Chalk renaissance

Introduction and review

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The chalk remains the miracle reservoir of the North Sea. It is hard to improve upon the comment by Campbell & Ormaasen (1987), when writing about the chalk in the context of reviewing the history of oil and gas exploration in Norway, that: 'it was regarded as a singularly unpromising reservoir for hydrocarbons, being deficient in porosity and permeability . . .'.

As noted by **Mackertich & Goulding**, the first oil discovery in the North Sea was the A1 well drilled in the Danish sector, and this found oil in a Danian chalk reservoir. Careful reservoir management has resulted in much greater recovery of the oil and gas contained in the chalk traps than was envisaged at the time of development. **Bramwell *et al.*** noted that the Greater Ekofisk area alone has produced more than 2×10^9 BBL of oil and 8.9×10^{12} SCF of gas.

The last few years have seen renewed exploration for chalk targets and this has been driven by:

(i) continued success in production;
(ii) improved seismic imaging from greater use of 3D seismic;
(iii) greater use of advanced seismic techniques – seismic attributes, seismic inversion, amplitude versus offset and rock physics;
(iv) more detailed stratigraphical analysis using sequence stratigraphy and improved biostratigraphy;
(v) extending the chalk play fairway into new areas.

The first two papers in the section detail the search for stratigraphic traps in the chalk in the Ekofisk area. **Bramwell *et al.*** document how the use of 3D seismic data combined with a major well based sequence stratigraphic study led to the identification of a number of potential stratigraphic traps in the chalk. The following paper by **Anderson** details the geophysical techniques used to attempt to predict porosity and fluid fill in such a stratigraphic trap, that was later drilled. This case history demonstrates that high porosity zones can be identified with a good degreee of confidence, but that differentiating between brine filled and oil filled chalk remains a problem.

The following paper by **Farmer & Barkved** on the Valhall and Hod fields, again documents how the combination of sequence stratigraphy, 3D seismic data and advanced geophysical techniques has been used to construct a revised geological model that identifies significant syn-depositional faulting, with associated resedimentation of chalk on the down-flank areas of the growing structures. This in turn has led to the identification of potential stratigraphic traps on the flanks of the field.

The paper by **Mackertich & Goulding**, on the South Arne Field in the Danish sector, highlights the difficulty in imaging caused by gas escape. This field, although discovered in 1969, was only shown to be commercial in 1995 following the drilling of an appraisal well into the gas cloud, proving thick pay in a crestal position.

The final paper by **Evans *et al.***, discusses the Banff Field, an accumulation that lies toward the western edge of the Central Graben in the UK sector, some 100 km to the west of the main chalk province. This field, discovered in 1991, again demonstrates the remarkable ability of the chalk to form surprising traps. A detached chalk raft sitting on the flank of a salt dome, dipping at more than 45°, displays an oil column of more than 1000 m (3300 ft).

Looking forward, we can expect more wells to test stratigraphic traps in the chalk and a reappraisal of the chalk potential throughout the Central Graben rather than just in the immediate area of the prolific Norwegian and Danish fields. Advances can also be expected in seismic imaging, particularly from increased use of ocean bottom cables in areas where gas clouds exist as a result of hydrocarbon leakage from chalk reservoirs. In the absence of gas clouds, porosity in chalk is relatively easy to detect from seismic data, but what is not easy to determine is whether the porosity is filled with hydrocarbons or water. It can also be anticipated that production technology will continue to advance, with greater use of complex well paths to drain lower permeability rservoirs,. The success in production will continue to act as a stimulus for further exploration activity.

Reference

CAMPBELL, C. J. & ORMAASEN, E. 1987. The discovery of oil and gas in Norway: an historical synopsis. *In*: SPENCER, A. M. *et al.* (eds) *Geology of the Norwegian Oil and Gas Fields*. Graham & Trotman, London, 1–37.

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