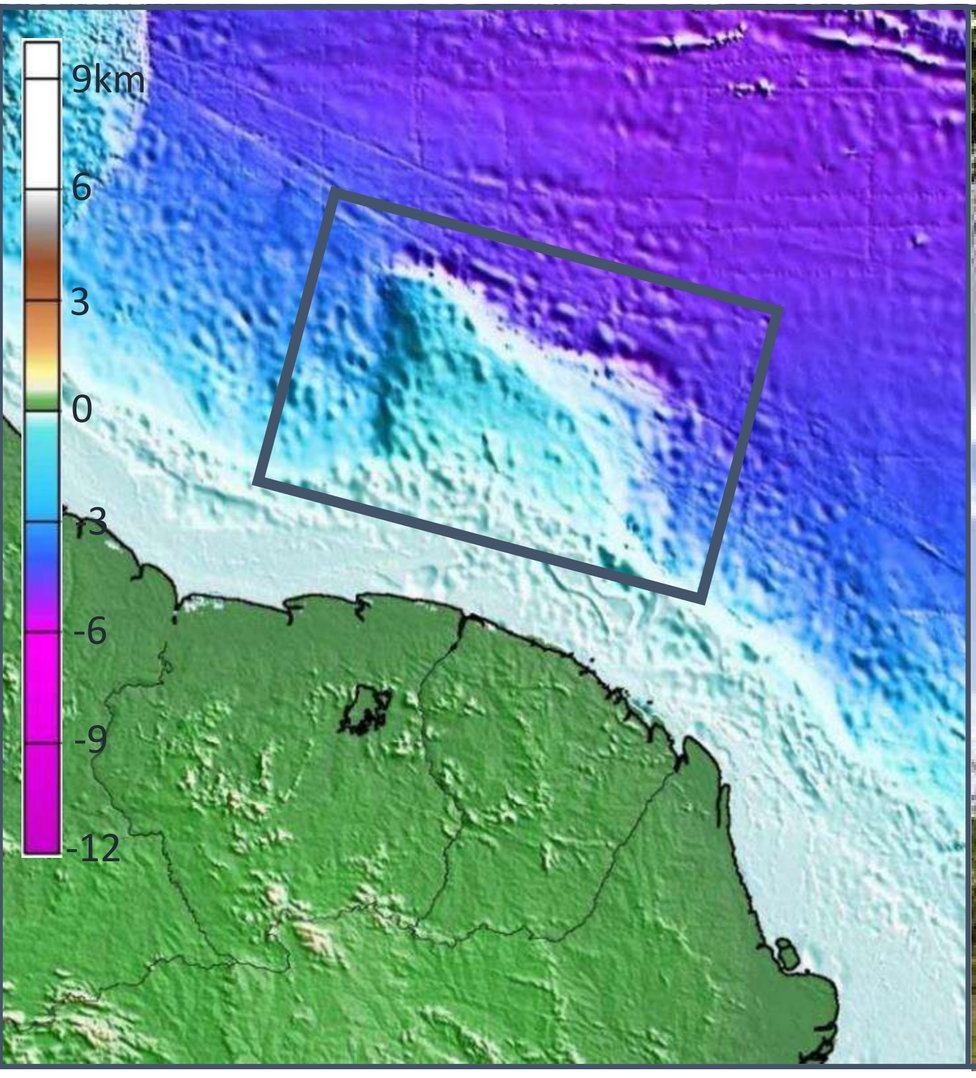
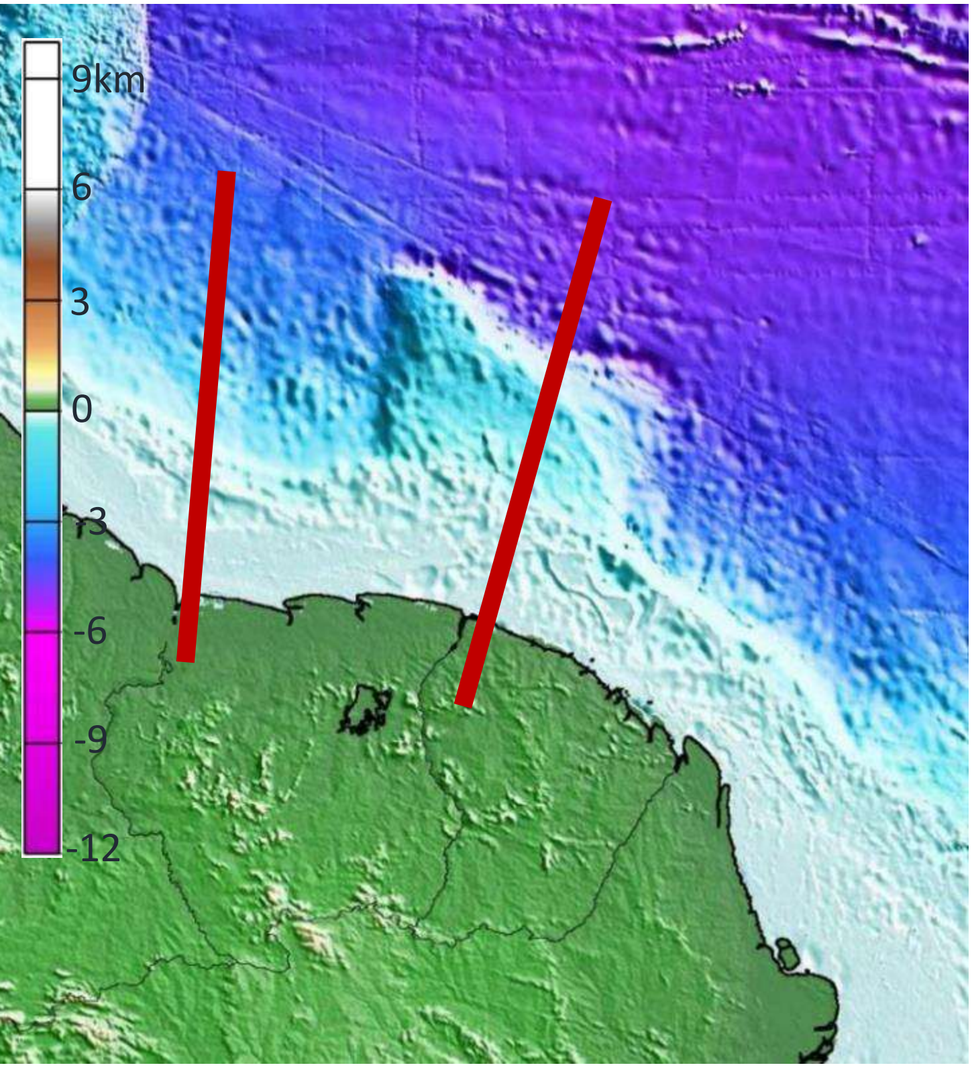
Structure, evolution and magmatic origin of the Demerara marginal plateau

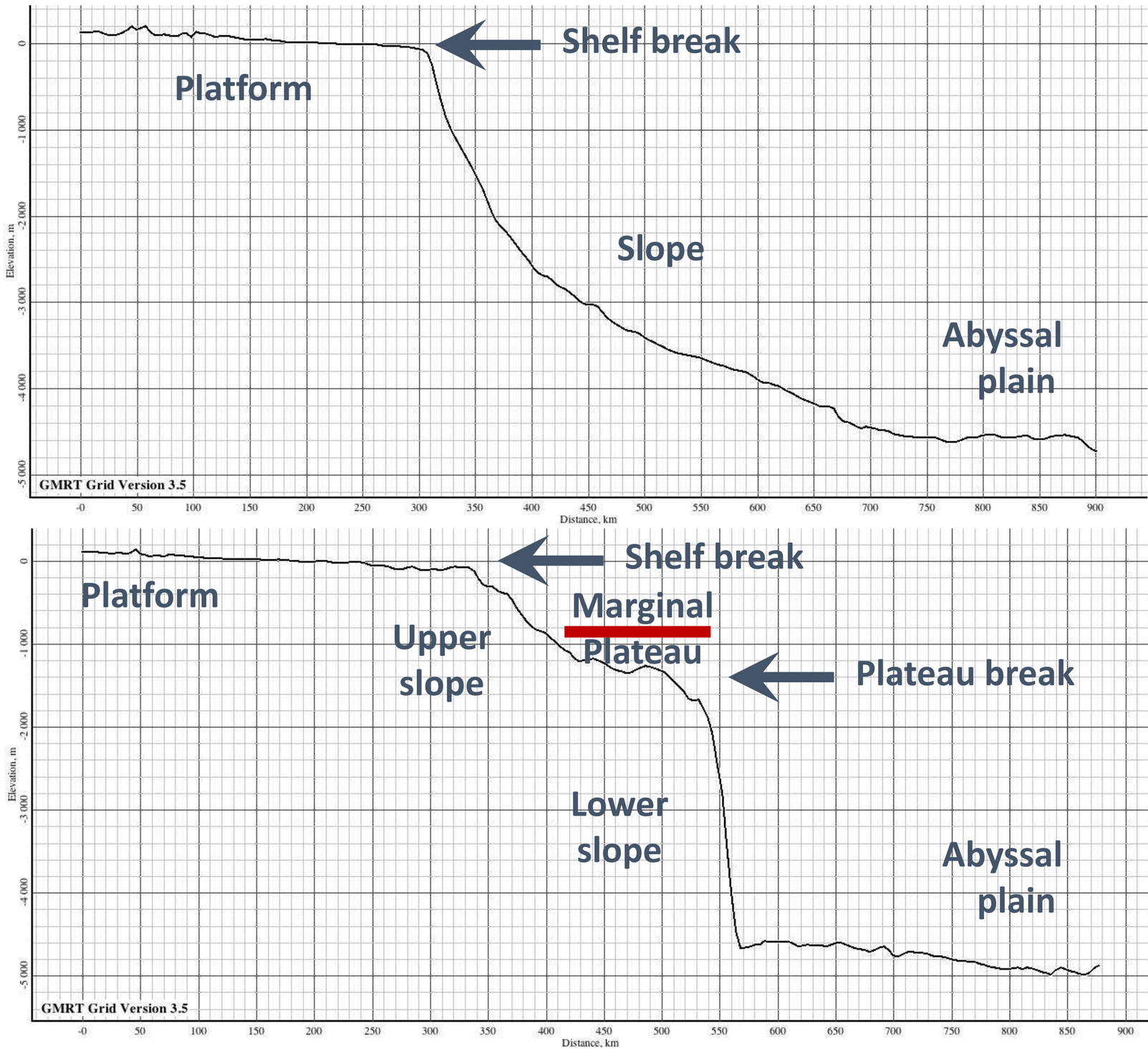
as revealed by multidisciplinary oceanographic exploration



A. HEURET, L. LONCKE, W. ROEST, C. BASILE, D. GRAINDORGE, E. POETISI

Characteristics of the Demerara Plateau





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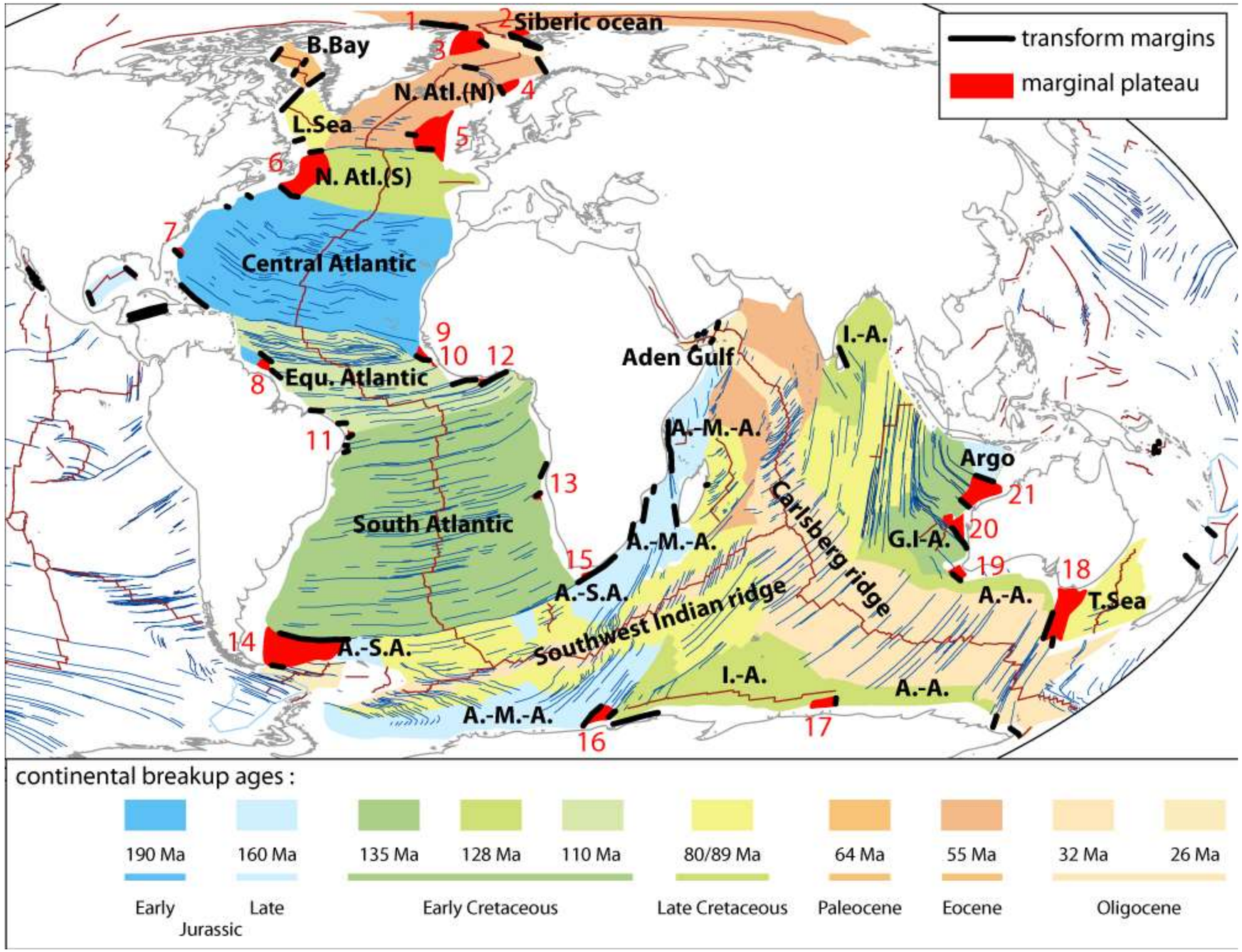
Marginal plateaus : worldwide distribution



Mercier (2016)

- ± 20 marginal plateaus around the world
- Located at the intersection of oceanic domains of different ages
- All limited by or related to transform margins

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Oceanographic exploration of the Demerara Plateau

- May, 2003 – GUYAPLAC (N/O Atalante) : W. Roest (Ifremer)
  Bathymetry, seismic imaging (shallow structure)

- April-may, 2013 – IGUANES (N/O Atalante) : L. Loncke (Perp.)
  Bathymetry, seismic imaging (shallow structure)

- July, 2016– DRADEM (N/O Pourquoi pas ?) : C. Basile (Grenoble)
  Dredging

- Oct.-nov., 2016 - MARGATS (N/O Atalante) : D. Graindorge (UBO)
  Seismic imaging (deep structure)

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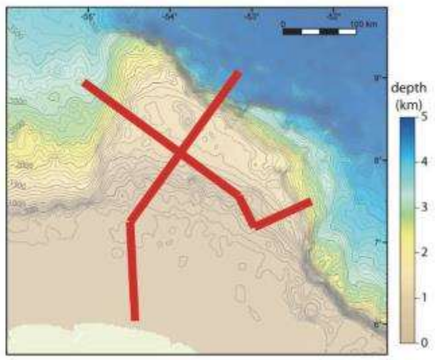
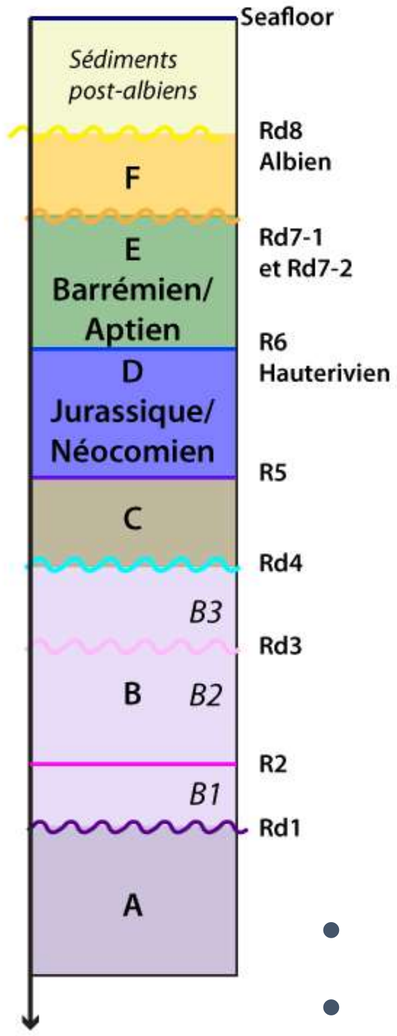
Shallow structure of the Demerara Plateau

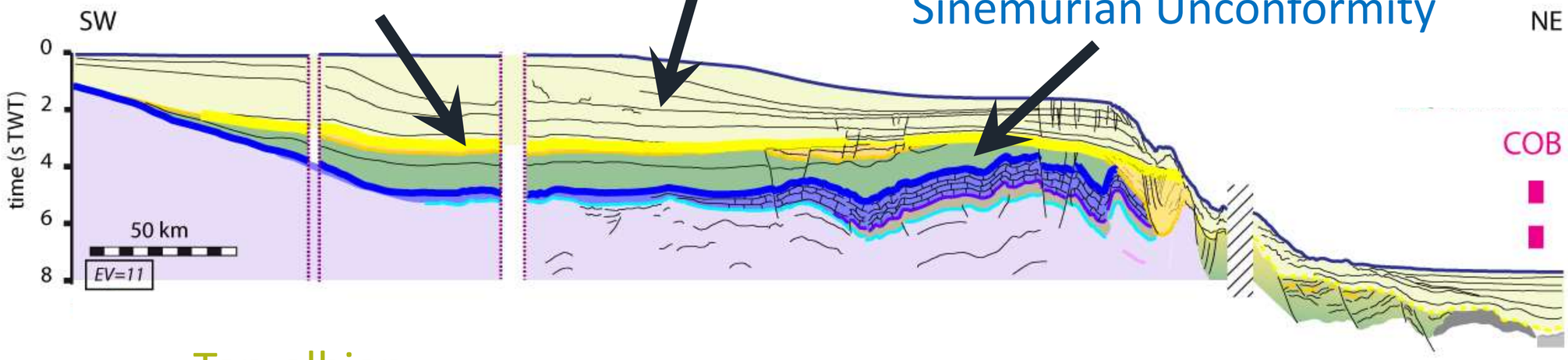




Top-albian Unconformity

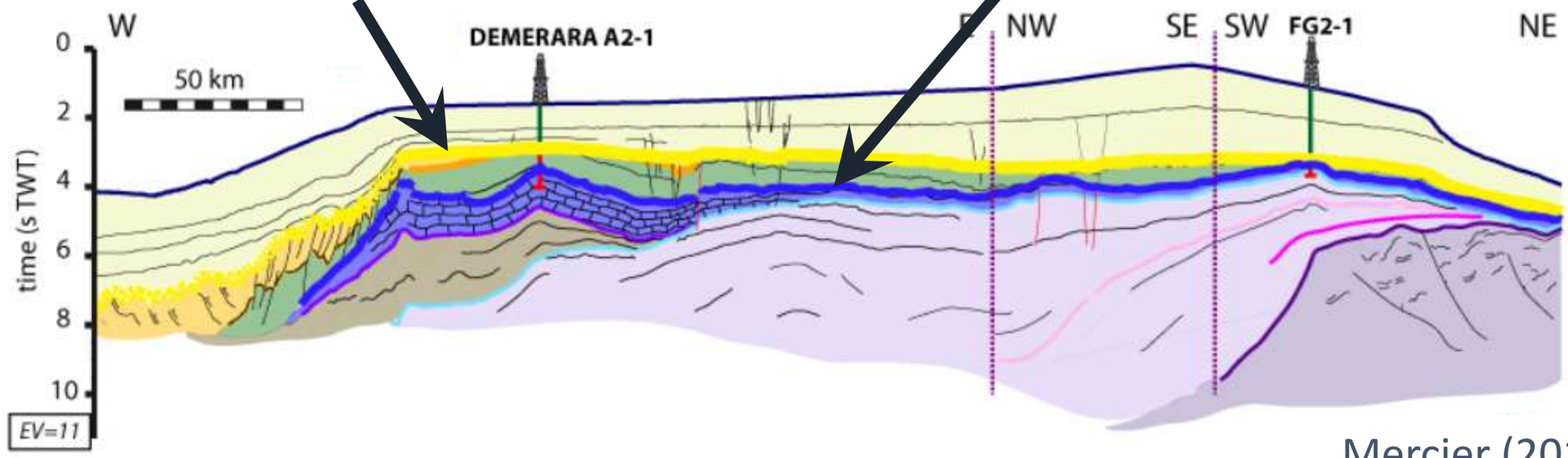
Prograding shelf

Sinemurian Unconformity



Top-albian Unconformity

Sinemurian Unconformity



Mercier (2016)

- A deep horizontal surface 200 x 200 km at 2000 m depth
- Partly covered by the prograding shelf
- Two regional unconformities

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Geodynamical background of the Demerara Plateau

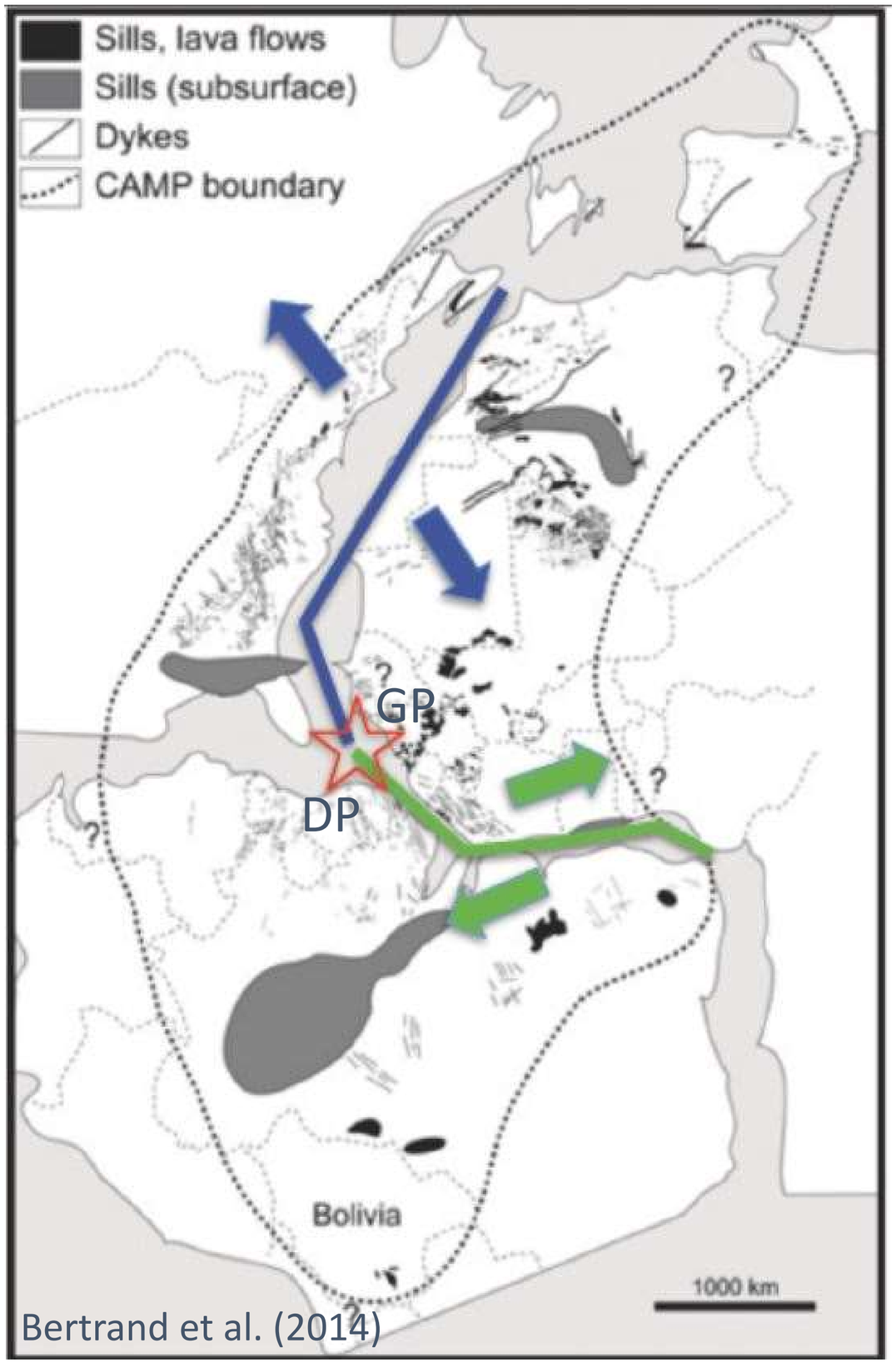
- The Central Atlantic Magmatic Province (CAMP) : 201 Ma

- Jurassic opening of the Central Atlantic
  - 190 Ma in the northern part
  - 170 Ma in the southern part

- Cretaceous opening of the Equatorial Atlantic : ~ 120 Ma

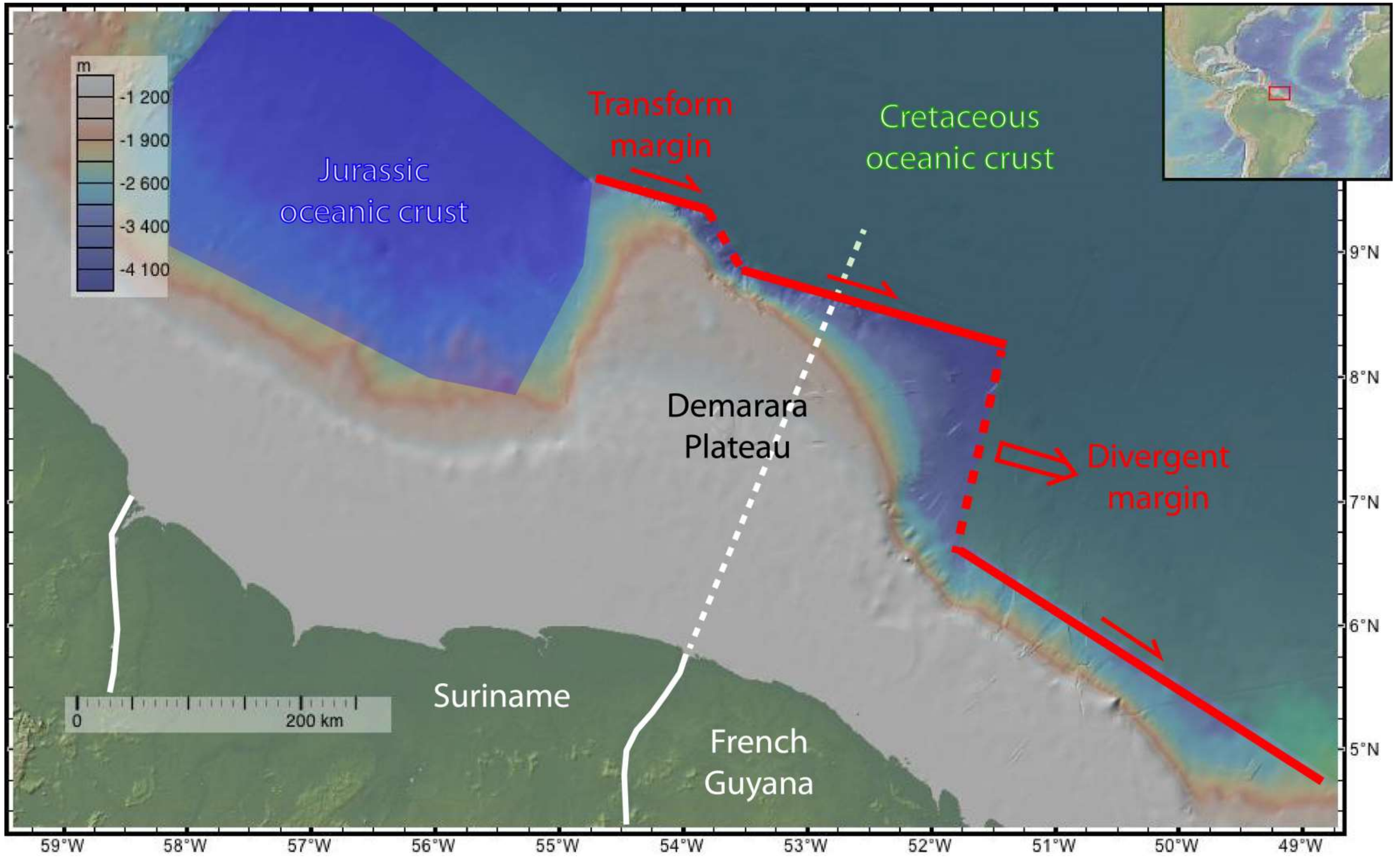
DP = Demerara Plateau
GP = Guinean Plateau

Two regional unconformities = two stages of oceanic formation



Bertrand et al. (2014)

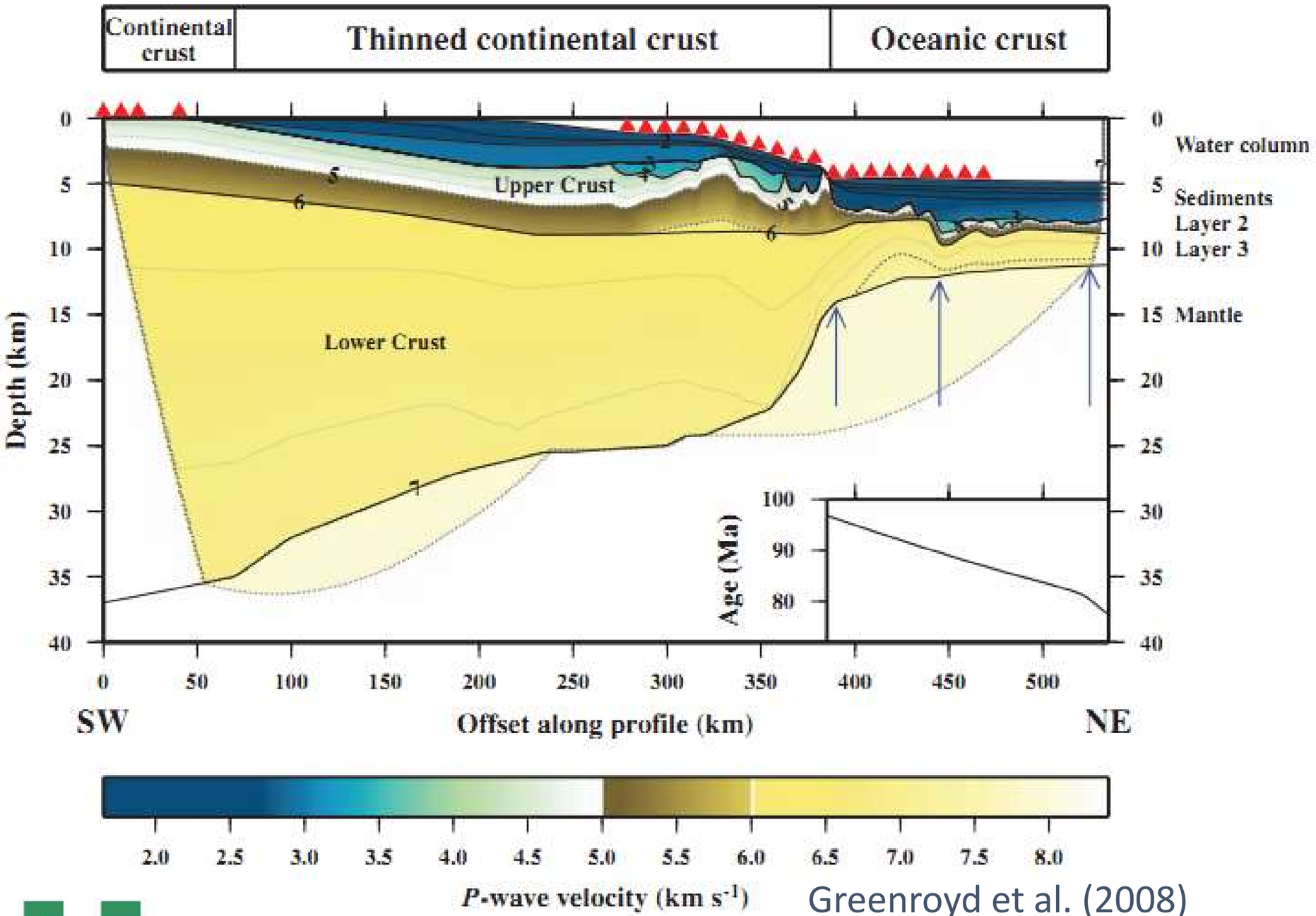
Geodynamical background of the Demerara Plateau



Two types of continental margins

The deep structure of the Demerara Plateau

The starting point



Greenroyd et al. (2008)

‘The Demerara Plateau is, therefore, interpreted as a margin segment comprising **thinned continental crust**’

i.e. deep plateau at isostatic equilibrium implying jurassic stretching

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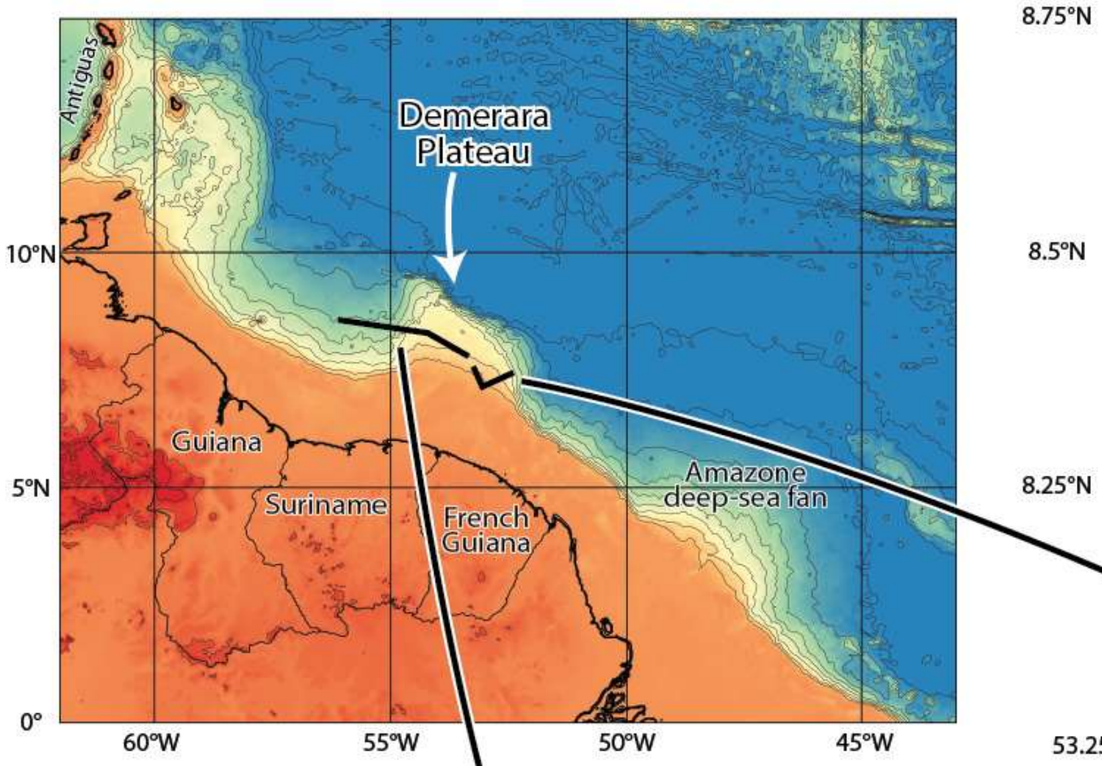
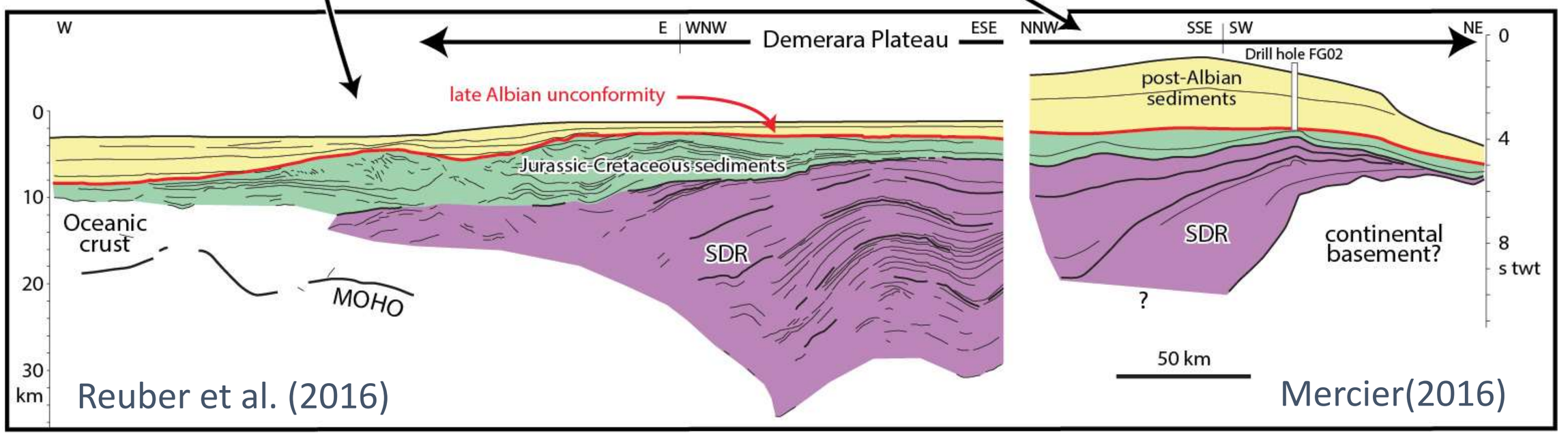
The deep structure of the Demerara Plateau

The starting problems



- Jurassic rifting without any associated structures (tilted blocks, …)
- Very thick (>20 km) Seaward Dipping Reflectors (SDR) below the Demerara plateau

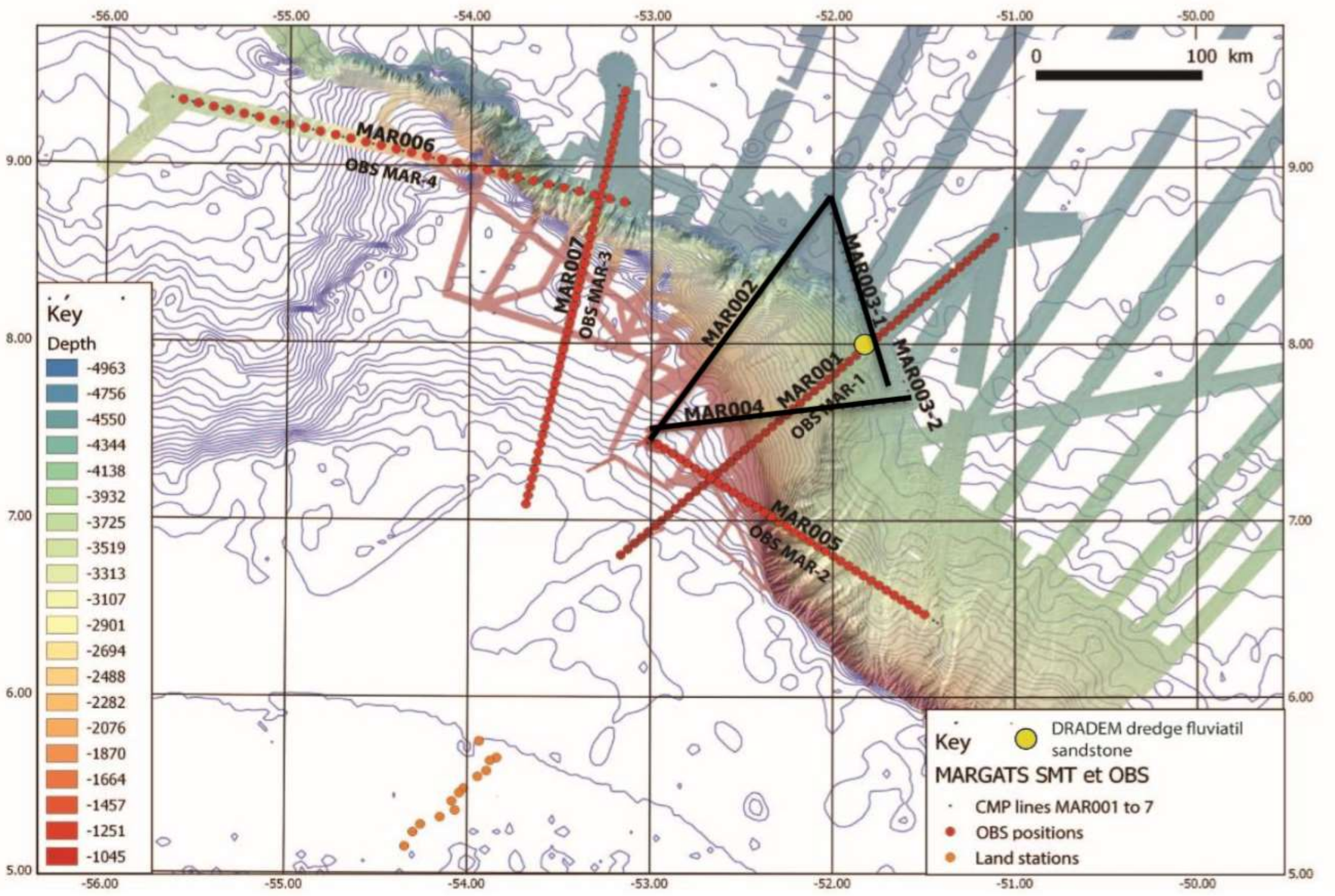


Reuber et al. (2016)

Mercier(2016)

The deep structure of the Demerara Plateau

MARGATS cruise



From October 20th to November 16th 2016 on the R/V L'Atalante.

171 OBS deployments along 4 combined wide-angle and reflection seismic profiles as well as 3 additional MCS profiles.

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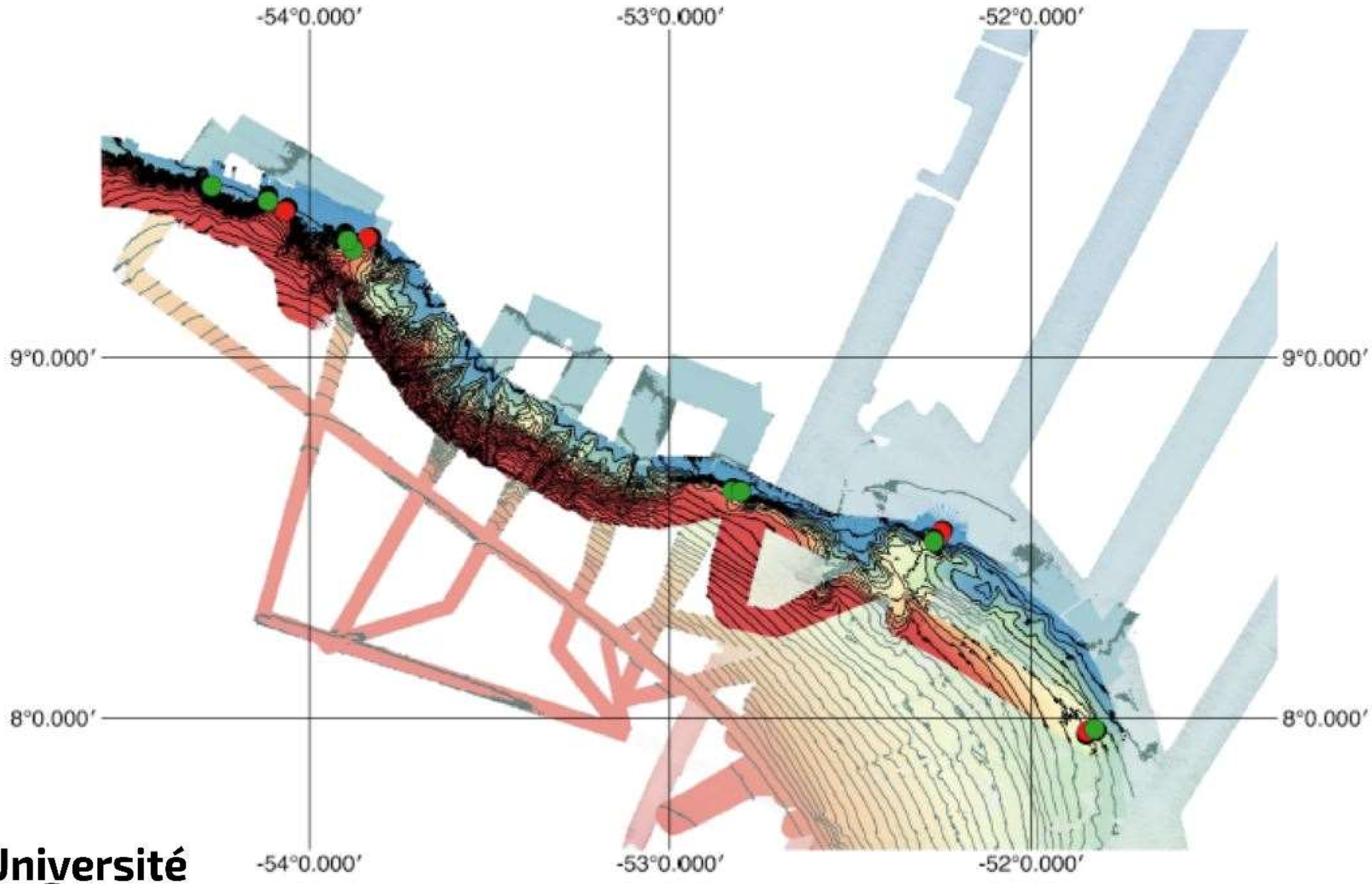
The deep structure of the Demerara Plateau

DRADEM cruise



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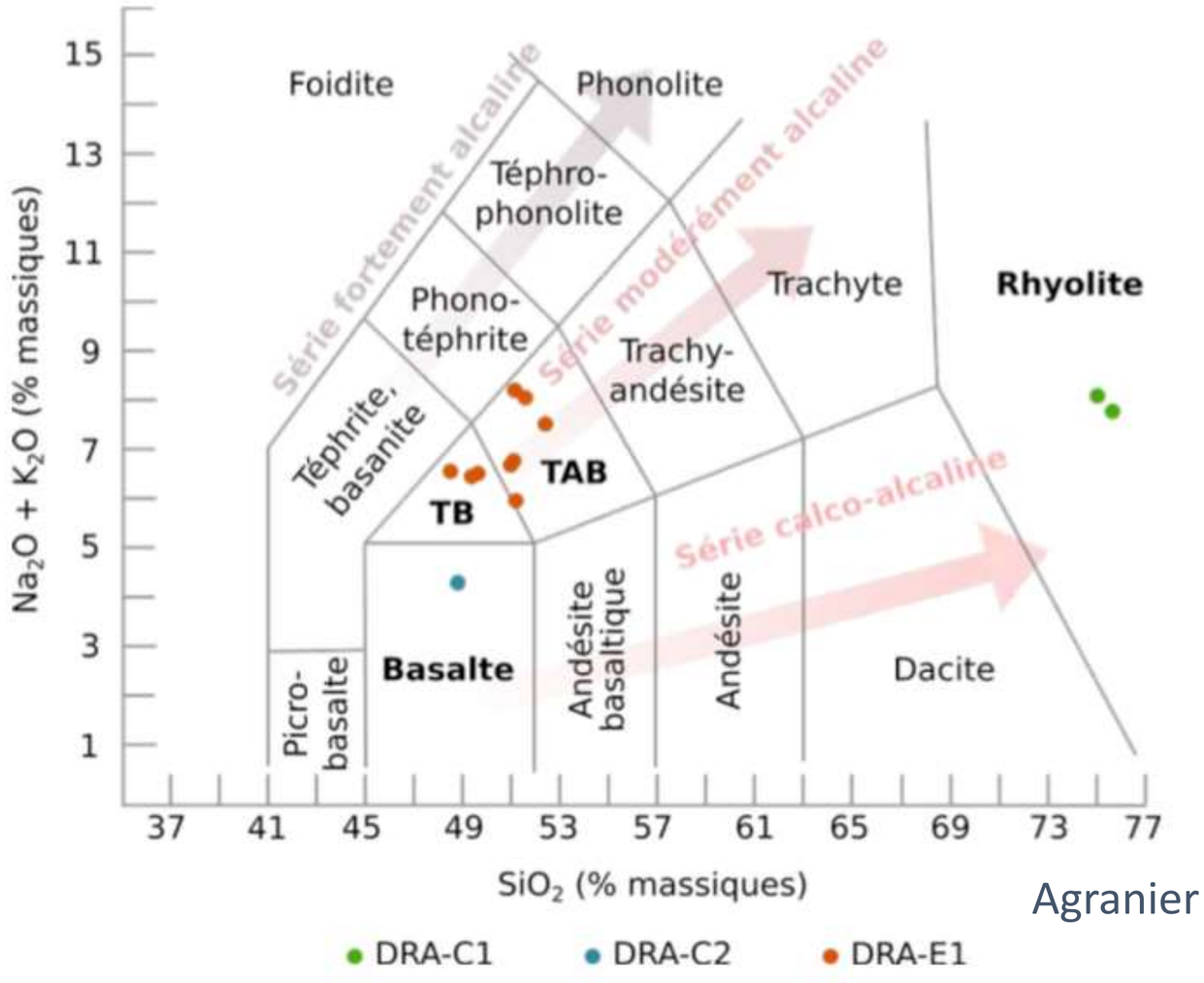
The deep structure of the Demerara Plateau

DRADEM cruise

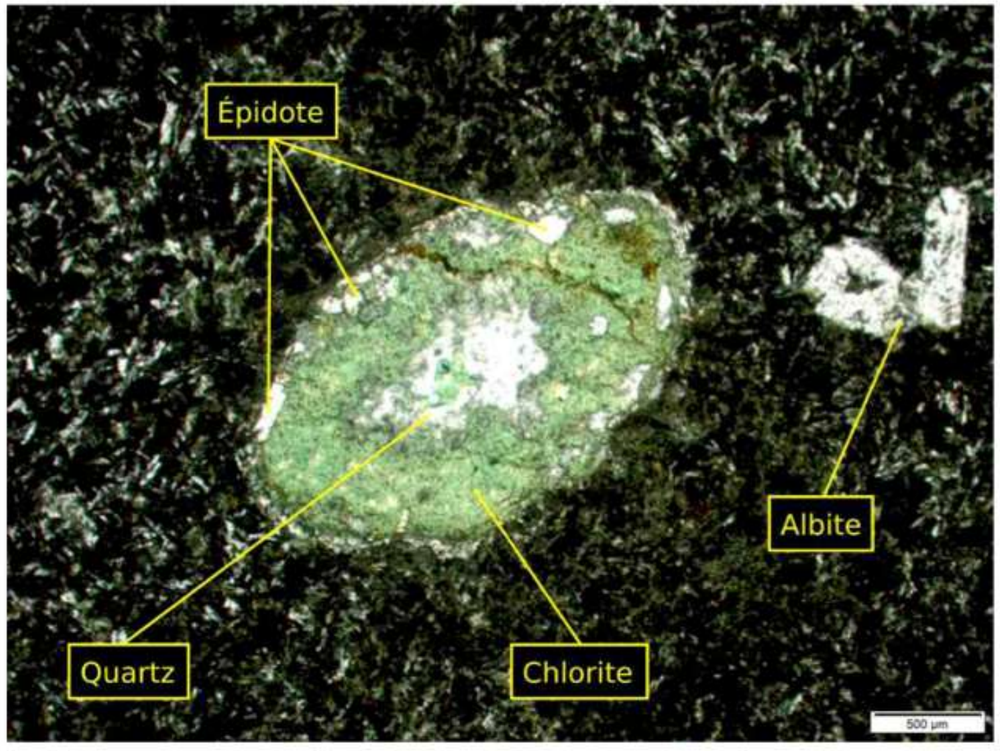
Girault

3 dredges at 2 sites recovered magmatic rocks:

- Basalts
- Trachy-basalts (altered)
- Rhyolites



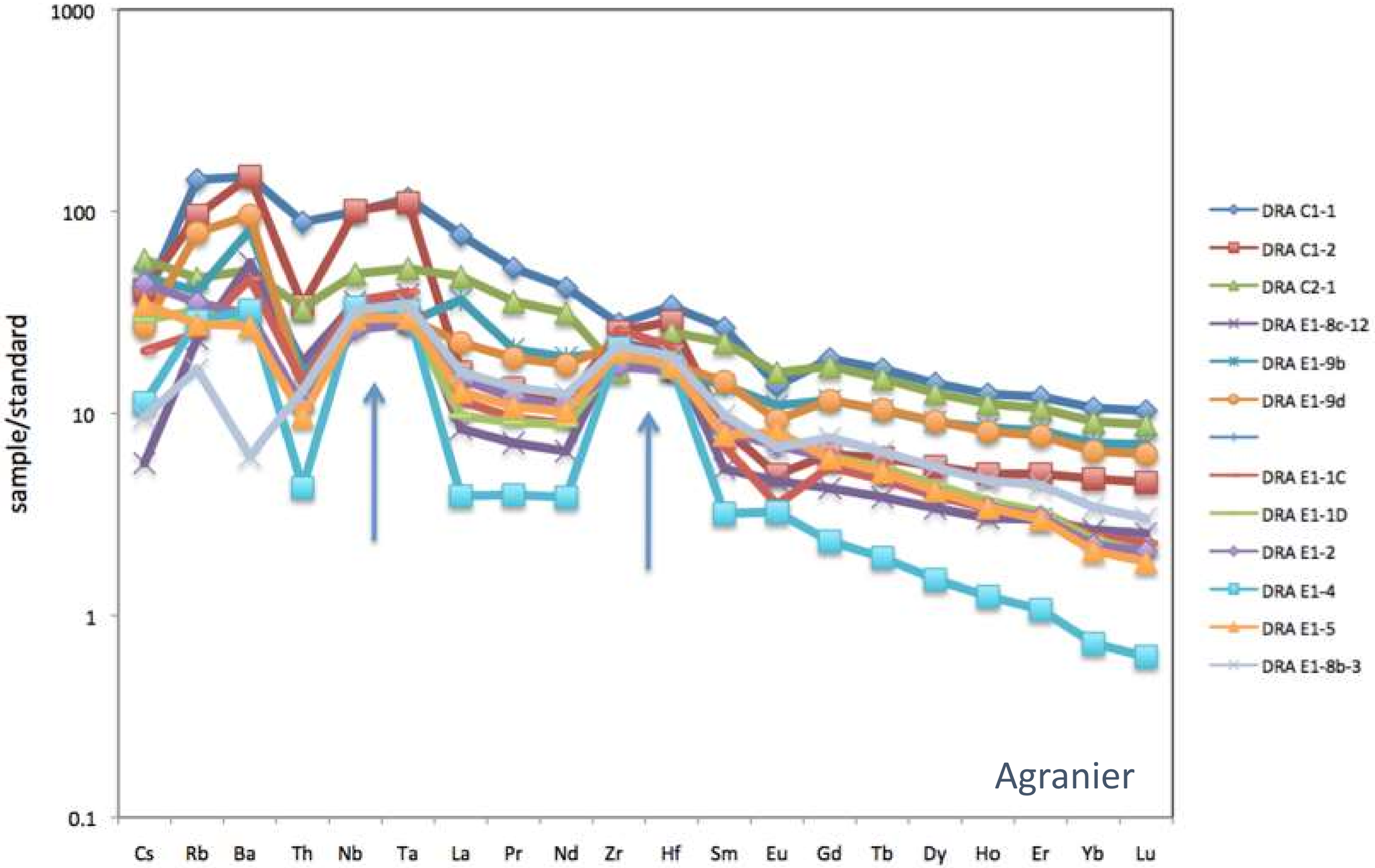
Agranier



Rare Earth Elements spectra characteristic for hotspot lava

The deep structure of the Demerara Plateau

DRADEM cruise



Same Rare Earth Elements spectra : positive anomalies in Nb, Ta, Zr, Hf

Characteristic for hotspot lava (Ocean Island Basalts = OIB type)

The deep structure of the Demerara Plateau

DRADEM & MARGATS cruises

The basement of the Demerara plateau includes

- Very thick SDR units
- Remnants of hotspot magmatism
- Magmatic rocks 28 Ma younger than the CAMP

We test the hypothesis of a hotspot below the Demerara plateau at 173 Ma :

- Hot spot fixed by reference to the terrestrial rotation axis
- Use the GPlates model (Seton et al. 2012) that describes the absolute displacements of lithospheric plates during the last 200 Ma

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Next step : DIves At DEMerara (DIADEM, 2020)