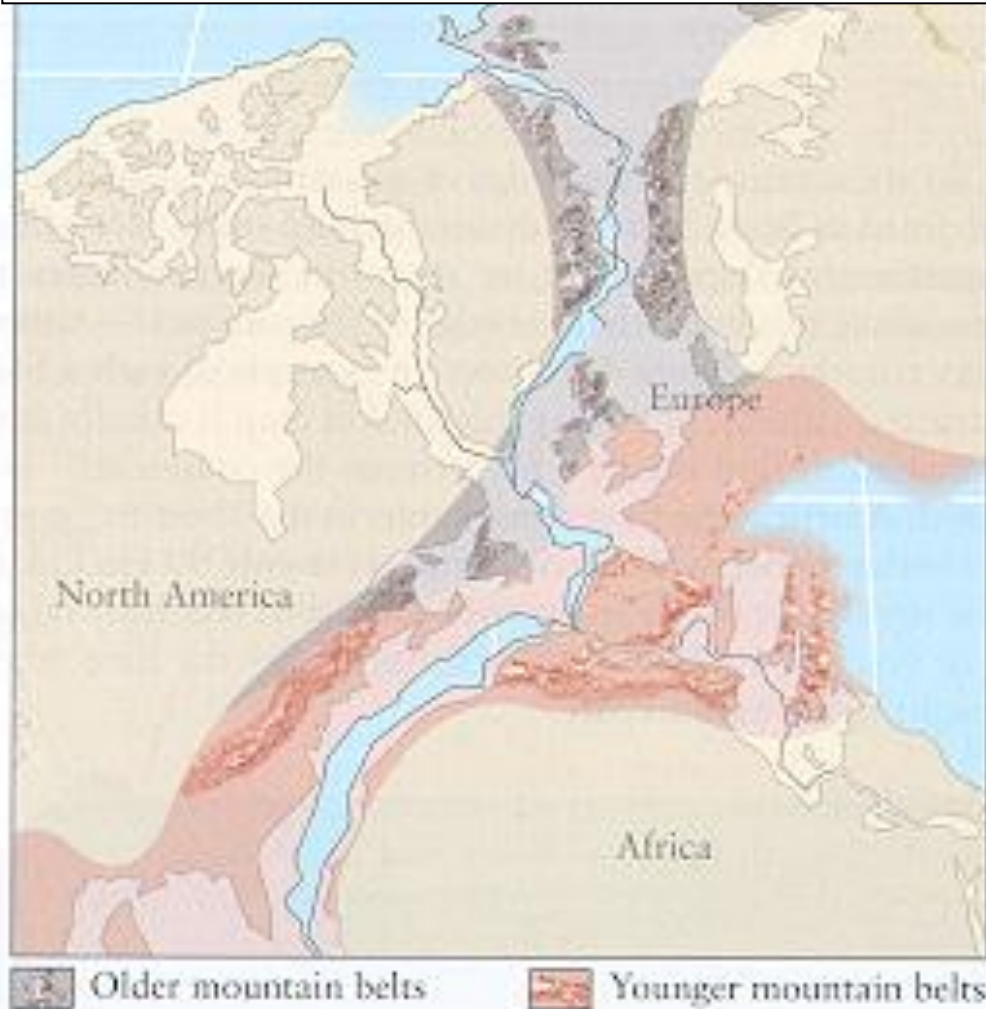


Evidence of Continental Drift

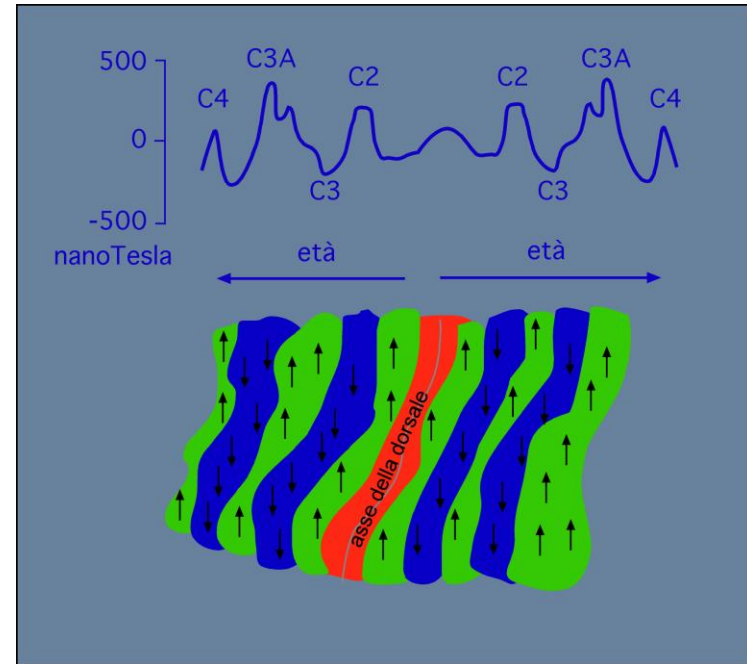
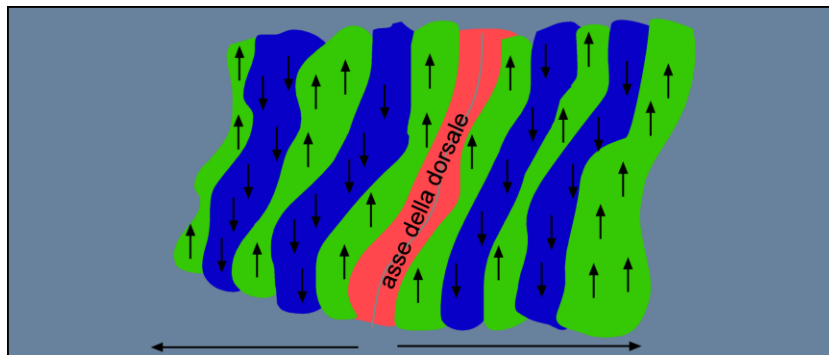
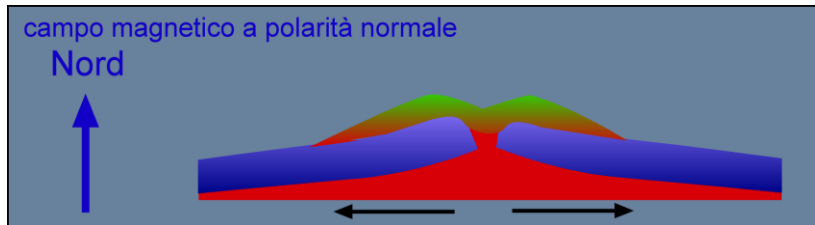
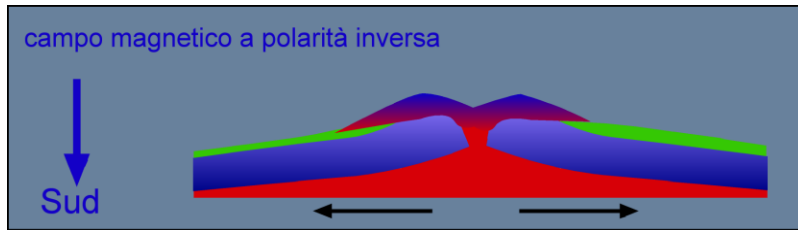
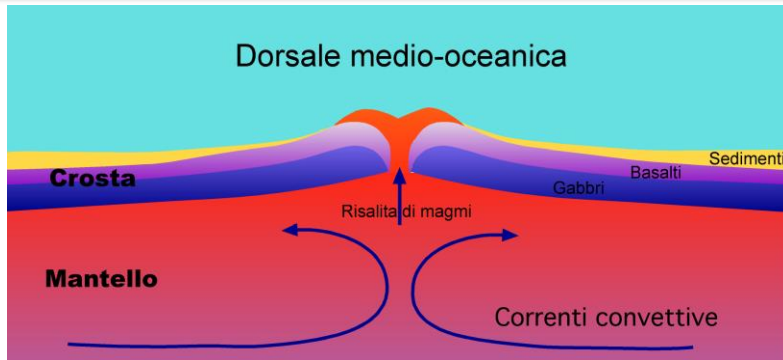


- **Geographic Evidence**
 - that even a child can see.
 - The continents match up like a puzzle.
 - Side note: There have actually been several cycles of supercontinent assembly and disassembly reconstructing pre-Pangea puzzles is a challenge.

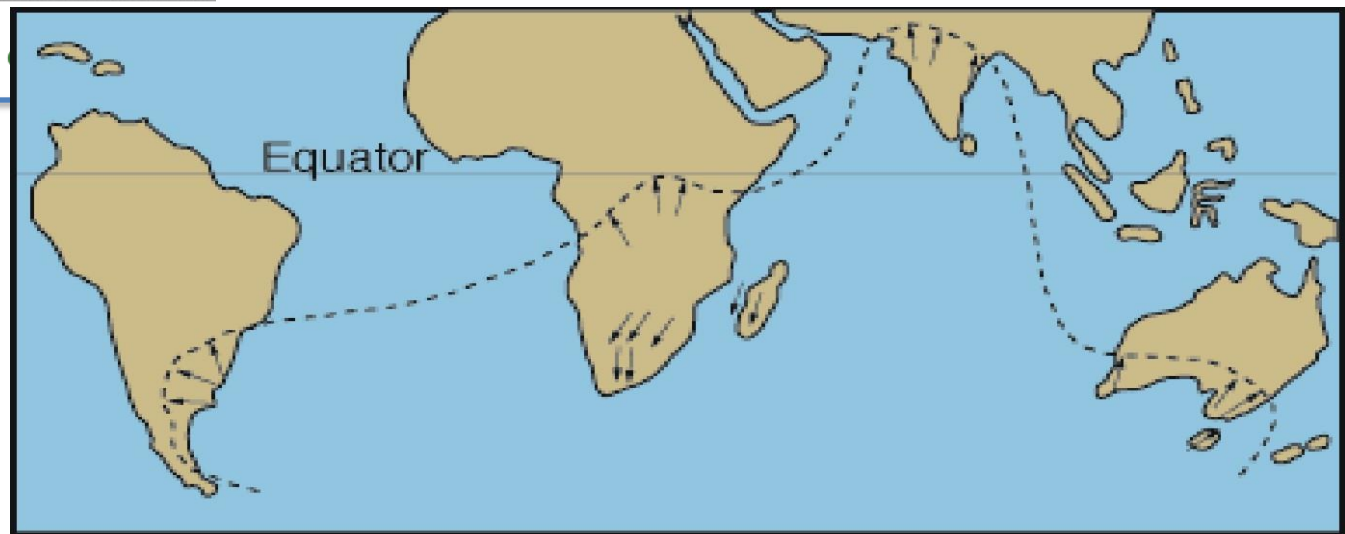
Evidence of Continental Drift : the rock ages and deformation



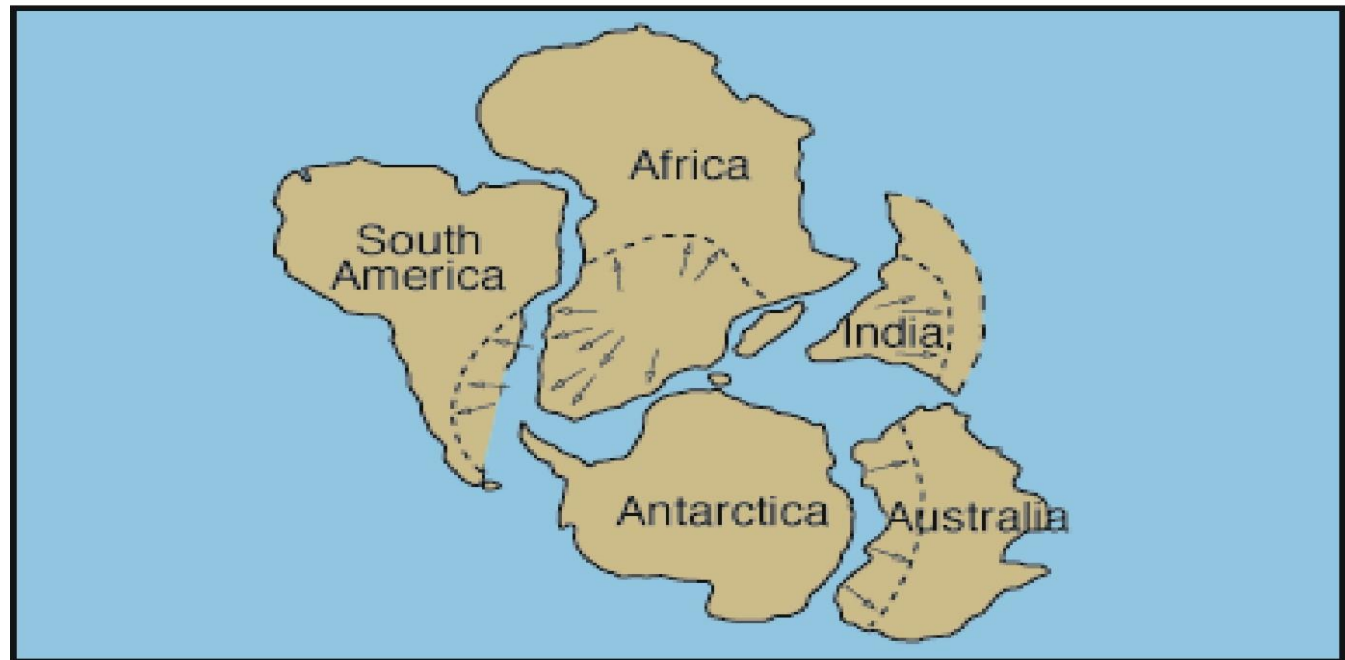
Even before geochronology, the relative framework of rock ages showed strong correlation across the Atlantic, as did mountain ranges of similar age.



Evidence of continental Drift: Glacial Evidence



Grooves carved by glaciers (shown by arrows) provided evidence for continental drift. This diagram assumes the continents were in their present-day locations.



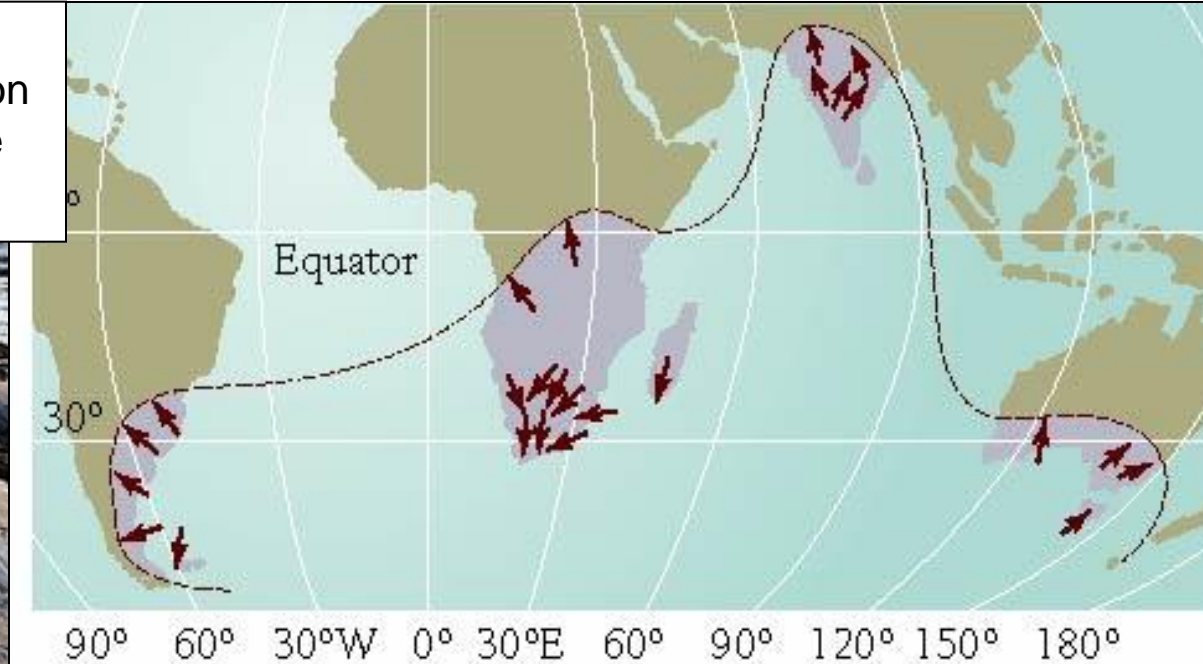
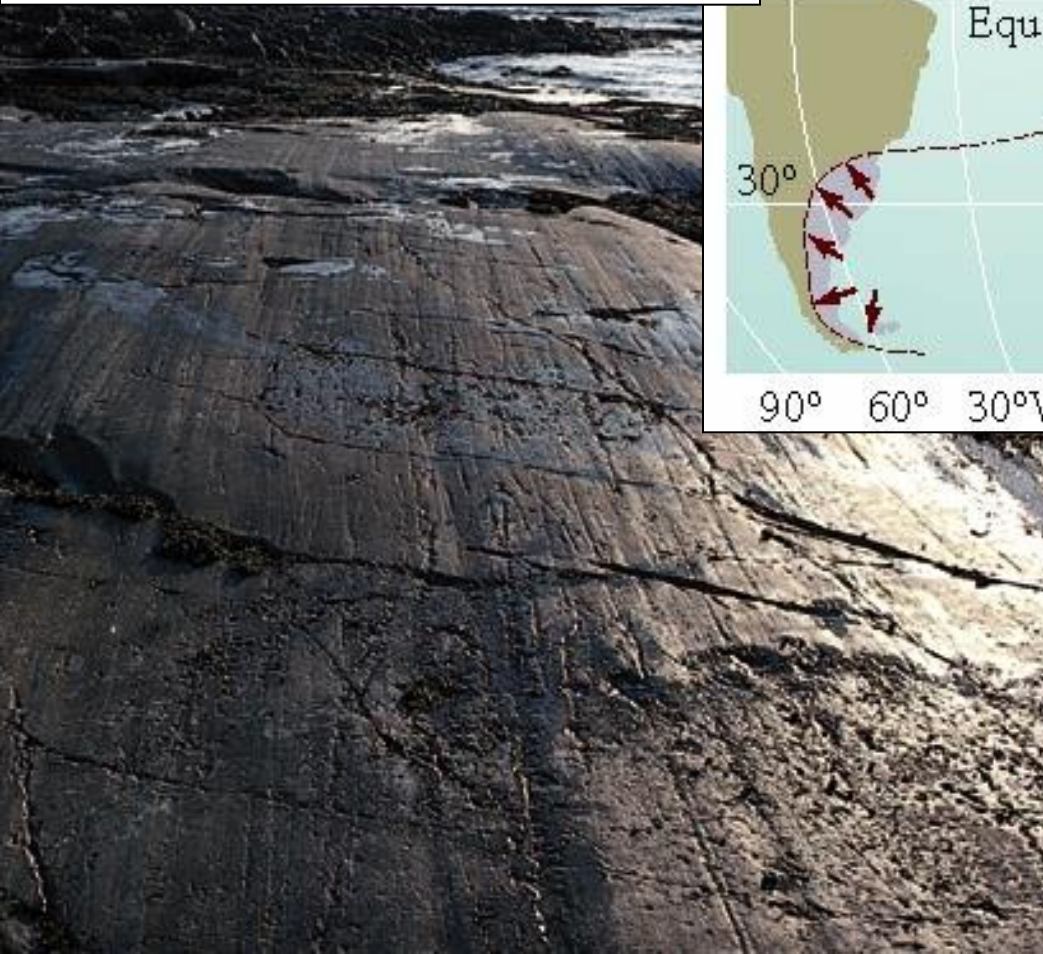
The distribution of glacial features can be best explained if the continents were part of Pangaea.

Large ice masses carve grooves in the rocks over which flow.

Such masses tend to flow outward (generally downhill) from a central locality

Evidence of Continental Drift

- **Stratigraphic Evidence:**
Orientation of glacial markings on all continents suggest they were linked



La glaciazione Permo-Carbonifera ha determinato lo sviluppo di una calotta glaciale che ha lasciato tracce in Antartide, Australia, India, sud Africa e sud America.

ricostruzione del supercontinente Gondwana

175 milioni di anni fa

Età degli orogeni:



Mesozoico e Cenozoico



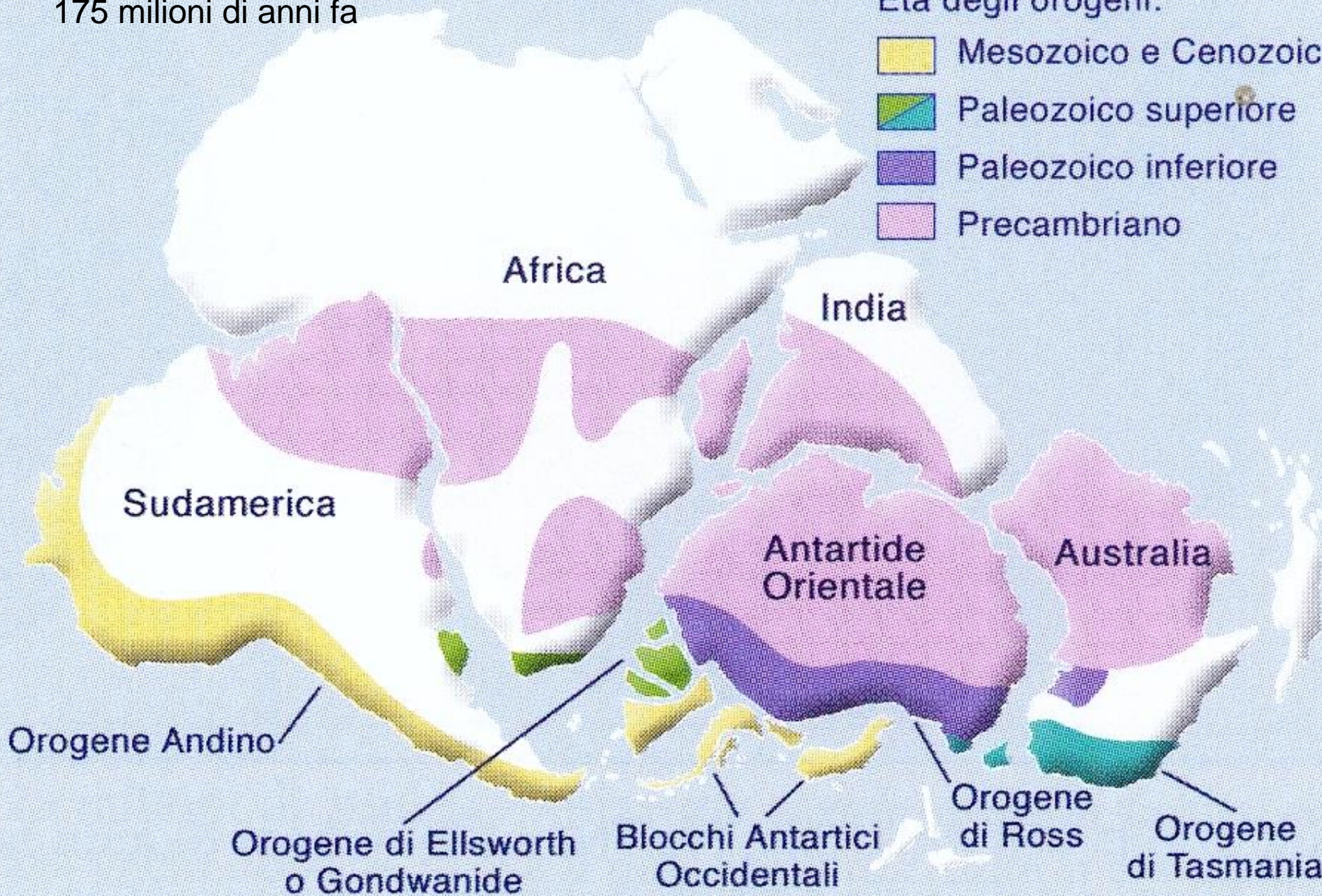
Paleozoico superiore



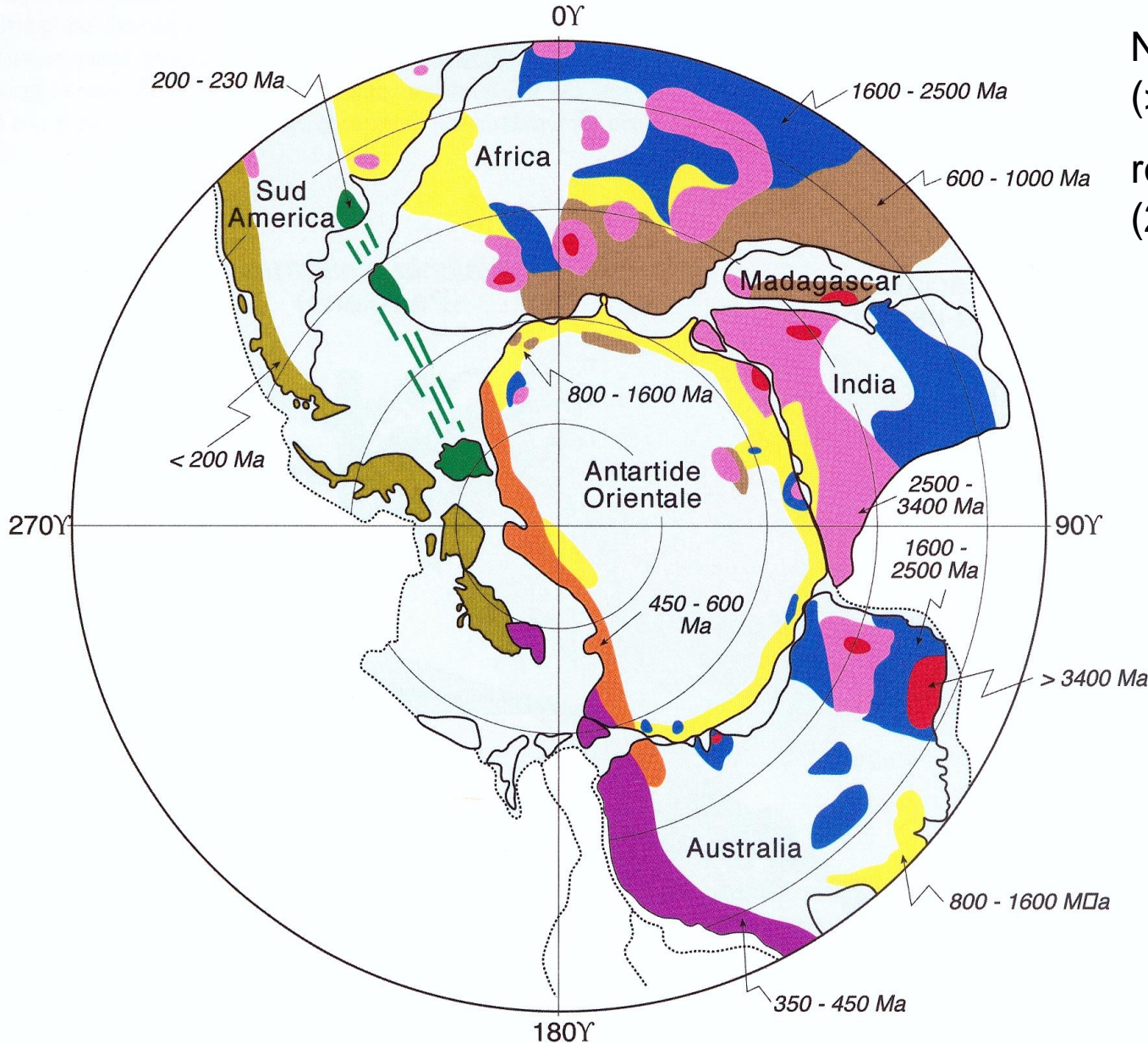
Paleozoico inferiore



Precambriano



Il supercontinente Gondwana è esistito fra 500 e 150 milioni di anni



Nuclei archeani
(>2500 Ma)

rocce proterozoiche
(2500-600 Ma);

Fasce orogeniche
di Ross (450-600
Ma),

Fasce orogeniche
di Ellsworth (200-
230 Ma)

Fasce orogenica
Andina (200-65
Ma).

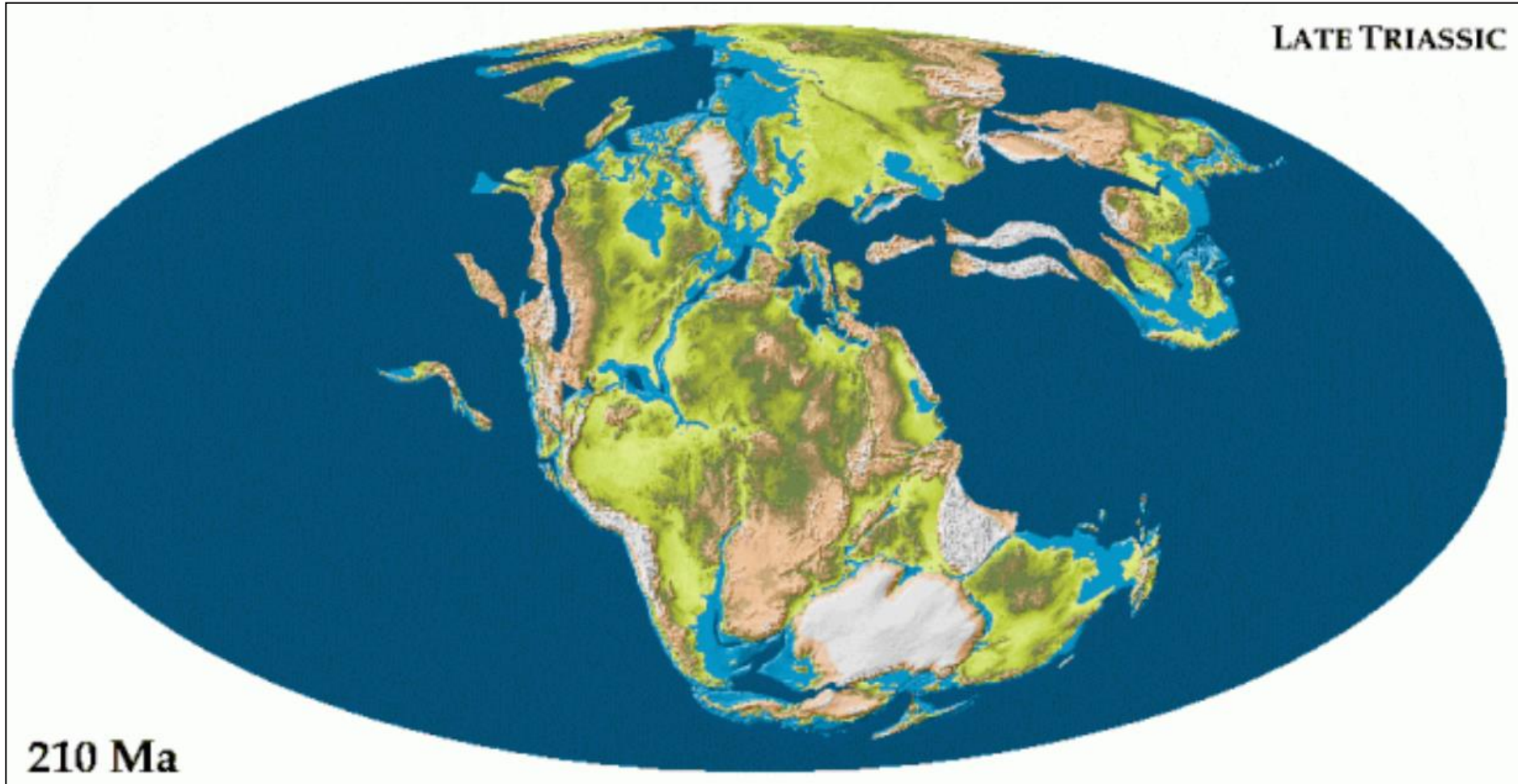
Il supercontinente Gondwana è esistito fra 500 e 150 milioni di anni fa.

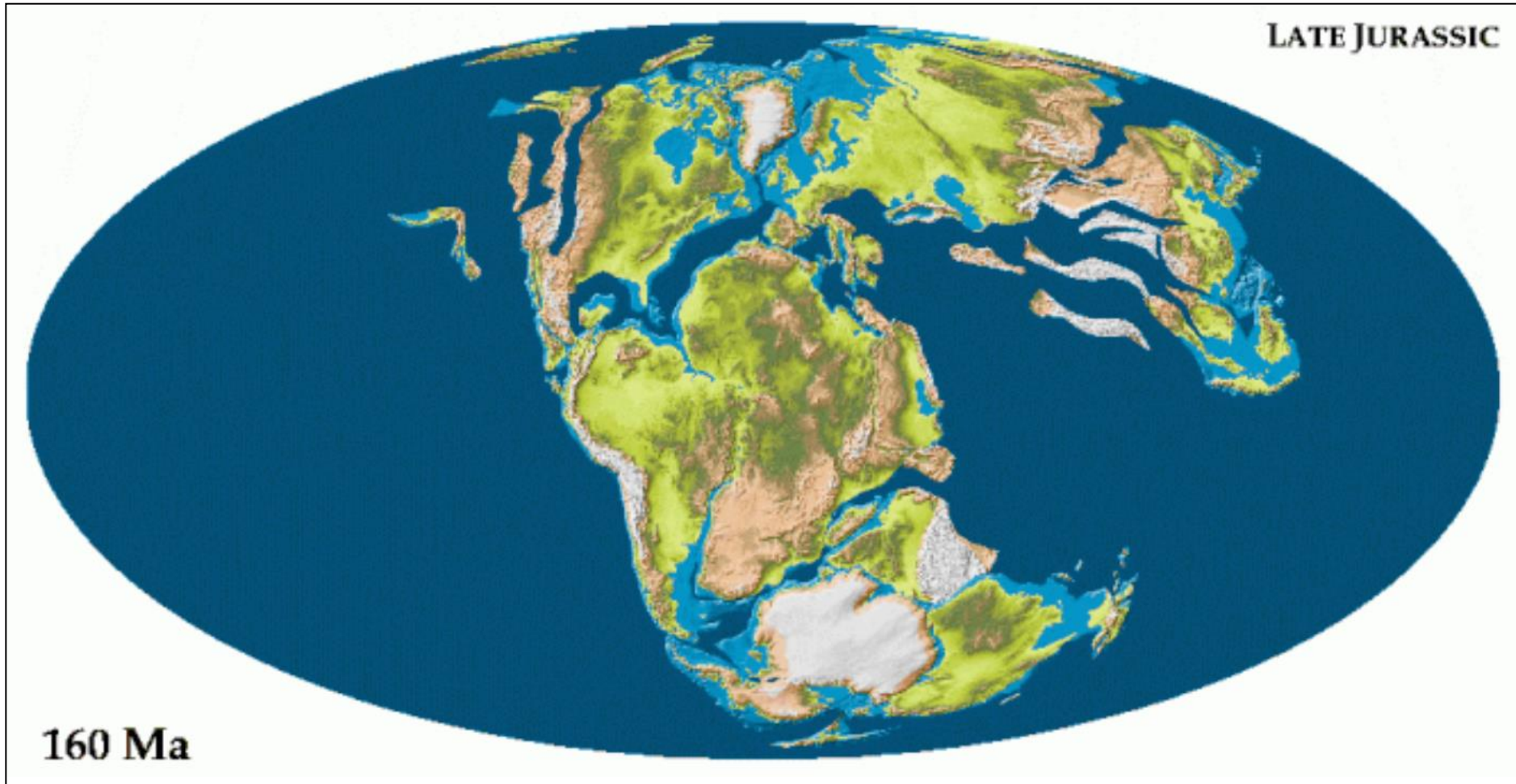
La sua ricostruzione è basata sulle corrispondenze morfologiche e dalla comune storia geologica documentata dalle rocce che sono presenti nei vari continenti.

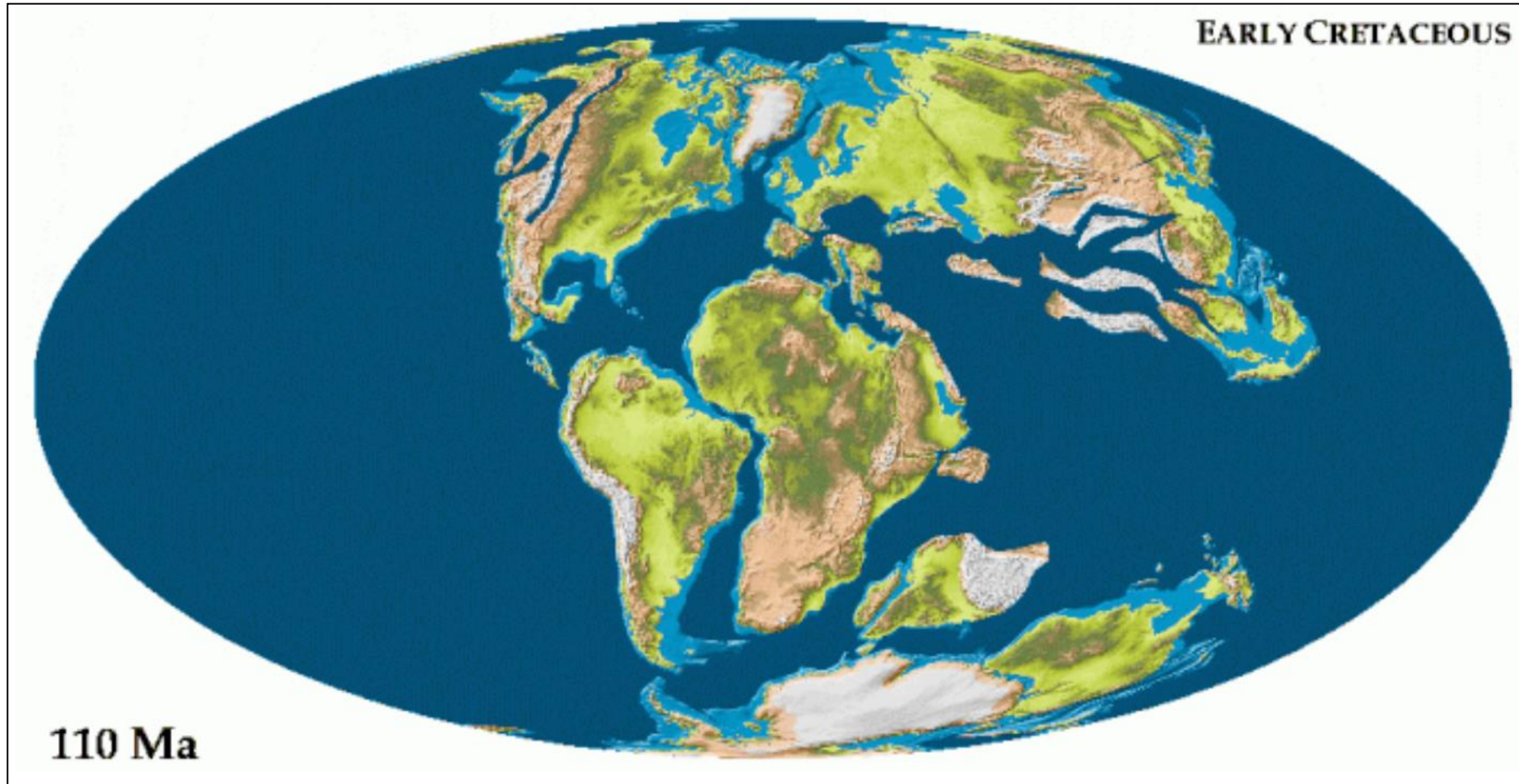
La figura precedente evidenzia in modo schematico i nuclei archeani (>2500 Ma) e quelli proterozoici (2500-600 Ma); le fasce orogeniche di Ross (450-600 Ma), di Ellsworth (200-230 Ma) ed Andina (200-65 Ma). La ricostruzione colloca l'Antartide orientale al Polo Sud attuale.

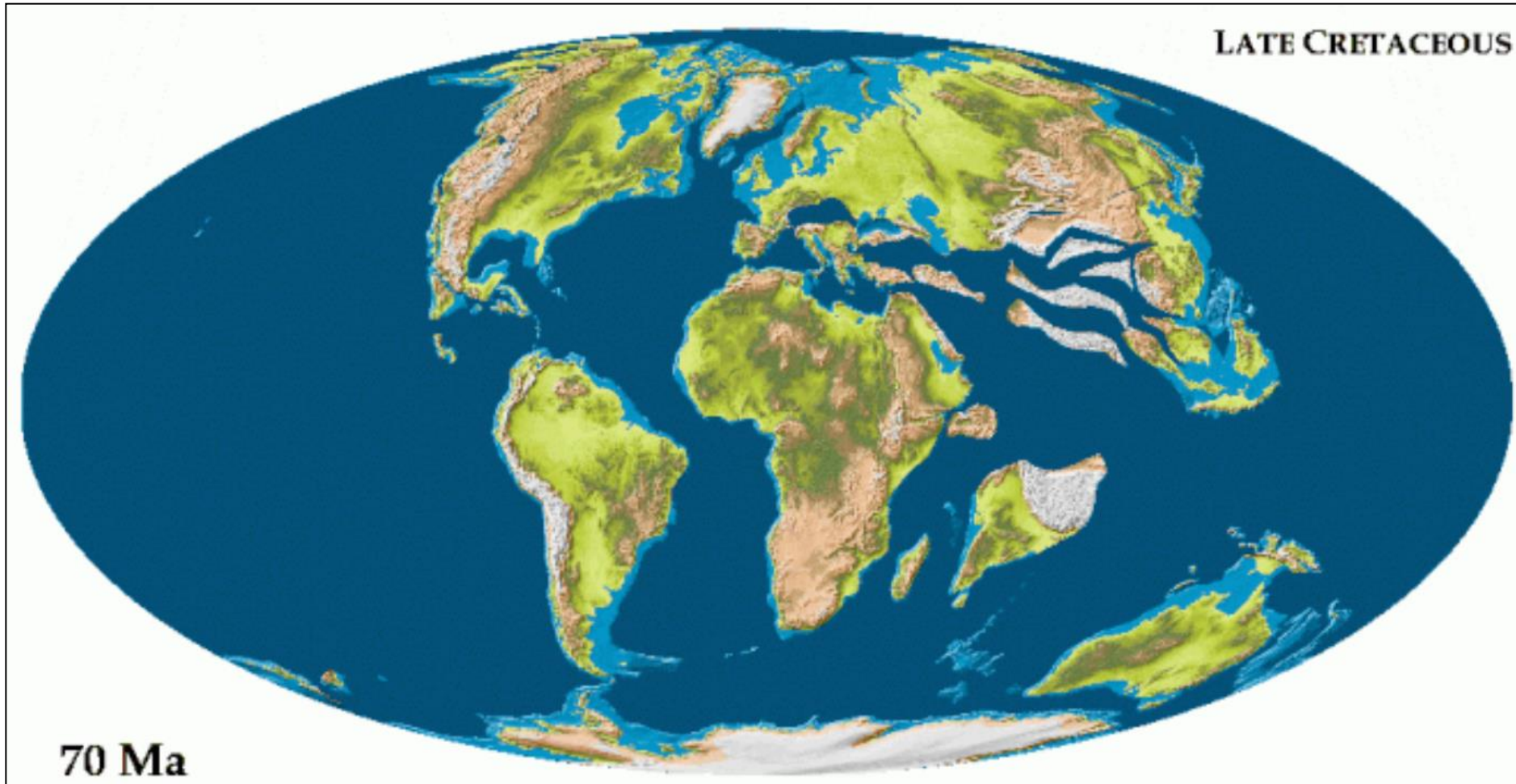
Nel tardo Permiano il Gondwana iniziò a migrare verso latitudini intermedie ed il clima divenne progressivamente più mite: cominciarono a svilupparsi delle grandi foreste a *Glossopteris*, una flora decidua, esclusiva dell'emisfero meridionale, che è testimoniata dalla presenza di foglie e tronchi fossili in rocce sedimentarie di età Permo-Triassica.

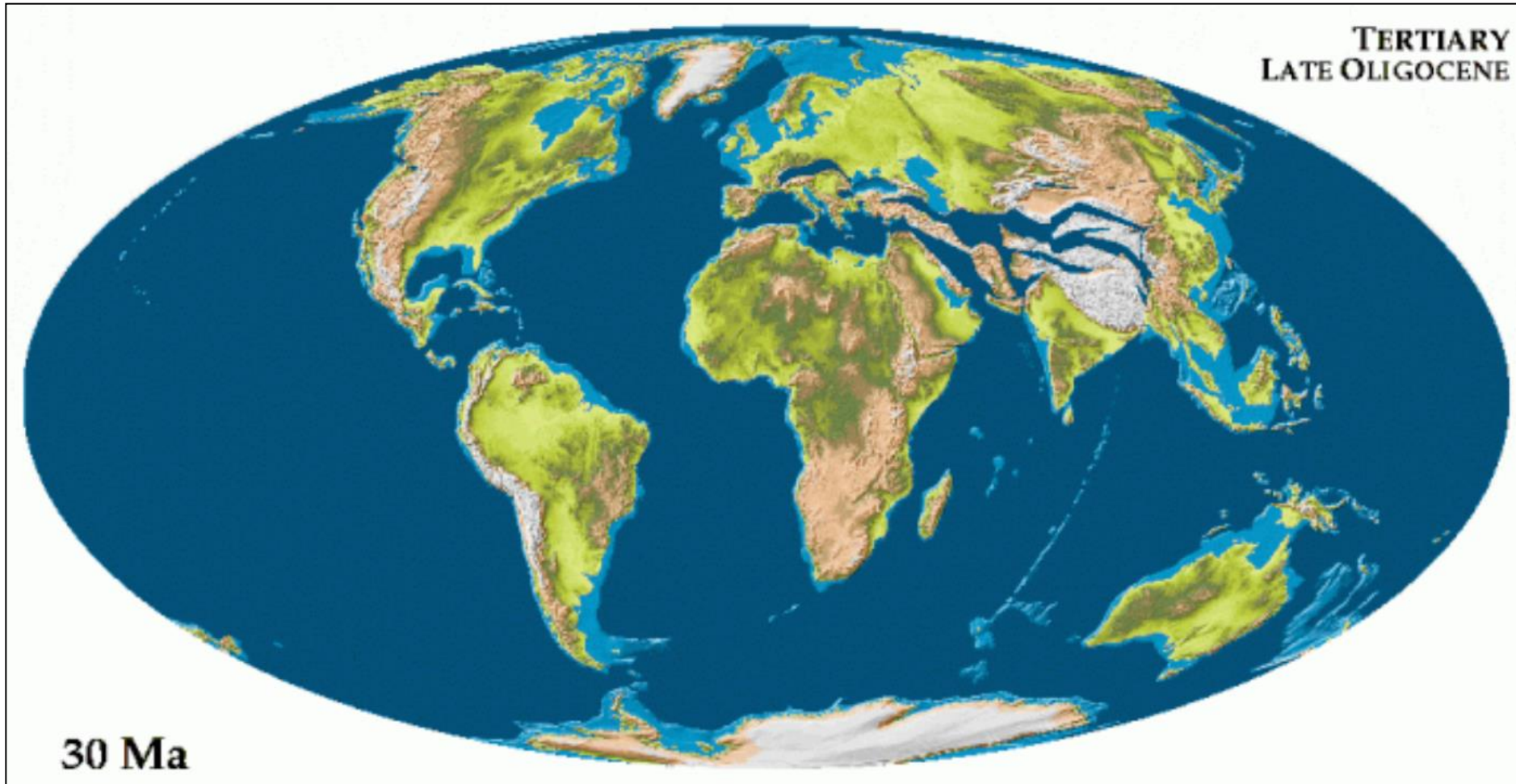
Nel Trias un rettile erbivoro noto come *Lystrosaurus*, vive in Australia, sud America, India oltre che in Antartide. Tenendo presente le scarse capacità natatorie su lunghe distanze di tale rettile e che quindi questi poteva spostarsi da un punto all'altro dei vari continenti solo attraverso la terra ferma, la contemporanea presenza del listrosauro in queste differenti regioni, è un importante prova a sostegno dell'esistenza di un unico continente, nell'intervallo di tempo tra il Carbonifero e il Giurassico.

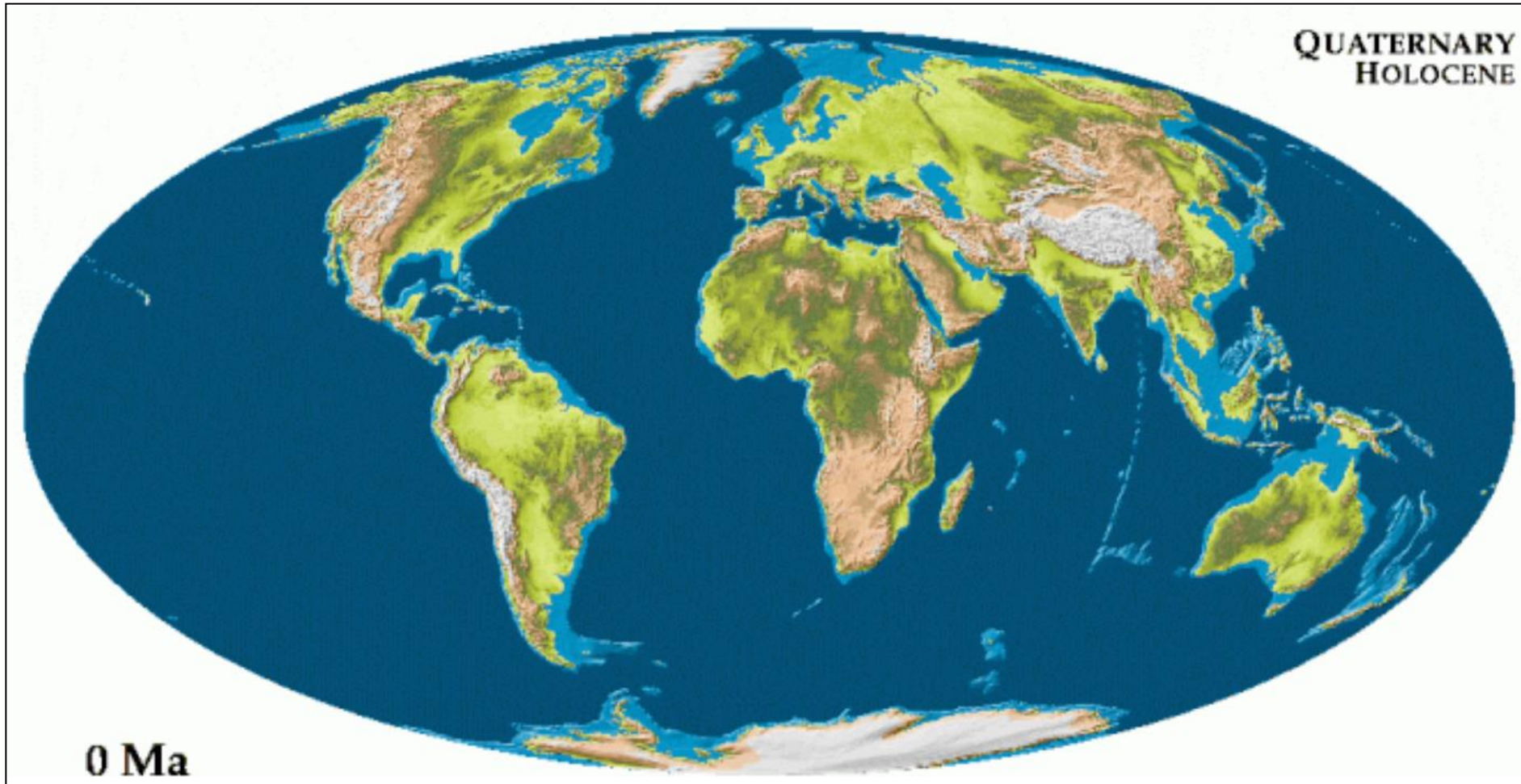












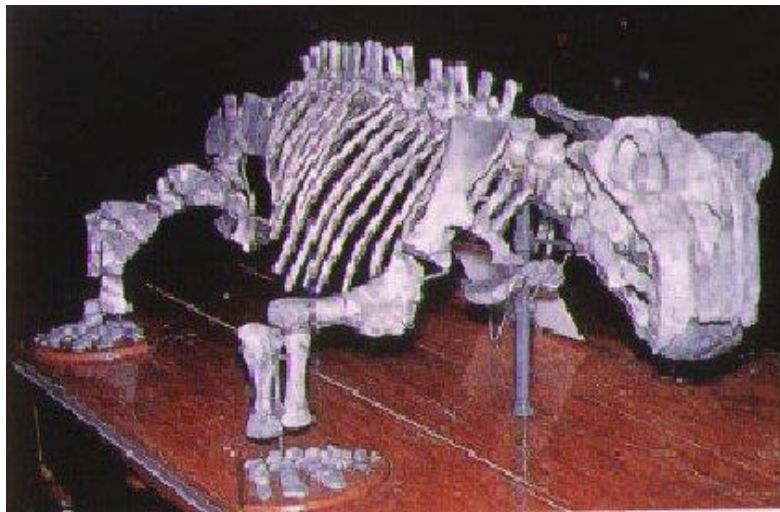
Successivamente (tardo Permiano) Gondwana iniziò a migrare verso latitudini intermedie ed il clima divenne progressivamente più mite:



Foglie fossili di Glossopteris presenti in tutto il Gondwana dopo la glaciazione Permiana. Foto: P. Barrett.



Tronco fossile di Glossopteris nelle Arenarie di Beacon della Terra Vittoria settentrionale (età Permo-Triassica), che testimonia la presenza in Antartide di foreste di conifere dopo la glaciazione Permo-Carbonifera. Foto: C. A. Ricci.



Ricostruzione dello scheletro di Lystrosaurus, un rettile erbivoro alto circa un metro e lungo quasi due metri che in grandi mandrie abitava varie regioni del supercontinente Gondwana durante il Trias ed aveva scarse capacità natatorie. Foto: P. Barrett.

Catena Transantartica

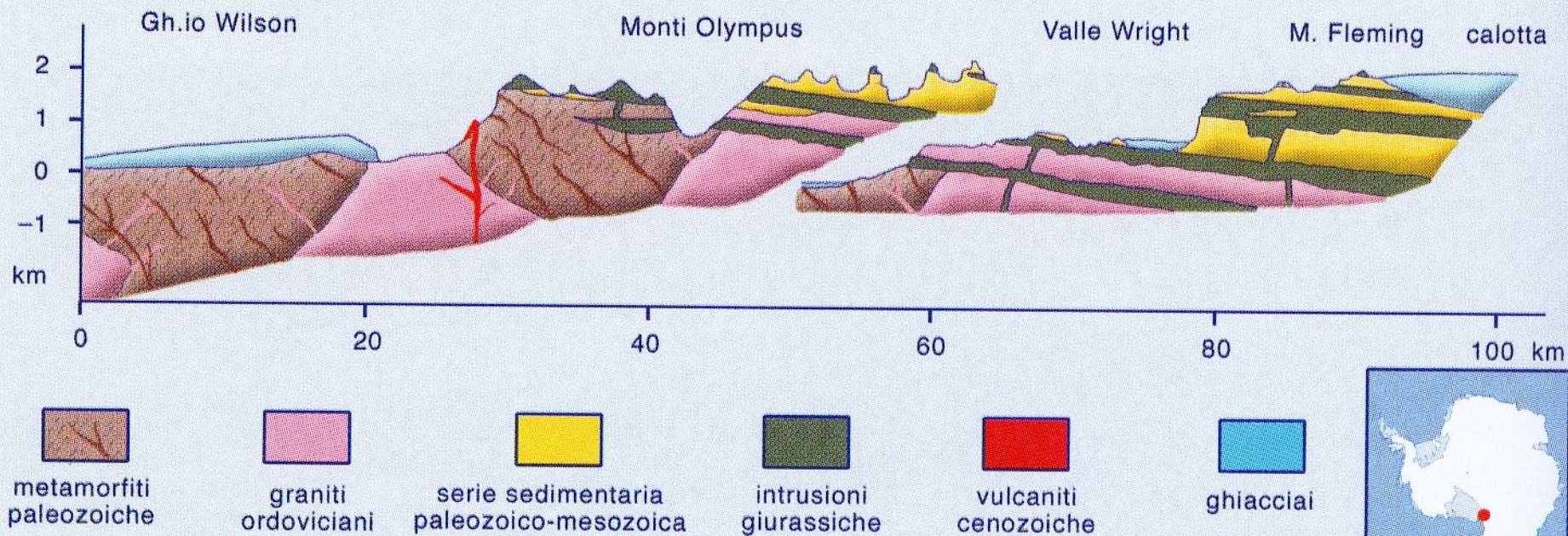
Arenarie del Beacon (tardo Paleozoico, *Devoniano* – Mesozoico, *Triassico*)
Doleriti del Ferrar (lave giurassiche)



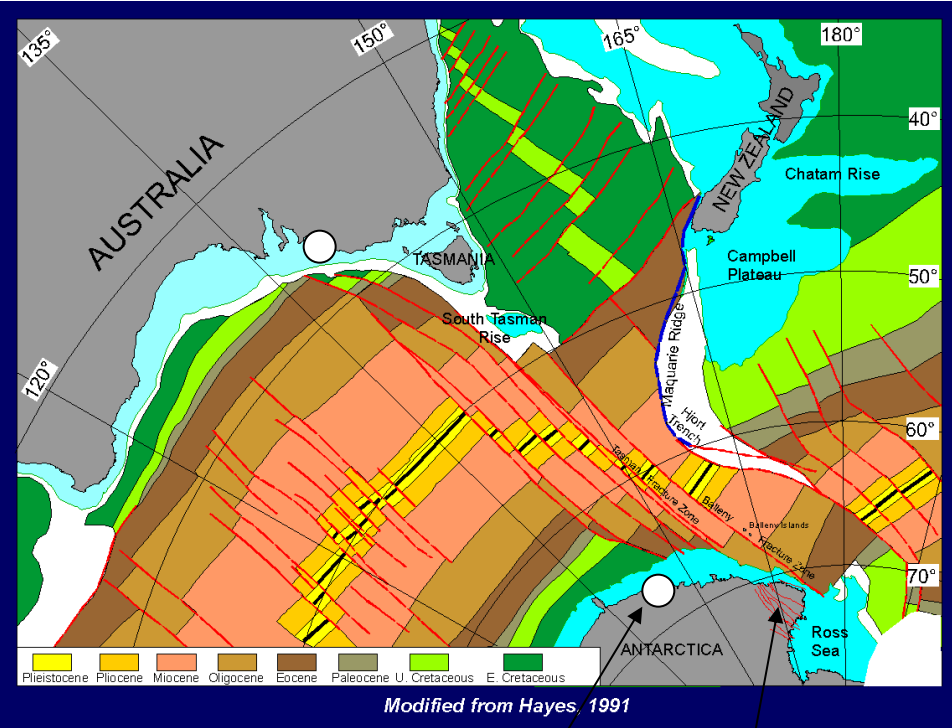
Foto: L. De Santis



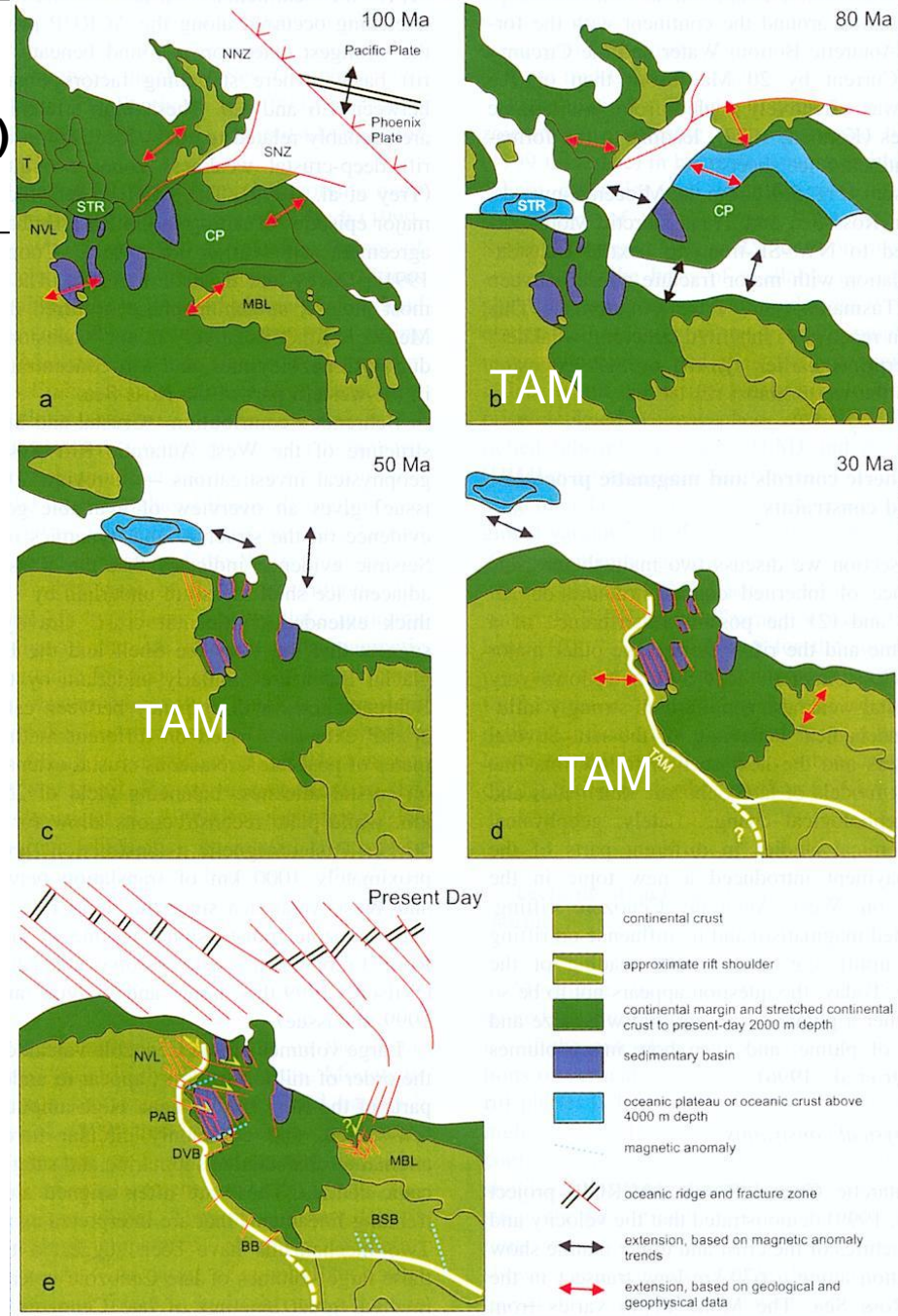
sezione geologica attraverso le Valli Secche di McMurdo



Break-up tra:
Australia e Antartide (83 Ma)
Mare di Ross Orient. e Campbell Plateau (84 Ma)
Mare di Ross Occ. e Tasmania (50 Ma)



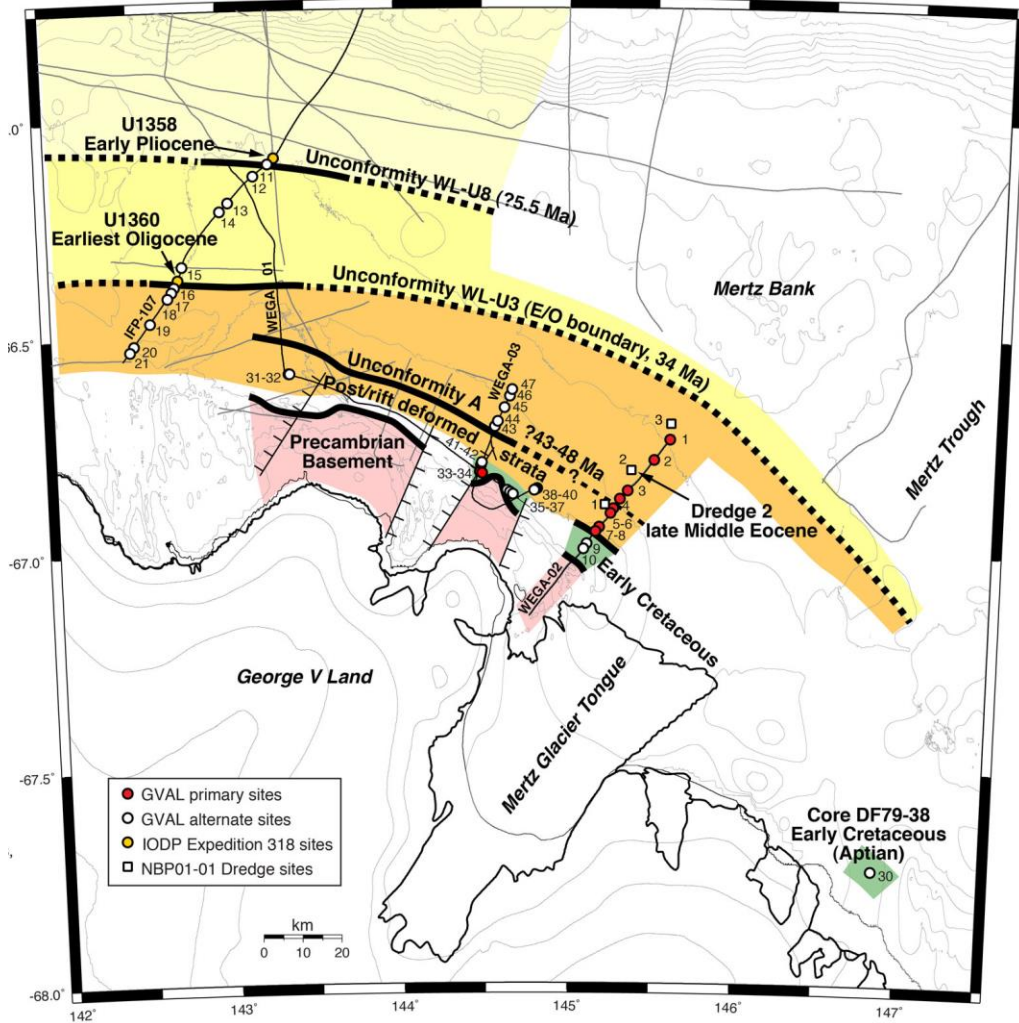
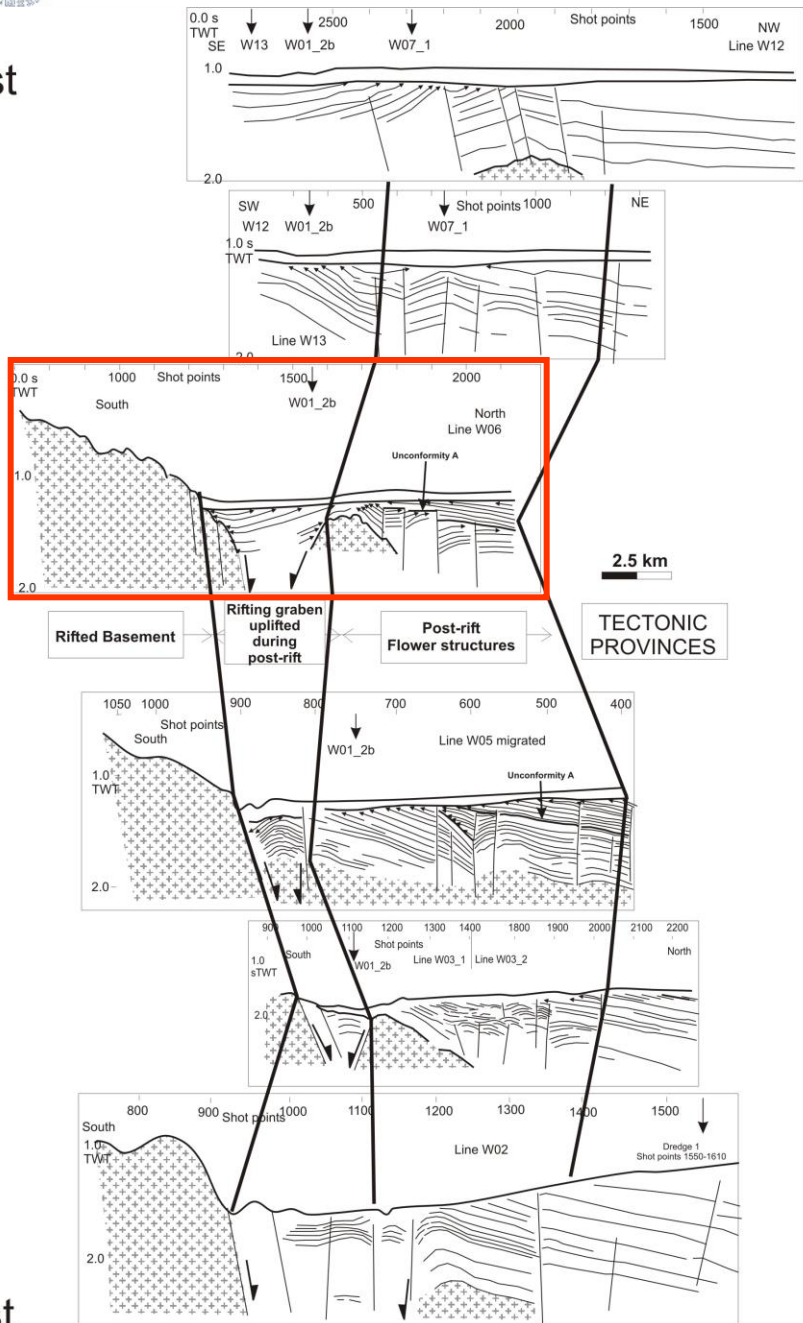
George V Land
 Victoria Land



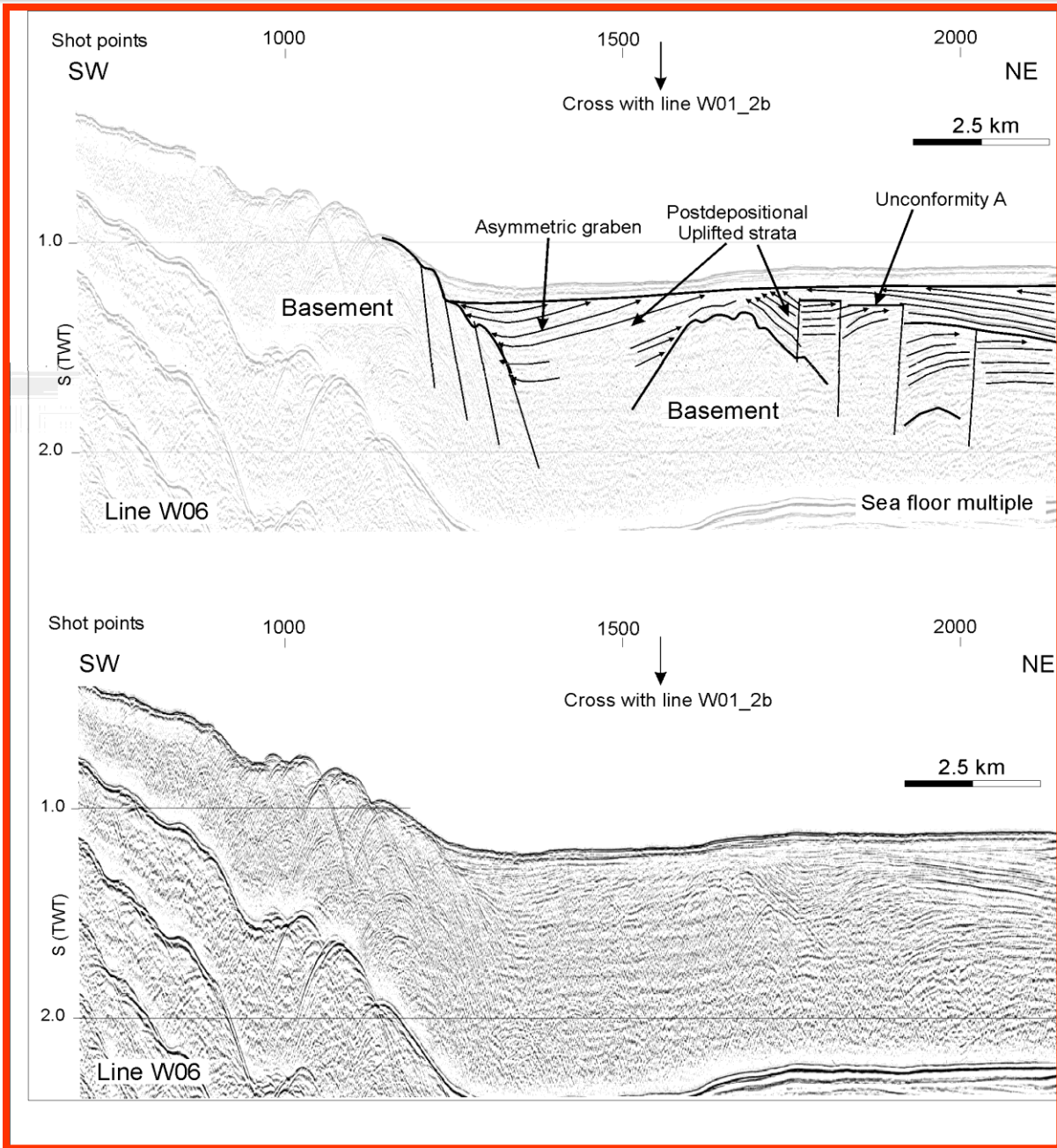


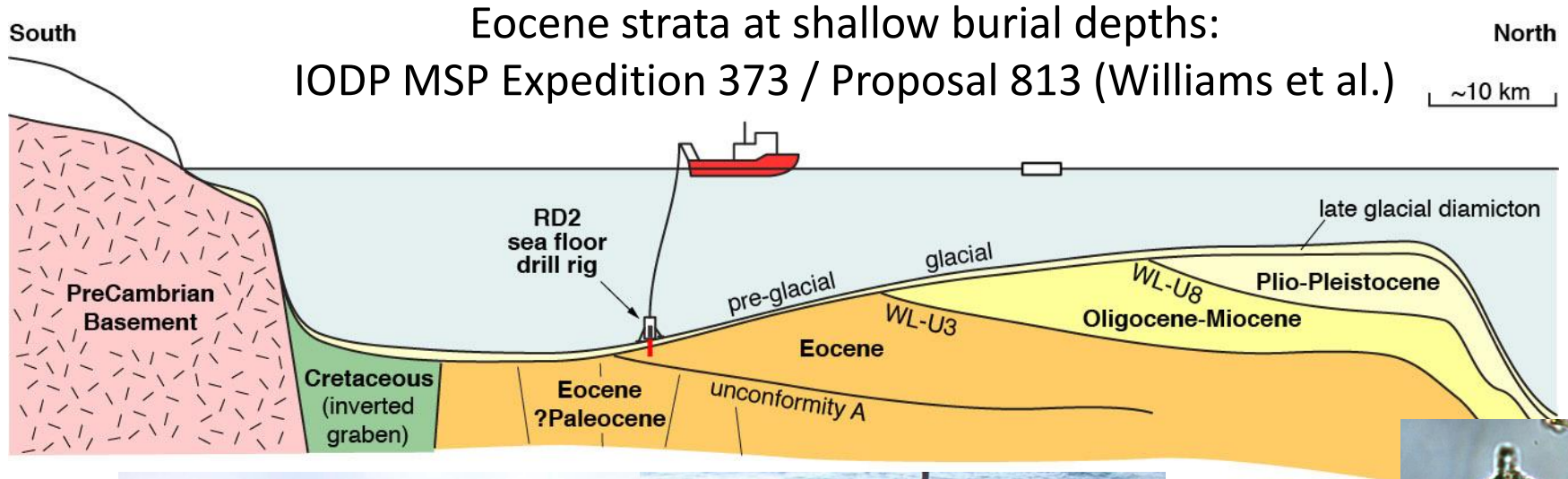
West

East

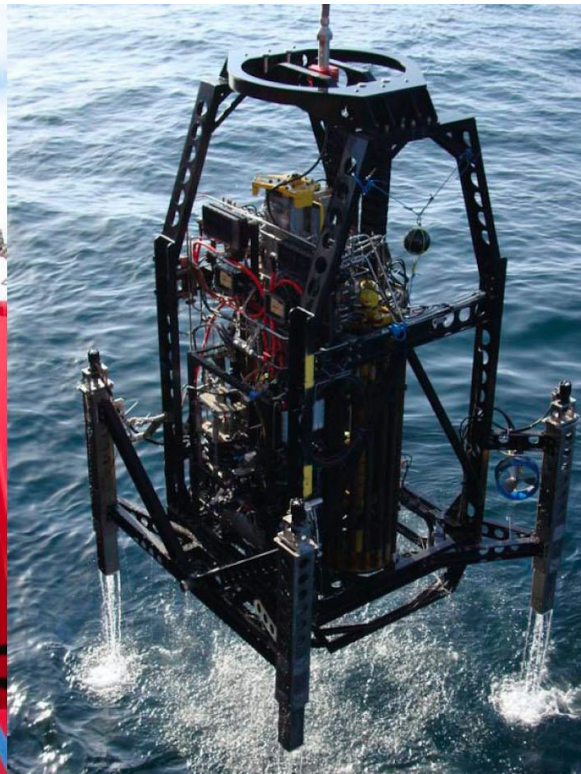


George V Land continental margin

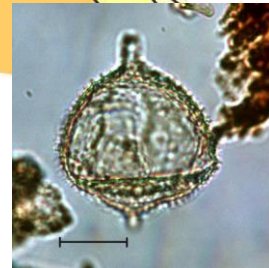




Seabed
Rockdrill:
BGS RD2



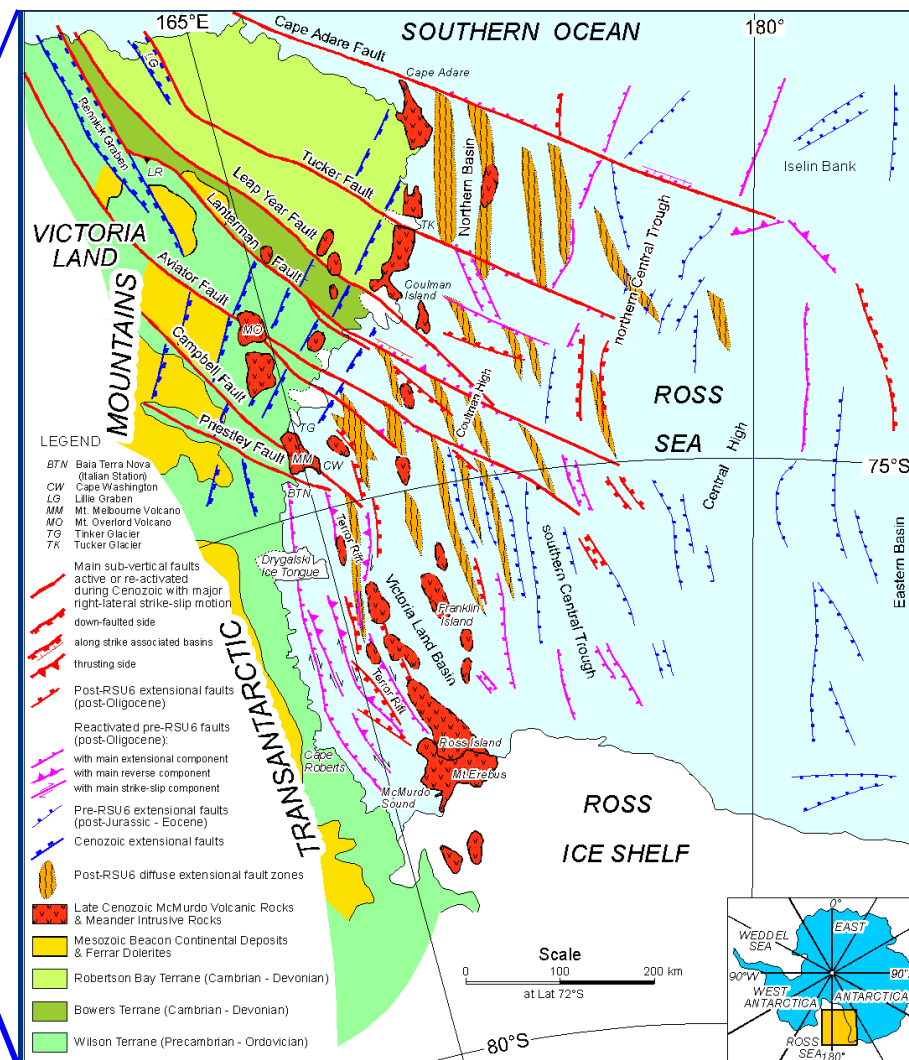
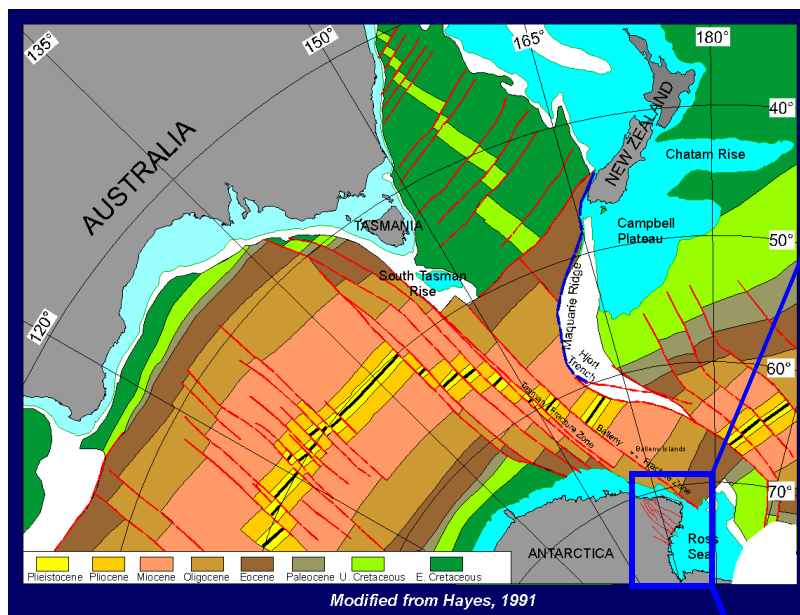
*Vozzhennikova
apertura
Francesca
Sangiorgi*

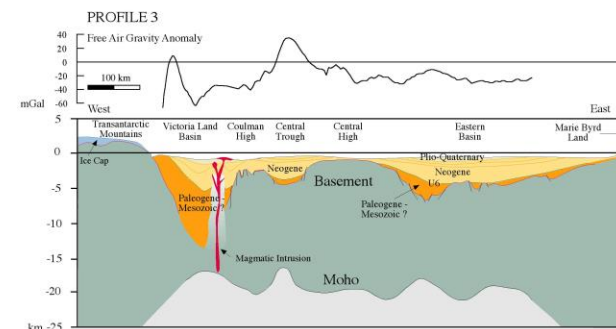
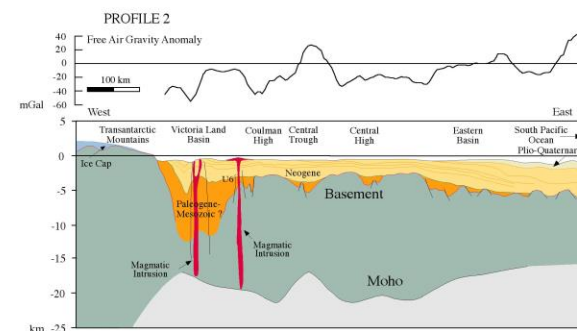
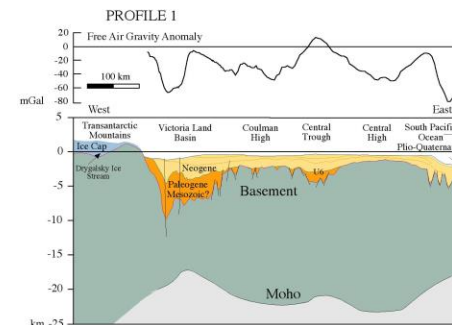
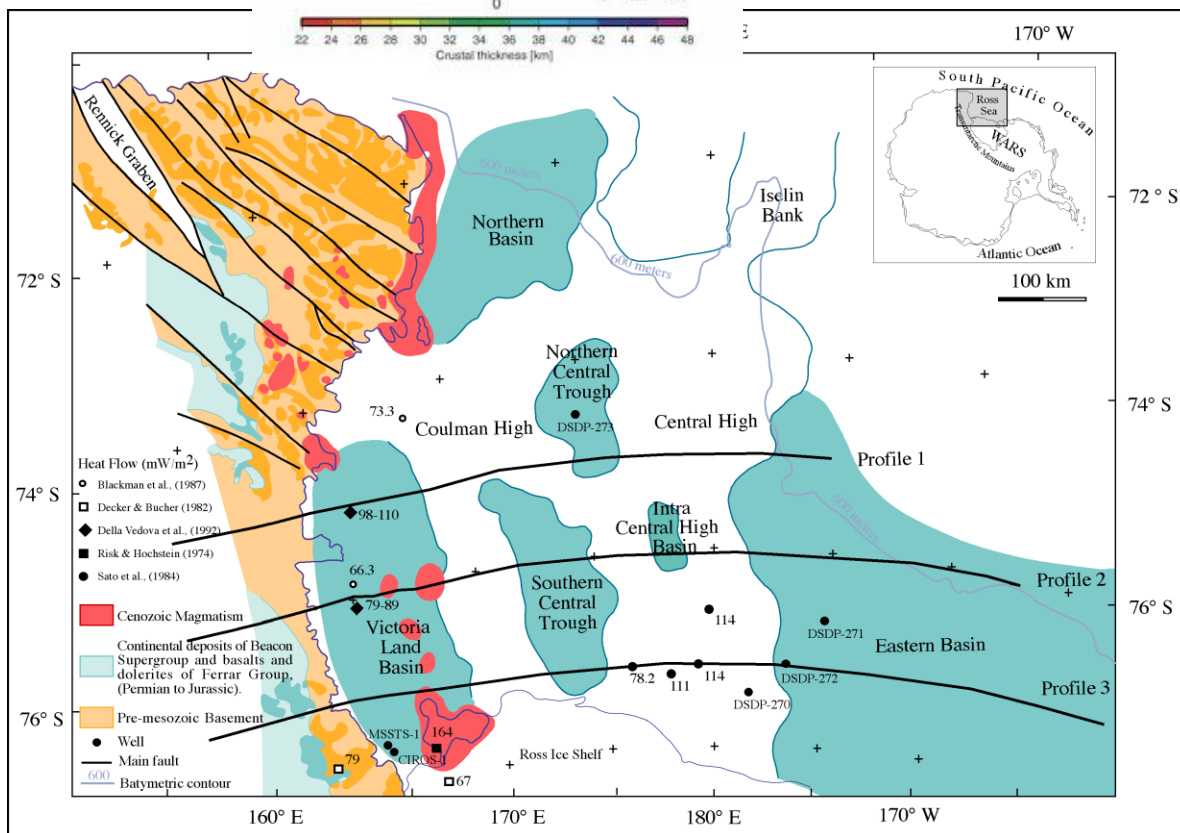
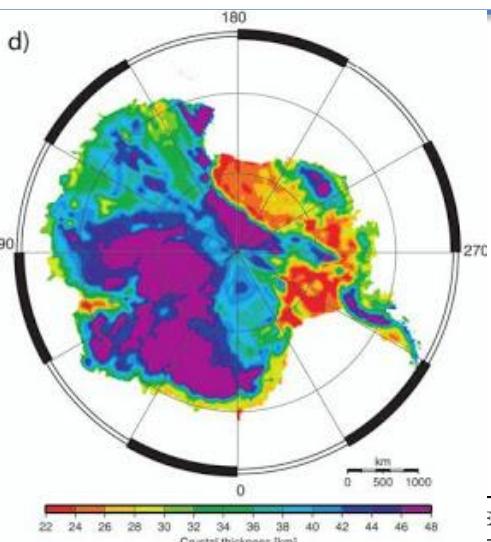


Dredge samples
Leventer, Domack, et al., NBP01-01 2001.
Paleogene lignite present.
New Dredges from Leventer, Domack et al. NBP14-02
Campanian to L. Eocene

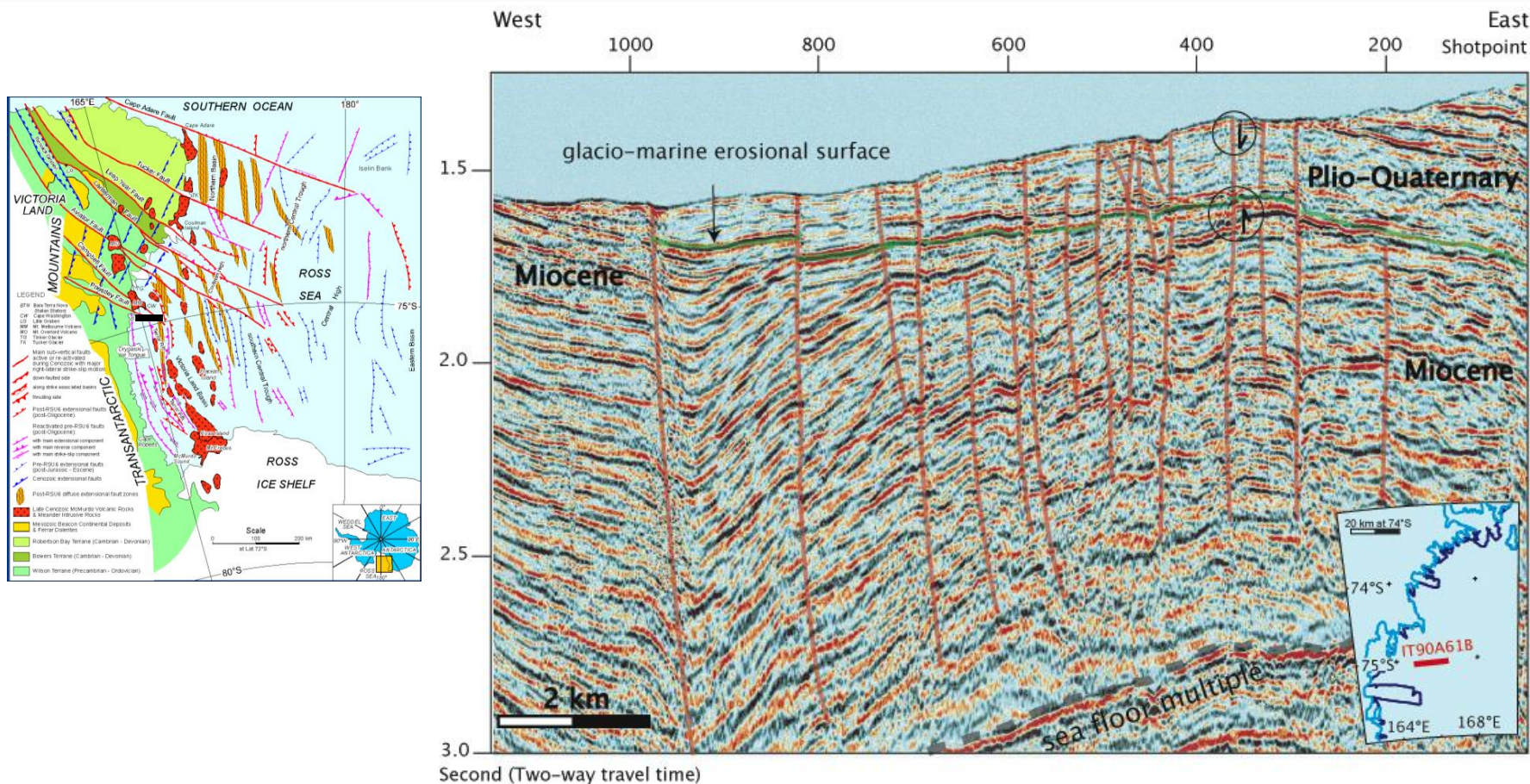
50m
below sea
bed
Max.
4000 m
water-
depth

Il collegamento delle faglie trasformi oceaniche con le faglie trascorrenti della Terra Vittoria e con le strutture nel Mare di Ross



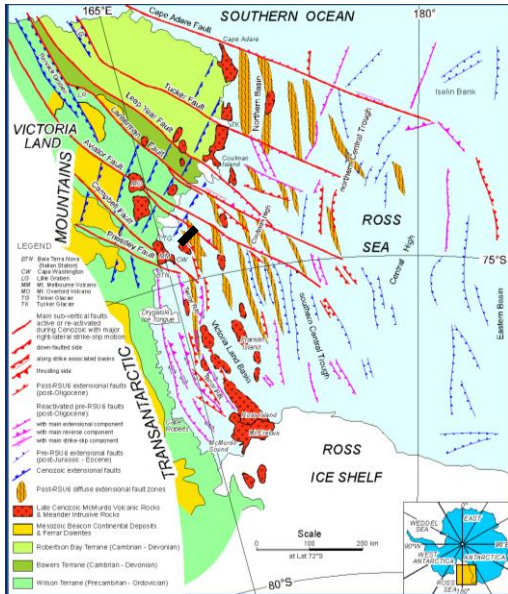
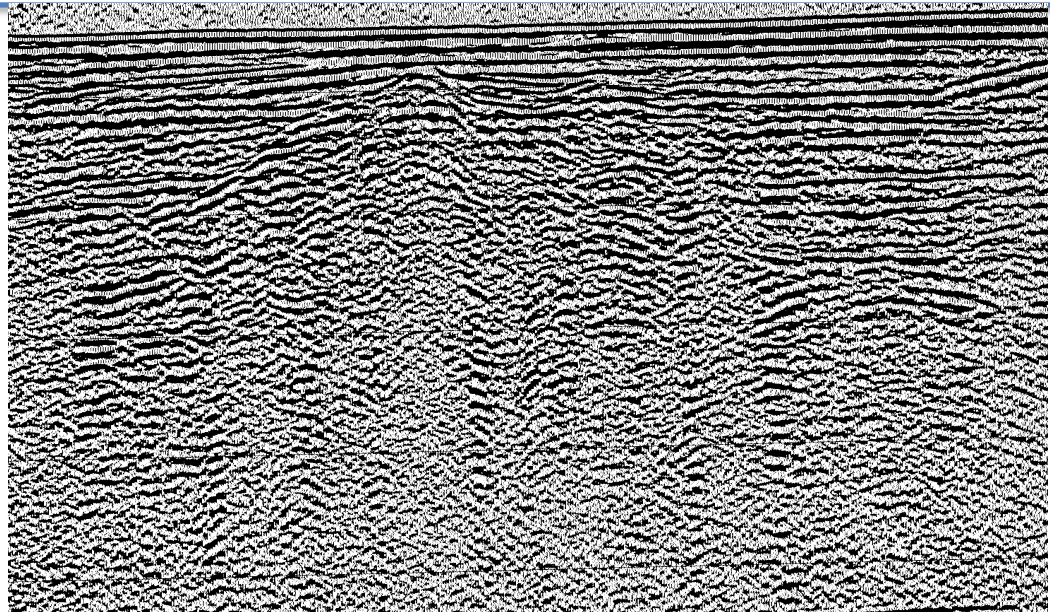


Busetti et al., 1999



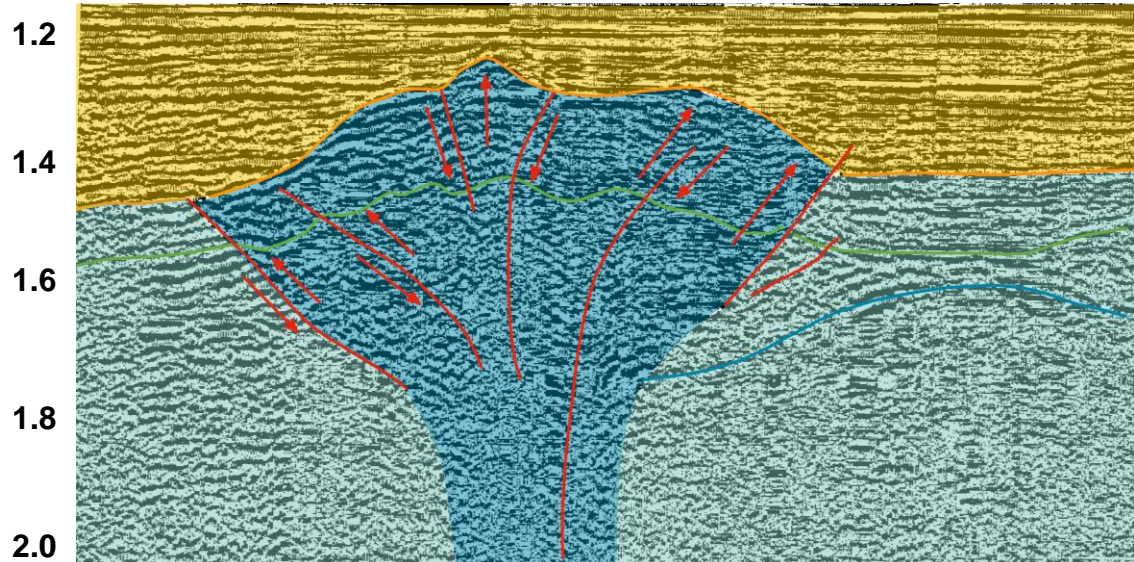
Evidenza della prosecuzione a mare del sistema tettonico legato alla faglia del Ghiacciaio Priestly, trascorrente destra con direzione NW-SE. L'attività è anche neotettonica come dimostra la morfologia del fondo mare caratterizzata da piccoli gradini di faglia.

Faglia transpressiva Struttura a “fiore”



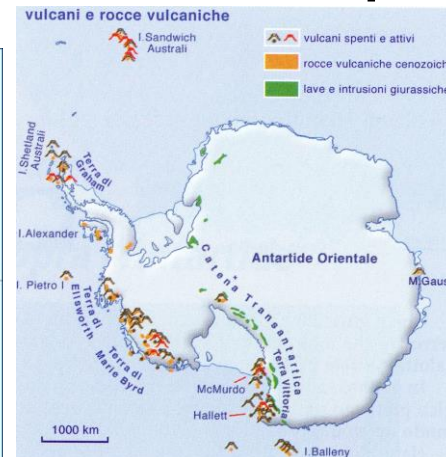
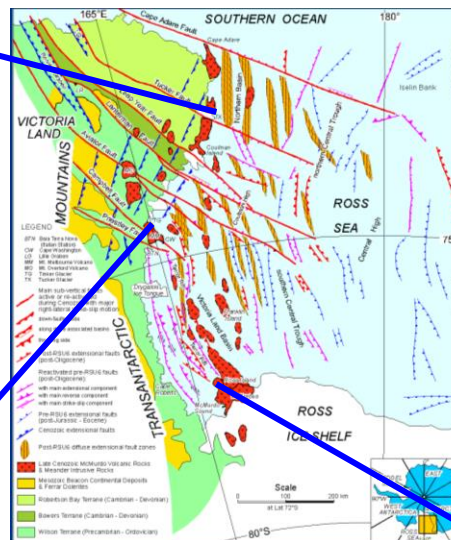
Salvini et al., 1997 JGR
vol. 102, n. B11

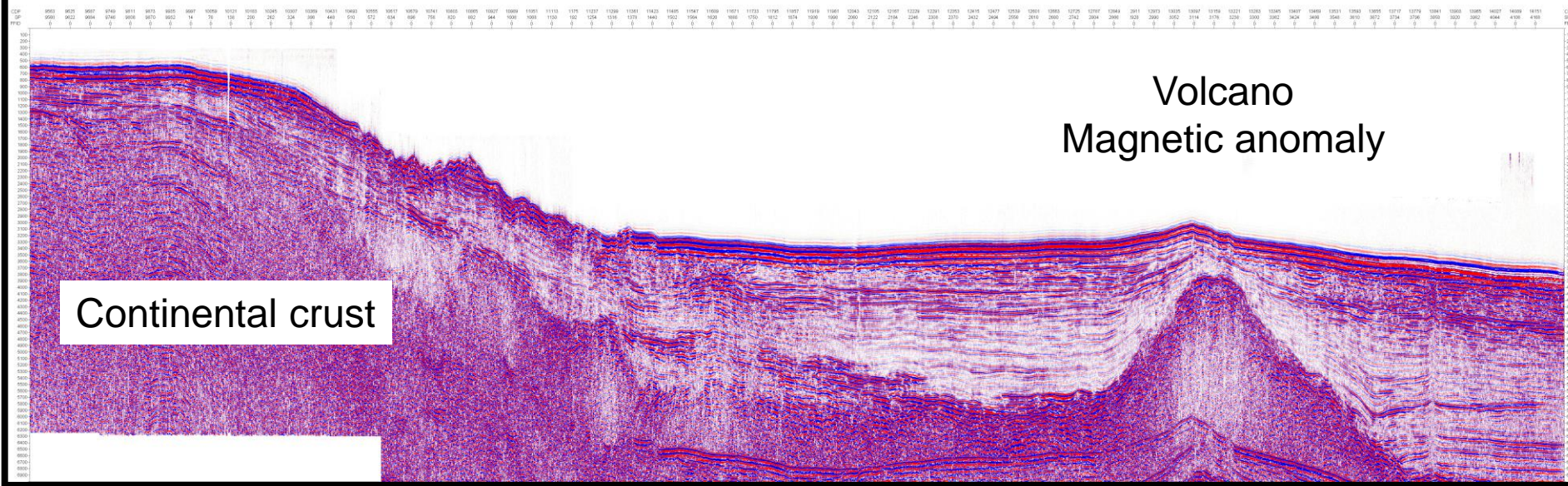
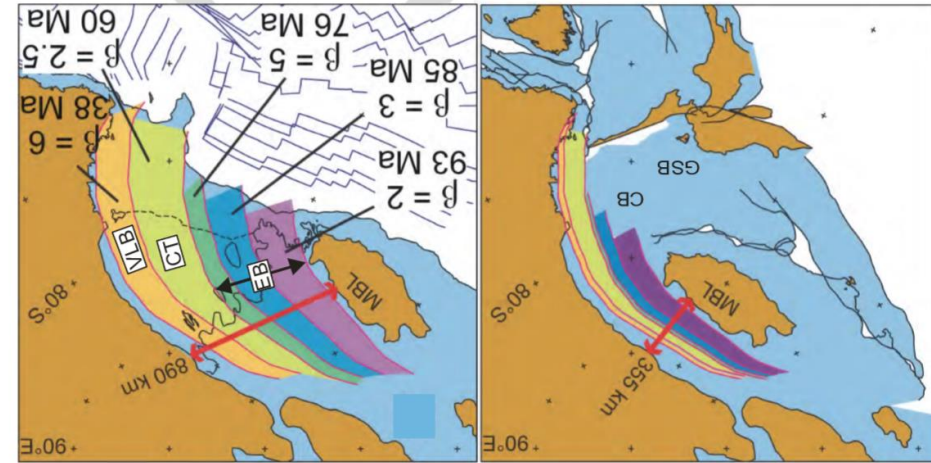
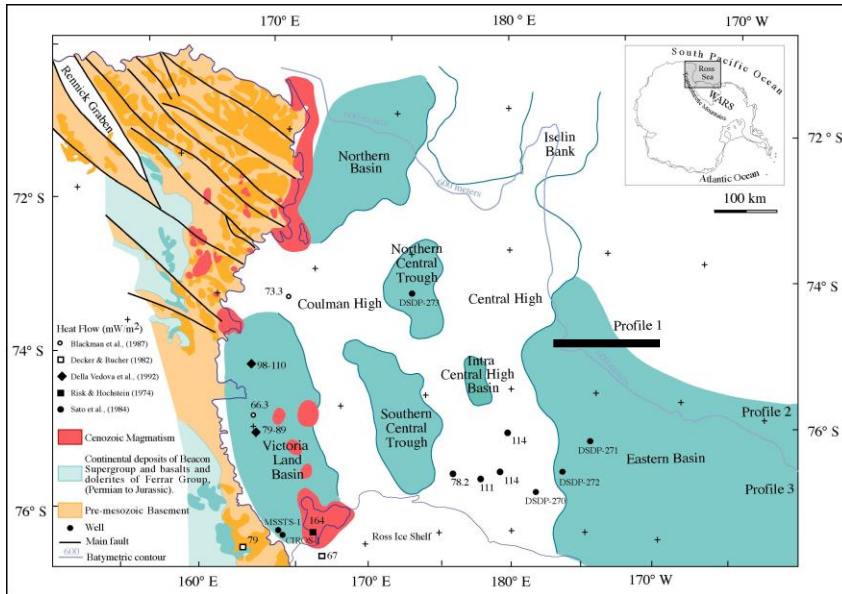
Secondi (Two Way Travel Time)



Evidenza della prosecuzione a mare del sistema tettonico legato alla faglia del Ghiacciaio Aviator, trascorrente destra con direzione NW-SE.

Il vulcanismo alcalino Plio-Quaternario del Mc Murdo Volcanic Group





Profilo MAGE02

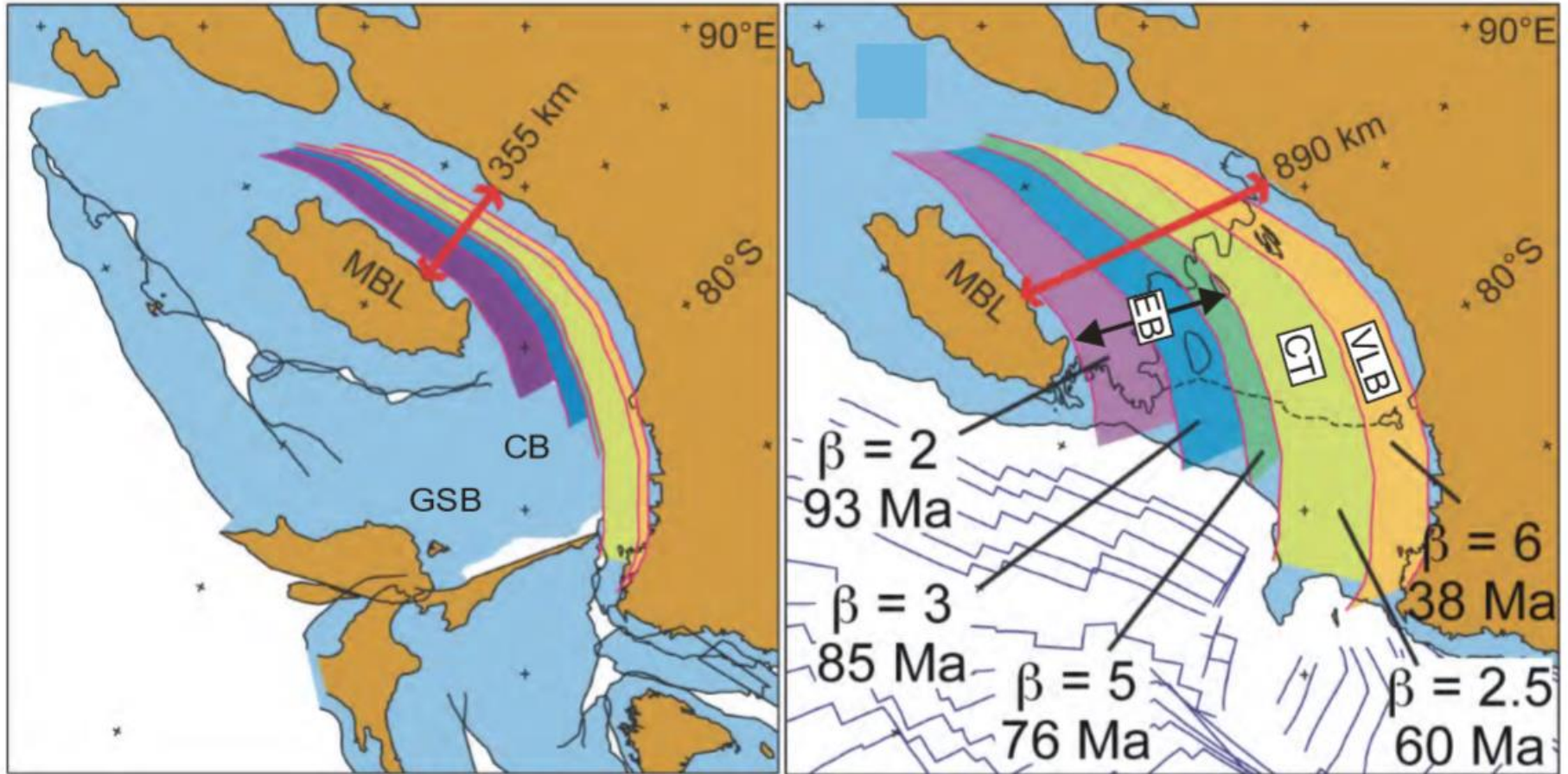


Figure 4 Multi-stage rift model for the Ross Sea (after Wilson and Luyendyk, 2009). (left) prior to extension, showing location of New Zealand and the Great South (GSB) and Campbell (CB) basins. Right present day showing timing and magnitude of rifting events through the Ross Sea.