

Role of Tectonic Inversion in the Structural Evolution and Petroleum Prospectivity Along the Northern Margin of the Southern Permian Basin

John R. Underhill¹

¹Institute of Petroleum Engineering, Heriot-Watt University, Edinburgh, Midlothian, United Kingdom.

ABSTRACT

The Southern Permian Basin (SPB) is a major, Late Permian-age, W-E striking intra-continental basin that stretches from the east coast of the UK, across the Southern North Sea (SNS) to onshore Poland. It is defined to the north by the Mid North Sea High (MNSH), which separates it from its North Permian Basin counterpart, and the Anglo-Brabant Massif to the south. The basin hosts a major petroleum province in which gas, sourced from the underlying Upper Carboniferous, resides in Carboniferous, Permian and Triassic clastic reservoirs. The most significant reserves occur on the southern side of the basin, where prospectivity is dominated by structural traps largely created during post-depositional structural inversion of normal fault precursors. The traps contain aeolian and fluvial sandstones belonging to the Permian Lemn Sandstone Formation (LSF). The LSF reservoir was classically thought to shale out to the north into an area termed the Silverpit Basin where it was replaced by the Silverpit Claystone Formation. Disappointing early exploration results on the northern margin of the SPB at Rotliegend level and limited successes in the underlying Carboniferous instead, led to the perception that the area was devoid of the LSF reservoir fairway and discouraged further exploration along the southern side of the MNSH. It was only after successful drilling in 2008 of the large Cygnus structure which was found to contain gas in both Carboniferous and LSF reservoirs, that exploration interest was reignited in the area. The aim of this paper is to outline how a new understanding of the tectonic evolution of the Southern Permian Basin contributes to the description of a hitherto neglected LSF play fairway in the Southern North Sea Basin. We focus in particular on the role that reactivation of NW-SE and WNW-ESE striking precursor faults had in not only controlling the structural styles, reservoir thickness and facies distribution but also the internal compartmentalisation of the field. Integration of the structure and sedimentology suggest that the play fairway is likely to extend along strike and that further prospectivity exists along strike in both UK and Dutch offshore waters.