Sedimentology and Sequence Stratigraphy of the Hugin Formation, Quadrant 15, Norwegian Sector, South Viking Graben

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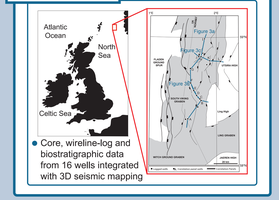
1. Introduction and Background

1a. Study Aims

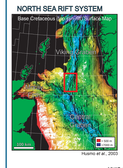
- To investigate sedimentologic character and facies distribution within the transgressive, shallow-marine Hugin Formation
- To investigate the controls on this facies distribution, in particular the impact of syn-depositional rift-related faulting and halokinesis, and the associated localised uplift and subsidence
- To investigate timing of structural development within the South Viking Graben of the Northern North Sea
- To provide a robust tectono-stratigraphic understanding of reservoir distribution and reservoir quality in the Middle Jurassic Play of the South Viking Graben, which will aid future exploration in the region

1b. Study Area

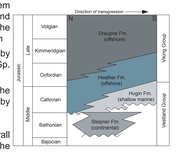


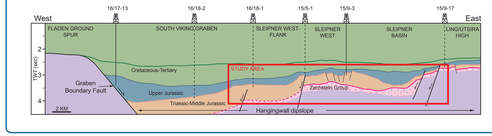
- Core, wireline-log and biostratigraphic data from 16 wells integrated with 3D seismic mapping

1c. Geological Setting



- The Jurassic North Sea trilete rift system comprises the Viking Graben, Moray Firth and Central Graben rift arms. The study area lies on the hangingwall dipslope of the South Viking Graben
- Basin geometry is structurally complicated by rift-related normal faulting and Zechstein Gp. halokinesis
- Shallow-marine Hugin Fm. lies above the continental Sleipner Fm., and is overlain by offshore shales of the Heather Fm.
- Hugin Fm. was deposited during an overall transgression that saw diachronous flooding of the South Viking Graben from the north



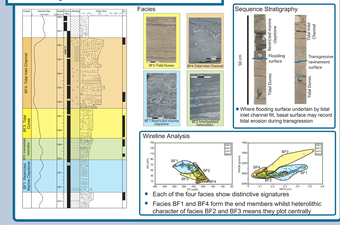


2. Facies Analysis

2a. Database

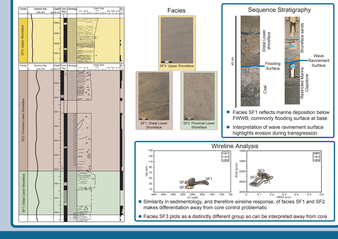
- Detailed sedimentological and ichnological analysis undertaken on almost 600m of core from 16 wells
- Fifteen facies have been recognised which can be grouped into six facies associations: Bay-fill; Shoreface; Mouth Bar; Fluvio-Tidal Channel; Coastal Plain (all discussed below); and Open Marine

2b. Bay-Fill Facies Association



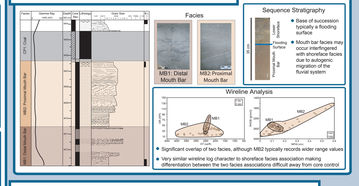
- Each of the four facies show distinctive signatures
- Facies BF1 and BF4 form the end members whilst heterolithic character of facies BF2 and BF3 means they plot centrally
- Where flooding surface underlain by tidal inlet channel fill, basal surface may record tidal erosion during transgression

2c. Shoreface Facies Association



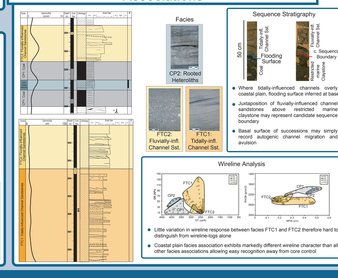
- Facies SF1 reflects marine deposition below FWWB, commonly flooding surface at base
- Interpretation of wave ravinement surface highlights erosion during transgression
- Similarity in sedimentology, and therefore wireline response, of facies SF1 and SF2 makes differentiation away from core control problematic
- Facies SF3 plots as a distinctly different group so can be interpreted away from core

2d. Mouth Bar Facies Association



- Significant overlap of two facies, although MB2 typically records wider range values
- Very similar wireline log character to shoreface facies association making differentiation between the two facies associations difficult away from core control

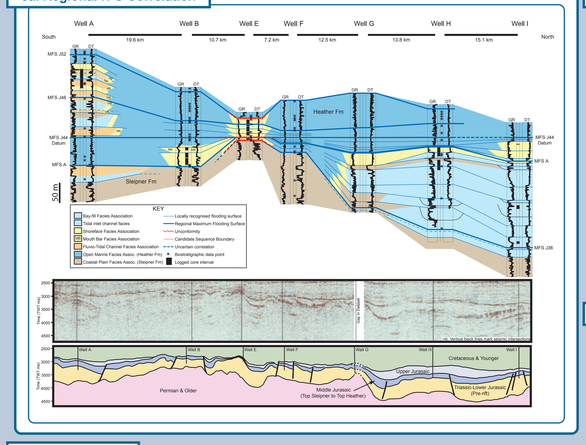
2e. Fluvio-Tidal Channel & Coastal Plain Facies Associations



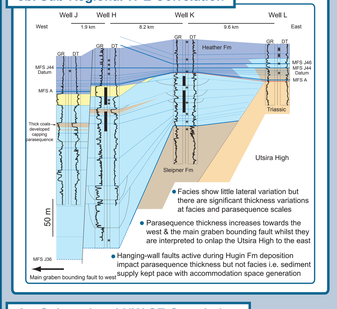
- Where tidally-influenced channels overly coastal plain, flooding surface interval at base
- Juxtaposition of fluvially-influenced channel sandstones above restricted marine claystone may represent candidate sequence boundary
- Basal surface of successions may simply record autogenic channel migration and avulsion
- Little variation in wireline response between facies FTC1 and FTC2 therefore hard to distinguish from wireline-logs alone
- Coastal plain facies association exhibits markedly different wireline character than all other facies associations allowing easy recognition away from core control

3. Sequence Stratigraphic Correlation

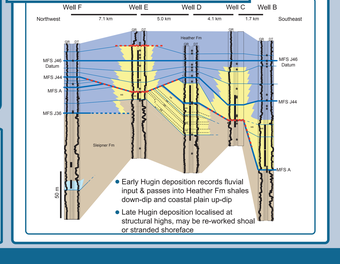
3a. Regional N-S Correlation



3b. Sub-Regional W-E Correlation



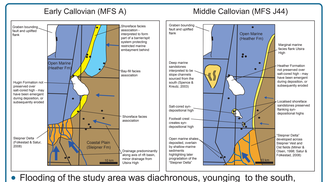
3c. Sub-regional NW-SE Correlation



3d. Observations

- A regional, high resolution biostratigraphic framework has enabled correlation of Maximum Flooding Surfaces throughout the study area
- Rift-related faulting and salt movement have impacted parasequence thickness and facies development
- Higher order flooding surfaces of sub-regional and local extent are likely to reflect variations in sediment supply and accommodation creation caused by rift-related faulting and the growth of salt-cored highs
- Local extent of sequence boundaries typical of sequence boundary suppression within net-transgressive strata and also of rift basins where their development is enhanced by marginal uplift but suppressed by increased subsidence in axial depocentres

4. Palaeogeography



- Flooding of the study area was diachronous, younging to the south, along the graben axis, and also to the east, up the hanging-wall dipslope
- Evolving fault and salt-related structures led to a complex relationship between shallow and open marine deposits, this is particularly apparent in the south of the study area
- Deep marine sandstones developed in the graben axis coeval with Hugin Formation deposition

5. Summary

- Sedimentology of the Hugin Formation is highly variable and geographically compartmentalised
- Geographical localisation is controlled by distance from the main axial feeder system into the basin and syn-depositional structural development
- Higher order flooding surfaces and candidate sequence boundaries can only be recognised locally due to the transgressive nature of the deposits and significant spatial variation in fault- and halokinesis-controlled subsidence
- A robust understanding of temporal and spatial variation in depositional system type, basin geometry and syn-depositional tectonics is critical to successful exploration of the Hugin Formation

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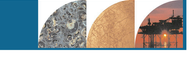

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