Syn-Rift and Post-Rift Petroleum Systems in the North Falkland Basin

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ABSTRACT

The North Falkland Basin lies to the north of the Falkland Islands beneath 150 m to 2,000 m of water. This N-S striking basin is approximately 250 km long and 30-50 km wide. It comprises a complex system of offset depocentres that follow two structural trends (N-S & NW-SE), which are the result of two phases of rifting. The first phase of rifting probably ceased in the Jurassic and reactivated NW-SE structures. The second and main phase of rifting initiated in the Late Jurassic or Early Cretaceous, associated with the opening of the South Atlantic. This rifting phase was followed by a thermal sag phase, which began in the Berriasian-Valanginian and continued under predominantly continental-lacustrine conditions until Albian-Cenomanian times, when the basin began to develop increasingly marine conditions. Initial exploration in 1998, targeted late post-rift sands draped over structural highs in the central parts of the main depocentre. Although they encountered reservoir sands, these intervals were undercharged. This campaign provided key insights into the stratigraphy of the basin fill, but also identified two source rock intervals, in the syn-rift and post-rift successions. The syn-rift is expected to be gas-prone, due to kerogen type and burial depth. This interval is composed of dominantly woody kerogen complexes, typical of fluvial and fluvio-lacustrine environments in developing rifts. The post-rift interval is a fully lacustrine, oil-prone source rock with an average TOC of 7.5%. This source is mature for oil generation below 2800 m MDBRT, and potentially generated up to 60MMMbbls of oil since reaching thermal maturation. The post-rift petroleum system has a relatively simple set of migration pathways, as the source rock underlies, inter-fingers with and overlies basin margin sand-rich fan systems (such as the prolific Sea Lion discovery), acting as a source and seal. Conversely, the deeper syn-rift source requires migration along deep-seated normal faults that extend from shallow reservoir intervals, through to the deeper early-late syn-rift succession. There is now a significant amount of information regarding the post-rift petroleum system. This paper will highlight our understanding of the syn-rift petroleum system, as well as its spatial distribution. This is particularly significant, as the syn-rift source rocks may be a viable source on the shallower fringes of the basin where the post-rift source rocks are modelled to be above the oil window.