3. Induction Electrical Log (to 5079)

4. Continuous Dipmeter (1884 to 4834)

Acid Solubility Analyses

At the request of Petrofina, acid solubility analyses of well samples were made at 10, 20 or 50-foot intervals beginning at 50 feet from the surface. The analyses were made by Core Laboratories, Inc. of Dallas, Texas and included "percent acid soluble in one minute" and "percent total acid solubility". These analyses are very useful when used in conjunction with the lithologic description and can assist materially in a definitive classification of rocks penetrated. Core Analyses Results are included as Appendix III.

Drilling Time

A graph of the drilling time to 5120 feet is included as Appendix II. In general, the drilling rate was slow. In the Stony Point the rate varied from 7 to 8 minutes per foot to as high as 48 minutes per foot, but the average was nearer 10-15 minutes per foot. From 1700 to 3300 feet, the drilling rate was consistently less than 10 minutes per foot. Below the Stony Point shale, the rate slowed to 20-30 minutes per foot, and some sediments required 50-55 minutes per foot drilling time. Between 4000 and 4950 feet, the average drilling rate was of the order of 35 to 50 minutes per foot. From 4950 feet to total depth (5120), the rate was averaging 60 minutes per foot or more.

No significant hydrocarbon shows were logged by Core Laboratories. Minor indications of gas were noted from time to time, but apparently nothing of commercial significance was found.

Original Objectives of Alburg No. 1 Test

In the pre-drilling phase of exploratory work in the Champlain basin, a detailed evaluation was made of all available literature in Vermont as well as for adjacent parts of New York State and the St. Lawrence Lowlands. Surface studies were undertaken in Vermont, particularly, but brief reconnaissance trips were also made into New York and Quebec. A review of all these studies revealed that it would probably be impossible to locate a single test well which would adequately evaluate all desirable objectives in the Champlain basin of Vermont.

Among the objectives to be tested were limestone reef and sandstone facies in the Chazy (Table I); the Beekmantown dolomite and sandstone facies; the Potsdam sandstone; and various pre-Potsdam Cambrian sandstones, dolomites and conglomerates known only in outcrop in the eastern part of the basin. Since the limestone reef facies of the Chazy are exposed in much of the western and southwestern portions of the basin, these facies can be tested only in the northern and eastern areas where the Chazy is covered. A similar situation also exists with the Beekmantown which is widely exposed in the western part of the basin (Fig. 3).

Sandstones assigned to the Potsdam are exposed over considerable areas in the western and northwestern portion of the basin, particularly in New York State and in Quebec. The Potsdam is covered but presumably present in the western part of the Champlain basin in Vermont and is believed to underlie Isle la Motte, South Hero, North Hero, and Alburg. Since no exact equivalent of the Potsdam is known in outcrop in northeastern Vermont, the Potsdam sandstone facies and the exact time equivalent may disappear or at least change facies between the western and eastern flanks of the basin. Based upon this concept, the farther east a well is located, the less likely it is to find the Potsdam, or its time equivalent, in a sandy facies similar to that seen in outcrops on the western flank of the basin. Some students of the region believe that the Potsdam facies becomes older to the east.

Pre-Potsdam Cambrian sediments have not been identified on the western side of the basin either in outcrop or in wells drilled to date. These rocks are known only in outcrop on the eastern flank of the basin in the so-called "thrust belt". It is considered unlikely, therefore, that a well drilled to basement near the western edge of the Champlain basin will encounter pre-Potsdam sediments. From data at hand, it is impossible to know how far these rocks may extend westward into the basin. A test well designed to penetrate the middle and lower Cambrian sequence should be located in the eastern portion of the basin, presumably east of the "thrust front". It is possible that at least some of the "thrusts" were very shallow (hundreds of feet) low-angle faults which overrode middle Ordovician shales. Although not the standard interpretation, if it is correct the Ordovician and underlying Cambrian rocks will be "in place" and can be tested without encountering thrust faults at depth on the eastern flank of the Champlain basin.

The Alburg No. 1 site, as noted above, is situated on an anticline in the Stony Point (middle Ordovician) shale. It is about six miles north and two miles east of a Chazy reef facies exposed on Isle la Motte. It is some 8 to 10 miles east of Potsdam outcrops in New York State to the west. The top of the Beekmantown is exposed below Chazyan reefs at the south tip of Isle la Motte, some 6 miles southwest of the Alburg location. It was anticipated that the entire sequence to be tested would

be covered by 1000 feet or more of middle Ordovician Stony Point shale. It was hoped that the East Alburg anticlinal fold mapped at the surface on the Stony Point would persist at depth and form a trap for any hydrocarbons present.

In summary, therefore, the objectives of the Alburg No. 1 well were to test the following on a closed anticlinal fold:

1. Chazy reef and sandstone facies
2. Beekmantown dolomite, limestone and sandstone facies
3. Potsdam sandstone

Brief Resume of Well Lithology

0 -3320 - Shale, gray to black, calcareous (percent of carbonate 40.8 minimum to 78.4 maximum, averaging 60 percent), hard, sometimes silty and micaceous. Pyrite is always present and can be abundant. Calcite is disseminated throughout the entire interval and sometimes is abundant: 10 to 20 percent from 1014 to 1029; 10 percent at 1685. Slickensides also frequently observed in shales.

Thin beds of shaly limestone occur, especially toward the base.

3320-3364 - Shale and shaly limestone as above; also limestone, dark gray to bluish black, micro-crystalline with some brown limestone, medium grained with very coarse calcite crystals (recrystallized fossils ?) and some coarse, well-rounded quartz grains.

Three fragments of Brachiopoda and one of recrystallized Bryozoan were found in this interval.

3364-3390 - Mostly limestone as above. No fossils.

3390-3420 - Limestone as above and dolomite or dolomitic limestone with coarse quartz grains.

3420-3630 - Dolomite, white micro to finely crystalline; gray brown, fine to medium crystalline; black and white (coarse recrystallization of a black microcrystalline matrix), some thin bedded gray dolomite; some sandy dolomite with coarse, well-rounded quartz grains; some shale inclusions.

Pyrite frequent and very abundant from 3550 to 3580. Some traces or outlines of fossils (3520 to 3530 and 3560), (probably dolomitized coquinoidal limestone).

Two intercalations of shale (electric log) at 3610 and 3626 to 3630. Calcite is abundant from 3600 to 3630.

3630-3680 - Mainly black, calcareous and/or dolomitic shale, hard, with some intercalations of dolomite.

3680-3715 (?) - Dolomite - white micro to finely crystalline

- gray, fine to medium crystalline

- sandy with coarse, well-rounded quartz grains

Becomes more sandy toward the base, and grading into dolomitic sandstone below 3700.

Intercalations of dolomitic black shale. Pyrite frequent.

3715-3722 - Conglomerate - with slightly dolomitic coarse sandstone matrix; pebbles not contiguous at top of the interval; very compact toward the base; diameters up to 2 inches near the top; from 1/8 inch to 1/2 inch near the base; pebbles angular near the top, less angular toward the base.

Composition of pebbles:

Conglomerate

Dolomite - white, pure, finely crystalline;

Dolomite - white, sandy (well-rounded quartz);

Dolomite - brown, medium crystals; some fragments show bedding.

3722-4290 - Sandstone, dolomitic matrix, clear to frosted, sub-round to well-rounded; medium to coarse grains, white to translucent. Some black inclusions (shale ?) toward the base.

Dolomite - sandy to very sandy, medium to coarse quartz grains, gray color. The percentage of dolomite diminishes toward the base, and the white sandstone becomes quartzitic.

White soft clay (kaolinite ?) always present -- averaging 5 to 10 percent; slickensides.

Several intercalations of black shale (3788 to 3796, 3810 to 3812, 3872 to 3876, 3900 to 3950).

4290-4330 - Sandstone, white, quartzitic, gray with black inclusions; slightly to non-dolomitic; fine to coarse grained; 10 percent of kaolinite (?).

Intercalations of black calcareous shale.

4330-4470 - Sandstone - same as above.

Black shale - same as above.

Kaolinite

Shale - gray-black, very micaceous, non-calcareous (5%)

Sandstone - red-brown, dolomitic; grading into sandy dolomite (20% at 4350); diminishing toward the base.

4470-4580 (?) Sandstone - white to translucent, quartzitic, slightly to non-dolomitic; rounded to well-rounded; fine to coarse.

Sandstone, gray as above, but with black inclusions - (Shale ?)

Dolomite, dolomitic sandstone or sandy dolomite; reddish brown.

Kaolinite (?)

Black shale

4580-5120 T. D. - Sandstone, quartzitic, slightly to non-dolomitic; fine to coarse grained; rounded to well-rounded; clear to frosty; white or gray with black inclusions (slate ?).

Traces of black calcareous shale.

Interpretation of Well Geology

Based upon preliminary examination of well cuttings and cores, it appears that the Alburg No. 1 spudded in Stony Point (Table I) and continued

TABLE I

A L B U R G A R E A

Stratigraphic Sequence Compiled from Regional Surface and Subsurface Data

GROUP		FORMATION	LITHOLOGY	ESTIMATED THICKNESS
Utica		Iberville	Non-calcareous black shale with some interbeds of silty dolomite	1000-1500'
T R E N T O N	S H A L E S	Stony Point	Calcareous shales Interbedded Shaly limestones Percent of limestone increasing downward	Total Thickness 2000-2500'
	L I M E S T O N E S	Cumberland Head	Calcareous shales Alternation Fossiliferous limestones	100 - 200'
		Glens Falls	SHOREHAM MEMBER - Thick bedded fossiliferous limestones and shaly partings	100 - 150'
			LARRABEE MEMBER - Thin-bedded fossiliferous limestone and shaly partings	
Black River		Black River	Massive to thick bedded fossiliferous limestones, fine grained to sub-lithographic	50 - 100'
Chazy		Chazy	Massive, coarse grained, very fossiliferous limestones, possibility of reefs, oolitic beds, basal sandstone (10-20')	400 - 800'
Beekmantown		Beekmantown Dolomite	Mainly dolomite. Also limestone, shale, sandstone	1000-1800'
		Theresa	Dolomitic sandstone and sandy dolomite	0 - 200'
Potsdam		Potsdam	Quartz, sandstone	1000-2000'
Middle or Lower Cambrian ??			?	?
Pre-Cambrian			Basement (granite, gneiss)	

State Vermont County Grande Isle Township Alburg
Well Operator Amer. Petrofina Well Name Alburg #1

Sample Depths	Sample Descriptions (Type, color, texture, etc.)
0'-1500	Sample Gap
1500-1510	Shale, black, very calcareous, slightly fissile, soft, tr. white calcite vein fill
1510-1520	as above
1520-1530	" "
1530-1720	" " , Note: this interval represents 19 sample envelopes.
1720-1730	" "
1730-1740	" " , absence of white calcite
1740-1750	as above
1750-1790	" " , Note: this interval represents 4 sample envelopes.
1800-1810	Shale as above, trace white calcite vein fill (two envelopes had this marking)
1810-1820	as above
1820-1850	" " , Note: 3 envelopes.
1850-1860	" " , trace slickensides
1860-1870	Shale and calcite as above
1870-1950	as above, Note: 8 envelopes.
1950-1960	Sample Gap
1960-2000	Shale and calcite as above, Note: 4 envelopes.
2000-2500	Large Sample Gap
2500-2630	Shale, black, very calcareous, slightly fissile, soft, tr. wht. calcite Note: 13 envelopes in this interval.
2630-2640	Sample Gap
2640-2690	Shale and calcite as above, Note: 5 envelopes.
2690-2700	Sample Gap
2700-2710	Shale and calcite as above
2710-2720	Sample Gap
2730-3000	Shale and calcite as above, shale almost pure, only one or two chips of calcite per envelope, Note: 27 envelopes in interval.
3000-3300	Shale as above, no white calcite, (a few have tr. white calcite) Note: 30 envelopes in this interval.
3300-3340	Shale as above, tr. wht. calcite vein fill
3340-3350	" " " , picking up limestone characteristics
3350	Limestone, shaley, black, tr. crinoid stem
3350-3370	Sample Gap
3370-3380	Limestone, gray, xtalline, 20% sh. as above (maybe cavings?)
3380-3390	Limestone, dk. gray, shaley, " " " " " "
3390-3400	80% shale, black, slightly calcareous, 20% ls., dk. gray as above
3400-3410	as above
3410-3420	80% ls. as above, 20% shale as above
3420-3430	as above, tr. pyrite
3430-3440	Dolostone, dk. gray, sandy texture, easily broken, angular xtalline (sand size) grains
3440-3450	as above
3450-3460	70% Dolst. as above, 30% siltstone, med. gray, dolomitic
3460-3470	as above
3470-3480	80% Dolst. as above, 20% shale, black, calcareous
3480-3490	as above
3490-3500	" " , shale content increasing to 50%
3500-3510	" "
3510-3520	" " , " " " above 50%
3520-3530	70% shale as above, 30% dolst. as above
3530-3540	Shale, black, tr. white calcite veinlets as above, tr. dolst.
3540-3550	80% shale as above, 20% dolst. as above
3550-3560	50% " " " , 50% " " "
3560-3570	as above
3570-3580	" " , xtalline dolostones getting finer textures
3580-3590	" " , dolostone slightly darker, tr. pyrite
3590-3600	80% shale, black, calcareous, tr. wht. calcite 20% dolostone, dk. gray, xtalline, sandy texture, tr. pyrite
3600-3610	90% shale as above, 10% dolst. as above
3610-3620	as above, tr. slickensides
3620-3630	Shale as above, tr. dolst. as above
3630-3640	" " " , tr. wht, calcite
3640-3650	as above
3650-3660	" " , tr. slickensides
3660-3670	Shale as above
3670-3680	60% shale as above, 40% dolostone, sandy, xtalline, well cemented Quartz: clear, well-rounded, course grained, in dolst. & traces
3680-3690	as above, dolst. now a darker gray
3690-3700	80% shale as above, 20% dolst. as above

State Vermont County Grande Isle Township Alburg
Well Operator Amer. Petrofina Well Name Alburg #1

Sample Depths	Sample Descriptions (Type, color, texture, etc.)
3700-3710	70% dolostone, gray, sandy, xtalline, w/ qtz., clear, angular, sand grains 30 % shale, blk., calc.,tr. wht calcite.
3718	80% shale as above, 20% sandy dolomite, no quartz
3720	as above
3724	90% shale as above, 10% shale, gray, dolomitic
3728	as above
3730	70% blk. shale as above, 10% wht. calcite vein fill, 20% dolostone as above, w/ well rounded quartz grains
3731	as above, tr. slickensides
3740	70% dolst., gray, sandy, w/qtz., rounded & angular, well cemente 30% black shale as above
3750	Sandstone, lt. gray, dolomitic, sandy texture, qtz. increasing sand grains both quartz and dolostone
3760	as above, finer grained } 10% blk. shale as above
3770	" " , }
3780	as above
3782	" "
3790	Sandstone, half becoming clear, 10% blk. shale as above
3800	Qtz. sandstone, clear, dolomitic cement, 10% sh. as above
3805	80% blk. shale as above, 20% ss. as above
3810	60% " " " " , 40% " " "
3820	80% " " " " , 20% " " "
3830	70% ss. as above, 30 % sh. as above
3840	90% sandstone, lt. gray, dolomitic, 10% sh. as above
3850	as above
3860	" "
3870	" "
3880	" " , ss. becoming clear, qtz. sand grains both rounded and angular
3890	as above
3900	" "
3910	80% ss. clear as above, 20% sh., blk, calcareous, with white calcite vein fillings
3920	as above
3930	" "
3940	" "
3950	" "
3960	" " ,trace dolomite, tan
3970	" " , no "
3980	as above
3990	" " , tr. tan dolomite
4000	" " , w/ black shale fragments scattered in the clear ss.
4000-4090	Sample Gap
4090-4095	Sandstone, clear, dolomitic, qtz. grains both rounded and angula
4095-4100	as above
4100-4110	ss. as above, 10% dolomite, white
4110-4120	" " " , tr. " , "
4120-4130	as above
4130-4140	" " , 5% blk. shale as above
4140-4150	" "
4150-4160	" " , becoming more quartzitic
4160-4170	" " , 10% blk. shale
4170-4180	ss. as above, 40% blk. shale
4180-4190	" " " , 10% " " , 10% white dolomite
4190-4200	" " " , 30% " "
4200-4210	" " " , 10% " " , 10% " " , 5% wht. calcit
4210-4220	" " " , slightly gray, tr. blk. shale, tr. white dolomite, tr. white calcite vein fill
4220-4230	ss. as above, 10% blk. shale, tr. wht. dol., tr. wht. calcite
4230-4240	as above
4240-4250	" "
4250-4260	" "

Sample Depths	Sample Descriptions (Type, color, texture, etc.)
4260-4270	Sandstone, clear and lt. gray, dolomitic cement, variable qtzitic qtz. rounded to angular, 10% black shale as above, trace white dolomite, trace white calcite as above
4270-4280	as above
4280-4290	" " , dolomitic cement increasing in black shale content
4290-4300	60% black shale as above, 40% ss. as above
4300-4310	as above
4310-4320	80% ss. as above, 20% sh. as above
4320-4330	ss. as above, again more blk. sh. content in the dolomitic cement
4330-4340	as above
4340-4350	60% sh. as above, 40% ss. as above, ss. matrix varies from clear to opaque shaley dolomite.
4350-4360	90% ss. as above (variable matrix), 10% blk. shale, tr. wht. calc
4360-4370	80% " " " " " , 20% " " , " " "
4370-4380	60% " " " " " , 40% " " , " " "
4380-4390	70% " " " " " , 30% " " , " " "
4390-4400	60% " " " " " , 40% " " , " " "
4400-4410	90% sandstone, as above, slightly finer grain size, tr. red in matrix 10% blk. shale as above
4410-4420	as above
4420-4430	60% ss. as above, no red, 30% blk. shale, 5% wht. dolomite as ab
4430-4440	70% " " " , tr. red, finer texture, 20% sh., 10% milky dol.
4440-4450	70% blk. shale as above, 25% ss. as above, 5% milky white dolomit
4450-4460	70% ss. as above, 25% blk. shale " " , 5% " " "
4460-4470	60% blk. shale as above, 35% ss. " " , 5% " " "
4470-4480	80% ss. as above,10% sh. as above, tr. milky wht. dol.
4480-4490	80% " " " ,20% " " " , " " " "
4490-4500	as above, tr. white calcite
4500-4510	90% sandstone, with distinct red in matrix, 10% sh., tr. dol, tr. calc.
4510-4520	as above
4520-4525	Sample Gap
4525-4530	as above, ss. matrix clearer, no dolomite or calcite
4530-4540	80% sandstone, pink, matrix has increase in black shale content 20% black shale as above, tr. milky white dolomite
4540-4550	as above

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