Structural style and fault evolution in the greater Bay du Nord area, Flemish Pass Basin, offshore Newfoundland, Canada

ASDRÚBAL J. BERNAL[1], RAINER TONN[1], ENRIQUE NOVOA[2], AND BO SØDERSTRØM[3]

1. Equinor Canada Ltd., St. John's, Newfoundland and Labrador A1C 6J5, Canada
2. Equinor Gulf Services LLC, Houston, Texas 77042, USA
3. Equinor ASA, Martin Linges vei 33, Fornebu 1330, Norway

The structural style, timing of deformation, and interaction of fault sets in the Greater Bay du Nord Area, Flemish Pass Basin, have been interpreted using seismic and borehole data. The structural style in the study area is dominated by rollover anticlines with erosion in the up-dip, crestal areas. These rollovers are related to complex interactions of low angle listric and associated synthetic and antithetic faults; some of them displaying conjugate geometry. We interpret three Mesozoic fault populations: (1) relatively long, NESW-striking faults with dominant vergence to the east and high displacement and height that extend into pre-Jurassic strata; (2) NW-SE-striking faults, with no clear dominant vergence and confined within the Jurassic–Cretaceous succession, has much less displacement and length; and (3) faults with NNE-SSW to NNW-SSE strike and variable displacement, lateral extent, and height. A major normal fault striking E-W bounds the Greater Bay du Nord Area to the south.

Integration of structural and isopach maps, growth strata analysis, and evaluation of fault interactions allows us to propose a timing of fault activity and relate it to the rotation of extension direction throughout the Mesozoic. We suggest three pulses of tectonic activity. The first pulse relates to a rift climax phase of Oxfordian–Kimmeridgian in the Flemish Pass, with the major E-W-striking and NE-SW-striking fault population accommodating this deformation. A period of relative tectonic quiescence is observed in the Upper Tithonian, where differential subsidence and minor faulting is interpreted. The second pulse develops in the Early Cretaceous with most of the fault growth and propagation occurring during the Berriasian to Hauterivian(?) with a NNE-SSW to NNW-SSE orientation and dominant vergence to the east. These developed west-dipping rollover anticlines and associated west-verging half-graben depocentres. The NW-SE-oriented fault population develops during the Aptian-Albian. The E-W-striking bounding fault and the NNE-SSW fault sets re-activate during this time, with different degrees of strike-slip displacement expected during fault reactivation in Early Cretaceous time. The third phase of tectonic deformation comprises mild inversion in the transition of Early to Late Cretaceous, followed by westward subsidence of the basin during Tertiary and the development of polygonal faulting.

Atlantic Geology, 2018, Volume 54
Conjugate Margins Conference 2018, August 19-22, 2018
doi: 10.4138/atlgeol.2018.014