Volcanic Reservoirs in Rift Basins of Onshore China – A Growing Play

Andrew Racey[1]

[1]ARG Ltd, Bordon, Hampshire, United Kingdom.

ABSTRACT

Volcanic rocks in Chinas' onshore basins cover around 2.1 million square kilometres with "potential" volcanic reservoirs occupying 20% of this area. Several of these basins (Junggar, Tarim, Songliao and Bohai) are classified as deep in having a total fill of between 4500 and 6000 m. In eastern China they comprise Late Jurassic to Palaeogene intermediate to acidic volcanic rocks dominated by Early Cretaceous rhyolitic rocks and Palaeogene basalts erupted during Circum-Pacific rifting and include the Songliao, Bohai, Erlian, Hailaer, Zhangwu, Jianghan, Sanshui and Subei basins. In the west Lower Permian – Carboniferous intermediate (andesitic) to basic volcanics (basaltic) related to intracontinental rifting and island arc activity in the palaeo-Asian ocean dominate and include the Junggar, Santanghu, Sichuan, Yin E, Tuha and Tarim basins. Proven hydrocarbon bearing reservoirs occur close to mature lacustrine source rocks in the eastern basinswhilst in the western basin the source rock is marine and longer distance migration is required. In both areas seals are provided by either interbedded or overlying tight volcanics or mudstones. China has a long history of hydrocarbon exploration in volcanic rocks with >40 fields discovered across some 14 basins/sub-basins. The first volcanic discovery was made by accident in the Carboniferous of the Junggar Basin in 1957 with further small discoveries made in the 1970s' and 1980s' including discoveries in Cenozoic volcanics in the Bohai Basin. It was not until 1990 - 2004 that volcanic rocks became important exploration targets with a number of significant discoveries in the Subei, Erlian, Jianghan, Sichuan and Songliao basins. From 2005 onwards they became primary exploration targets with major gas discoveries in the Songliao Basin.Hydrocarbons are recovered from a broad range of depths (1000 to 5000 m) with the deepest well to date being to 7000 m.The volcanic rocks retain significant porosity at depth due to their greater mechanical strength under compaction and consequently they represent an additional deep exploration target even in areas where significant resources have been found at shallower levels. The total resource potential for Chinas volcanic rocks is estimated at 1.9 to 2.6 BBbbls of liquids and around 148 Tcf of gas onshore with a proven resource of 365 MMbbls of oil and 14 Tcf of gas discovered by 2014.