Syn-sedimentary Tectonics of the Jurassic Sedimentary Sequence in the Northern Viking Rift Graben (North Sea), Producing Asymmetrical Stratal Packages

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The Permo-Triassic and the Upper Jurassic rift-phases in the Northern North Sea has been regarded as a time of crustal scale thermal cooling with uniform basin-wide subsidence, and with only minor tectonic movement along some of the larger basin faults. Well data indicate, however, that fault block rotation occurred on both field and regional scale during deposition of the Jurassic strata. This shows that the transition from thermal cooling and subsidence following the Permo-Triassic rift-phase to renewed rifting was gradual and complex. On a regional scale, the Jurassic package defines a profound westward thickening sedimentary wedge(3 times), indicating rotation of a Permo-Triassic mega-block. The prograding Rannoch and Etive Fms of the Brent Group show a uniform east-west thickness distribution indicating no tectonic influence during deposition, as they were deposited within a relative short time-period. However, the Ness, Tarbert and Heather Fms show a dramatic asymmetrical east-west (5 times thickness increase) strata wedge indicating the initiation and escalation of tectonic extension leading up to the Upper Jurassic phase of rifting. The tectonic extension caused an increase in relative sea-level that forced the Brent Delta to switch from progradation to aggradational stacking style (seen in a S-N direction) and finally to retrogradation and drowning of the Brent Gp.

On field-scale, the Upper Jurassic rifting above Etive Fm is clearly seen from inter-well correlation and in some cases in seismic sections. Here, the Ness-Tarbert-Heather succession shows considerable thickness differences (6 times) across faults in both data sets within few kilometers.

In contrast to passive margins, extensional basins undergoing thermal cooling and rifting have a different style of sedimentary infill (facies architecture, N/G ratios etc). Where the sedimentation rates are less than the local subsidence (underfilled basin), the structural relief will control the drainage pattern. When near equal, a segregation of the facies distributions will occur (balanced filled), and when the sedimentation rate exceeds the subsidence rate (overfilled basin), the facies distribution will be governed by autocyclic processes. The studied Jurassic package shows these interesting aspects and it is important to take these aspects into account when evaluating the reservoirs and adjacent exploration potensionals.