HGS International Dinner Meeting

This abstract, though not received in time for inclusion in the February issue of the HGS Bulletin, *is published here in the March* Bulletin *as a service to our membership. The actual presentation was made Monday, February 13, 2012.*

PSDM Imaging of the Petroleum Systems of the South Atlantic

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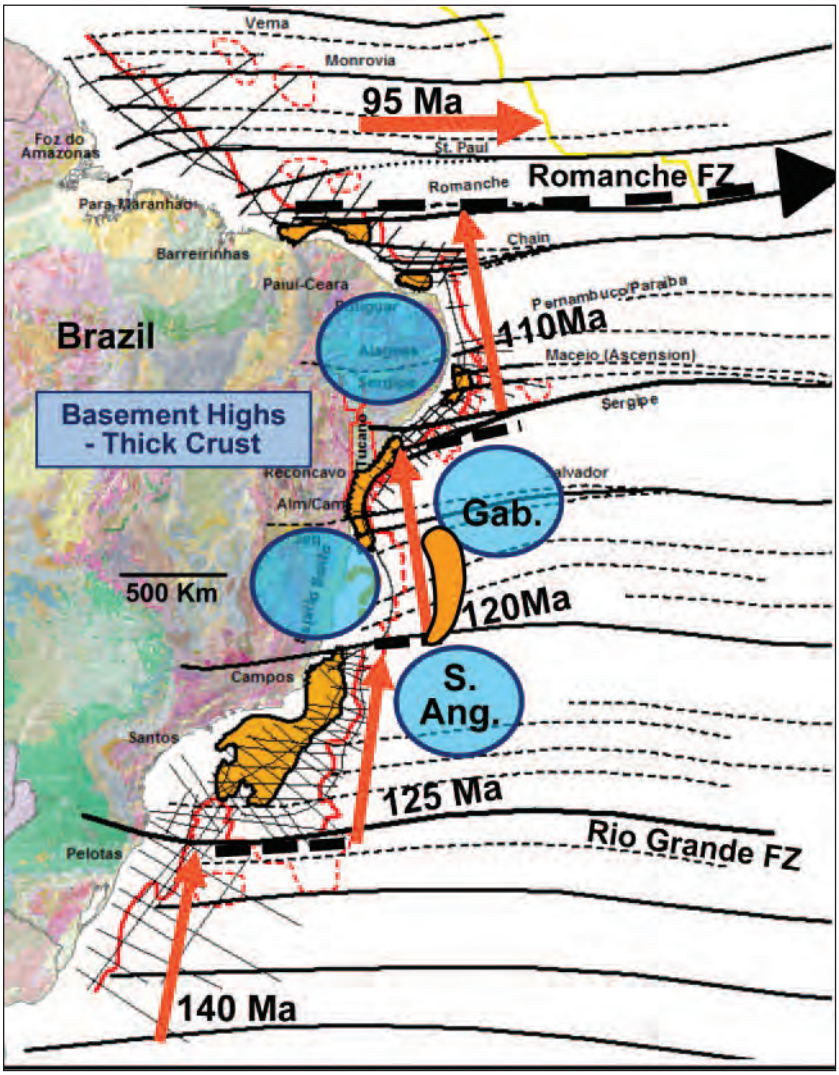

Figure 1. Areas of thicker continental crust are in the blue circles and sedimentary sag basins with Valanginian-aged sediments are shown by the orange polygons. The offshore Angola sag basin is shown between the Gabon and S. Angolan cratons and have been restored to their pre-drift positions. The progressive opening of the South Atlantic is shown here as a series of extensional (red) and strike slip (black dashed) segments. The estimated oldest age of the oceanic crust within each segment is shown, as well as the major (solid black) and lesser (dashed) oceanic fracture zones (FZ). The oldest sediments on oceanic crust north of the Romanche FZ are Turonian, providing the age for Early Drift.

Recently acquired (2004 through 2010) regional (100s km, dip-oriented), long offset (10 km), long record length (18 sec.) reflection seismic data (SPANs) have been processed to provide pre-stacked depth migrated (PSDM) images (25-40 km) on both sides of the South Atlantic and along the South American equatorial margin. 63 dip-oriented lines from Angola, Congo, and Gabon and 69 Brazil profiles have been interpreted, with about 20 sequence boundaries correlated and tied to 25 wells in West Africa and more than 75 wells in Brazil. The spacing of the dip line ranges from 10 to ~75 km (avg. ~50 km). 1500-5000 km long strike lines on both margins have an average spacing of about 50-100 km. These constrain and correlate the major sequence boundaries mapped on the dip lines. These data have helped understand the existing producing petroleum systems, extend these systems across the South Atlantic, and identify new potential petroleum systems.

In this presentation we will show seismic data that illustrate the pre-salt petroleum system in the Brazilian Santos Basin and the 2011 pre-salt discovery on the conjugate margin in the Angolan Kwanza Basin. Analogs will be shown along the Brazilian equatorial margin for the equatorial African Jubilee in Sierra Leone and Venus in Ghana discoveries in the Early Drift sequences along with a recent Early Drift discovery along the northeastern coast of Brazil. These petroleum systems and their relative timing will be put into context using a new model for the opening of the South Atlantic (Figure 1). In this model the northward opening consists of a series of stalled extensions with the separation of the cratons taken up in continental strike slip faulting. This

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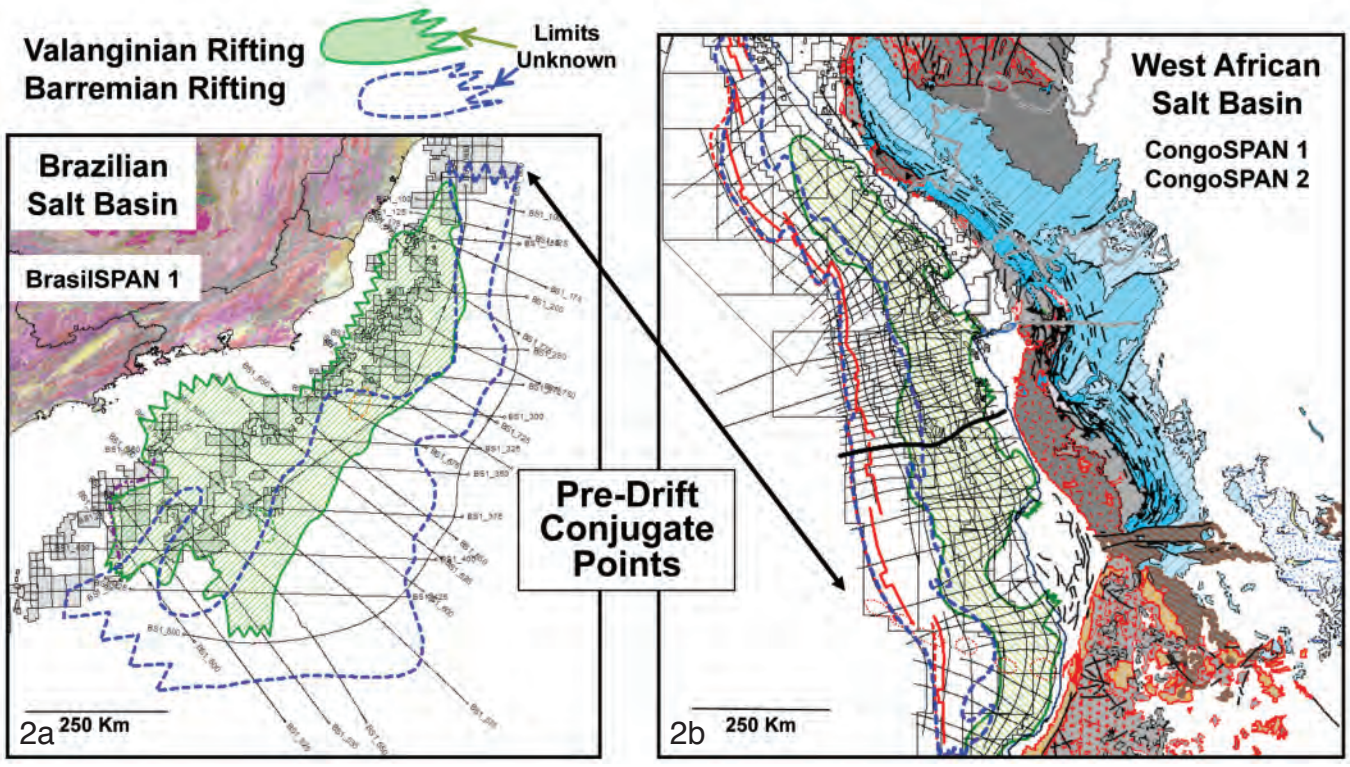

Figure 2. Regional mapping in the pre-salt of South Atlantic salt basins has identified two distinct periods of rifting. A failed rift in the Valanginian thinned the crust, with sag basins (green) formed that contain rich source rocks, the Lagoa Feia in Brazil and Organic Bucomazi / Falcao in Angola. The successful rift that separated the continents and generated oceanic crust was initiated in the Barremian (blue dashed) along this segment (Fig. 2a). The Angolan sag basin (Fig. 2b) is north of the Brazilian sag basin as indicated by the black reconstruction arrow. The Barremian rifting breaks back into the Valanginian sag basin, and places these sediments into a the pre-rift setting during the Barremian.

model is supported by mapping the age of the first sediments deposited on the newly-formed oceanic crust.

Remarkably similar features and the timing of their development are observed on both the West African and South American margins (Figure 2). Regional mapping of the major features in West Africa at 300 x 2000 km and in Brazil at 600 x 3000 km has been critical for understanding tectono-stratigraphic relationships and has been used to define a model of diachronous rifting. In this model, failed episodes of rifting with no formation of oceanic crust developed during periods of extension and subsidence; with sag basins forming over the thinned crust. Shown in Figure 2 is the mapped position of sag basins (green) formed over the failed Valanginian rift. These sag basins, which only overlie failed rifts, contain rich and laterally extensive source rocks such as Lagoa Feia in Brazil and the Organic Bucomazi / Falcao in Angola; these drive the petroleum system responsible for the pre-salt discoveries. The successful episode of rifting, which separated the continents along this segment of the South Atlantic, was in the Barremian (blue dashed line), and the syn-rift fill for this episode is volcanic with less potential for source rock development.

This regional PSDM data is also ideal for examination of the Early Drift sequences and search for new petroleum systems such as those identified along the African equatorial margin. As the continents separate, especially along the transform / strike slip segments, the first basins to develop have restricted circulation and therefore have potential for developing source rocks. Recent discoveries along the Brazilian equatorial and northeastern margins illustrate the value of conjugate margins reconstruction and identification of the timing of their openings. ■

Biographical Sketch

Steven G. Henry, Ph.D., has interpreted pre-stacked, depth-migrated (PSDM) seismic data for ION-GX Technology for the past eight years. During that time he has interpreted over 100,000 km of SPAN data in West and East Africa, Brazil, India, and the Seychelles to better understand continental rifting, basin formation, and the petroleum potential of the offshore deepwater continental margins. Mr. Henry left Houston five years ago, and now lives and works in the southern Rio Grande Rift in Las Cruces, New Mexico. His additional interests include providing training to national oil companies and ministries through the Rift Institute For Teaching and Training (RIFTT) in Las Cruces, where seismic interpretations can be compared to actual outcrops.