



Carboniferous stratigraphy of the Bradelle L - 49 and Brion Island wells, central and northern Gulf of St. Lawrence, Maritimes Basin, eastern Canada

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NOTES IN EXPLANATION

The Bradelle L-49 and Brion Island wells are the only deep hydrocarbon exploration wells drilled to date in the north-central portion of the Gulf of St. Lawrence region and are therefore of considerable importance to the understanding of regional stratigraphy in this part of the Maritimes Basin. In particular, these wells provide an excellent record of the Upper Carboniferous succession which can be correlated with similar strata in other Gulf of St. Lawrence wells drilled to the south, and with wells drilled on Prince Edward Island (see Giles and Utting, 1999). We have applied the Upper Carboniferous formation names first used by Rehili (1996) as we did in our earlier work in the southern parts of the Gulf, so that these wells could be more easily placed in a regional stratigraphic framework. We have assigned Upper Carboniferous palynomorphs to a simple Westphalian to Stephanian biostratigraphic framework comparable to that applied in our previous work, retaining the designations Westphalian A,B,C and D. We recognize the need for a formal re-appraisal of biostratigraphic zonations for the Upper Carboniferous. However, we have proceeded informally with the present work so as to make available to the user current stratigraphic interpretations which might assist in hydrocarbon exploration.

Based on our regional correlation (Giles and Utting, 1999), both wells collared in the Naufage Formation which we believe to be of latest Carboniferous to earliest Permian age. The Brion Island well may have intersected unnamed Permian sandstones in its uppermost portion, but biostratigraphic control to confirm this speculation is lacking and the overall succession beneath the sandstone cliffs of Brion Island is quite typical of the Naufage Formation. The thick sandstones of Brion Island itself, where the well was sited, may represent interbedded channel deposits within the Naufage Formation which we believe to be transitional upwards into the sand-dominated unnamed Permian rock unit of the southern Gulf of St. Lawrence (Giles and Utting, 1999). The Naufage Formation is characterized regionally by red siltstones and mudstones, rich in pedogenic carbonate as nodules and thin amalgamated beds (calcretes) and containing increasing channel sandstone bodies towards the top.

Both wells intersected complete sections of the Cable Head Formation, dominated by thick, multistoried sandstone bodies with interbedded red siltstones and shales. The Cable Head Formation is approximately 100m in thickness in the Bradelle L-49 well, and more than 450m thick in the Brion Island well. We have used the top of the Cable Head Formation as an arbitrary datum in correlating these two wells. This same datum was used in our previous study of deep wells in the southern Gulf of St. Lawrence (Giles and Utting, 1999).

The Green Gables Formation lies beneath the Cable Head Formation in both the Bradelle L-49 and Brion Island wells, and is characterized by mainly red fine-grained rocks with interbedded sandstones. The Green Gables Formation contains the highest Upper Carboniferous coals and coaly shales, interbedded with minor grey mudrocks and distributed throughout the formation.

The Bradelle Formation conformably underlies the Green Gables Formation in both wells and is characterized by grey mudrocks with associated coals, and thick multistoried sandstone bodies. In the Bradelle L-49 well from which the formation takes its name (Rehili, 1996), coals are abundant throughout the succession. In the Brion Island well, coals and coaly shales are common in the upper Bradelle Formation, but are not reported from the lower part of the formation which is dominated by sandstone. This sand-dominated interval in the Brion Island well is apparently not represented in the Bradelle L-49 well where it may have been overstepped by the coal-bearing fine-grained facies of the upper Bradelle Formation. Alternatively, the sand-dominated lower Bradelle Formation of the Brion Island well may be a facies equivalent of coal-bearing strata in the Bradelle L-49 well. The base of the Bradelle Formation is a significant regional unconformity, in this area within the Duckmantian (Westphalian B). In the Brion Island well, the unconformity is marked by a dramatic change from the sand-dominated lower Bradelle Formation to interbedded red and grey fine-grained rocks which we have assigned to an undivided Mabou Group. In the Bradelle L-49 well, in contrast, the unconformity at the base of the Bradelle Formation is identified mainly on the basis of biostratigraphy, and is marked by the appearance of Late Viséan to earliest Namurian palynomorphs beneath Duckmantian spore assemblages in strata with associated thin coals.

Beneath the unconformity at the base of the Bradelle Formation, stratigraphic assignment remains problematic in these wells. The Brion Island well penetrated a succession dominated by grey fine-grained strata, with minor red colours and some interbedded sandstone in relatively thin channel bodies, and with interbedded anhydrite in the lowermost 100 metres. These rocks passed downwards into limestone-bearing strata which we believe to represent a part of the middle Windsor Group. Interbeds of anhydrite are associated. At approximately 2750m, the well entered rock salt which continued to the total depth of 3206.5 metres. We assume that this thick salt interval represents the main lower Windsor Group salt. It is quite possible that this thick salt interval represents a penetrative salt structure, and that the apparent stratigraphy is a fragmental record of a potentially more complete Windsor Group succession. The Bradelle L-49 well, drilled 128km to the west, presents a somewhat different picture of the Windsor Group.

Beneath the basal Bradelle Formation unconformity in the Bradelle L-49 well, fine-grained strata are typically red in colour with lessor grey colours. Minor sandstone occurs in localized channel bodies, several of which are of significant thickness and multistoried. A conventional core taken at approximately 2240m depth yielded Viséan palynomorph assemblages typical of the *Schopfipollenites acadensis* - *Knoxiporites triradiatus* (AT) Concurrent Range Zone of Utting (1987). These palynomorphs establish an upper Windsor Group equivalence for this interval. We suggest that these rocks are best assigned to the Mabou Group, due to the lack of any associated marine strata which might argue for a Windsor Group assignment, but note that there are non-marine Windsor Group partial equivalents in this part of the Maritimes Basin. They overlie a 50m thick succession containing oolitic and sparsely fossiliferous marine limestones which, in the Bradelle L-49 well, represents the total preserved Windsor Group. The base of the Windsor Group interval is placed at a depth of 2924m. We cannot be certain that these marine rocks represent lowest Windsor Group strata, since stratigraphic overstepping is well known in the Windsor Group in southern and eastern portions of the Maritimes Basin (Boehner and Prime, 1993). However, in southeastern New Brunswick and on the New Brunswick Platform, the basal Windsor Group limestone is typically the only widespread carbonate rock unit preserved in the Viséan succession. In the Bradelle L-49 well, the carbonate rocks assigned to the Windsor Group may indeed represent the basal Windsor Group.

Beneath the Windsor Group in the Bradelle L-49 well, we have assigned a heterogeneous succession of sandstones and shales (both red and grey in colour) to an undivided Horton Group. No stratigraphic data are available for other Horton Group successions in this part of the Gulf of St. Lawrence which might allow comparative study at the formation level. In addition, no definitive palynomorph assemblages which might assist in establishing some equivalence with successions in onshore areas to the south or to the west have been recovered within this 1500m thick interval.

A minor gas show was reported in the Bradelle L-49 well from ~2240m, within the interval which we assign to the undivided Mabou Group, and which we believe to be biostratigraphically equivalent to beds of the Upper Windsor Group. A second minor gas show was reported from just beneath the base of the Windsor Group in the Bradelle L-49 well. No tests were conducted and details of the gas occurrences are lacking. The Brion Island well yielded no evidence for hydrocarbons.

In our earlier assessment of Maritimes Basin stratigraphy in the southern portion of the Gulf of St. Lawrence (Giles and Utting, 1999), we did not apply group terminology to our Upper Carboniferous formations. Here we have used the term Pictou Group, recognizing that this practice does not agree with the proposed revision to Upper Carboniferous terminology of Ryan et al. (1991). This informal publication is not an appropriate venue in which to argue our case, but the reader might appreciate that our use of the term Pictou is more closely aligned with historical usage, and that our decision is driven largely by the regional significance of the mid-Westphalian unconformity. This major tectonic and sedimentologic break in the stratigraphic record of the Maritimes Basin would be hidden within the revised Cumberland Group of Ryan et al. (1991) had we applied that term which was recommended as the group name for all Carboniferous coal measures in Atlantic Canada.

References Cited:

- Boehner, R.C. and Prime, G., 1993. Geology of the Loch Monod Basin and Glenarry Half Graben, Richmond and Cape Breton Counties, Cape Breton Island, Nova Scotia. Nova Scotia Department of Natural Resources, Mines and Energy Branches, Memoir 9, 68p.
- Giles, P.S. and Utting, J., 1999. Maritimes Basin stratigraphy - Prince Edward Island and adjacent Gulf of St. Lawrence. Geological Survey of Canada, Open File 3732
- Rehili, T.A., 1996. Late Carboniferous nonmarine sequence stratigraphy and petroleum geology of the central Maritimes Basin, eastern Canada. Ph.D. dissertation, Dalhousie University, 406p.
- Ryan, R.J., Boehner, R.C. and Calder, J.H., 1991. Lithostratigraphic revisions of the upper Carboniferous to lower Permian strata in the Cumberland Basin, Nova Scotia and the regional implications for the Maritimes Basin in Atlantic Canada. Bulletin of Canadian Petroleum Geology, 39, pp.289-314
- Utting, J., 1987. Palynology of the Lower Carboniferous Windsor Group and Windsor-Canso boundary beds of Nova Scotia, and their equivalents in Quebec, New Brunswick and Newfoundland. Geological Survey of Canada, Bulletin 374, 93p.

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BIOSTRATIGRAPHIC ANNOTATION

- S** - Stephanian
- W** - Westphalian
- WA, WB, WC, WD - Westphalian subdivisions
- VINAM** - Viséan to earliest Namurian
- VNS, VAT, VINAM SM, NS, AT and SM zone
- T** - Tournaesian (may include latest Devonian)

LITHOLOGY AND SYMBOLS

- channel sandstone
- siltstone, shale, mudstone - red
- siltstone, shale, mudstone - grey
- bedded limestone (major and minor units)
- halite
- anhydrite
- palynology sample location
- core location
- coal, coaly shale
- minor natural gas show

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