The Early Jurassic Heracles Sequence, Scotian Basin, Canada: Recognition of a latest stage synrift / pre-breakup tectonic and sedimentary event

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Seismic profiles on the Scotian shelf, slope and abyssal plain offshore Eastern Canada reveal a previously unrecognized earliest Jurassic post-salt / pre-breakup stratigraphic succession. The Heracles Sequence is observed on the shelf margin as an eastward-directed infill succession within a series of half grabens having counter-regional, northwest-dipping boundary faults. On the slope, its inferred presence in the salt depocentre adjacent to the basin hingeline is masked by a thick wedge of later Mesozoic and Cenozoic sediments and salt structures. In deep water, it is recognized as a poorly-imaged but apparently extensive sequence between interpreted basement and the late Sinemurian breakup unconformity. At the eastern extremity of this region, it appears as westward-thickening wedges in highly rotated fault blocks.

The Heracles Sequence is interpreted as the product of the last phase of synrift tectonism prior to separation of the Nova Scotian and Moroccan conjugate margins in the late Sinemurian. Post-salt (early Hettangian) uplift of the mainland Nova Scotia shoulder region and the eventual rift spreading centre provided sources for sediments that prograded east- and westwards respectively into the main salt basin. Interpreted fluvial sequences advanced over marine evaporites ponding in depressions on a rifted basement setting and induced syndepositional halokenesis and the formation of salt-evacuation synclines. Where thin on the margins (especially near the future spreading axis), the salt provided a detachment surface and facilitated the observed high rotation on loading-induced fault blocks during a final uplift phase. This interpretation buttresses other geophysical evidence that suggests the underlying basement may not be oceanic crust, as previously proposed, but rather highly attenuated and fractured continental crust or serpentinized mantle.

The recognition of this late stage pre-breakup synrift sequence in the Scotian Basin offers important insights on this phase of the rifting process, and possibly its Moroccan conjugate and other margins. It thus has significant implications regarding the recognition of the continental crust and crustal boundaries, age and timing of syntectonic deposition and salt tectonism, original distribution and extent of marine evaporite sequences, timing and style of rifting, modelling of crustal heat flow, and petroleum systems attributes and modeling.

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