Abiogenic origin of giant oil fields on Brazil's South Atlantic margin

PETER SZATMARI

Petrobras Rio de Janeiro, Brazil; szatmariek@gmail.com

South America rifted from Africa in the Early Cretaceous by rotating clockwise about a pole in its NE tip. As a result, the central segment of the South Atlantic rift widened and deepened to the south: pre- and syn-rift tholeiitic basalt flows, rift sediments, overlying salt, and localized post-rift alkali basalts all increase southward to the Santos Basin [1] where giant pre-salt oil fields hold more than 45 billion barrels of oil. While geochemical data show good correlation of the oil with organic-rich shales in the rift, the large volumes of mantle-derived CO_2 that accompany the oil and contain noble gases with high $^3He/^4He$ ratio [2, 3] admit of an abiogenic origin. The following sequence of events may be considered: 1. Lacustrine microbiolites and travertines, intercalating with tholeiitic basalt flows, deposited in the wide southern part of the rift and sag basin. 2. Salt 2 km thick covered these carbonates as the rift lake opened up to the Central Atlantic. 3. CO_2-rich magma erupted in the Late Cretaceous as kimberlites on land and mostly as alkali basalts offshore. 4. Part of the CO_2 rising with water was reduced at high P-T by ferrous mantle peridotites to complex hydrocarbons [4, 5]. 5. Huge volumes of CO_2 and hydrocarbons passed through the thick rift sequence, adsorbing/desorbing and bursting through organic-rich shale beds and accumulating beneath the salt seal. 6. The CO_2 leached the pre-salt carbonates, vastly increasing their porosity and permeability. 7. Most of the CO_2 was removed from the carbonates by migrating pore water while the mostly abiogenic petroleum remained.

[1] Szatmari & Milani (2016) J. Marine Petroleum Geol.77, 567-596. [2] Santos Neto et al. (2012) AAPG ICE Long Beach, Calif., www.searchanddiscovery.com. [3] Rouchon et al. (2013) Goldschmidt Conference, Florence, Italy [4] Szatmari (1989) AAPG Bulletin 73, 989-998. [5] Kolesnikov et al. (2017) ChemistrySelect 2, 1336-1352.