

Late Jurassic to Early Cretaceous depositional systems and sequences, Flemish Pass extensional basin, offshore Newfoundland, Canada

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The Flemish Pass is a Mesozoic extensional basin located 500 km offshore of Newfoundland, containing oil discoveries in multiple stacked reservoirs. Recent wells (2013–2017) drilled into the Bay du Nord and Baccalieu discoveries retrieved cores that were logged sedimentologically and ichnologically to understand Late Tithonian to Early Berriasian depositional systems and to build a sequence stratigraphic framework. Micropaleontological and petrological data were also utilized to refine these interpretations.

Late Tithonian reservoirs in Bay du Nord are interpreted as fifth- to sixth-order composite sequences. Fluvial channel sandstone complexes with erosional bases represent broad, shallow lowstand incised fluvial valley fills (5–7 km wide and 15–40 m thick) overlying subaerial unconformities. Sandstones are sublitharenites to feldspathic litharenites with siliciclastic metasedimentary and reworked carbonate rock fragments. Lower delta plain deposits are overlain by delta-front heterolithic intervals, recording transgression in a hypoxic, inner neritic environment. By contrast, outer shelf mudstones, consisting of coccolithophoroids, with quartz grains and minor illite and mica, pass upwards into prodeltaic heterolithic intervals, correspond to highstand system tracts in an oxic, inner neritic environment. The sandstones were sourced from sedimentary and metasedimentary rocks with a significant proportion of limestone lithic fragments lying to the south and west of Bay du Nord, which were fed into a low gradient basin with minor topographic relief.

The Early Berriasian reservoirs at Baccalieu consist of progradational cycles 15–50 m thick. Outer shelf calcareous mudstones, overlain by prodeltaic silty mudstones and delta-front structureless sandstones, were deposited in an oxygenated inner to middle neritic environment, largely by hyperpycnal flows, and represent a late lowstand/early transgressive sequence set. Early Berriasian sandstones are litharenitic with metamorphic rock fragments. Mudstones are illite–mica with minor intercalated quartz grains. The sediments represent localised lowstand shelf-type deltas (~10 km wide fans) with hyperpycnal flows building out onto a steeper, narrow basin with sediment sourced from the east. The changes in paleoenvironment, depositional systems, and provenance during the Early Berriasian are linked to fault movement and generation of localized accommodation space along the margins of the Flemish Cap.