The Saint-Flavien Natural Gas Field in Québec

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ABSTRACT

The dolomites of the Beekmantown Group (early Ordovician) are among the most attractive strata for oil and gas exploration in Québec. The subsurface dolomites has interesting petrophysical properties as much in its allochthonous as in its autochthonous sequences. The first natural gas field in the platform of the St. Lawrence Lowlands was found in Saint-Flavien. It was discovered in 1973 through exploratory work conducted by the Société québécoise d'initiatives pétrolières (SOQUIP). The field was in operation from 1980 till 1994, with a total production of 161 million m3 (5.7 bcf) of natural gas composed of 95% methane. The field structure consisted of an anticline formed by the emplacement of the Saint-Flavien thrust sheet during the Taconic orogeny. The gas reservoir is in an allochthonous sequence of the St. Lawrence Lowlands platform and is located stratigraphically in the dolomites of the Beekmantown Group, specifically in the Beauharnois Formation. The Saint-Flavien gas reservoir is located at two different levels in the Beauharnois Formation. A microcrystalline dolomite, which is cryptocrystalline in places, comprises the reservoir level located in the middle section of the Beauharnois. This horizon is characterised by an intercrystalline and vuggy porosity that varies from 3 to 15%. A complex network of fractures in this horizon has considerably increased the porosity and permeability of the gas reservoir. The producing level of the lower Beauharnois, just above the Theresa formation, is less developed than the preceding level. It is made up of a microcrystalline to cryptocrystalline dolomite that is sandy in places. The porosity varies from 3 to 6% and occurs in intercrystalline pores and open fractures. The depositional environment, the region's tectonics and the circulation of subsequent hydrothermal fluids most likely permitted the development and preservation of open fractures, thereby favouring an increase in vuggy porosity through dissolution and allowing the horizon to accumulate hydrocarbons and keep the petrophysical properties that facilitate the field's exploitation. With respect to fluid circulation, the forming of the Saint-Flavien natural gas reservoir has certain analogies with some of the geological phenomena that created the Mississippi Valley Type (MVT) lead-zinc deposits. Nonetheless, no definitive conclusions can be reached based on currently available data.

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INTRODUCTION

The search for oil and gas in Québec, primarily in the St. Lawrence Lowlands (SLLL) and the Appalachian foothills, began near the end of the 19th century. In total, 229 wells have been drilled in the palaeozoic sedimentary sequence that extends from the Cambrian to the late Ordovician. The SLLL sedimentary zone and the Appalachian foothills extend over 34,000 km^2. However, the exploration maturity of this vast sedimentary basin remains low with 1 well per 150 km^2. These prospecting programs have resulted in one discovery of natural gas, namely the Saint-Flavien field, which is located approximately 50 km south-west of Québec City (Figure 1).

The Saint-Flavien field is located in the external zone of the Appalachian geological province. The reservoir trap, which is structural in nature, is composed of a thrust-fault anticline formed by the emplacement of the Saint-Flavien thrust sheet during the Taconic orogeny. The natural gas reservoir is stratigraphically located in the dolomites of the Beekmantown Group. The Beekmantown is subdivided into two formations. At the base is the Theresa Formation which is composed of an interstratification of dolomite and quartzitic and dolomitic sandstone. The Beauharnois Formation, which is at the top and which is conformable with the Theresa, is composed of successive massive and laminated dolomites. The reservoir consists of two horizons which are found in the middle and lower section of the Beauharnois Formation. It is now agreed that the producing horizons are composed of dense dolomite with an intercrystalline and vuggy porosity varying from 3 to 15%. The distribution of the porosity and permeability seems to be controlled by fractures caused by the emplacement of the thrust-fault anticline and probably by post-Taconic tectonic adjustments. The Saint-Flavien reservoir has highly heterogeneous petrophysical properties (porosity and permeability) on a decametric scale.

The field produced natural gas from 1980 to 1994 with a total production of 161 million m^3 (5.7 bcf). There was, originally, an estimated 250 million m^3 (8.9 bcf) in the reservoir. At the start, the gas was composed of 95% methane (CH_4) with a bit of ethane (C_2H_6) and nitrogen (N_2). Given the growing need to store natural gas, the field was converted into an underground reservoir before the reserves were exhausted. The first phase of natural gas reinjection/withdrawal in the Saint-Flavien field occurred in 1998.

REGIONAL GEOLOGY

The Saint-Flavien region is located in the Appalachian geological province, and, more precisely, in the external zone. This zone is characterized by allochthonous sequences put in place by thrusting faults on the autochthonous platform of the SLLL (Figure 2). The main lithologic units of the autochthonous platform of the SLLL are as follows. At the bottom, there is the Potsdam Group sandstone which is unconformable with its Precambrian basement. It is followed by the Beekmantown dolomites, the Chazy limestone and sandstone, the Trenton-Black River limestone and the Utica black shale. All of this is covered in part by Lorraine shale and siltstone and by Queenston molasses of red shales and sandstones (Figure 3). The SLLL sequence is controlled by normal, en echelon faults that resulted from the opening of the Iapetus Ocean in the Cambro-Ordovician. The faults are unconformable in places. The allochthonous sediments of the external zone are thrust sheets of the SLLL platform. These sheets, which are more or less complete, come from the south and represent a more distal sequence of the carbonate platform. These overlapping sequences are themselves covered by the Chaudière Nappe (Cambrian) which is the distal equivalent of the Potsdam sandstone.

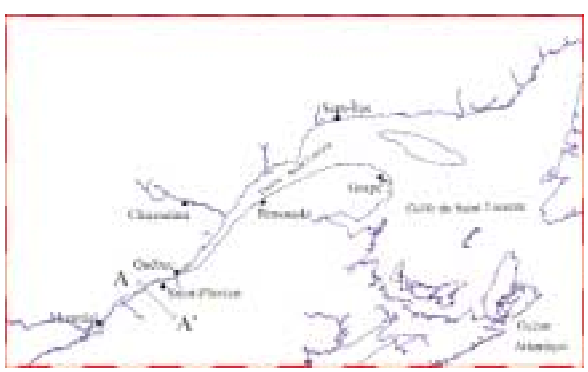

Figure 1 – Map of the location and the schematic geological cross-section A – A'

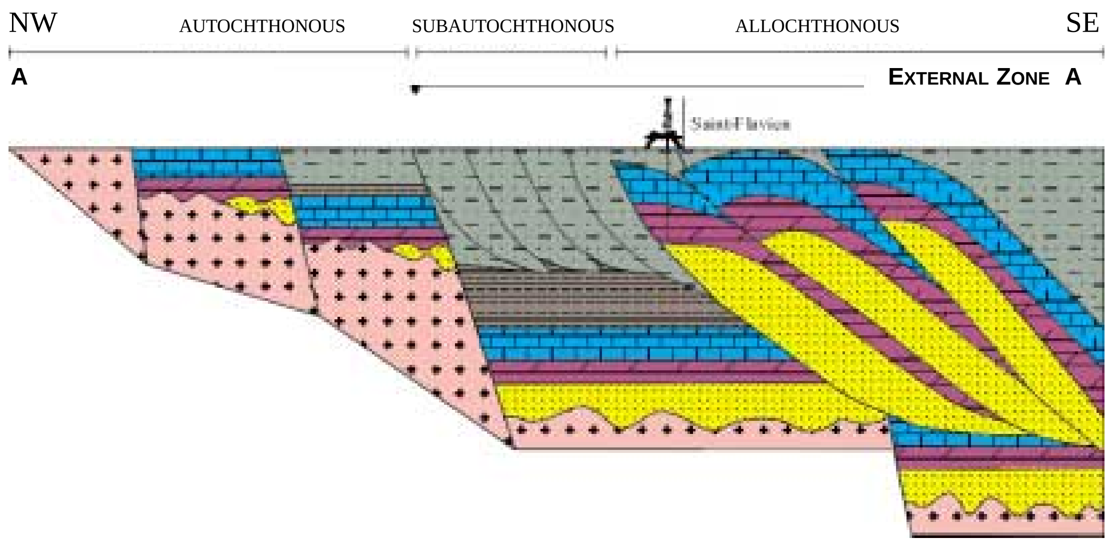

Figure 2 – Geological and tectonostratigraphical model of the St. Lawrence Lowlands sedimentary basin

From a paleogeographic point of view, the Beekmantown sedimentation was deposited in the early Ordovician on the North American craton when it was situated along the paleo-equator. At that time, the SLLL was located between latitudes 15° and 20° South. The warm tropical climate favoured the sedimentation of carbonates. The sedimentation environment of the Beekmantown at Saint-Flavien was characterized by cyclical sequences shallowing upward on the slightly inclined ramp of a shallow sea with an epeiric shelf. Mudstone to wackestone type facies are generally found in such low energy paleo-environments.

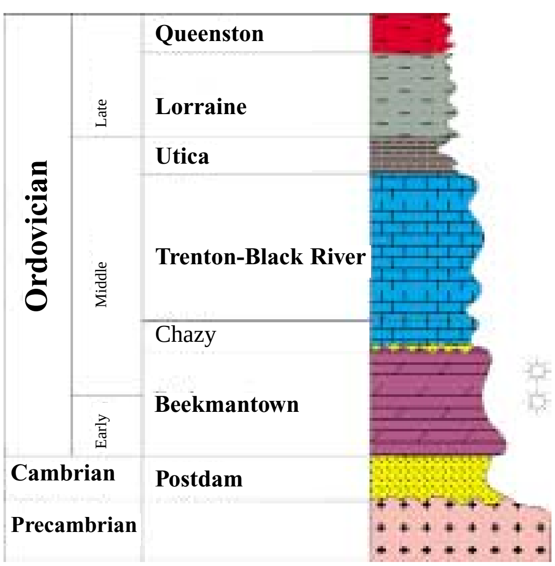

Figure 3 – Stratigraphy of the St. Lawrence Lowlands sedimentary basin and stratigraphic position of producing horizons

PREVIOUS WORK

The first phase of work in the Saint-Flavien region was part of the Shell Canada exploration program. At the end of the 1960s, Shell acquired more than 2,000 km of seismic reflection in the SLLL and Appalachian foothills. At the time, the “foothills” concept, which was popular in Western Canada, was the validated geological concept. Once the geophysical survey was complete, several targets were identified and the Shell Saint-Flavien No.1 well was drilled in 1972 (Table 1 and Figure 4). Even though there were several gas shows in this well, commercial production did not seem to be conceivable.

In 1973, SOQUIP, a Québec government corporation, farmed-in all of the lease holdings in the SLLL and the Appalachian foothills previously held by Shell. Based on this farm-in, SOQUIP drilled the first well of the lease arrangement. Only gas shows were found in this well, the SOQUIP Shell Saint-Flavien No.1 (Cèdre) well. Concurrent to this work, the SOQUIP personnel analyzed the results of the very first well drilled in the Saint-Flavien structure, the Shell Saint-Flavien No.1 well. SOQUIP decided to return to this well and make additional well logs. The analysis of these well logs showed that there was a gas horizon, and subsequent production tests established that a commercial operation was possible. This discovery lead SOQUIP to undertake a development program for the Saint-Flavien structure. However, several of the subsequent drills were unsuccessful. Indeed, wells Nos. 2, 4, 5 and 6 were dry, while the SOQUIP et al. Saint-Flavien No.3 well revealed two zones of commercially exploitable gas. Finally, in order to increase

NUMBER	MRN NUMBER	WELL NAME	LATITUDE	LONGITUDE	DEPTH (m)	STATUS
A164	1972FA164	Shell, Saint-Flavien No 1	46° 30’38,26”	71° 34’8,21”	2,376	Completed / gas
A 169	1974FA169	SOQUIP Shell, Saint-Flavien No 1 (Cèdre)	46° 29’24,47”	71° 36’19,03”	2,509	Abandoned / gas shows
A177	1975FA177	SOQUIP et al., Saint-Flavien No 2	46° 30’38,00”	71° 32’48,00”	1,817	Abandoned / gas shows
A178	1976FA178	SOQUIP et al., Saint-Flavien No 3	46° 30’21,00”	71° 34’58,00”	1,795	Completed / reinjection-withdrawal of gas
A180	1976FA180	SOQUIP et al., Saint-Flavien No 4	46° 29’52,50”	71° 34’ 0,46”	2,235	Abandoned / gas shows
A182	1977FA182	SOQUIP et al., Saint-Flavien No 5	46° 30’38,60”	71° 36’04,90”	1,589	Abandoned / gas shows
A183	1977FA183	SOQUIP et al., Saint-Flavien No 6	46°30’51,00”	71° 34’47,00”	1,951	Abandoned / gas shows
A191	1979FA191	SOQUIP, Saint-Janvier-de-Joly No 1	46° 27’58,66”	71° 37’15,80”	2,812	Abandoned / gas shows
A193	1979FA193	SOQUIP, Saint-Janvier-de-Joly No 2	46° 29’41,79”	71° 36’56,12”	1,142	Abandoned / gas shows
A200	1984FA200	SOQUIP, Saint-Flavien No 7	46° 30’28,00”	71° 34’39,00”	1,785	Abandoned / gas shows
A202	1985FA202	SOQUIP Lemaire et al., Joly No 3	46° 28’49,7”	71° 37’39,9”	1,329	Abandoned / gas shows
A215	1991FA215	SOQUIP et al., Saint-Flavien No 8	46° 30’20,30”	71° 34’57,60”	1,717	Completed / observation
A221	1993FA221	SOQUIP et al., Saint-Flavien No 9	46° 30’15,50”	71° 35’ 8,30”	1,745	Completed / reinjection-withdrawal of gas
A225	1994FA225	SOQUIP et al., Saint-Flavien No 10	46° 30’21,44”	71° 34’55,45”	2,305	Completed / reinjection-withdrawal of gas
A226	1194FA226	SOQUIP et al., Saint-Flavien No 11	46° 30’34,00”	71° 35’13,00”	1,628	Completed / observation
A227	1995FA227	SOQUIP et al., Saint-Flavien No 12	46° 30’21,75”	71° 34’51,70”	1,805	Completed / reinjection-withdrawal of gas
A228	1995FA228	SOQUIP et al., Saint-Flavien No 13	46° 30’44,00”	71° 34’ 6,00”	1,860	Completed / gas

Table 1 – List of wells drilled in the Saint-Flavien region

production in the field, well No.7 was drilled between the two producing wells, Nos. 1 and 3. This new well proved to be unsuccessful as well and led to a complete revision of the geological concept of the field. As for the producing wells, natural gas was extracted from 1980 to 1994, using a gas pipeline for well No. 1 and compressed natural gas transport for well No. 3.

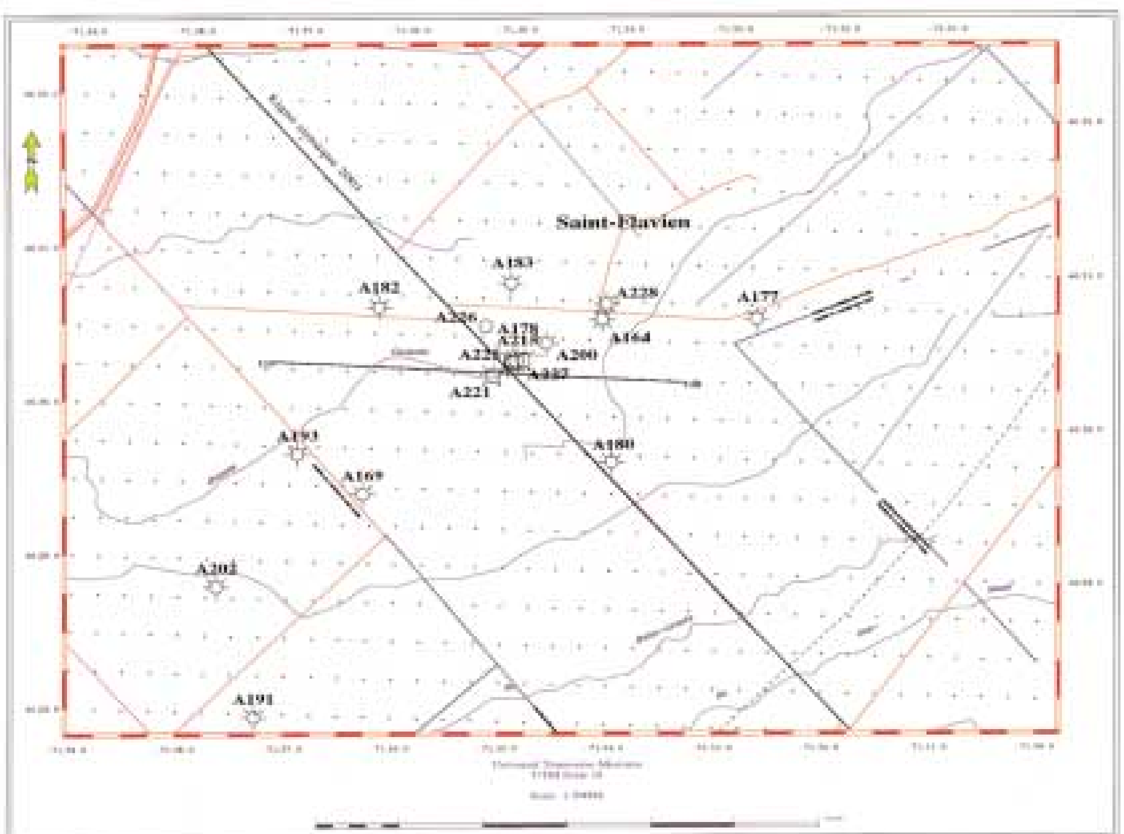

Figure 4 – Location of drilled wells in the Saint-Flavien region. Position of Québec government seismic line 2001 and east-west seismic line 110 of the Intragaz SEC 3D survey.

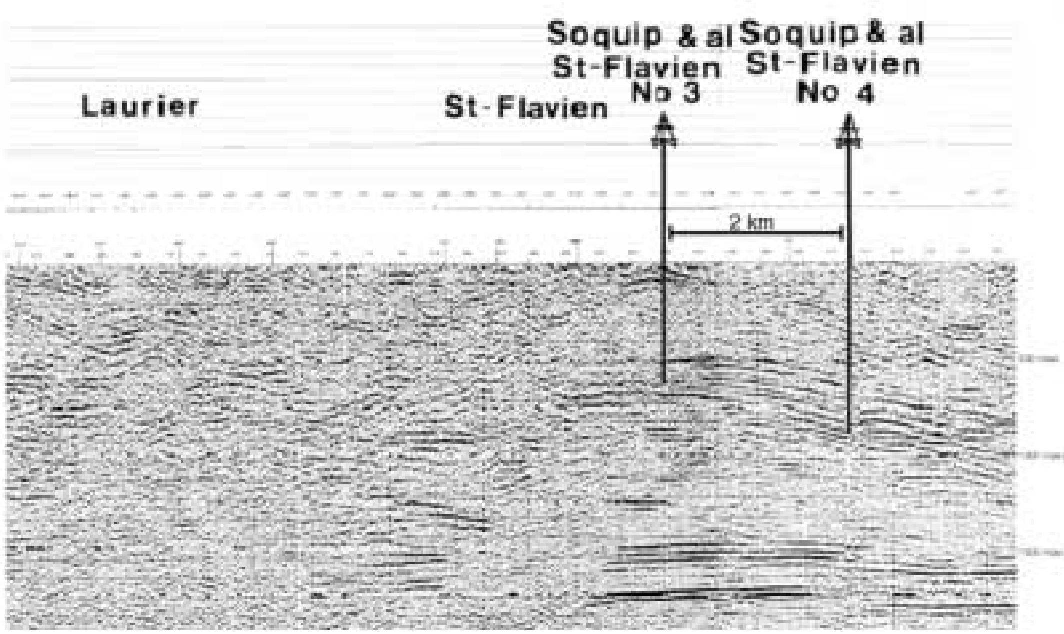

Figure 5 – Seismic reflection profile passing through Saint-Flavien, drawn from the Québec government seismic line 2001 (1978). Location of wells Nos. 3 and 4 on the structure and the seismic line shown in Figure 4

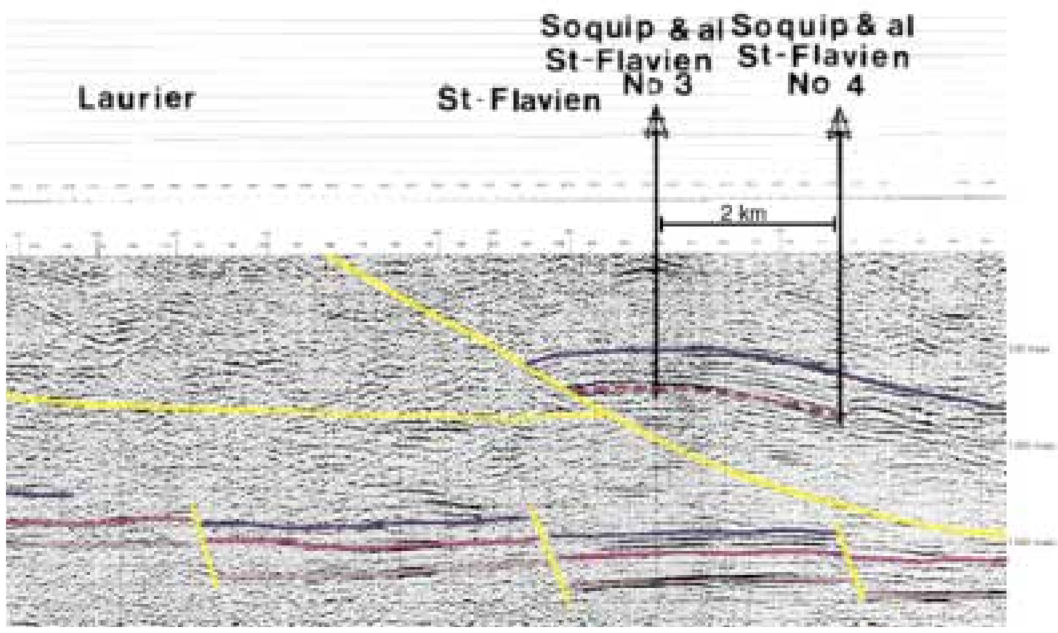

Figure 6 – Interpretation of the seismic reflection profile passing through Saint-Flavien, drawn from Québec government seismic line 2001 (1978). The main thrusting fault that forms the rollover incorporates an allochthonous sequence of the SLLL platform. The underlying autochthonous platform clearly shows the normal, en echelon faults resulting from the opening of the Iapetus Ocean.

At the beginning of the 1990s, SOQUIP gave Intragaz SEC a mandate to turn the natural gas field into an underground reservoir due to the reservoir's decrease in pressure, the depletion of the reserves and the strong demand for natural gas storage. The first work began with the drilling of well No. 8 which only had gas shows despite the fact that the subsurface projection of the well in the middle Beauharnois reservoir was no more than 300 m away from producing well No. 3. This fact demonstrates the reservoir's heterogeneous nature and complex geometry. This observation led SOQUIP to carry out a WLP (wide line profiling) seismic reflection survey in 1992. The results of this seismic survey led to the drilling of the SOQUIP et al., Saint-Flavien No. 9 well which was located so as to intercept the crest of the structure. This well hit a fractured horizon and gas in the middle level of the Beauharnois. Following these encouraging results, a 3D seismic reflection survey was conducted on the whole structure. This survey made it possible to develop a fracture-based concept and facilitated the positioning of subsequent drilling. Wells Nos. 10 to 13 were located over the whole structure so as to encounter as many fractures as possible in the reservoir. Wells Nos. 10, 12 and 13 in the Saint-Flavien field were successful and have provided suitable reservoir levels. Finally, wells Nos. 9 and 10 were stimulated to increase their productivity. The wells that are currently being used for the reinjection and withdrawal of natural gas are Nos. 1, 3, 9, 10 and 12.

Reservoir Structure

The Saint-Flavien field is structural in nature. The reservoir trap consists in an anticline formed by an allochthonous thrust sheet. Seismic profile 2001, conducted by Québec's ministry of natural resources (Figures 5 and 6), has helped in the interpretation of the geological and tectonic context of the Saint-Flavien region. The Saint-Flavien thrust-fault anticline was established tectonically through a series of overlapping thrust faultings that occurred during the closing of the Iapetus Ocean (Taconic orogeny). This tectonic event developed a system of smaller faults in the allochthonous sequence and a complex fracture network within the reservoir (Figure 7). The fractures are concentrated in the most competent horizons of successive dolomite layers and are extremely important with regard to the reservoir's porosity and permeability.

The petrophysical properties contributing to the development of the Saint-Flavien field reservoir level are very heterogeneous and irregularly distributed, varying considerably from one well to another. The fracturing of competent horizons and the presence of faults has probably determined the movement of hydrothermal fluids and, consequently, the distribution

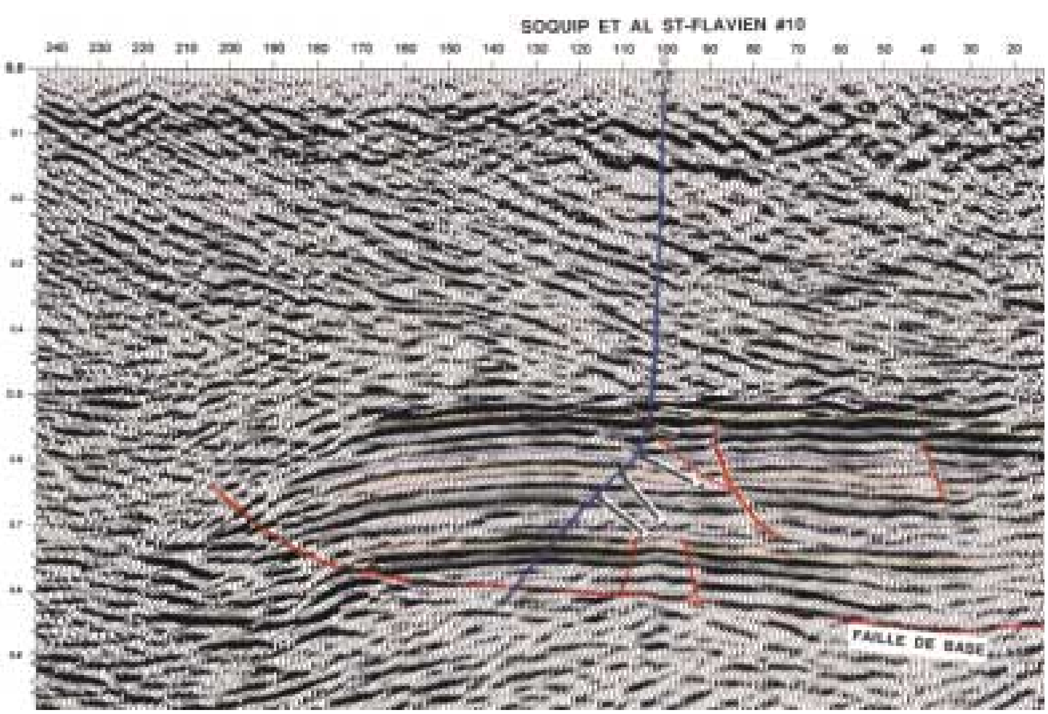

Figure 7 – Interpretation of east-west seismic reflection profile 110 developed from Intragaz SEC survey 3D. Public report No. 1993YA002

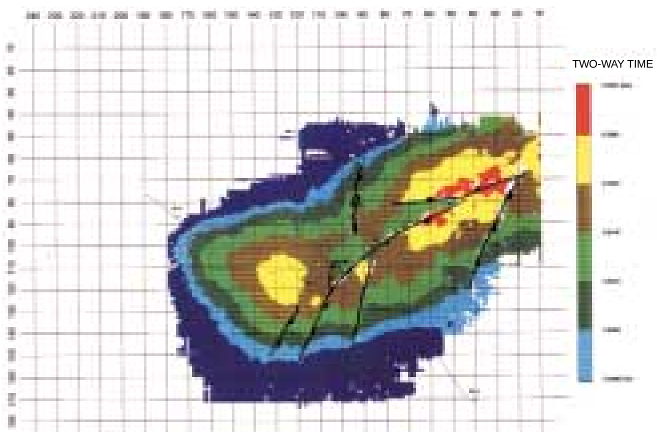

Figure 8 – Isochrone in two-way time of the top of the middle Beauharnois developed from Intragaz SEC seismic reflection survey 3D. Public report No. 1993YA002

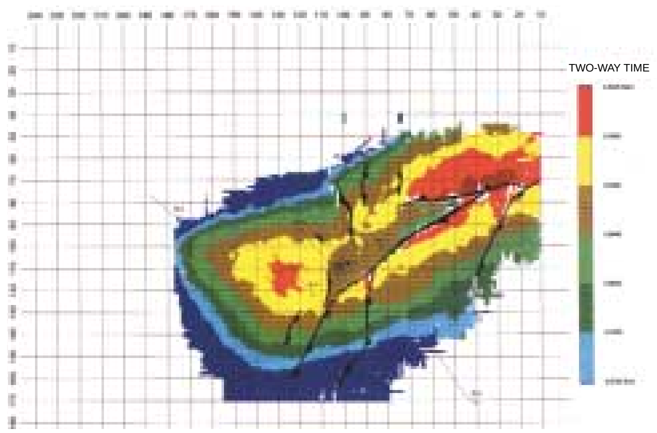

Figure 9 – Isochrone in two-way time of the top of the lower Beauharnois developed from Intragaz SEC seismic reflection survey 3D. Public report No. 1993YA002

of the petrophysical properties needed for the creation of hydrocarbon reservoirs. Moreover, the field is divided into two independent pools comprising two crest structures which influence where the producing wells are found. Wells Nos. 1 and 13 are located over the compartment in the north-east section of the structure, whereas wells Nos. 3, 9, 10 and 12 are found over the structure's south-west section (Figures 8, 9 and 10).

PETROGRAPHY

Petrographic analysis was conducted on more than 45 thin sections from producing wells. In certain cases, the porosity of the thin sections was brought out using impregnated blue epoxy. The highlights of this analysis are as follows. The producing horizons are composed of microcrystalline to cryptocrystalline dolomites which have a sucrosic texture in some places (Figures 11 and 21). The thin sections of the dolomite (Figures 14 and 22) are composed of euhedral and anhedral dolomite crystals. The dolomitization of the rock has removed the original deposit texture, with the exception of a few traces of bioclast remains (Figure 24). The three main types of porosity in the Saint-Flavien reservoir (intercrystalline, vuggy and fracture-based) were accentuated through dissolution.

Intercrystalline porosity, acquired during the dolomitization of the carbonates, is low in most of the wells, ranging from 1 to 5% (Figures 13, 14, 21 and 23). This porosity takes the form of spaces between

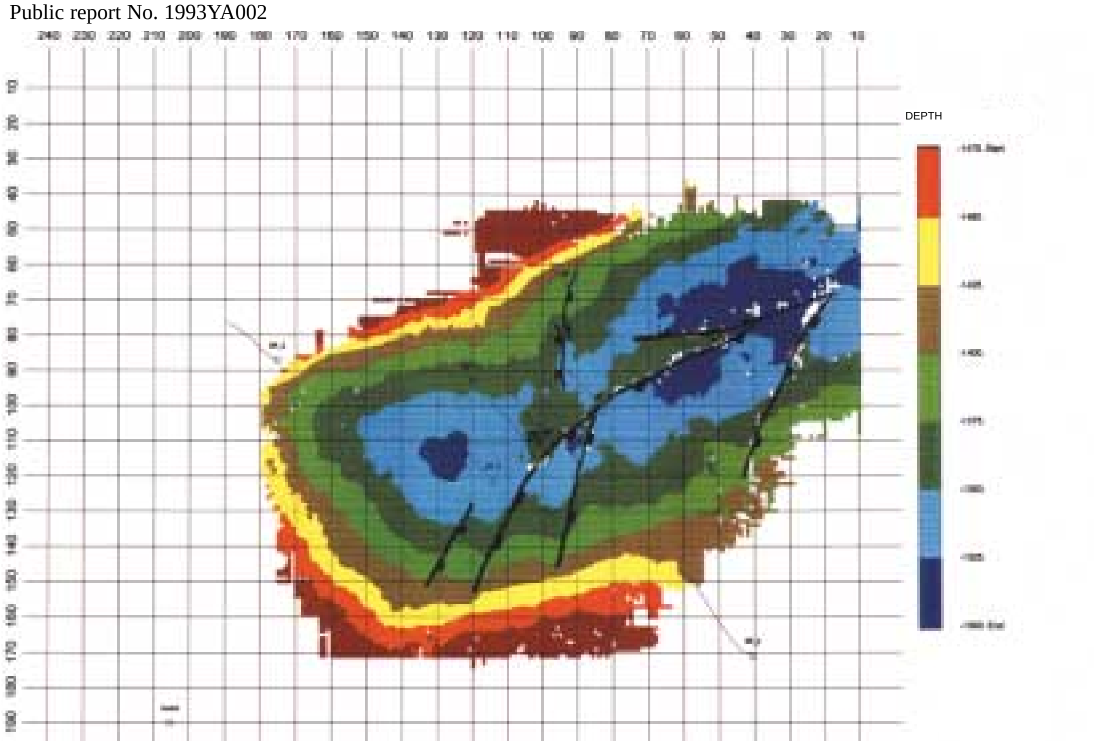

Figure 10 – Isocontour map of the depth of the top of the middle Beauharnois developed from Intragaz SEC seismic reflection survey 3D. Public report No. 1993YA002

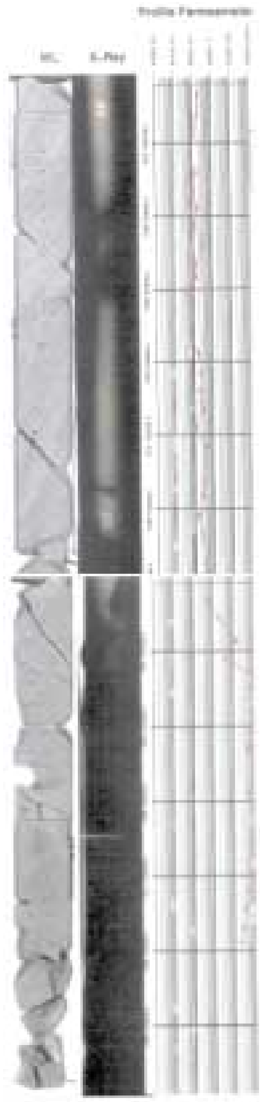

Figure 11 – Core sample from the SOQUIP et al. Saint-Flavien No. 10 well (A225), 1,549.62 – 1,550.99 m, attaining more than 15% porosity. This core shows the best visual porosity in the whole Saint-Flavien field.

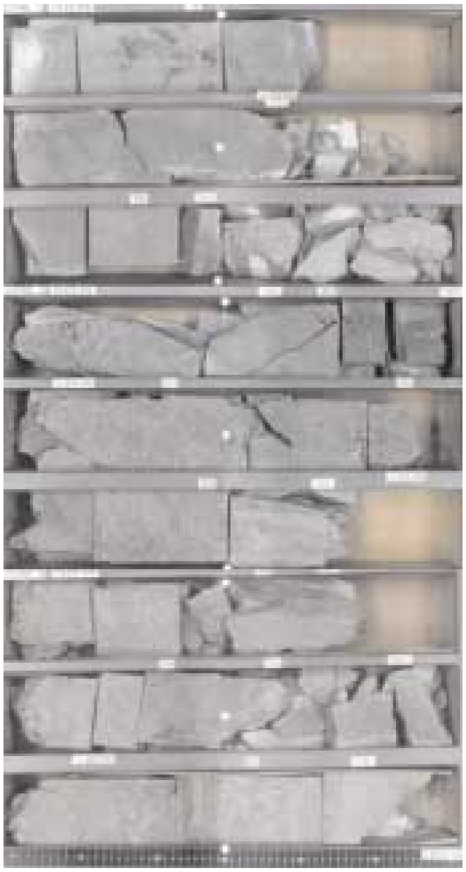

Figure 12 – Core sample from the SOQUIP et al. Saint-Flavien No. 9 well (A221), 1,522.65 – 1,526.96 m. Dolomites from the middle reservoir level directly at the top of the structure. Microfractures were observed on the bulk of the core samples.

the euhedral dolomite crystals. The Saint-Flavien No. 10 well, on the other hand, has an exceptionally well developed intercrystalline porosity of more than 10% over 1.4 m (Figures 12, 16, 17 and 18).

The vuggy porosity, which formed early in the structure's history, is distributed randomly in the samples. The vugs are dispersed in the dolomite matrix and are sometimes concentrated along fractures or the old circulation channels of partially dolomitized fluid (Figures 17, 19 and 23).

The fractures, which were caused by tectonic movement in the most competent dolomite levels during the emplacement of the Saint-Flavien thrust sheet and, possibly subsequently, bring the maximum porosity of the reservoir to more than 15%. The open fractures in certain samples allow the reservoir to maintain a suitable permeability and govern the circulation of fluid within the reservoir (Figures 15, 17, 19 and 23).

Tectonic and geochemical processes seem to be responsible for the development of secondary porosity. Dissolution phenomena at the decimetric level are found in the producing horizons, which would seem to explain the increase in porosity. The dissolution of dolomite crystals and the presence of partially filled-in channels in thin sections attest to the subsequent circulation of hydrothermal fluids in the rock's diagenetic cycle (Figures 15, 17, 18, 19, 20 and 23). These petrographic observations, gathered from the regional geological context and the geological and petrophysical qualities of the field, make it possible to draw the following parallels. The geological characteristics of the Saint-Flavien field show certain analogies with the geological phenomena that created the Mississippi Valley Type (MVT) lead-zinc deposits. These metal deposits are often associated with oil or natural gas fields in the extension of the Appalachian foreland in the United States. The analogies with the geological phenomena that created the MVT deposits include the field's position in the extension of the Appalachian foreland, the circulation of hydrothermal fluids, unconformity at the top of the Beekmantown (Sauk), surrounding dolomites rocks, and braccia feature in the core samples of the Beauharnois Formation. Nonetheless, given the absence of sulphidic minerals indicating an MVT type process (sphalerite, galena) and the absence of the characteristic white spathic dolomite found in the core samples, it is difficult to reach a definitive conclusion about this hypothesis.

The reservoir qualities of wells Nos. 1, 3, 9, 10, 12 and 13 are good to moderate, whereas, in the other wells, they are poor to tight. The reservoir, whose average depth below the surface is 1,500 m (Figure 10), has the following petrophysical properties. Its porosity varies from 2.8% to more than 15% (6% on average), its permeability from 0.1 mD to 70 mD (2 to 6 mD on average) and its thickness from 1 to 8 meters (3.5 m on average). The reservoir's initial pressure was 13,500 kPa and the water saturation, less than 15%.

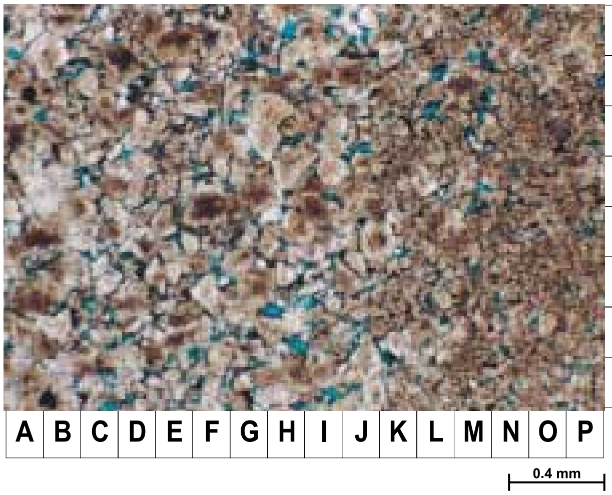

Figure 13: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 9 (A221) - 1,542.3 m (middle Beauharnois). Photomicrograph showing two distinct granulometries. To the right of the figure, a mudstone dolomite shows, to a lesser degree, intercrystalline porosity development (O-2, L-23).

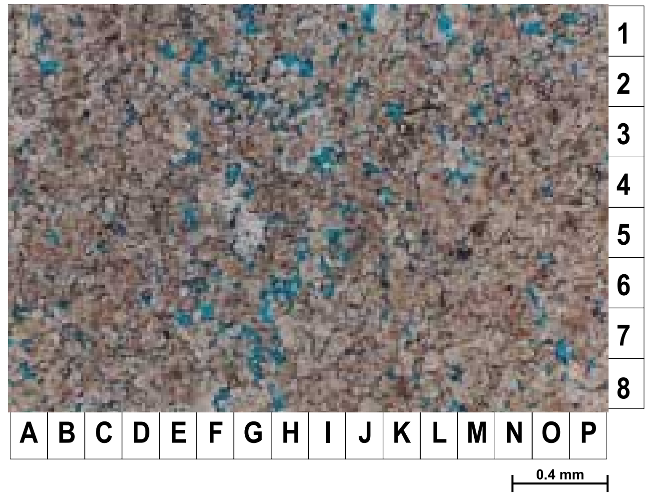

Figure 14: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 9 (A221) - 1,530.5 m (middle Beauharnois). Photomicrograph of a mudstone dolomite characterized by euhedral and anhedral crystals. There is partial development of intercrystalline porosity between these crystals (FGH-567).

Figure 15: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 3 (A178) - 1,532.3 m (middle Beauharnois). Photomicrograph showing two open fractures that favour permeability in the mudstone cryptocrystalline dolomite, with a poor to moderate intercrystalline porosity.

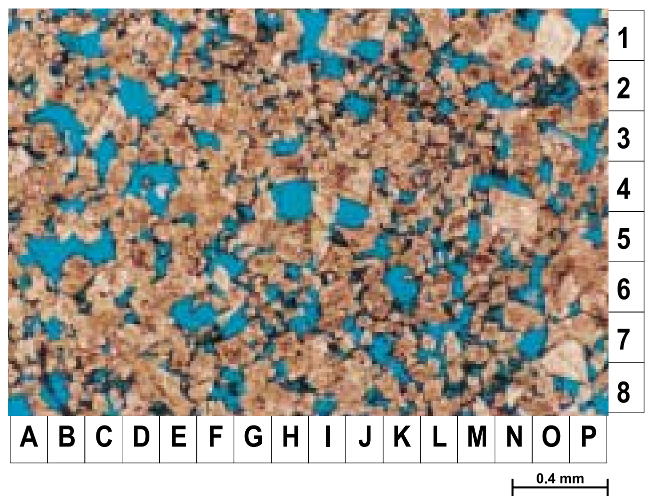

Figure 16: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,551.05 m (middle Beauharnois). Photomicrograph of a microcrystalline dolomite with euhedral crystals showing an exceptionally well-developed intercrystalline and vuggy porosity (H-4, B-5).

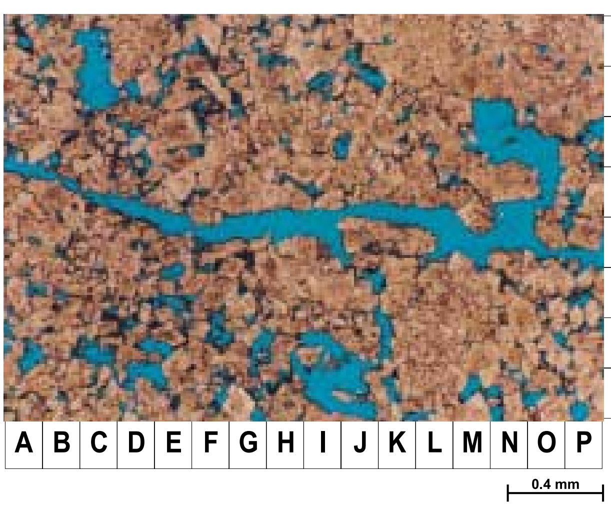

Figure 17: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,551.27 m (middle Beauharnois). Photomicrograph of a microcrystalline dolomite with euhedral and anhedral crystals. An open fracture crosses the sample (5) with dissolution along the fracture wall and on the vugs (MN-23). Intercrystalline porosity is visible at MNOP-678.

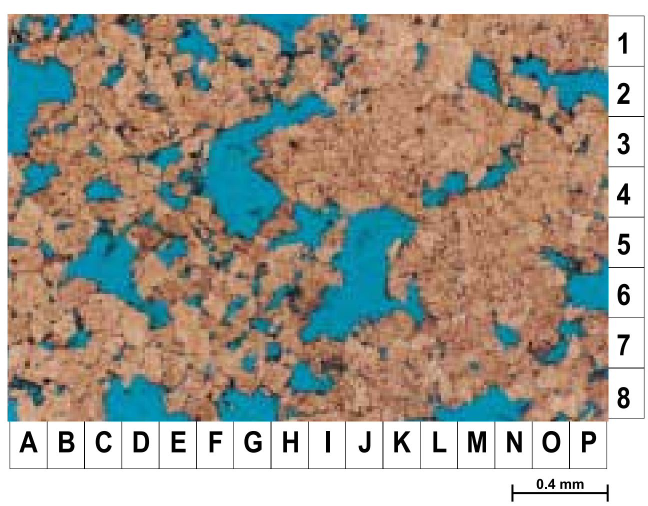

Figure 18: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,550.75 m (middle Beauharnois). Photomicrograph of a microcrystalline dolomite with euhedral crystals showing vuggy porosity that is strongly accentuated by subsequent dissolution (IJ-56). Intercrystalline porosity is visible at OP-34.

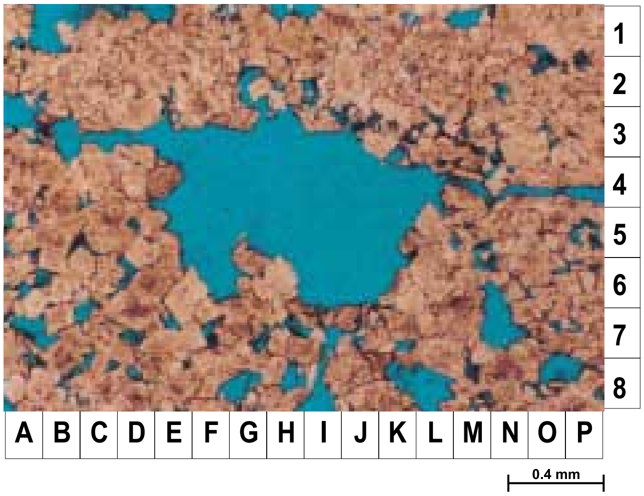

Figure 19: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,551.27 m (middle Beauharnois). Photomicrograph of a microcrystalline dolomite with essentially euhedral crystals. All three types of porosity can be seen, namely intercrystalline (O-5), vuggy (M-67) and fracture (34). The pores are accentuated by subsequent dissolution and erosion at I-6, F-6 and NOP-4.

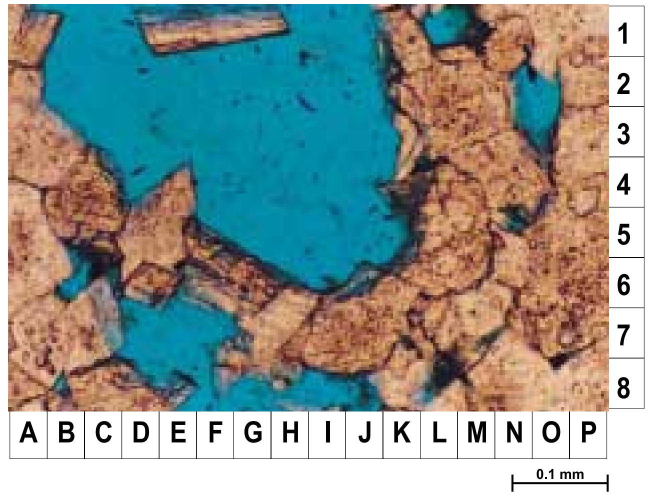

Figure 20: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,551.0 m (middle Beauharnois). Photomicrograph at a larger scale of a vug which clearly shows the effect of the dissolution/corrosion on the dolomite crystals caused by hydrothermal fluids (FGHIJ-56).

Figure 21: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,768.5 m (lower Beauharnois). Photomicrograph showing a mudstone microcrystalline dolomite from the lower reservoir level. Note the lack of development of intercrystalline porosity for this facies (GH-4).

Figure 22: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,776.75 m (lower Beauharnois). Photomicrograph showing good development of intercrystalline porosity in the lower reservoir level. Note the micritic aspect of the mudstone dolomite (O-34, K-6).

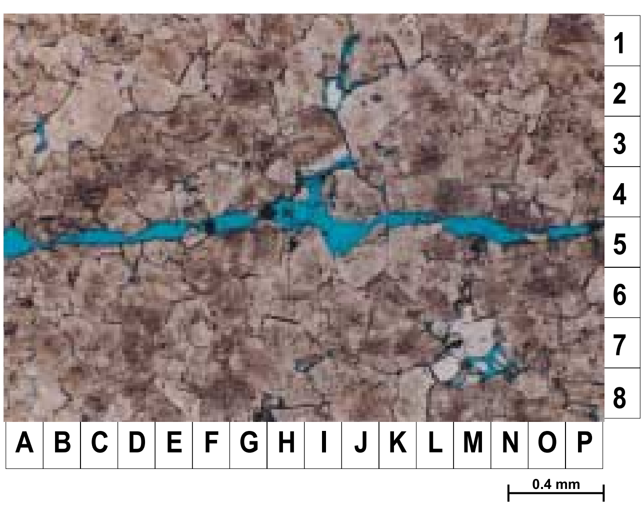

Figure 23: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,776.7 m (lower Beauharnois). Photomicrograph of a microcrystalline dolomite with anhedral crystals crossed by a fracture (4-5) displaying corrosion on the walls (L-5, C-5). Note the vug which is partially filled in with calcite at M7.

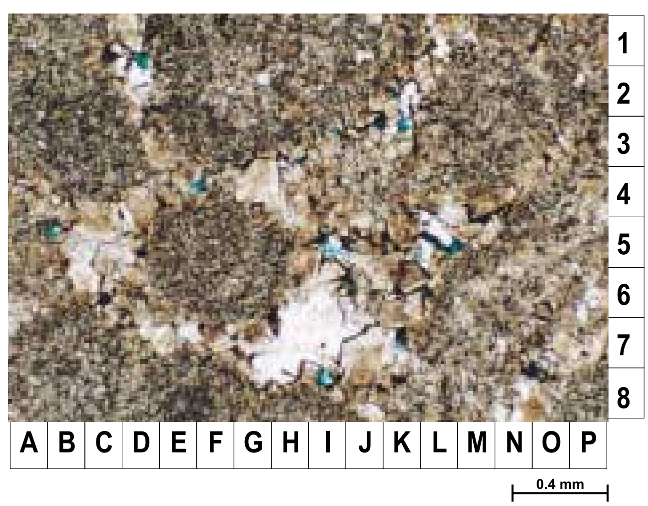

Figure 24: [P.L. 2.5X] SOQUIP et al. Saint-Flavien No. 10 (A225) - 1,771.6 m (lower Beauharnois). Photomicrograph of completely dolomitized oolite ghosts that are partially filled in with a dolomitic and calcitic cement (GHI-67). Intercrystalline porosity is visible at B5, D2, E4, I7 and K3.

CONCLUSION

The Saint-Flavien natural gas field is complex both in the way it has developed in the Québec geological context and with regard to its heterogeneousness. The emplacement of the Saint-Flavien thrust sheet through a series of thrusting faults probably created the reservoir fractures. The intercrystalline and vuggy porosity is clearly well developed in some sections. Subsequent dissolution by hydrothermal fluids has, moreover, accentuated the vuggy porosity. The well-developed intercrystalline and vuggy porosity in the dolomite strata, combined with the above-mentioned conditions, makes it possible to obtain reservoir levels that permit hydrocarbon accumulation in Saint-Flavien.

EXPLORATION GUIDE

Despite the reservoir's complex origin and geometric distribution, the Saint-Flavien field is probably not the only one in Québec. Moreover, east of the Saint-Flavien thrust sheet is the Joly structure which has a very porous and permeable reservoir and which produced the formation water found in the Beekmantown dolomites.

Since the 1960s, at least 50 overlapping thrust sheets have been mapped along the Montréal-Québec City axis and in the external zone of the geological province formed by the Appalachians. All of them have shown hydrocarbon potential. However, with the exception of the Saint-Flavien and Joly structures, only eight thrust sheets have undergone exploratory drilling. Gas shows have been present in five of these. For example, the Shell Saint-Simon No. 1 well has a flow rate of 500 mcf/d and the SOQUIP, Dome et al. Notre-Dame-du-Bon-Conseil No. 1 has a non-stabilized flow rate of 2 mmcf/d.

The keys to discovering other natural gas fields such as that of Saint-Flavien are not simple. Nonetheless, while continuing to study the origin and development of the Saint-Flavien field geometry, an analysis of the geotectonics of two outcropping thrust sheets, those of Saint-Dominique and Philipsburg, should be conducted.

Furthermore, given the wells drilled in the SLLL and surface geology, a better understanding of the stratigraphy, along with suitable paleogeographic models, would be desirable. What is more, if we are to better determine the characteristics of Saint-Flavien type reservoirs, a deeper understanding of the evolution of the spatio-temporal fracturing of the stratigraphic units in question is now essential.

In conclusion, an efficient search for other Saint-Flavien type fields would ultimately require that all of the preceding analyses and currently available geoscientific data be combined with an interpretation of a seismic reflection survey so that a map of the geological traps most likely to accumulate hydrocarbons could be drawn up.

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