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GEOLOGICAL SURFACE MAPPING, GASPE PENINSULA

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CONSULTING LIMITED

GEOLOGICAL SURFACE MAPPING

GASPE PENINSULA

(Part I)
July 5-16, 1970

(Part II)
September 8 and 9, 1970

for

SHAWNEE PETROLEUMS LIMITED

TORONTO, ONTARIO

London, Ontario, Canada
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C. J. Hadley, B.Sc., P.Geol., P.Eng.

TABLE OF CONTENTS

PART I

I N T R O D U C T I O N

Field studies of scattered Ordovician and Silurian outcrops in the Gaspe Peninsula was undertaken during the period July 5 - 16, 1970 and September 8 and 9, 1970 by Metals, Petroleum & Hydraulic Resources Consulting Limited of Toronto. The client, Shawnee Petroleums Limited of Toronto, required accurate dip and strike on any outcroppings that were found to be available within or bordering their Quebec Oil and Gas Exploration permits. (Hamilton, Cox, and New Richmond Townships, Bonaventure County).

In addition the company required an appraisal of the oil and gas possibilities; suitability of reservoirs, particularly reefal and availability of source rock.

Mr. C. J. Hadley with the assistance of Mr. Charles Allard of Carleton, Gaspe examined exposures in brooks located in the St. Alphonse de Caplan area; road cuts in the St. Antoine de Cascapedia and Robidoux area; the well exposed outcroppings at Cap Noir, and the reef exposures in the Pt. Daniel area. Mr. C. Berry, of Shawnee Petroleums accompanied Messrs. Hadley and Allard on the Cap Noir and Pt. Daniel studies.

As a finale the group chartered a plane from the Dalhousie, New Brunswick Flying Club and flew from Maria to Pt. Daniel, observing surface lineations, and topographic expression of partially exposed reefs.

On September 8 and 9, 1970 Mr. Cameron Berry and C. J. Hadley mapped outcroppings on the banks of the Bonaventure River.

G E O L O G I C A L O B S E R V A T I O N S

ST. ALPHONSE DE CAPLAN AREA (BROOKS)

Several brooks were traversed in this area and the exposures are plotted on the 1" - 1320' Feuille No. 22 A/4 N.E. The brooks were found to be generally dry but overgrown with alders and spruce making it extremely difficult to navigate.

The few outcroppings observed were found to be mainly Bonaventure conglomerate with variable strike and dip. Contacts between the Bonaventure conglomerate and Silurian carbonates as indicated on Government maps must have been assumed from the occurrence of limestone "Float", most of which appeared to be dark grey, dense limestone of the Chaleurs Bay Group, possibly La Vielle.

Two limestone exposures in a brook immediately west of the village of St. Alphonse de Caplan exhibited idential strike and dip, the dip being W. - N.W. 20^{o} at 17^{o}. The limestone can best be described as medium grey, mottled red, generally fine crystalline with brachiopods common. Since these exposures afford the only accurate dip and strike immediately north of the prospective oil and gas area covered by Bonaventure conglomerate, one would have to conclude that the N.E. - S.W. trending anticlinal structures as shown on Government maps, plunge into the Caplan area. They may also reflect a local condition, possibly a lime bank or brachiopod supported mud mound. Such mud mounds could serve as platform for the initiation of reef growth, similar to the platforms created by crinoidal mounds.

ST. ANTOINE DE CASCAPEDIA AREA (ROAD CUTS)

Three limestone outcroppings were examined in road cuts and a stream east of the village of St. Antoine de Cascapedia. Published Government maps indicate that this limestone is of Ordovician Age. The most southerly exposure occurs on a hill just above the turnoff to St. Edgar. (Covered Bridge). The limestone is dark grey, generally massive bedding with traces of fine fossil debris, and dipping E.S.E. 10° at 23°. North east of this outcrop, at the junction with the road to Robidoux, a similar limestone bed was examined, generally free of fossil debris and dipping N.N.E. 30° at 21°.

An excellent outcropping occurs in Ruisseau Brown just south of the road to Robidoux and although similar and near to the previously mentioned Ordovician limestone exhibited the nodular characteristics found in the La Vielle of Silurian Age. These rocks were observed to dip E.S.E.45° at 24°.

The Ordovician limestones are similar to those found in the Black River Group of Ordovician Age; possibly not so lithographic but generally argillaceous, hard and devoid of any porosity. Reservoir possibilities in the Ordovician rocks would probably be dependent on secondary porosity formed through dolomitization of limestone around fracture/fault zones. Little evidence for reefing is suggested by the paucity of fossils.

These exposures are plotted on the 1" - 1320' feuille No. 22 A/4 N.E. As will be observed little can be offered for structural interpretation in this area.

ROBIDOUX ROAD TRAVERSE

This traverse is a continuation of the studies carried out east of the village of St. Antoine de Cascapedia; continuing in Ordovician rock and terminating in Silurian rock north of the St. Alphonse de Caplan Area. (Hamilton Twsp.-Robidoux Twsp. Line).

Four outcroppings of Ordovician limestone were examined along the Robidoux road and are plotted on the 1" - 1320' Feuille No. 22 A/5 S.E. In general the limestone is very similar to that described previously; dark grey, brittle and devoid of fossil content, and porosity. An outcrop, approximately one mile west of the junction of the Robidoux road with the road south to St. Alphonse de Caplan, indicated the presence of interbeds of buff and maroon siltstone, with evidence of cross bedding and flame structures. This occurrence is probably indicative of changing environmental conditions. Dips and strikes are variable on these outcrops as will be observed on the base maps, lending little to structural interpretation.

Examination of outcrops continued on the road south to St. Alphonse de Caplan. One outcrop approximately 1200' south of the Robidoux Road junction was examined and observed to be Ordovician limestone and as indicated on Government maps would be close to the Ordovician/Silurian contact. The limestone was observed to be dark grey, dense type with very fine mineralization present.

Seven additional outcrops were examined where numerous exposures are available in road cuts. The Ordovician/Silurian contact as observed and plotted on Fueille No. 22 A/5 S.E. agrees quite favourably with that indicated on published Government maps.

The most obvious thing noted on passing into Silurian rocks is the sudden increase in fossil content. Although the matrix, colour etc. are generally similar to that observed in the Ordovician rocks, brachiopods and bryozoans were commonly noted with accompanying well developed leached fossil porosity. Most of these rocks give little evidence for reefing but certainly indicate shoal conditions in Silurian time, and probably belong to the La Vielle Formation of the Chaleur Series. The last exposure on the road south to St. Alphonse de Caplan consists of limestone and interbedded siltstone, grey green in colour and sometimes mottled maroon. This exposure could be Gascons or Bouleaux Formation of the Chaleur Series.

Strike and Dip of the Silurian rocks as will be observed on the base map are generally more consistent than noted in the Ordovician. On the average these rocks dip in a southerly direction at approximately 30°, similar to the exposures at Cap Noir but considerably more gentle. (Cap Noir average dip 65° south).

LES CAPS NOIRS (SEASHORE EXPOSURES)

The excellent exposures of the Chaleurs Group at Black Cape were examined on two occasions; firstly by walking the seashore for a detailed examination and secondly by boat for an overall view and to reach inaccessible areas where abrupt cliffs made for hazardous walking.

The exposures examined are plotted on Feuille No. 22 A/4 N.O. and S.O.

Beginning in the La Veille formation one can walk an almost complete Chaleurs Group of rock. In general it can be said that the

rocks strike east - west and dip at 65° south.

The La Veille Formation is typical dark grey limestone, generally nodular and argillaceous indicative of a subsiding basin. Very few fossils were observed; usually brachiopods. Porosity or other evidence of reservoir is lacking.

The Gascons and Bouleaux Formations are present in the area but it is very difficult to pick contacts. Maroon and green siltstones were observed to be interbedded with dark grey limestones similar to the La Veille, and sometimes exhibiting narrow beds of crinoidal hash. This sequence extends from Pointe Howatson to just beyond (1000') the 2nd pier. (shown on Feuille No. 22 A/4 No. and So.) The pier has now been partially destroyed by storms. Possibly this portion of the section could all belong to the Gascons Formation and represents the beginning of shoal conditions where deposition is mainly clastic in nature.

The next succession of rocks extend southeastward to just beyond the point which marks the beginning of Woodman's Beach. These rocks possibly belong to the Bouleaux Formation and consist mainly of dark grey limestone with numerous thin beds of fossil debris; mainly of coralline and stromatoporoidal origin. This section extends approximately 900' along the coast and would probably represent at least 800' of intermittantly fossiferous limestone. There is no suggestion of reefing but one would have to conclude that the debris has been derived from bioherms growing in a shelf position. Any of the beds of debris where localized in mounds could form the platform for the growth of younger reefs of possibly late Bouleaux or early West Point Formation Age. There is no evidence for

reservoir conditions to be present in the Bouleaux Formation as observed in this exposure.

One has to be enthused however over the fact that numerous zones of bioclastics exist over possibly 800' of section; any one of which could have, where abnormally thick, touch off reef growth. Chances of finding biostromal and/or biohermal reef growth within the Bouleaux Formation, deeper in the basin, i.e. the Caplan Area or offshore in the Chaleurs Bay, is certainly quite good.

Source beds are not obvious, however one could assume that the various bioclastic zones as well as forming good reef platforms, could also generate hydrocarbons to fill reefal reservoirs.

The Bouleaux Formation is further exposed along Woodman's Beach and beyond to a point adjacent to Black Cape. The top of the Bouleaux Formation is a very sharp contact where green and maroon siltstones end abruptly at the base of pink crinoidal limestone.

The pink crinoidal limestone is considered to be within the West Point Formation. It is very distinctive and forms a sharp contact with the overlying Black Cape Volcanics. The crinoidal debris is abundant and obviously would make an excellent reef platform for biohermal/biostromal reef growth within the West Point Formation. The beds would not appear to form a reservoir as such, but could possibly where sufficient wave action may have winnowed lime mud matrix from the abundant skeletal hash. Such a condition would create a prolific reservoir.

A 20' zone of grey white, evaporitic looking, rock (appears to

be calcite) was observed to overlie the volcanics and underlay the Bonaventure conglomerate cover. This bed has a more gentle dip of 30° as contrasted with the average dip of 65° south for the rocks of the Chaleurs Group. It would be significant to see a West Point Biohermal Reef (such as observed at Port Daniel) in contact with this bed as it would appear to be a suitable cap rock. Assuming that the volcanics are local, it would seem reasonable that a reef stratigraphically equivalent to the volcanics could be assured to have a dense impervious cap.

PORT DANIEL AREA

The Port Daniel Area was visited for one day to derive some idea of the type and size of reefal bodies that one could expect to find in the subsurface.

Not all exposures were examined, nor were dips and strikes recorded since we were more interested to delve into the nature of the reefing in the short time that we had allotted for the Port Daniel Area.

The two most significant outcroppings were encountered at West Point on the seashore and at Gascons Ouest in a road cut.

The exposure of West Point Formation at Pointe Ouest would appear to be a reefal body in its entirety. It is possibly a large bioherm but more probably a biostrome of undertermined extent. The layered nature and repetition of fossil communities would suggest a biostrome. Excellent beds of stromatoporoids, corals, bryozoan, and crinoids were observed in layers, probably in place or not far removed from growth position. Other beds of skeletal hash would suggest periods of moderate to stormy wave

action. Minor areas of porosity were noted, generally confined to individual coral heads and streaks of skeletal hash. From all observations one would have to conclude that the environment being considered was extremely similar to that of reefal conditions and environment as known and understood to exist in the Guelph-Lockport System of S.W. Ontario. The reefal development as observed at Pointe Ouest, combined with the suspected Cap Rock observed at Black Cape would undoubtedly be a prolific reservoir and hydrocarbon trap if found in the subsurface.

One additional outcrop was observed which was felt to be significant. It is located west of the village of Gascons Ouest in a road cut north of Anse Harrington and represents a significantly different environment from that commonly observed in the West Point Formation. The significant difference is in the size of the crinoid fragments. The rock consists of a fine crinoidal - grain matrix with interformational fragments of stromaoporoids, and algal coated limestone. This rock would appear to represent an environment not far removed from reefal activity with some considerable wave and current action present. The skeletal material has possibly been derived from the reef exposures at Pointe Ouest. Such material encountered in a well would indicate a near miss and would be a candidate for an offset well, to encounter the reef.

GAS RESERVE ESTIMATE FOR A PRODUCTIVE WEST POINT REEF

The size of the reefal body at Pointe Ouest can be roughly estimated from the geological map contained in Geological Report No. 120 of the Chandler - Port Daniel Area by W. G. Ayrton (Quebec Department of Natural Resources 1967).

The length of the reef, assuming that there is a long axis, would appear to be at least 2 miles long, or in the order of 10,000' (from Pointe de L'Indian to Pointe Ouest). The topographic map suggests possibly two or more bodies but in essence it is one reef complex. The width is estimated to be 3500' and the height 1,000'.

Assuming such a reef were found in the subsurface, using these estimated dimensions, one can calculate roughly the size and volume of the reservoir.

The figures would indicate a reefal body extending over 800 acres with an average 600' of vertical extent after deducting a reasonable amount for tight platform, flank dip, and intercrestal channels. If the reef were gas filled, with an average 8% porosity, one could assume that 400 M.C.F./acre foot would be reasonably contained within such a body. This would give approximately 192 B.C.F. of gas reserves in place. Increasing the average vertical height parameter will consequently increase the gas reserves. W. G. Ayrton's report indicates anywhere from 1445' - 1714' of West Point Formation present in the Port Daniel - Gascons Area. The 600' average reservoir height as used in this estimate, is considered to be conservative.

C O N C L U S I O N S

1. The anticlinal-synclinal structures as observed on published Quebec Government maps are felt to extend into the general Caplan Area under the Bonaventure conglomerate cover. Evidence of closure on any of the anticlinal structures is not obvious from the few limestone exposures available in the area of study.

2. The reef exposures as seen at Port Daniel are impressive as to size and the range of reef building organisms present. They would appear similar to the Niagaran Reefs encountered in Southwestern Ontario, but possibly larger in extent and vertical height. Such reefs could be found deeper in the basin, with adequate cover and cap rock to have captured and preserved migrating hydrocarbons.

PART II

GEOLOGICAL OBSERVATIONS
Bonaventure River

On September 8, 1970 Mr. C. Berry and Mr. C. J. Hadley with the able assistance of Mr. Felecian Arsenault and Mr. Michel Arsenault, began a traverse of the Bonaventure River using a canoe with an outboard motor.

The canoe was launched at the Molson Salmon Club at Ruisseau Jaune and proceeded up stream to Ile du Ruisseau Creux, working downstream and ending at the Molson Salmon Club. The stations are numbered from 1 to 15 beginning just below Ile du Ruisseau Creux and are plotted on map sheets Nos. 1, 2 and 3, Feuille No. 22 A/3 S.O., No. 22 A/3 N.O. and No. 22 A/4 N.E. respectively.

The exposures examined at stations No. 1 through No. 8 (map No. 3, Feuille No. 22 A/4 N.E.) were observed to be dark grey limestone belonging to the La Vieille; with the exception of station No. 6 which exposure consists of sandstone, coarse quartzitic, poorly sorted subrounded grains and probably Clemville in age. Structurally speaking it would appear that these rocks of La Vieille and Clemville age are exposed on the North flank of a N.E. - S.W. plunging anticline. At station No. 9 the limestone is much like La Vieille, but is very fine crystalline (possibly silty) and slightly argillaceous, fine laminated and should be included in the Gascons as shown on map No. 3. The exposures at station No. 10 are felt to be very near the crest of the anticline, consisting of dark grey limestone with much calcite veining, and infilling of natural cleavage and joints. These rocks are probably La Vieille. The crest of the anticline is illustrated on Map No. 3 as trending N.E. - S.W. immediately south of station No. 10. It seems reasonable to assume that this anticlinal

structure continues under the cover of the Bonaventure Group of rocks and is probably present immediately north of the town of Caplan.

The rocks of La Vieille age show some fossil content; mainly brachiopods. The exposure at station No. 1, is significant in that bryozoans are common, indicating near reef environment. The possibility of finding reefal developments within the La Vieille on the flanks of this anticlinal structure are good although no distinct bioherms were observed in any of the Bonaventure River exposures.

Exposures at station No. 11 through No. 14 are plotted on map No. 2, Feuille No. 22 A/3 No. and are situated on the south flank of the anticlinal structure. The rocks at station No. 11 consist of dark grey, dense, limestone probably of the La Vieille. Peter C. Badgley's geological map (1949) indicates faulting in this area, south of this outcropping, which puts rocks of the Gascons group adjacent to those of the Clemsville. The outcrop at station No. 12 could be classified as Gascons, consisting of limestone, dark grey, mottled green, intermittently grading to shale.

The Clemsville is exposed at station No. 13, consisting of a light maroon, mottled green, pebble conglomerate with interbedded maroon, mottled green, silty limestone.

The last exposure plotted on map No. 2 Feuille No. 22 A/3 No. is at station No. 14 and consists of dark grey nodular limestone of the La Vieille. All of these exposures from station No. 11 through No. 14, are on the south flank of the aforementioned anticline; the dips being approximately 32^{o} south.

One additional exposure at station No. 15, plotted on Map No. 1, Feuille No. 22 A/3 So., is also on the south flank of the anticlinal structure and consists of dark grey, silty limestone considered as belonging to the Gascons.

On September 9, 1970 the canoe was launched at the bridge, on the Bonaventure River approximately 2800' below Ruiseau Garin in Robidoux Township.

A short run was made (approximately 1 mile) upstream from the bridge to observe a few exposures of Ordovician rocks of the Honorat Group, generally consisting of dark grey, dense limestone. These rocks are at stations Nos. 16 and 17 and are not plotted on the base maps.

The first exposure of Silurian Age was encountered at station No. 18 and is plotted on map No. 4, Feuille No. 22 A/5 S.E. This exposure consists of dark grey, dense limestone, probably La Vieille, but could also be Ordovician in age. No distinctive fossil assemblages or the characteristic nodules of the La Vieille were observed.

The limestone changes somewhat at the next station (No. 19) although the attitude of the beds remains the same; dipping south at 34°. The limestone matrix is the same as at station No. 18, but now has fine interbeds of siltstone, showing cross bedding. This exposure represents a sudden change to shallow water conditions and is felt to belong to the Gascons Formation. Ordovician rocks are again exposed at station No. 20, consisting of limestone, medium grey, lithographic with a sharp conchoidal fracture, very similar to limestones encountered in the Black River Formation of Ordovician Age in the Appallachian Geosyncline.

At station No. 21 the exposure consists of medium to dark grey, limestone, very fine crystalline to probably silty, with traces of worm burrows. There are some brachiopod and coral fragments and the environment is interpreted as being shore face, probably belonging to the Gascons Formation.

The next exposure, just below the Robidoux - Hamilton Township line at station No. 22, probably belongs to the La Vieille Formation, consisting of dark grey limestone with thin bands of fossil hash, mainly brachiopods. This is the last exposure plotted on map No. 4.

Continuing downstream, the next exposures are plotted on map No. 3, Feuille No. 22 A/4 N.E. beginning with station No. 23. The exposures at station No. 23 and 24 are felt to belong to the Clemville Formation, being clastic in nature. The dip has changed to a more west south westerly direction, and would appear to indicate the termination of a breached anticlinal structure. The La Vieille is exposed at station No. 25, consisting of medium grey, fragmental limestone. The environment is obviously shallow shelf with much wave action, and possibly not too far removed from reefal growth.

The Gascons formation is well exposed at stations No. 26 and 27, consisting of grey-green siltstone. The attitude of these beds is generally the same as for the exposures of La Vieille and Clemsville, and located on the same structure.

The exposure at station No. 28 is dark grey limestone of the La Vieille, and represents the last exposure on the aforementioned structure.

There are no additional exposures of any significance beyond station No. 28 to Camp Kelly. Immediately below Camp Kelly, additional exposures of the La Vieille Formation are prominent. A shallow synclinal feature is interpreted to trend N.E. - S.W. through Ile du Portage as indicated by the attitude of the beds observed at stations Nos. 29, 30 and 31. The limestone at station No. 30 exhibited much shell debris and individual coral heads. This particular rock has a distinct petroliferous odor when freshly broken. This outcrop is approximately 3000' North of the previously discussed outcrop at station No. 1 (first day traverse) which showed excellent bryozoan fossil preservation. This environment within the La Vieille - showing solitary coral heads and bryozoan colonies is obviously shallow shelf near reef growth activity.

The second day traverse ended at station No. 31, immediately above Ile du Ruisseau Creux, the starting point for the first day traverse.

C O N C L U S I O N S

The anticlinal and synclinal features mapped by geologists for the Quebec Department of Natural Resources, are believed to carry under the cover provided by the Bonaventure conglomerate and be present north of the Town of Caplan.

The presence of solitary coral heads together with beds of bryozoa, suggest an environment close to growing reefal mounds, probably of similar magnitude to those described at Port Daniel.

SUMMARY AND RECOMMENDATIONS

Exposures of Ordovician and Silurian rocks were examined within the boundary of the Shawnee Petroleums Limited Quebec Oil and Gas permits together with some outlying exposures.

Structures as delineated on the published Province of Quebec geological maps were confirmed as trending into the permit area, consisting of anticlines and shallow synclines. In addition a limestone mudmound or reef platform appears to be present in the St. Alphonse de Caplan area.

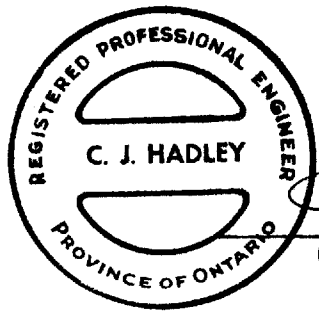
The rocks of the Chaleurs Bay Group intermittantly display faunal zones indicative of shelf conditions and near reef environment. The reefs exposed at West Point are impressive as to size and reservoir potential. In addition, beds of debris, generally crinoidal, which are present in the Cap Noir, and West Point exposures are felt to be potential reservoir traps.

The area north of the town of Caplan which has a cover of Bonaventure conglomerate, is felt to be a basinal area and should be favourable for encountering the complete Chaleurs Bay Group of rocks. Any hydrocarbon migration should have been trapped within this area. The reefal reservoirs as observed in outcrop should be present and hopefully hydrocarbon filled.

An aerial survey of the area from West Point to Caplan indicates the presence of distinct surface lineation and isolated topographic highs. The West Point reef exposures show as a series of interconnected topographic highs, generally round and moundlike. There are a number of isolated topographic highs in the general Caplan area which are possibly reflections

of structure at depth, quite possibly reefal.

It is recommended that geophysical surveys be conducted over the Caplan area within the subcrop of the Bonaventure conglomerate, to detect anomalous conditions of a reefal or anticlinal nature. Further to this it is recommended that Shawnee Petroleums Limited apply for the bordering off-shore permits in the Bay Chaleurs.



C. J. Hadley, B.Sc., P.Geol.,P.Eng.

BONAVENTURE RIVER - GASPE PENINSULA

S A M P L E L O G

SAMPLE	
Station No. 1	Limestone, dark grey, fine crystalline, bryozoans common. Trace fine pyrite and sparry calcite.
Station No. 6	Sandstone, coarse quartzitic, poorly sorted, sub-rounded grains.
Station No. 7	Limestone, grey and grey brown mottled red, fine crystalline even textured, almost sucrosic in part, brachiopods common.
Station No. 9	Limestone, dark grey, very fine crystalline, slightly argillaceous, extra finely laminated.
Station No. 15	Siltstone, greenish grey, limey, finely laminated, micromicaceous, could be classified as silty limestone.
Station No. 16	Limestone, dark grey, dense, to partially sublithographic. No evidence of fossils. Much sparry calcite infilling.
Station No. 20	Limestone, medium grey, lithographic, sharp conchoidal fracture.
Station No. 21	Limestone, medium to dark grey. Very fine crystalline to silty, trace worm burrows, some brachiopods and coral fragments. Shore face environment.
Station No. 23	Interbedded - siltstone, medium grey, limey, micaceous and limestone, dark grey, dense argillaceous, gradational to siltstone.
Station No. 24	Arkosic sandstone grit, fine medium and coarse quartz and feldspar pebbles and fragments cemented with white quartz. Interbedded with dark grey, micromicaceous mudstone. (argillaceous limestone) showing worm burrows.
Station No. 25	Limestone, medium grey to grey brown, fragmental, brachiopod fragments common, much sparry calcite infilling. Apparently represents shallow environment with much wave action. Interbedded with limestone, medium grey, finely laminated, fine crystalline.