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Early Cretaceous Stratigraphic Response to Hyperextension, Porcupine Basin, Irish Atlantic Margin

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ABSTRACT

The Porcupine Basin, located on the Irish Atlantic Margin, is recognised as a prospective basin for potential deep-water petroleum plays. It displays a strong north-to-south lateral strain gradient along with evidence for hyperextension. Mid-Late Jurassic rifting was followed by a protracted phase of thermal subsidence during the Cretaceous. However, a feature of the post-rift Cretaceous stratigraphy is the presence of prominent unconformities that cap deeply eroded and structurally-rotated lowermost Cretaceous successions. Curiously, the latter are mainly preserved perched on the main basin flanks and are passively overstepped by the younger Lower Cretaceous infill. In the main basin, the Lower Cretaceous is comprised of laterally variable clastic packages and important localised erosional surfaces. Identifying the relationship between the stratigraphy of the basin margins and basin centre is critical for understanding the evolution from normal to hyperextension to major thermally-controlled subsidence focussed along the basin axis. The present study uses a combination of 2D and 3D seismic data and well information to identify, correlate and examine the character and distribution of the post-rift successions. Exploration wells on the NE flank indicate the early post-rift here ranges from Berriasian to Aptian in age and is predominantly a mud-dominated marine sequence with localised turbidite sandstones. These packages, which variably thicken and thin and locally appear to converge and onlap towards what became the later axial depocentre, are truncated by an unconformity with high relief referred to as the ‘Aptian’ unconformity. Similar unconformity-bound early post-rift packages are recognised in the southern Porcupine Basin where they are more strongly rotated towards the younger axial depocentre. Axial correlations linking the northern and southern sectors of the basin suggest the flank rotation and development of the “Aptian” unconformity may be diachronous. Seismic and depositional mapping, combined with decompaction of the Lower Cretaceous succession across the basin, provides an enhanced understanding of the syn-rift to post-rift sedimentary evolution and tests the hypothesis that fault-controlled extension led directly to underfilled deep bathymetry. The results provide important clues to the timing, distribution and potential reservoir quality of deep-water sedimentary systems in hyperextended basins.