

Tectonic control of the oil-rich large igneous-carbonate-salt province of the South Atlantic rift.

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Research paper

Tectonic control of the oil-rich large igneous-carbonate-salt province of the South Atlantic rift

Peter Szatmari ... Edison J. Milani

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Highlights

- South America's clockwise rotation controlled rifting, LIP, carbonates, and salt.
- Rotation opened the rift, compressed the Solimões Basin, and dislocated West Africa.
- Rotation controlled three long dike swarms transversal to the rift.
- Igneous activity created the endorheic basin and lasted until salt deposition.

â€¢ Supergiant oil fields occur where flood basalts and non-marine carbonates overlap.

Abstract

The Early Cretaceous South Atlantic Magmatic Province (SAMP), which includes the Parana-Etendeka LIP, produced about 8 million km³ of tholeiitic basalt and diabase over an area of 4 million km². Huge pre-salt oil reserves, discovered in 2007 by Petrobras in non-marine carbonates, are estimated at more than 45 billion barrels. Here we show the close causal relationship of the southward increasing width of the wedge-shaped South Atlantic rift with the similarly southward increase in igneous activity, in the thicknesses of non-marine carbonate and salt, and in the size of oil reserves, all controlled mainly by South America's early clockwise rotation away from Africa about a pole in its northeast. Large diabase dike swarms transversal to the rift witness to South America's rotation that opened in its wake the southward widening South Atlantic rift. Westward increasing pressure on the Equatorial margin by South America's clockwise rotation forced open the Benue trough and created pre-late-Aptian folds in the Demerara Plateau and in Brazil's Solimões (Upper Amazonas) basin. Prerift and synrift volcanic activity increases southward, culminating in the Parana-Etendeka LIP and in the offshore volcanic SDRSs that continue southward to the Cape Basin. Berriasian-Valanginian rift sediments deposited from about 145 Ma, 10 Ma before the flood basalts of the Parana-Etendeka LIP. The largest transversal dike swarm continued in the proto-Walvis Ridge that separated the central South Atlantic endorheic rift basin from the sea in the south; erosion and leaching of basalts supplied Ca, Mg, and SiO₂ to the endorheic basin for the deposition of non-marine carbonates and authigenic clays. Basalt flows intercalated with carbonates nearly until salt deposition about 113 Ma. Hypogenic leaching of carbonates by mantle-derived CO₂ created optimal reservoirs. Supergiant oil deposits occur where the widest endorheic basin and the volcanic province overlap.



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Keywords

South Atlantic rift · Large igneous provinces · Parana-Etendeka LIP · Diabase dike swarms ·

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