

Ulleung Basin, Offshore South Korea: A New Province for Deep-Water Stratigraphic Traps

Vitor Abreu ACT-Geo LLC*

Brandon Harper ACT-Geo LLC

Jungsam Kim Korea National Oil Corporation

Woong Mo Koo Korea National Oil Corporation

ABSTRACT

Deep-water stratigraphic traps are hydrocarbon plays with strong stratigraphic controls on trap/seal that occur along tectonically over-steepened extensional margins. They have received renewed attention with the 2007 Jubilee (Ghana) and 2015 Liza (Guyana) discoveries along the Atlantic Transform Margin. However, this is not a new play concept (e.g., Marlim Field, Brazil – 1985).

Successful deep-water stratigraphic plays have predictable genetic elements that are useful in identifying, characterizing, risking, and ranking such opportunities. Significant post-rift DW Strat Plays develop in regions of:

- High-gradient continental margin slopes
- Significant post-rift sedimentation for maturation
- “New” offshore marine source rock
- “First-order” lowstand reservoirs
- Close age between source and reservoir
- Trap configuration defined by the disconnection of the deep-water sandy fairway from the slope to the basin.

The Ulleung Basin, located in the southwest of the East Sea, was one of the three back-arc opening centers in the East Sea along with the Japan and Yamato basins (Yoon and Chough, 1995). On the southern margin of the basin, over 10 km thick sedimentary successions preserve superimposed stratigraphic records of subsidence/uplift and structural deformations in association with the back-arc opening and subsequent tectonic inversions throughout the Miocene and post-Miocene periods.

This basin evolved from rifting to a classic shelf-slope-basin configuration, with a relatively narrow, sand-rich shelf, a mud-rich and steep slope and a bow-like, almost structureless basin center showing an intercalation of mud-prone (MTC's and mud drapes) and sand-prone (channels and lobes) seismic facies.

These observations are key to predict the potential existence of a deep-water stratigraphic play, in which relative falls in sea level could erode the sandy shelf and be carried as turbidites to deep water through canyons and deposited from the end of the canyons to the basin center and margins, mostly by-passing the slope canyons.

In fact, sand-rich, thick turbidites were encountered and cored in 3 deep water wells drilled in the first exploration phase of the Ulleung deep basin. These wells also proved a new petroleum system in the basin marked by marine source rocks with different degrees of continental influence.

Stratigraphic traps were not the target for this first phase of exploration, but the potential for this play was highlighted and pursued in the second phase. Results of this exploration effort will be presented, with a series of prospects mapped, risked and ranked, based on a rich data set including 3D and 2D volumes, wells and cores, as well as Vshale and AVO volumes.