South Atlantic Margin Basin Analysis using a G3 Approach (Geophysical, Geological and Geochemical)

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Abstract

The continental margin basins of Brazil and West Africa share strongly similar tectono-stratigraphic units resulting from their late Jurassic/early Cretaceous proximity. Because of the paleogeographic ties between the South American and the African plates, the oil habitats of the marginal basins of both continents can often be correlated. The tectonic evolution and possible mechanistic causes have been discussed elsewhere (Lehner and De Riuter, 1977; Rabinowitz and La Brecque, 1979; Torquato and Cordani, 1981; Karner and Driscoll, 1997; and references therein). In general, five stages of continental margin basin development can be described (Horn, 1980): the pre-rift intracratonic stage; the continental rift stage; the evaporite stage; the post-evaporite transgressive stage; and the post-evaporite regressive stage.

The Brazilian continental margin extends over eight thousand kilometers from 5° north latitude to 35° south latitude. The corresponding West African basins are located between the Walvis Ridge and the Guinea Rise. Excepting the Niger Delta, most of the substantial oil production established along these margins has been generated from lacustrine sediments deposited during the rifting (Neocomian) of Africa and South America (Brice, *et al*., 1980, Mello, *et al*., 1988a and b; Burwood, 1997; and references therein). Subsequent opening and invasion of marine seas in a restricted basinal setting allowed for deposition of a thick Aptian salt. Post-salt sediments with liquid hydrocarbon source potential (key to the recent Oligo-Miocene deepwater reservoirs of the Congo Fan) were laid down in shallow marine and fluvio-deltaic environments as spreading continued into the Late Cretaceous (Mello, *et al*., 1988a and b; Teisserence and Villemin, 1990; Sofer, 1993; Burwood, 1997; Katz, *et al*., 1997; and references therein).

The purpose of this investigation is to analyze the South Atlantic Margin basins combining geological, geophysical and geochemical data. Geophysical data include bathymetry, gravity and magnetics attribute data and seismic profiles. Geological data include a GIS features database, surface geology and summaries built from the literature. Initial efforts (Dickson, *et al*., 1998 and in press; and references therein) used plate reconstructions to illustrate the relationship through time of the Brazilian and African basin equivalents and to define the continental-oceanic crust boundary (COB) along both margins. Subsequent work (Dickson *et al*., 2000) indicates strong correlations between reservoir fairways and gravity signatures, inter-raft sediment pathways and depo-centers in the Congo and Kwanza Basins, Angola, and basement control on fans and bypass zones in the Campos and Santos Basins, Brazil. Recently, correlations have been demonstrated between source basins and their extents that can be extrapolated on potential field attribute images (Fryklund, *et al*., 2000). Geochemical data include oil chemistries based on an evaluation of samples representing basins along either side of the

margin plus supplementary data obtained from surface geochemical techniques and basin modeling.

This approach of jointly interpreting complementary data sets can be used to examine the development and present structural and stratigraphic configuration of the Brazilian and West African basins.