Structure, evolution and magmatic origin of the Demerara marginal plateau as revealed by multidisciplinary oceanographic exploration

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Characteristics of the Demerara Plateau

- Platform
- Shelf break
- Slope
- Abyssal plain
- Plateau
- Platform break
- Marginal Plateau
- Upper slope
- Lower slope
- Abyssal plain
Marginal plateaus: worldwide distribution

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

Mercier (2016)
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)
Shallow structure of the Demerara Plateau

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

Mercier (2016)
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

Two regional unconformities = two stages of oceanic formation

DP = Demerara Plateau
GP = Guinean Plateau

Bertrand et al. (2014)
Geodynamical background of the Demerara Plateau

Two types of continental margins

- Jurassic oceanic crust
- Transform margin
- Cretaceous oceanic crust
- Divergent margin

Demarara Plateau

Suriname

French Guyana
The deep structure of the Demerara Plateau

The starting point

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

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

Greenroyd et al. (2008)
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
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.
The deep structure of the Demerara Plateau

DRADEM cruise
The deep structure of the Demerara Plateau

**DRADEM cruise**

3 dredges at 2 sites recovered magmatic rocks:
- Basalts
- Trachy-basalts (altered)
- Rhyolites

Rare Earth Elements spectra characteristic for hotspot lava

Girault

Agranier
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).

Agranier
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
Next step: Dives At DEMerara (DIADEM, 2020)