

The East Orphan Basin, Offshore Newfoundland and Labrador: a Deepwater Super Extended Rift with Hydrocarbon Potential

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EXPANDED ABSTRACT

The **East Orphan Basin**, an Atlantic rifted area situated in deepwater north of Cumberland Transfer Zone (Enachescu, 1987) and south of the Charlie Gibbs Transfer Zone, is the latest frontier exploration area to be licensed and to boast hopes for the next Canadian giant field discovery (Figure 1).

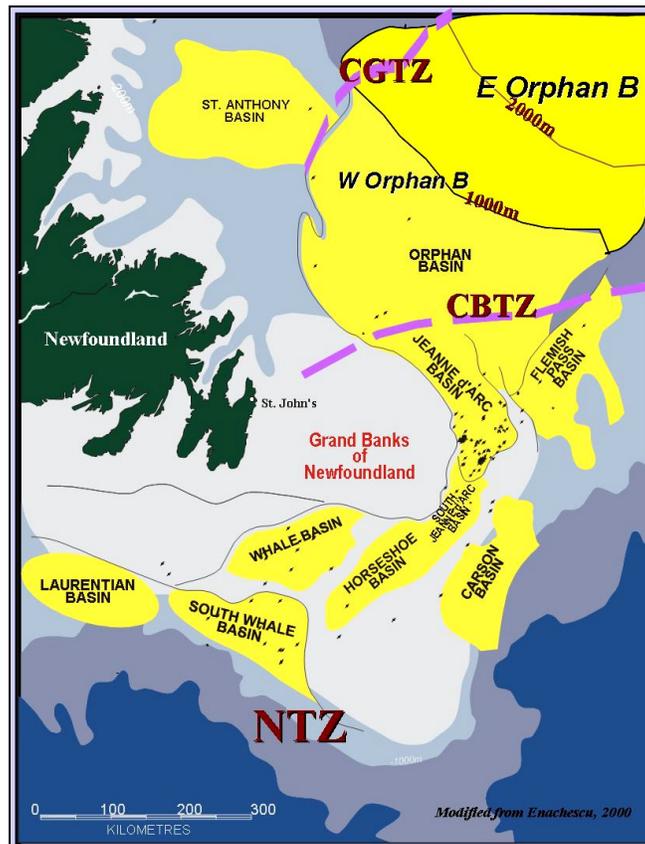


Figure 1. Location of East Orphan Basin offshore Newfoundland.

In the previous offshore exploration round of 1975 -1985 only the younger and shallower West Orphan Basin was explored and seven wells were drilled, but no hydrocarbons or source rock beds have been encountered (Smee et al., 2003).

According to interpretation based on a dens 2D coverage, the geologic evolution of **East Orphan Basin** has included significant tectonic subsidence during the Tethys and Atlantic rifting phases. Extension and minor transtension, continued during the Labrador rift phase and into several Late Cretaceous and Tertiary extensional episodes. As a result, the architecture of the basin is dominated by alternating ridges of sedimented basement blocks and deep sub-basins, mostly oriented NE-SW or N-S. To give an indication of the scale of these structural elements, the ridges have comparable sizes to the Grand Banks' Central Ridge and the sub-basins have areas similar to Jeanne d'Arc Basin (Figure 2).

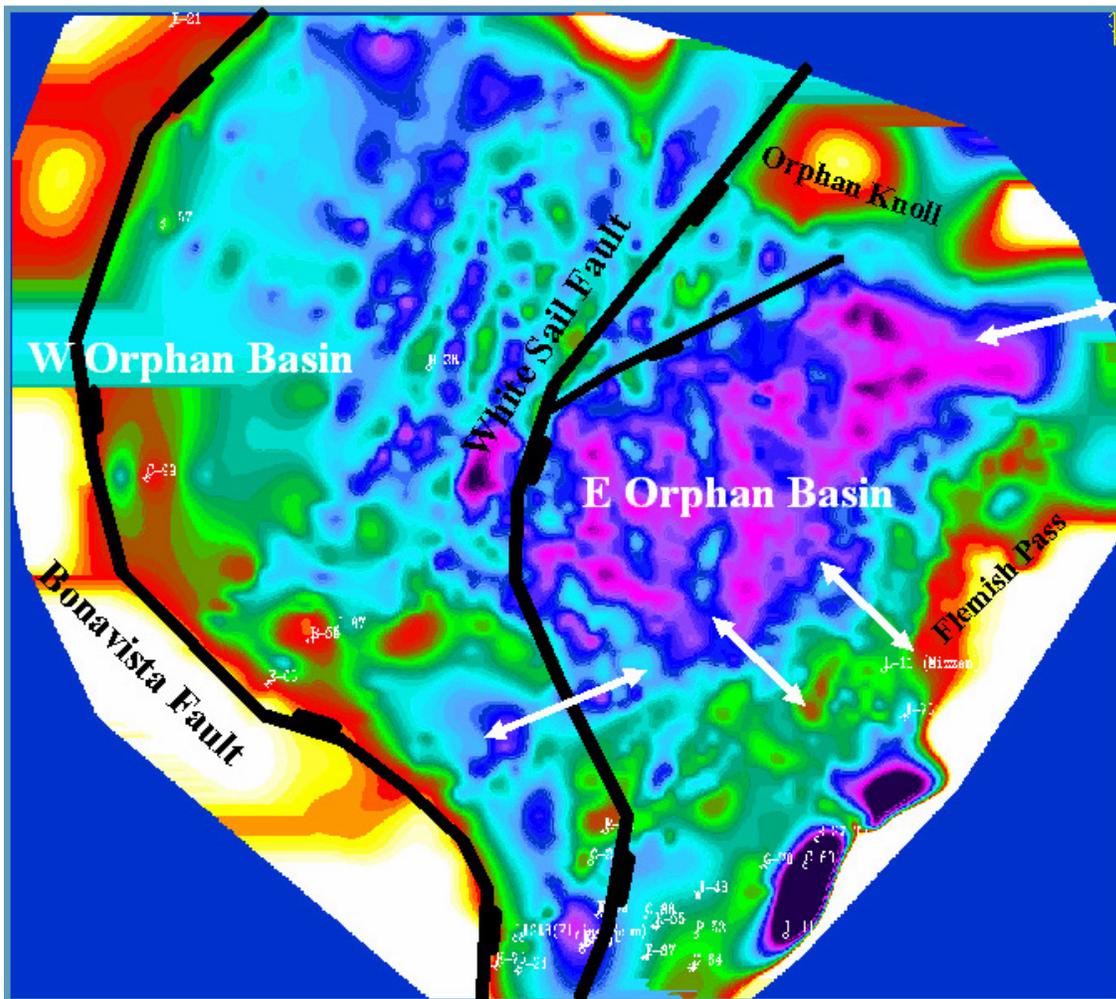


Figure 2. Time Structure of interpreted Economic Basement. The two most important fracture zones and location of East Orphan Basin are shown. Arrows indicate communication in Kimmeridgian time with Jeanne d'Arc, Flemish and Porcupine Basins. Seismic data provided by Geophysical Survey Incorporated.

The basin is bounded to the west by the White Sail complex fault zone, probably a continuation to the north of the Murre-Flying Foam Fault lineament moving north out of the Jeanne d'Arc basin (Figure 2). This fault and its imbricates had a crucial position in the initiation of the Late Triassic rifting and plays a role of basing bounding fault for the **East Orphan Basin**.

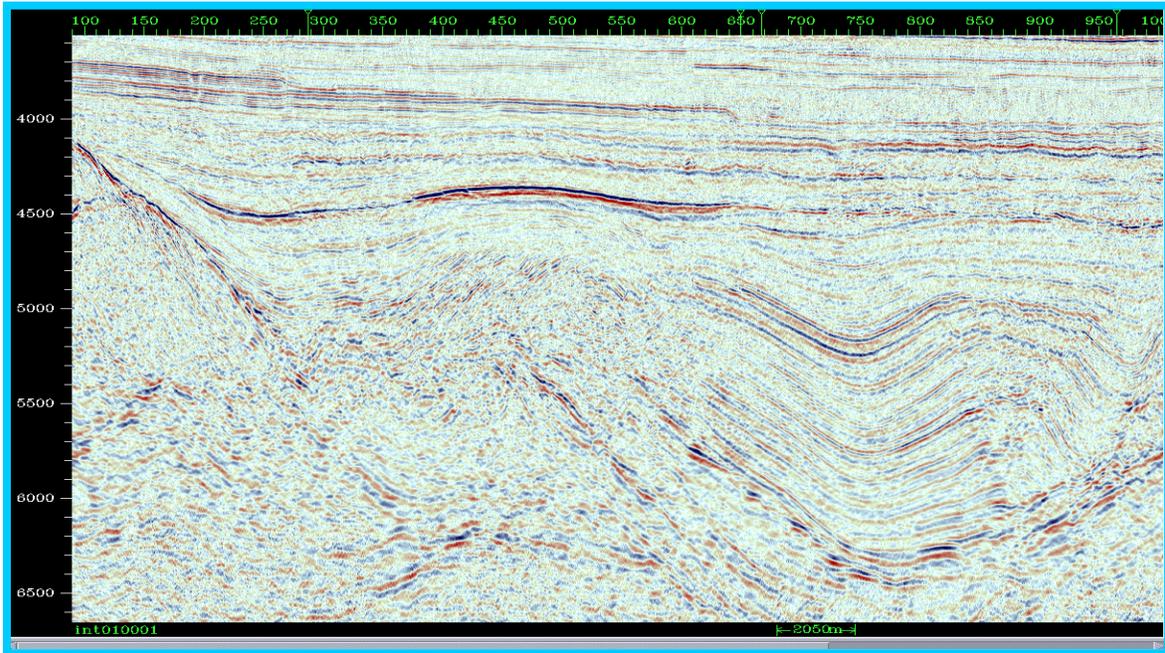


Figure 3. Large faulted anticlines within Jurassic and Cretaceous sequences in East Orphan Basin

Salt tectonics is less pervasive in this basin, with only indications that stratified and alternating salt beds (Salifère) were deposited during the early marine rift stage. Rotation of the extensional vector during rifting, pure transtension across transfer zones or continental resistance to the plate motion during drifting have created major (sedimented ridges) and minor (reverse faulting) inversion structures. Since Late Cretaceous the entire basin and its outer ridge Orphan Knoll have suffered rapid subsidence and foundering in the deeper Atlantic waters. The basin remains to a great extent underfilled during Tertiary to present time, but the Late Cretaceous to late Tertiary sedimentary cover should provide efficient seal for older structures.

The Petroleum system of the Eastern Orphan Basin should include: a) Kimmeridgian and probably Albian source rocks; b) Late Jurassic, Early and Late Cretaceous and Tertiary reservoirs; c) large roll-over anticlines, rotated fault blocks and submarine fans and d) source maturation, generation and short distance migration of oil and gas from large sub-basins into existing antiforms and submarine fans. Future drilling will prove the validity of this postulated petroleum system.

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