Geometries and kinematics of fault systems in the Flemish Pass Basin: Insights from the Bay du Nord 3D seismic survey, offshore Newfoundland, Eastern Canada

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Abstract EGU2023-7509

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1.Aims and introduction

The aim of this study is to investigate fault nucleation and growth history, and how this may relate to previous interpretations of multi-stage rifting, plus the possible role of structural inheritance in controlling basin evolution

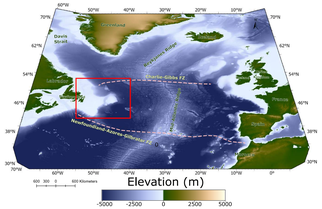


Figure 01. Study area overview (redbox) relative to the southern North Atlantic Bathymetry

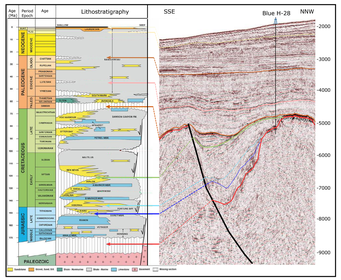
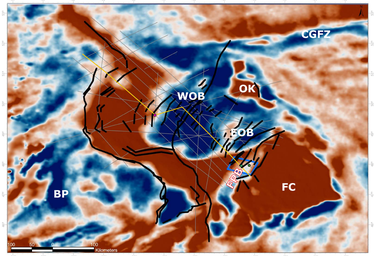
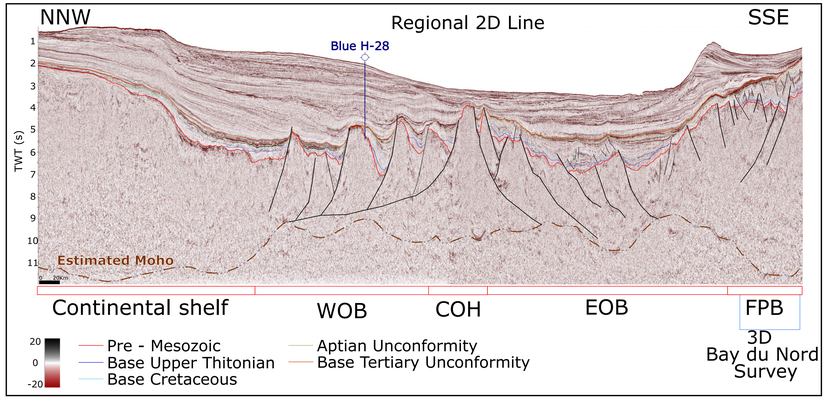


Figure 03. General stratigraphic framework for the research area (modified from Cawood et al, 2021).



Legend :
- Blue H-28
- Bay du Nord C-78
- Baccalieu I-78
- The Bay du Nord 3D Survey
- Regional composite 2D line

Figure 02.Free air gravity anomaly map (Sandwell et al., 2014) of the zoom in the redbox from figure 01, overlay with regional structures (black lines) (Peace et al., 2022) and available data; wells, 2D lines, and the Bay du Nord 3D seismic data. Abbreviations : CGFZ = Charlie-Gibbs Fracturezone, BP = Bonavista Platform, WOB = West Orphan Basin, EOB = East Orphan Basin, OK = Orphan Knoll, FC = Flemish Cap, FPB = Flemish Pass Basin, COH = Central Orphan High



2.The Bay du Nord 3D interpretation

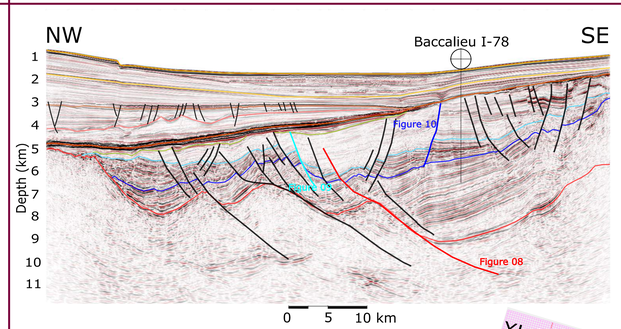


Figure 04. Interpreted crossline (XL) 7100 Bay du Nord 3D data set tied with Baccalieu I -78. The architecture of the FPB depicting low angle normal faults in the Mesozoic sequences, with younger faults, abruptly terminated at the base of Tertiary unconformity horizon

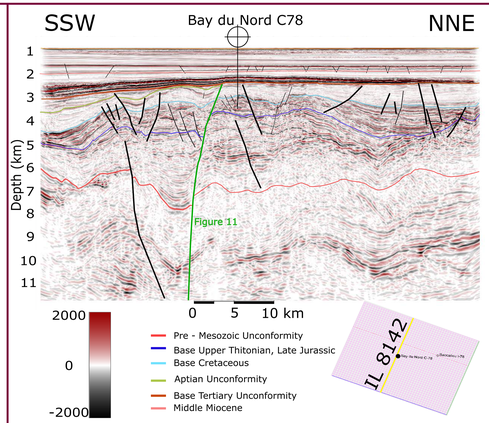


Figure 05. Interpreted inline (IL) 8142

3. Subsurface maps

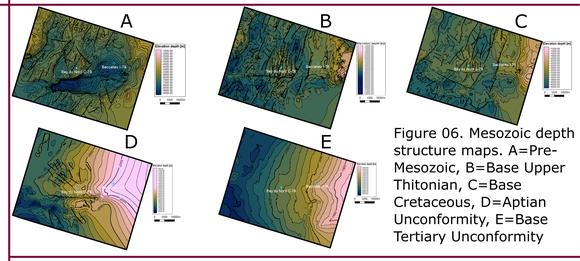


Figure 06. Mesozoic depth structure maps. A=Pre-Mesozoic, B=Base Upper Thitonian, C=Base Cretaceous, D=Aptian Unconformity, E=Base Tertiary Unconformity

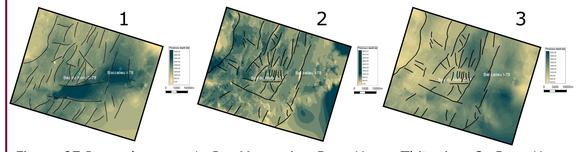


Figure 07.Isopach maps. 1=Pre Mesozoic - Base Upper Thitonian, 2=Base Upper Thitonina - Base Cretaceous, 3=Base Cretaceous - Base Tertiary Unconformity

4.Quantitative fault systems analysis

Fault analysis theory

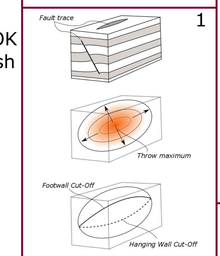
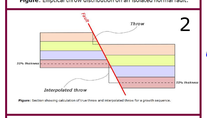
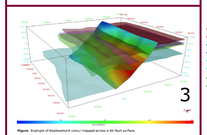


Figure: Elliptical throw distribution on an isolated normal fault.





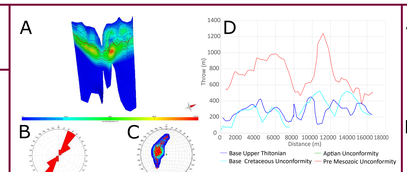


Figure 08. NE-SW low-angle normal fault
A. Vertical displacement (m) distribution across 3D fault surface
B. Strike data set in rose plot suggesting NE - SW orientation
C. Fault dip poles to the ESE representing irregulaarities currogations
D. Throw values vs distance

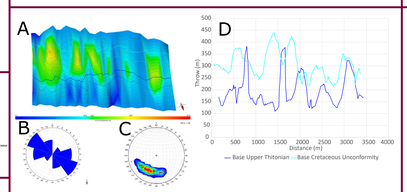


Figure 09. NW-SE normal fault
A. Vertical displacement (m) distribution across 3D fault surface
B. Strike data set in rose plot suggesting NW-SE orientation
C. Fault dip poles to the NNE representing irregulaarities currogations
D. Throw values vs distance

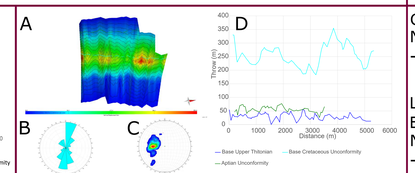


Figure 10. normal fault
A. Vertical displacement (m) distribution across 3D fault surface
B. Strike data set in rose plot suggesting NNE - SSW orientation
C. Fault dip poles to the ESE representing irregulaarities currogations
D. Throw values vs distance

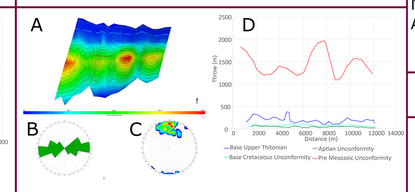
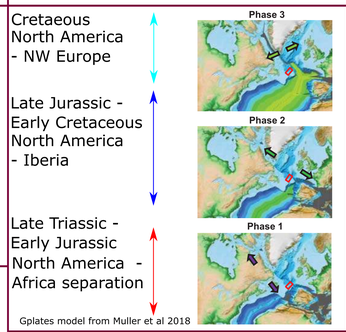


Figure 11. E-W normal fault
A. Vertical displacement (m) distribution across 3D fault surface
B. Strike data set in rose plot suggesting E-W orientation
C. Fault dip poles to the S representing irregulaarities currogations
D. Throw values vs distance

5.Tectonic model and take-home messages



Creation and analysis of subsurface maps and representative fault systems model derived from the Bay Du Nord 3D seismic survey has presented the structural style and evolution of the Flemish Pass Basin. There are 4 fault systems that have been modelled in this study that appeared to be governed by 3 different rifting phases in the Mesozoic with different rift axes (Non-coaxial rifting).

Acknowledgments

NSERC Discovery Grant RGPIN-2021-04011 awarded to Dr. Alex Peace.

Canada-Newfoundland & Labrador Offshore Petroleum Board (C-NLOPB) for subsurface data.

Schlumberger for Petrel.

Petroleum experts Ltd. for MOVE.

References