High pressure/high temperature plays

Introduction and review

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A substantial amount of costly high pressure/high temperature (HP/HT) exploration and appraisal drilling in the Central Graben was represented by four papers in this theme. HP/HT conditions are defined as greater than 10000 psi and/or more than 300°F. For the exploration geologist, the HP/HT play represents an involved geological challenge:

1. prediction of trap integrity, based on understanding of structural geology, seal strength, formation pressure evolution and hydrocarbon type;
2. prediction of reservoir quality based on sequence stratigraphy, and diagenetic evolution (linked back to trap integrity); and
3. interpretation of deep seismic data with frequently difficult multiple problems due to velocity inversion below the Chalk, and complex salt related structures.

For the development geologist further challenges include:

1. the need to guarantee very high flow rates to sustain the high drilling costs;
2. the difficulty in planning and drilling wells due to the small margins between formation pressures and shoe strengths, particularly at the crest of the fields; and
3. production technological problems with the highly saline brines and condensates, as well as the hostile environment for tools and tubulars.

A theme of all the papers is the absolute necessity for a multi-disciplinary approach to such problems with early identification of critical risks. The competitor in the HP/HT play is mostly Mother Earth!

This is most clearly brought out in the paper by Pooler & Amory on the ETAP development, which although it includes just two fields which are strictly HP/HT (the Shell/Esso Heron and Skua fields), highlights the variety of critical risks found in the Central Graben and how they had to be cooperatively attacked to enable the development of the smaller fields. The project would appear to indicate the way forward in the North Sea, with pooling of resources both technical and financial for the benefit of all partners in the ETAP group. Somewhat more straight-forward developments at Elgin, Franklin and Shearwater are described by Lasocki et al. and Blehaut et al. respectively. Both papers deal with the projects as a whole rather than solely the sub-surface aspects. The sub-surface is however highlighted by Helgesen who presents an interesting and appealing structural model for the post salt sequence based on the interaction of grounded post-salt (Triassic and Jurassic) blocks with the pre-salt structures. The precise structure depending on the fulcrum where grounding first occurred. This model explicitly disconnects faults in the Mesozoic section from the basement faults, and thus helps explain why lineament-type analyses of the fault patterns of the Central Graben tend to be unconvincing, or at least very involved.

It is clear from these four papers that while great strides have been made in the last 5 years, particularly with the planning of the first developments, the challenges presented by this play are still very great.