Early opening of the Central Atlantic and its connection to the Western Tethys

Benjamin Heudes[1], Julie Tugend[1], Geoffroy Mohn[1], and Nick Kusznir[2]

[1]CY Cergy Paris Université, Sorbonne Université, CNRS-INSU, Institut des Sciences de la Terre de Paris, ISTeP, F-95000 Cergy (benjamin.heudes@cyu.fr), [2]Department of Earth, Ocean and Ecological Sciences, University of Liverpool, Liverpool, United Kingdom

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1. Motivation

Scientific question:

How do oceanic basins initiate, segment and propagate in response to continental breakup dynamics ?

Objectives:

Constrain the segmentation of nascent oceanic basins before the establishment of continuous oceanic spreading and the development of reliable kinematic markers such as marine magnetic anomalies.

2. Case study: Central Atlantic Ocean (CAO) and its continental rifted margins

Fig. 1: Simplified structural map of the Central Atlantic domain

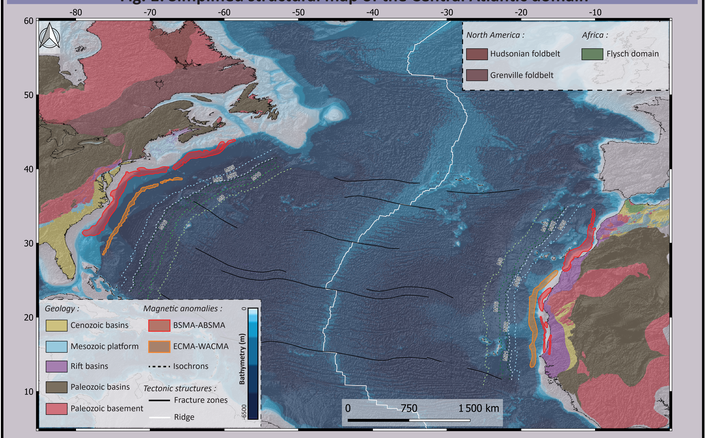


Fig. 2: Kinematic reconstruction of Pangea breakup

We focus on the earliest stage of Pangea breakup leading to the opening of the Central Atlantic Ocean (CAO) prior to its connection with the Panthalassa Ocean through the Western Tethys.

Central Atlantic Ocean (CAO):

- Debated timing of oceanic spreading onset (195 vs 175 Ma)
- Rift and oceanic basin segmentation and connectivity unresolved

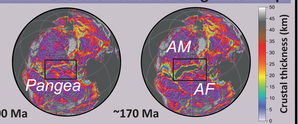
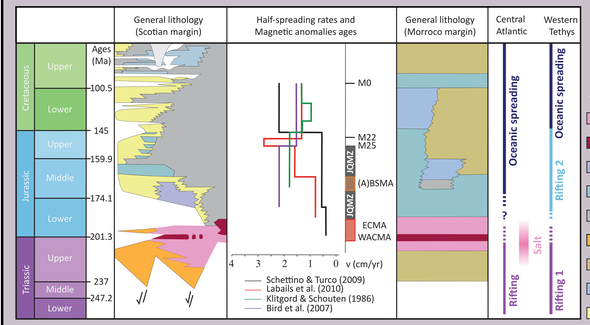


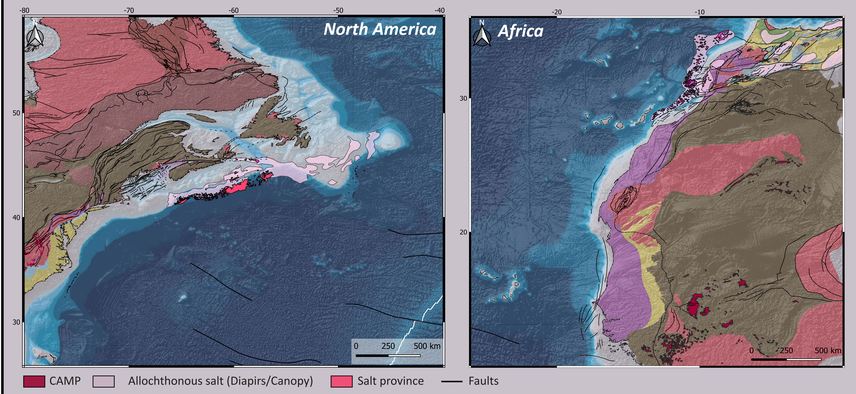
Fig. 3: Tectono-stratigraphic and kinematic framework



- Seafloor spreading onset occurs during the Jurassic Magmatic Quiet zone (JMQZ)
- Two Jurassic magnetic anomalies that may represent kinematic markers for early Atlantic reconstruction:
  - *(West African) East Coast Magnetic Anomaly:* ***WACMA/ECMA***
  - *(African) Blake Spur Magnetic Anomaly:* ***(A)BSMA***

3. Results

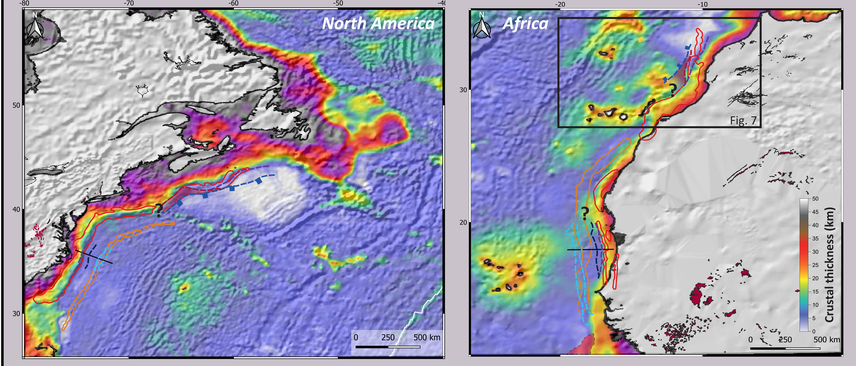
Fig. 4: Map of major rift structures and Upper Triassic salt basins distribution



Key observations.

- Thick salt basins occur in the northern part of the Central Atlantic (Nova Scotian and West Moroccan rifted margins) close to the connection with the Western Tethys.
- Only minor salt basins are identified in the southern part of the Central Atlantic (East American and Senegal-Mauritanian rifted margins).

Fig. 5: Crustal thickness map derived from gravity inversion (EMAG2 shaded relief)



Key observations.

- Variable nature of the ocean-continent-transition (OCT) along the Central Atlantic rifted margins.
- Variations in magmatic volumes emplaced during the initial phases of oceanic spreading in relation with the emplacement of (A)BSMA (East American and Senegal-Mauritanian rifted margins) and ECMA (Scotian rifted margin).

Fig. 6: Seismic profiles of northern segment of the Central Atlantic Ocean

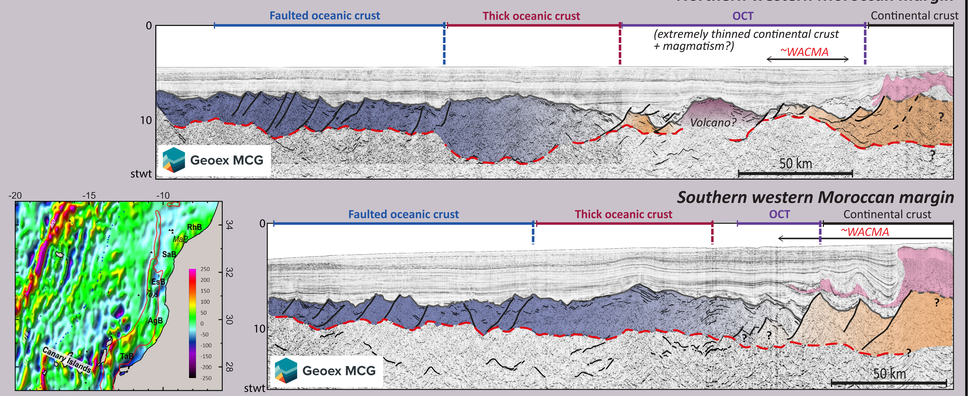
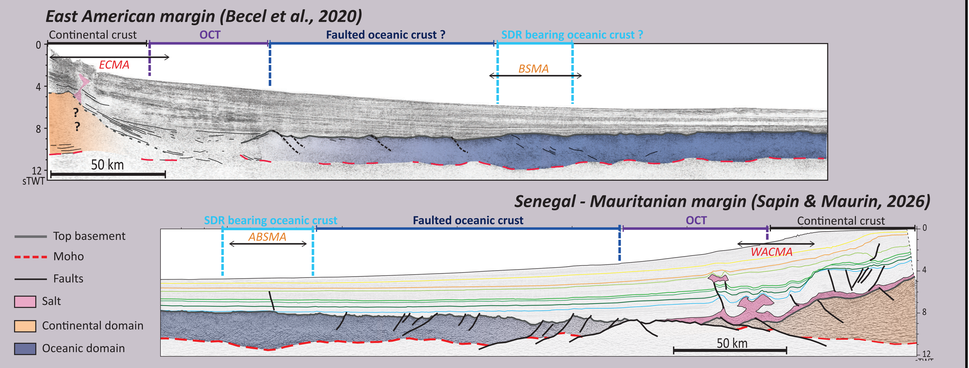


Fig. 7 Magnetic anomaly map (reduced to the pole)

Perspectives.

- We will compare our interpreted seismic Moho against the Moho derived from gravity inversion results with the aim of constraining oceanic crust thickness variations.

Fig. 8: Seismic profiles of southern segment of the Central Atlantic Ocean



Key observations.

- Different crustal domains are observed in the Jurassic oceanic crust (oceanic crust of variable thickness, roughness, and seismic facies as well as potential exhumed mantle domains).
- The nature of the crust is variable at the location of the ECMA/WACMA anomalies (SDR - Nova Scotia margin; Extremely thinned continental crust / OCT - Western Moroccan margin)

4. Perspectives

- Map and analyze the spatial distribution of the different Jurassic oceanic domains. The comparison between conjugate margins will assess symmetry versus asymmetry in Jurassic seafloor spreading.
- Re-evaluate the significance of ECMA, WACMA and (A)BSMA magnetic anomalies in relation with oceanic crust magmatic budget and their reliability as potential kinematic markers for plate reconstructions.
- Evaluate early oceanic basin segmentation and incorporate the results in a plate kinematic model.

5. References

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6. Acknowledgments

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Geoex MCG