The Angle of the North

Shallow water oil is hidden in plain sight in North Gabon.

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The 5,500 km² of open acreage in shallow water off North Gabon sits adjacent to the site of one of the biggest discoveries in the world in 2014 – ENI’s Nyonie-Deep discovery. One might expect that such a discovery would have made the surrounding acreage incredibly highly sought-after. Actually this area now suffers from one more drawback – the Nyonie-Deep discovery.

The issue at first glance is that Nyonie-Deep discovered gas in pre-salt syn-rift Dentale formation sandstone (locally called Coniquet Sandstone) that has low permeability. Gas in itself is not the hydrocarbon of choice in Gabon, which is at an early stage in its development of a gas export system, and the meme has grown from this discovery that the pre-salt of North Gabon is tight and gas prone. Nyonie redeems itself commercially by being a very large accumulation, estimated to bear opens the probability that this unexplored area is ready to yield major surprises in the next wave of exploration.

Exploration Plays in North Gabon

As the figure below shows, traditionally two apparently separate systems are considered in North Gabon: a pre-salt syn-rift system with the lacustrine Melania and Kissenda source rocks, charging syn-rift Dentale fluvo-deltaic sands; and post-rift transgressive Gamba sandstone formation. An additional source rock, the restricted marine Vembo shale, is ubiquitously encountered sitting above the transgressive Gamba sandstone. Above the salt lie a number of deltaic clastic reservoirs such as the Ewongue, Anguille, and Cap-Lopez Formations, in drapes, turtle structures and stratigraphic traps generated by salt topography.

What is very clear on seismic is that the distribution of salt is very heterogeneous across the area. In the east it is very thin, or restricted to vertical diapirs, representing a salt body that has been mobilized by sediment loading, reactive fall withdrawal and gravity sliding, creating a clastic- and to the east carbonate-) rich section. To the west, however, the salt is still present in extraordinary amounts as complex salt walls, domes, canopies and diapirs. As we shall see, this heterogeneous distribution is crucial for exploration.

Reservoir Complexities

Although the number of penetrations of the pre-salt is a fraction of that in South Gabon, there is enough core data to show that porosities in the pre-salt of North Gabon range from 5–20%, and permeabilities from 1–700 MD. This range is similar to that in South Gabon, although based on far fewer penetrations. There may also be some sampling bias, as the Nyonie poroperm is relatively poor, reflecting a different style of structure drilled so far in the north compared to South Gabon. In the south the prolific Gamba is the main target due to the complexities of imaging plays even with early 3D coverage. Available data on pre-salt geothermal gradients show that the pre-salt to surface gradient can be as low as 22°C/km in the west adjacent to thick salt. Whilst this suggests the maturity of post-salt source rocks, it will retard the maturity of the syn-rift Melania and Kissenda source rocks, leaving them in the oil window.

Exploration Potential

Exploration of the pre-salt of North Gabon west of Nyonie has barely started, yet from the few penetrations to date we see good evidence for a working oil syn-rift system and are confident that good quality reservoir can be predicted in significant little eroded fault blocks and overlying units. The increase in presence and thickness of salt to the west has reduced the geothermal gradient locally to keep the Melania and Kissenda source rocks in the oil window.

Further west, into the salt domain, the post-salt sequences are very thick and complex and have not been fully explored due to the complexities of imaging plays even with early 3D data. The pre-salt systems may be working even the post-salt provides attractive targets as the post-salt source rocks are likely to be generative.

Spectrum’s exploration angle is the driving force that will lead it to acquire 3D in North Gabon in the next few months. This new coverage with long streamers designed to image the pre-salt will unlock the potential of this overlooked play system. The future for exploration in North Gabon is bright and offers the promise of shallow water oil of a resource magnitude that is hard to find anywhere in West Africa.