SUCCESS IN EXPLORING FOR RELIABLE, ROBUST PALEOCENE TRAPS WEST OF SHETLAND

Nick Loizou[1] and Ian Andrews[2]

[1]Department of Energy & Climate Change, London, SW1A 2AW, UK

[2]British Geological Survey, Murchison House, West Mains Road, Edinburgh EH9 3LA, UK

Following the discovery of Foinaven and Schiehallion Fields in the early 1990's, exploration success in Paleocene targets outside the Quadrant 204 area of the Faroe-Shetland Basin was initially rather limited. However, of the 13 Paleocene exploration wells drilled during the last seven years, 11 have encountered notable hydrocarbons.

Since 1972, 146 exploration wells have been drilled west of Shetland with 79 (54%) positioned on Paleocene prospects that resulted in twenty-six discoveries. Analysis of the 53 failed Paleocene wells shows that around 80% were mainly drilled on either a poor or invalid trap, with the remaining 20% failing mainly due to either lack of or no reservoir presence or poor top seal. Intriguingly, only 4 out of the 79 Paleocene wells appear to have been positioned on a Paleocene 'structural high', but all of these encountered hydrocarbons and are all located along the Corona Ridge.

Fifty-five Paleocene prospects contained a significant stratigraphic component, with 17 notable successes that are mainly located close to or at the basin margin and within the Upper Paleocene Vaila sequence. Ten key discoveries are located in the Foinaven Sub-basin (Foinaven, SE Foinaven, SW Foinaven, Schiehallion, Loyal, Alligin, Cuillin, Arkle, Amos and Tornado). A further five are located in the Flett Sub-basin (Laggan, Tormore, Torridon, Glenlivet and Laxford). The Flett Sub-basin discoveries are all situated immediately west of the Flett Ridge. Most of these discoveries have a north-westerly structural dip, and are sealed up-dip by an E-W or NE-SW fault in combination with stratigraphic pinch-out of the Vaila Sandstones.

Forty-five of the wells were positioned on an amplitude or AVO anomaly, of which 15 encountered notable hydrocarbons. Following post-mortem studies, the majority of the 30 wells that failed to find hydrocarbons could be shown to have drilled poorly defined amplitude anomalies (various lithologies including igneous), AVO artefacts, and spurious DHIs (which include multiples). What became a geophysically-led exploration emphasis often lost sight of geology, and it is evident from this analysis that the seismic-driven exploration risk reduction was not a silver bullet solution.

A number of the Paleocene wells were drilled between 1994 and 2003 on what the operator regarded as a Class III AVO anomaly (hydrocarbon bearing), but some of these failed. Wells 204/17-1 and 204/18-1 are good examples of poorly interpreted AVO responses in which high amplitudes are mainly present on the near (low offset) and there is significantly decreased amplitude on the high (far offsets). AVO and various attribute analyses carried out on these two wells show that these features are in effect Class I AVO anomalies that are not normally associated with hydrocarbons.

For a large number of the failed wells that were positioned on inferred AVO or high-amplitude features, the operating companies interpreted these as coinciding with the termination or up-dip limit/pinch-out edge of a sandstone interval. Furthermore, work carried out on these features implied that a hydrocarbon accumulation was present. For most of the failed cases, the cause of the AVO or high amplitude features was misinterpreted or poorly evaluated with respect to the data available at the time.

Interestingly, in recent years almost all of the wells positioned on Paleocene AVO anomalies have been successful in encountering hydrocarbons. Moreover, these wells show a clear increase in amplitude with offset. Undoubtedly, the recent triumph firmly demonstrates the remaining potential for a high Paleocene exploration success rate west of Shetland.

Without doubt, the evaluation of proven examples of successful traps like Foinaven, Schiehallion, Laggan, Tormore, Glenlivet and other analogues can add value to successful future exploration. However, to maintain the recent success and improve the future exploration success rate, there is a need for a fundamental awareness and understanding of the key ingredients that constitute a successful trap. Utilising high quality 3D seismic data together with other appropriate data, robust Paleocene traps can be successfully mapped with a high degree of confidence.

Location of Paleocene exploration wells west of Shetland