Linking Mesozoic and Cenozoic tectonic and stratigraphic events in the Orphan Basin, offshore Newfoundland, Canada

Lynn T. Dafoe, Charlotte E. Keen, Graham L. Williams, and Sonya A. Dehler
Geological Survey of Canada, Bedford Institute of Oceanography, Dartmouth, Nova Scotia B2Y 4A2, Canada <ldafoe@nrcan.gc.ca>

The formation of Orphan Basin is tied to rifting east of Newfoundland and development of the North Atlantic Ocean from the Triassic to Early Cretaceous. Renewed interest in this frontier basin has stemmed from a petroleum discovery in the adjacent Flemish Pass Basin. Our multidisciplinary approach to understanding the development of Orphan Basin builds on previous detailed seismic studies by incorporating data from well logs, core, cuttings, biostratigraphy, seismic and subsidence history. This approach has resulted in the identification of 7 significant tectonostratigraphic events that define Orphan Basin formation and associated stratigraphic responses to these events, which we describe here. (1) Initial rifting began with shallow marine deposition during the Middle to Late Jurassic or perhaps earlier, followed by deformation. (2) During the Tithonian and Early Cretaceous, rifting propagated westward, and thick deposits accumulated against major growth faults. (3) Termination of rifting was succeeded by the development of the Central Orphan High and deformation of Tithonian and Early Cretaceous deposits approximately coinciding with an Aptian sequence boundary. (4) Thinning of continental crust east of Orphan Knoll and possible contemporaneous development of a major flooding surface within the basin took place in the Albian to Cenomanian interval. (5) During the Santonian, another prominent sequence boundary developed around the same time as crustal faulting in northern Orphan Basin and north of the Charlie-Gibbs Fracture Zone (CGFZ). Just north of Orphan Basin and the CGFZ, possible transitional crust developed at this time, while true oceanic crust formed east of Orphan Basin and south of the CGFZ (Chron 34). These events were followed by major subsidence of the Orphan Basin. (6) During the latest Cretaceous to Early Eocene, magmatism was localized in northern Orphan Basin. (7) Finally, during the Tertiary, basin filling and shelf-slope development continued under eustatic sea-level fluctuations.

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