

Understanding the characteristics of hyperextended margins to model and predict new hydrocarbon plays in Atlantic deepwater provinces

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Over the past decade, hyperextension is increasingly recognized as a common extensional process on continental margins worldwide, although the complex history of these margins can prove to be problematic for explorationists. Extreme crustal stretching and thinning results in a corresponding and often overlooked high rate of thermal subsidence that creates accommodation space into which sediments are deposited. This requires a re-evaluation of hyperextended margins in terms of consequences for thermal subsidence, basin connectivity, and flexural uplift.

We have evaluated in detail the new hydrocarbon discoveries on the Newfoundland margin and southwest Barents Shelf using a palinspastic deformable plate reconstruction. This has provided insights into the characteristics of Atlantic deepwater provinces in general. We show that many of these provinces share characteristic structural features associated with hyperextension such as deepwater basins and starved basins on the distal margin, perched basins, uplifted basin margins and the development of submarine escarpments, highly rotated fault blocks, and localised shear zones. During extension, the amount of stretching of the continental crust generally increases from the hinge line, which marks the transition from undeformed to deformed crust, to the distal parts of the margin where maximum stretching occurs. This causes a corresponding change in facies and palaeogeography across the margin, variations in subsidence and basin margin uplift, and has consequences for heat flow and hydrocarbon maturity.

Our palinspastic deformable plate model extends from the Central Atlantic to the Arctic and includes exciting new areas such as Guyana/Suriname–Mauritania/Senegal conjugate margins where significant discoveries have recently been made. The application of new modelling methods in these areas reveals a complex tectonic evolution and allows comparisons to be made to regions of interest such as Nova Scotia and the US Eastern Seaboard, Morocco, the Porcupine and Orphan Basins, and Iberia.

The characteristics of hyperextended margins and adjacent structural features are not yet fully recognized, but when the structural processes at hyperextended margins are well understood, they can show us the way to potential new petroleum plays.