Depositional environment of the South Atlantic rift basins: the onset of the seawater intrusion

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The evolution of the South Atlantic Ocean has attracted substantial attention owing, in part, to the potential for petroleum accumulations in the rift-associated basins now distributed along the margins. These rift basins were formed in two stages, namely the early rift and late rift phases. Theoretically, these two phases will have large differences in terms of basin development, topography, hydrology, regional climate and biology etc. The late rift phase was followed by seawater intrusion with concurrent massive salt deposition. In the South Atlantic rift basins, seawater intrusion has been rarely reported in “pre-salt” strata. However, this standpoint is being challenged progressively with evidence accumulating for seawater intrusion prior to the Aptian salt deposition. However, questions remain concerning when and where seawater intrusion commenced.

In this study, we used core and cutting samples from two wells, ONEZ-1 in Gabon Basin and Maculungo-1 in Kwanza Basin, to investigate the paleoenvironment of the South Atlantic rift basins during early rift and late rift stages and to test the hypothesis of “pre-salt” seawater intrusion into rift basins. Our results suggested that the early rift stage was characterized by an arid climate with a predominance of cyanobacterial primary production, water column stratification and a strong methane cycle. In contrast, the late rift stage was characterized by a more humid climate with intensive algal primary production, water column stratification with sulfide permeating the photic zone, consistent with strong seawater intrusion. Our findings have scientific and economic implications and provide evidence supporting the revision of the ubiquitous lacustrine deposition model for all “pre-salt” strata to account for the deposition of massive carbonates in these basins.