

Company: Shell Oil Co., et al

VDMR Well No: W-1432

Farm: R. J. Whetzel

Geologic Log

Samples studied and described by:

Stanley S. Johnson

Virginia Division of Mineral

Resources December 30, 1965

Well No: 1

Elevation: 1464.8 (Ground)

Total Depth: 14,176

Location: Rockingham County
25,000' S. of 38°50' Lat.
11,000' W. of 78°55' Long.

Drilling Commenced: July 8, 1965

Drilling Completed: Nov. 4, 1965

Result: Dry Hole

Geologic Log

<u>Depth</u>	<u>Thickness</u>	<u>Description</u>
0-201'	201'	No samples
201-210'	9'	Cement
210-240'	30'	Shale, gray, soft, slightly brittle.
240-320'	80'	Shale, gray, hard, brittle.
320-550'	230'	Shale, silty and siliceous in part, gray, greenish-gray, hard, brittle, slightly micaceous.
		460-467' - no sample
550-590'	40'	Shale, silty and siliceous in part, light-to dark-gray, hard, brittle, micaceous, with pyrite and quartz.
590-620'	30'	Shale, silty and siliceous in part, light-to medium-gray, some greenish-gray, hard, brittle, micaceous, with pyrite; samples contain a few fragments of sandstone and loose white quartz (vein?); sample 610-620' contains calcite in fracture fillings; and fragments of shale with slickensides.
620-790'	170'	Shale, silty and siliceous in part, light-to medium-gray, hard, brittle, and micaceous; samples 620-640' contain fragments of sandstone; sample 640-650' contains calcite in fracture fillings; samples 650-790' contain quartz, pyrite, and calcite in fracture fillings.

790-820'	30'	Shale, silty and siliceous in part, light-gray, hard, tough, slightly brittle, micaceous, with loose calcite, white sandstone, and rare coarse-grained, well-rounded, clear quartz grains; sample 810-820' contains loose vein quartz.
820-860'	40'	Shale, light-gray, hard, tough, micaceous, with loose quartz and calcite.
860-1020'	160'	Shale, silty and siliceous in part, medium-gray, hard, moderately brittle, micaceous, with pyrite; sample 860-870' contains loose pink calcite; samples 880-890', 920-930', and 990-1010' contain loose quartz; samples 990-1010' contain loose calcite.
1020-1260'	240'	Shale with sandstone; shale, silty in part, medium-gray, moderately hard, brittle, micaceous, with pyrite; sandstone, greenish-gray, some white, well cemented, fine-to medium-grained, moderately well sorted, subangular (?), siliceous, some slightly calcareous, no visible porosity, micaceous; samples contain a few fragments of clear to translucent rock crystal quartz; sample 1070-1080' contains fragments that have slickensides; sample 1160-1170' contains loose calcite; sample 1190-1200' contains sphalerite; sample 1230-1240' contains loose pyrite that occurs in crystal groups.
1260-1680'	420'	Shale, silty and siliceous in part, medium-gray, some greenish-gray, hard, tough, slightly brittle, slightly micaceous, with pyrite; samples 1260-1270' and 1400-1680' contain loose rock crystal quartz; sample 1290-1300' contains fragments of green, soft, argillaceous dolomite (?); sample 1440-1450' contain fragments of lustrous, greasy, black shale; sample 1560-1570' contains slickensides; sample 1670-1680' contains fragments of lustrous, greasy, dark-gray shale with slickensides.
1680-1710'	30'	Shale, medium-to dark-gray, some gray-green, moderately hard, micaceous, with pyrite and rock crystal quartz; dark-gray shale is lustrous, greasy, smooth, soft, with slickensides.
1710-1730'	20'	Shale, silty in part, medium-gray, hard, micaceous, with pyrite, calcite rhombohedrons, rare rock crystal quartz, and rare rounded, translucent quartz grains.
1730-1760'	30'	Shale, light-to medium-gray, some gray-green, hard, with pyrite; sample 1730-1745' contains quartz, some in flat plates with slickensides.
1760-1780'	20'	Shale, light-gray, moderately soft, with pyrite.

VDMR Well No: W-1432

1780-1880'	100'	Shale, silty and siliceous in part, medium-gray, some greenish-gray, hard, brittle, micaceous, with pyrite and loose quartz, samples 1780-1810' contain loose calcite; samples 1780-1810' contain some quartz in flat plates with slickensides; samples contain fragments of lustrous, soft, dark-gray shale.
1880-1910'	30'	Shale, light-gray, hard, brittle, slightly micaceous, with pyrite and quartz.
1910-1970'	60'	Shale, silty in part, medium-gray, greenish-gray, hard, brittle, slightly micaceous; with pyrite, quartz, and calcite.
1970-1990'	20'	Shale, light-gray, hard, brittle, slightly micaceous, with pyrite and quartz.
1990-2120'	130'	Shale, silty and siliceous in part, medium-gray, some light gray-green, hard, tough, brittle, slightly micaceous, with pyrite, quartz, and minor calcite; sample 2000-2010' contains some quartz in flat plates with slickensides; sample 2010-2020' contains some calcite rhombohedrons.
2120-2420'	300'	Shale, silty in part, dark-gray to black, many with lustrous sheen, hard, brittle, micaceous, fair to good fissility, with pyrite, quartz, and minor calcite; samples 2350-2370' contain fragments of sandstone.
2420-2790'	370'	Shale, medium-to dark-gray, moderately hard, tough, calcareous, good fissility, with pyrite, quartz, and calcite; samples 2540-2790' are not as calcareous as the preceding intervals; samples 2670-2700' contain fragments with slickensides.
2790-3110'	320'	Shale, medium-to dark-gray, some with lustrous sheen, hard, brittle, calcareous, good fissility, with pyrite, calcite, and minor quartz; samples 2980-3110' are not as calcareous as the preceding intervals; sample 3080-3090' contains fragments with slickensides; samples 3070-3100' are black.
3110-3170'	60'	Shale, dark-gray to black, some with lustrous sheen, hard, brittle, calcareous, good fissility, with pyrite, calcite, and quartz.

VDMR Well No: W-1432

3170-3250'	80'	Shale, medium-gray, hard, brittle, calcareous, fair fissility, with pyrite, minor calcite and quartz; sample 3170-3180' contains a few fragments of buff-white, hard, calcareous clay (Tioga metabentonite ? Top of Needmore Shale picked on these fragments).
3250-3340'	90'	Shale and sandstone; shale, medium-gray, hard, tough, calcareous, fair fissility, with pyrite and calcite; sandstone, white, gray-white, some clear, well cemented, medium-to coarse grained, medium- to poorly sorted, angular to sub-angular, calcareous, no visible porosity, slightly micaceous; samples contain fragments of brown-gray, siliceous sandstone with pyrite.
3340-3450'	110'	Sandstone (orthoquartzite) with minor shale; sandstone, white, some clear, well cemented, medium-grained, moderately well sorted, sub-angular, slightly calcareous, no visible porosity, slightly micaceous; shale, light- to medium-gray, light gray-green, hard, tough, brittle, slightly calcareous, with pyrite and minor calcite; samples 3420-3450' contain a greater percentage of shale than the preceding 3340-3420' interval, the shale in this interval is generally black and calcareous; the sandstone samples appear generally as loose fractured fragments of quartz or quartz grains (?); shale fragments are probably contaminates.
3450-3470'	20'	Limestone, shale, and sandstone; limestone, medium-gray, sandy, hard, siliceous in part, fine- to medium-crystalline; shale, medium- to dark-gray, hard, few fragments are slightly calcareous, with pyrite and calcite; sandstone, white, clear, well cemented, medium-grained, moderately well sorted, subangular, calcareous, micaceous, slickensides are present on shale fragments in 3450-3460' and on limestone in 3460-3470'; shale and sandstone fragments are probably contaminates.
3470-3540'	70'	Limestone, light- to medium-gray, sandy, hard, fine- to medium-crystalline, fossiliferous, with abundance of gray to white microcrystalline chert that has dolomitic inclusions, pyrite, and calcite in vein fillings; samples also contain good percentage of dark-gray, microcrystalline limestone; samples 3520-3540' are composed mainly of dark-gray limestone; samples contain fragments of shale with pyrite and some sandstone (probably contaminates.)
3540-3560'	20'	No sample

VDMR Well No: W-1432

3560-3580'	20'	Limestone, medium-gray, hard, siliceous, microcrystalline, with blue-gray chert, quartz, and calcite; sample 3570-3580' contains large quantity of iron-stained quartz in fracture fillings; samples contain fragments of gray shale (contamination ?).
3580-3620'	40'	Limestone, dark-gray, hard, siliceous, microcrystalline, with dark-gray, gray-blue, and black chert, white and clear quartz, calcite, and pyrite; samples contain a few fragments of sandstone.
3620-3630'	10'	Limestone, medium- to dark-gray, some light-gray, hard, siliceous, microcrystalline, light-gray is medium-crystalline, with black and white chert, pyrite, calcite, and quartz; sample contains a few fragments of white sandstone and black, calcareous shale (probably contamination).
3630-3730'	100'	Limestone, light- to medium-gray, hard, siliceous, microcrystalline, light-gray is fine- to medium-crystalline, with white and black chert, calcite, pyrite, and minor quartz; samples contain a few fragments of black shale (contamination ?); samples 3700-3730' contain fragments of coarse-grained limestone; sample 3690-3700' contains a few fragments of white sandstone (contamination ?); samples 3630-3730' contain a greater percentage of white chert and calcite than sample 3620-3630'; samples 3630-3730' contain a smaller percentage of black chert than present in 3620-3630'.
3730-4040'	310'	Limestone, medium-gray, some light-gray, hard, siliceous, some shaly, slightly argillaceous, slightly fossiliferous (?), microcrystalline to fine crystalline, light-gray is medium- to coarse-crystalline, with calcite, pyrite, minor quartz, black and white chert, and a few fragments of shale (contamination ?); samples 3730-3780' contain fragments of sandstone (contamination ?); sample 3750-3760' contains fragments with a pisolitic structure; chert becomes very minor after 3840' and may be contamination.
4040-4300'	260'	Limestone, medium-gray, hard, siliceous, some shaly, slightly argillaceous, slightly fossiliferous, microcrystalline to fine-crystalline, with calcite, pyrite, minor quartz, a good percentage of calcareous and non-calcareous siltstone and shale; samples contain fragments of light-gray, medium- to coarse-crystalline limestone.

4120-4130' - no sample

VDMR Well No: W-1432

4300-4500'	200'	Limestone, medium-gray, some light-gray, siliceous, some slightly shaly, very argillaceous in places, slightly fossiliferous, microcrystalline to fine-crystalline, with calcite, pyrite, minor quartz, calcareous and non-calcareous siltstone and shale; samples contain fragments of light-gray, medium to coarse-crystalline limestone; samples 4330-4350' contain slickensides; samples 4350-4440' contain a good percentage of calcite vein material; samples 4380-4450' contain a greater percentage of shale fragments and the limestone is darker in color.
4500-4730'	230'	Limestone and dolomite; limestone, light to medium-gray, hard, siliceous, slightly argillaceous, some shaly, microcrystalline to fine-crystalline, with calcite, pyrite, and minor quartz; dolomite, light-green, soft, siliceous, fine-crystalline, with pyrite; sample 4520-4530' is mostly dolomite; samples 4610-4650' contain fragments of medium-crystalline limestone and gray dolomite; samples 4680-4730' contain fragments of calcareous, gray to white sandstone; samples contain a few fragments of gray shale.
4730-4800'	70'	Limestone, medium-gray, hard, siliceous, argillaceous, shaly, microcrystalline to fine-crystalline, with calcite and pyrite; sample 4730-4740' contains fragments of sandstone; sample 4790-4800' contains a few fragments of medium-crystalline limestone that has an oolitic structure; samples contain fragments of green and gray dolomite.
4800-4810'	10'	Limestone, dolomite, and sandstone; limestone and dolomite, medium-gray, some dolomite is light-green, hard, siliceous, some shaly, microcrystalline to fine-crystalline, with calcite and pyrite; sandstone, grayish-white, light-green, red-brown, well cemented, fine-grained, dolomitic, ferruginous, no visible porosity, with pyrite and quartz; sample contains some shale; ferruginous sandstone is minor.
4810-4840'	30'	Sandstone, light-green, some red-brown and gray-white, well-cemented, fine-grained, dolomitic, ferruginous, no visible porosity, ferruginous sandstone is fossiliferous, with pyrite; samples contain fragments of gray shale; samples contain fragments of limestone and dolomite (probably contamination).

VDMR Well No: W-1432

4840-4900'	60'	Sandstone and shale; sandstone, light-green, gray-white to white, red-brown, well-cemented, fine-grained, siliceous, ferruginous, no visible porosity, with pyrite; shale, medium-gray, some dark-gray and green, hard, brittle, with pyrite; samples contain fragments of limestone with calcite and slickensides; samples contain fragments of red, calcareous shale.
4900-4930'	30'	Shale and limestone; shale, medium-gray, hard, tough, brittle, calcareous, fair fissility, with pyrite; limestone is light-to medium-gray, hard, medium-to coarse-crystalline, fossiliferous (brachiopods), with calcite and pyrite; samples contain fragments of red, green, and white sandstone.
4930-4960'	30'	Shale, light-to medium-gray, hard, tough, calcareous, with pyrite; samples contain fragments of limestone and sandstone.
4960-4990'	30'	Limestone and shale; limestone, medium-to dark-gray, some light tan-gray, hard, siliceous, fine-to medium-crystalline, some coarse-crystalline, argillaceous, some shaly, fossiliferous, with pyrite, calcite, and quartz; shale, dark-gray, moderately hard, calcareous some siliceous, with pyrite; samples contain fragments of red, green, and white sandstone.
4990-5060'	70'	Shale, silty in part, medium-to dark-gray, hard, calcareous, with pyrite; samples contain good quantity of white and clear, quartz sandstone and gray limestone fragments; samples contain rounded grains of red-brown hematite, rounded shale fragments cemented by white calcite (conglomerate?), and loose, angular quartz (orthoquartzite?) fragments.
5060-5080'	20'	Shale and orthoquartzite; shale, light-to dark-gray, light-green, light-to dark-gray is hard, some fragments slightly calcareous, silty, brittle, with pyrite, light-green is moderately soft and brittle; orthoquartzite is white, clear, well cemented, fragments are angular, some authigenic quartz overgrowths; samples contain fragments of light-green, dolomitic siltstone and gray, fossiliferous limestone with calcite; samples contain fragments of rounded hematite and ferruginous sandstone (contamination?).
5080-5120'	40'	Shale, silty and siliceous in part, light-green, hard, tough, some brittle, with minor pyrite; samples contain fragments of limestone with calcite, gray shale, and gray-white orthoquartzite (contamination?) sample 5110-5120' contains fragments of red, ferruginous sandstone (contamination?).

VDMR Well No: W-1432

5120-5170'	50'	Shale and sandstone; shale, light-green, some gray, hard, tough, slightly micaceous, with minor pyrite; sandstone, red-brown with purplish tint, moderately well cemented, very fine- to fine-grained, some medium-grained, medium well-sorted, angular, some subangular, ferruginous, slightly dolomitic, with minor pyrite; samples contain fragments of red shale and gray limestone (contamination?); samples 5130-5160' have an increase in the amount of red-brown sandstone over the light-green shale; sandstone generally occurs in loose grains and small fragments.
5170-5330'	160'	Shale, silty in part, light-green, gray, moderately hard, tough, slightly dolomitic, slightly micaceous, with minor pyrite; samples 5210-5240' have an increase in the percentage of red-brown sandstone and gray shale over the other samples in this interval; samples 5260-5330' contain fragments of white sandstone.
5330-5410'	80'	Shale and orthoquartzite; shale, light-green, light- to medium-gray, hard, tough, brittle, with minor pyrite; orthoquartzite, light-green, white, some clear, well cemented, light-green orthoquartzite (sandstone?) is slightly dolomitic; white to clear orthoquartzite has some authigenic quartz overgrowths; samples 5350-5400' contain mostly white clear, orthoquartzite, some with light-green tint; sample 5400-5410' contains a greater percentage of orthoquartzite than the other samples in this interval.
5410-5500'	90'	Orthoquartzite with shale; orthoquartzite, white to gray-white, some with light-green tint, well cemented, siliceous, no visible porosity, with minor pyrite; shale (contamination?), light to medium-gray, hard, tough, with minor pyrite and micaceous and siliceous fragments; samples contain minor fragments of white to gray-white, well cemented, fine- to medium-grained, medium-sorted, subrounded, non-porous sandstone with black inclusions.
5500-5690'	190'	Orthoquartzite, white, some gray-white and light-green, well cemented, siliceous, no visible porosity, with minor pyrite; samples 5670-5690' have a green cast and contain fragments of red-brown and gray, silty shale; samples appear as small, loose, fractured fragments.

VDMR Well No: W-1432

5690-5720'	30'	Orthoquartzite and siltstone; orthoquartzite, white, gray-white, with light-green cast, well cemented, siliceous, with minor pyrite; siltstone red-brown, sandy in part, moderately hard, argillaceous in part, slightly micaceous; samples contain fragments of red-brown shale and sandstone and gray shale.
5720-6180'	460'	Sandstone, red-brown, moderately well cemented, fine-grained, subangular to subrounded, silty, ferruginous, very slightly porous, slightly micaceous, with minor pyrite; samples contain fragments of red-brown, green, and gray, calcareous shale; samples 5870-5980' contain fragments of a less ferruginous, white, to gray-white, some clear and green, generally medium-grained, subrounded sandstone; samples 5890-5980' contain fragments of gray limestone with pyrite; samples 5980-6180' appear as loose grains and very small cemented fragments.
		6110-6120' - no sample
6180-6200'	20'	No sample
6200-6370'	170'	Sandstone, gray, blue-gray, some gray-brown, clear, very fine to fine-grained, some medium-grained, moderately well sorted, subangular to subrounded, samples 6250-6360' contain greater percentage of clear, fine-grained, subrounded to rounded loose quartz grains.
6370-6450'	80'	Sandstone and orthoquartzite; sandstone, white, gray-white, some clear, well cemented, fine-grained, moderately well sorted, subangular, some subround, no visible porosity, with rare pyrite; orthoquartzite, generally clear, some white to gray-white, siliceous; samples contain fragments of gray shale and yellow-white to buff, soft, flat, well-rounded, very calcareous material (clay?; cement?); samples 6410-6450' contain a greater percentage of white and clear quartzitic sandstone and less gray sandstone and shale.
6450-6600'	150'	Orthoquartzite and sandstone with shale; orthoquartzite, clear, white to gray, some light-green, siliceous; sandstone, clear, white, gray-white, well cemented, fine-grained, moderately well to well-sorted, subangular to subrounded, no visible porosity, slightly micaceous, with rare pyrite; shale, light-gray, moderately hard, tough, some silty, some very argillaceous, micaceous, with minor pyrite; samples contain a few fragments of red shale; <u>samples have a green cast</u> ; samples 6560-6600' contain more sandstone than the preceding 100 feet and contain an increase in gray

(con't.)

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sandstone; samples 6520-6600' contain white sandstone that is calcareous; sample 6590-6600' contains a few fragments of limestone; samples contain a few fragments of yellow-white to buff, soft, flat, well-rounded, very calcareous material (clay ?; cement ?).

³⁰
6600-6640'

~~30~~
~~40~~

Sandstone and shale; sandstone, gray to gray-white, some clear and light-green, moderately cemented, very-fine to fine-grained, calcareous, slightly micaceous; shale, silty and siliceous in part, medium-gray, some dark-gray, hard, brittle, tough, some fragments are slightly calcareous, with rare pyrite.

(6630-6640') - no sample

6640-6790'

150'

Shale with sandstone; shale, silty, dark-gray, some medium-gray, hard, brittle, with calcite in vein fillings, and pyrite; sandstone, gray to gray-white, light-green, clear, well cemented, very fine-to fine-grained, dolomitic, slightly micaceous, with rare quartz; sample 6660-6670' contains slickensides on quartz vein fillings; samples 6710-6790' contain fragments of light gray-tan, micro-crystalline to medium-crystalline, siliceous, fossiliferous limestone; samples 6720-6740' contain some shale fragments that are slightly calcareous.

6790-6860'

70'

Shale with minor limestone; shale, silty in part, dark-gray, hard, siliceous, slightly calcareous, with pyrite, quartz, and calcite; limestone is light to medium-gray, gray-tan, moderately hard, fine to medium-crystalline, siliceous, fossiliferous with pyrite and calcite.

6860-6970'

110'

Shale with minor limestone; shale, silty, dark-gray to grayish-black, moderately hard, tough, calcareous, fossiliferous, with pyrite; limestone, medium-to dark-gray, some gray tan and gray-white, moderately hard, fossiliferous (some crinoids), some slightly siliceous, very fine to coarse-crystalline, with pyrite, minor calcite, and some quartz.

6890-6900' - no sample

6940-6950' - no sample

VDMR Well No: W-1432

6970-7240'	270'	Shale, silty, dark-gray to grayish-black, moderately hard, tough, calcareous, fossiliferous, with pyrite, rare calcite in vein fillings, and rare quartz; samples contain a few fragments of limestone; sample 7090-7100' contains a few fragments of rock crystal quartz; sample 7210-7220' contains more limestone than preceding samples in this interval.
7240-7250'	10'	Shale with limestone; shale, silty, dark-gray to grayish-black, moderately hard, tough, calcareous, with pyrite and calcite; limestone, dark-gray to tan-white, moderately hard, fossiliferous, fine-to coarse-crystalline, with pyrite and calcite.
7250-7330'	80'	Shale with very minor limestone; shale, silty, dark-gray to grayish-black, moderately hard, tough, calcareous, with pyrite and calcite in vein fillings; limestone, dark-gray to tan-white, moderately hard, fossiliferous, fine-to medium-crystalline, a few are coarse-crystalline; with pyrite and calcite, samples 7310-7330' contain limestone that is light-gray and microcrystalline.
7330-7350'	20'	Shale, silty, dark-gray to grayish-black, moderately hard, tough, calcareous, fossiliferous, with pyrite and calcite.
7350-7640'	290'	Shale with minor limestone; shale, silty, dark-gray to grayish-black, moderately hard, tough, calcareous, fossiliferous, with calcite in vein fillings and pyrite; limestone, light-gray to tan-white, moderately hard, fossiliferous, fine-to coarse-crystalline; with calcite in vein fillings and pyrite; samples 7560-7640' contain a greater percentage of calcite as vein fillings than preceding intervals.
7640-7680'	40'	Shale, silty and siliceous in part, dark-gray to grayish-black, moderately hard, tough, calcareous, with pyrite, calcite in fracture fillings, and fragments of fossiliferous limestone; sample 7670-7680' contains a few rock crystal quartz fragments; samples have clear crystals (?) of gypsum (?) on shale partings; samples have a good percentage of calcite fracture fillings.
7680-8180'	500'	Shale, silty in part, dark-gray to grayish-black, moderately hard, tough, calcareous, with calcite in fracture fillings, pyrite, and fragments of limestone; samples have clear crystals (?) of gypsum (?) on shale partings.

VDMR Well No: W-1432

8180-8200'	20'	Shale, silty and sandy in part, dark-gray to grayish-black, moderately hard, tough, calcareous, with calcite in fracture fillings, pyrite, and fragments of limestone; samples have clear crystals (?) of gypsum (?) on shale partings.
8200-8660'	460'	Shale and limestone; shale, silty in part, dark-gray to grayish-black, moderately hard, tough, calcareous, with calcite in fracture fillings and pyrite; limestone is gray, gray-white, tan-white, moderately hard, fossiliferous, fine-to medium-crystalline, with calcite and pyrite; sample 8450-8460' contains a few fragments of light-green sandstone; sample 8610-8620' contains some fragments with slickensides.
8660-8690'	30'	Limestone with shale; limestone, gray, gray-white, tan-white, moderately hard, fossiliferous, generally fine-crystalline, with calcite and pyrite; shale, silty in part, dark-gray to grayish-black, moderately hard, tough, calcareous, with calcite in fracture fillings and pyrite.
8690-8720'	30'	Shale and limestone; shale, silty in part, dark-gray to grayish-black, moderately hard, tough, calcareous, with calcite in fracture fillings and pyrite; limestone, gray, gray-white, tan-white, moderately hard, fossiliferous, generally fine-crystalline, with calcite and pyrite.
8720-8870'	150'	Limestone (mostly calcilutite) with shale; limestone, gray, light brownish-gray, tan-white, moderately soft, microcrystalline to very fine-crystalline, argillaceous, with calcite and minor pyrite; shale (contamination?), silty in part, dark-gray to grayish-black, moderately hard, tough, calcareous, slightly argillaceous, with calcite in fracture fillings and pyrite.
8870-8900'	30'	Shale, dark-gray, hard, tough, calcareous, with calcite in fracture fillings and pyrite; samples contain fragments of limestone and a few fragments of white to light-green sandstone.
8900-9090'	190'	Limestone, dark-gray, moderately hard to hard, dense, slightly fossiliferous, very-fine to fine-crystalline, some medium-crystalline (gray-tan to gray), argillaceous, with calcite in fracture fillings and pyrite; samples contain fragments of shale; samples 9040-9080' contain limestone with polished surfaces; samples 9070-9090' contain some brownish-gray, microcrystalline limestone (calcilutite).

VDMR Well No: W-1432

9090-9610'	520'	Limestone, medium-gray, gray, light brownish-gray, moderately hard, microcrystalline to fine-crystalline, argillaceous, with calcite, minor pyrite, and rare rock crystal quartz, samples contain some fragments that are slightly fossiliferous, medium- to coarse-crystalline, and slightly siliceous; samples 9180-9240' are mostly calcilutite; samples 9290-9450' contain fragments of gray, dolomitic shale; samples 9450-9490' contain shale fragments; samples 9580-9610' are mainly dark-gray and microcrystalline.
9610-9690'	80'	Limestone (calcilutite), light gray-white, light brownish-gray, some light- to dark-gray, moderately soft, microcrystalline, dense, argillaceous, with calcite, pyrite, and rare rock crystal quartz; sample 9610-9620' contains good percentage of gray limestone, New Market-Beekmantown contact is in this interval.
9690-9870'	180'	Dolomite with limestone; dolomite, light- to medium-gray; hard, microcrystalline to very fine-crystalline, slightly siliceous, with rare pyrite; limestone, mainly light- to medium light-gray, some dark-gray, moderately hard, microcrystalline, slightly argillaceous, with calcite and rare pyrite; samples contain fragments of New Market type limestone and a few fragments of white sandstone, rock crystal quartz, and gray shale.
9870-9890'	20'	Dolomite, medium light-gray to dark-gray, hard, microcrystalline, slightly siliceous, some argillaceous, with rare pyrite; samples contain fragments of light-gray and tan-gray limestones with calcite.
9890-9950'	60'	Dolomite with limestone; dolomite, medium-gray, hard, microcrystalline to very fine-crystalline, slightly siliceous, with rare pyrite; limestone is light to medium-gray, moderately hard, microcrystalline, some slightly siliceous and argillaceous, with calcite and rare pyrite; samples 9920-9930' and 9940-9950' contain a good percentage of light-gray dolomite; sample 9930-9940' contains fragments of light-green sandstone.
9950-10,290'	340'	Dolomite, light- to medium-gray, mainly medium-gray, hard, microcrystalline to fine-crystalline, some medium-crystalline, slightly siliceous, shaly, with calcite in fracture fillings and rare pyrite and rock crystal quartz; sample 10,270-10,280' contains some very light-gray dolomite.

9990-10,000' - no sample

VDMR Well No: W-1432

10,290-10,300'	10'	Limestone, medium-gray, moderately soft, micro-crystalline, argillaceous, shaly, with minor pyrite; sample contains fragments of calcareous, extremely fine-grain, porous, platy, iron-oxide stained material with bubbly appearance on the surface (flat-pebble conglomerate?); fragments with slickensides, and a few fragments of sandstone.
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10,300-10,320'	20'	Dolomite and limestone, light to medium-gray, moderately hard, microcrystalline, shaly, argillaceous, with calcite and dolomite in fracture fillings and pyrite.
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10,320-11,480'	1160'	Dolomite, slightly calcitic in part, mainly medium dark-gray, some very light-gray, very light-gray is soft, very fine-to fine-crystalline, some medium-crystalline, some slightly siliceous, shaly, with rare pyrite; medium dark-gray is hard, siliceous, shaly, argillaceous, microcrystalline (?), with minor calcite and dolomite in fracture fillings and rare pyrite, some of this medium dark-gray dolomite may possibly be called a dolomitic shale; samples contain fragments of gray limestone; samples 10,550-10,820' contain an increase in medium-crystalline dolomite; sample 10,800-10,810' contains fragments with slickensides; samples 10,590-10,620' and 10,800-10,820' contain fragments of calcareous, extremely fine-grain, porous, platy, iron-oxide stained material with bubbly appearance on the surface (flat-pebble conglomerate?); sample 10,810-10,820' contains fragments of white and light-green sandstone; sample 10,940-10,950' contains greater percentage of limestone; sample 11,140-11,150' contains a few fragments that are fossiliferous; samples 11,160-11,280' contain a good percentage of limestone.
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10,370-10,380' - no sample
 10,390-10,400' - no sample
 10,730-10,740' - no sample

11,480-11,760'	280'	Dolomite, slightly calcitic in part, very light-gray to medium dark-gray; very light-gray is soft, fine-to coarse-crystalline, some slightly siliceous, shaly, with rare pyrite; light-gray is hard, medium-to coarse-crystalline, siliceous, shaly, with rare pyrite; medium dark-gray is hard, microcrystalline (?), argillaceous, shaly, with calcite and dolomite in fracture fillings and pyrite, some of this dolomite may possibly be called a dolomitic shale; samples contain fragments of limestone and
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(con't.)

(con't.)

sandstone; samples 11,580-11,590', 11,700-11,710', and 11,720-11,730' contain fragments that are fossiliferous; samples 11,680-11,740' contain fragments of calcareous, extremely fine-grain, porous, platy, iron-oxide stained material with a bubbly appearance on the surface, (flat-pebble conglomerate?); samples 11,670-11,700' and 11,740-11,750' contain well rounded quartz grains in a few fragments of the very light-gray dolomite, these samples also contain a few fragments of rock crystal quartz.

11,490-11,500' - no sample

11,760-11,790' 30'

Dolomite with limestone; dolomite is very light-gray to medium dark-gray; very light-gray is moderately soft, fine-crystalline, shaly, with rare pyrite; light-gray is hard, medium-to coarse-crystalline, siliceous, shaly, with rare pyrite; medium dark-gray is hard, microcrystalline (?), argillaceous, with calcite in fracture fillings and pyrite, some of this dolomite may possibly be called a dolomitic shale; limestone is medium-gray, moderately soft, microcrystalline to fine-crystalline, argillaceous, with calcite; sample 11,760-11,770' contains a few fragments that are fossiliferous; samples 11,770-11,790' contain fragments of chert, rock crystal quartz, and minor sandstone.

11,790-11,800' 10'

Limestone, medium-gray to medium dark-gray, hard, microcrystalline to fine-crystalline, some medium-crystalline, argillaceous, with calcite in fracture fillings and minor pyrite; sample contains fragments with slickensides; sample contains fragments of dolomite and calcareous, extremely fine-grain, porous, platy, iron-oxide stained material with a bubbly appearance on the surface (flat-pebble conglomerate?).

11,800-12,300' 500'

Dolomite, slightly calcitic in part, very light-gray to medium dark-gray; very light-gray is soft to hard, medium-to coarse-crystalline, slightly siliceous, shaly, with pyrite and calcite; medium dark-gray is hard, microcrystalline (?), siliceous, argillaceous, with calcite, some of this dolomite may possibly be called a dolomitic shale; samples contain fragments of brownish-gray to medium-gray, microcrystalline to fine-crystalline limestone with calcite fracture fillings; many samples contain a few fragments of calcareous, extremely fine-grain,

(con't.)

VDMR Well No: W-1432

(con't.)

porous, platy, iron-oxide stained material (contamination?); sample 11,830-11,840' contains fragments of rock crystal quartz and chert; samples 11,920-11,970' are a slightly calcareous dolomite; samples 12,280-12,300' are darker in color; samples 12,280-12,290' and 11,920-11,950' contain fragments of limestone that are fossiliferous.

12,200-12,210' - no sample.

12,300-12,700'

400'

Dolomite, slightly calcitic in part, very light-gray to medium dark-gray; very light-gray is hard, medium-to coarse-crystalline, siliceous, shaly, some sandy and oolitic, with calcite and dolomite in fracture fillings and pyrite; medium dark-gray is hard, siliceous, argillaceous, some sandy and oolitic, with calcite and dolomite in fracture fillings, and rare pyrite; samples contain a few fragments of oolitic chert cemented with siliceous dolomite and fragments of dolomitic, white sandstone; samples 12,300-12,320' contain black chert; sample 12,320-12,330' contains black, dark-gray, and white chert; sample 12,330-12,340' contains only dark-gray chert; sample 12,670-12,680' contains a few fragments that are fossiliferous.

12,600-12,610' - no sample

12,700-12,710'

10'

Dolomite with sandstone; dolomite light-to medium-gray, moderately hard, fine-to medium-crystalline, siliceous, shaly, slightly argillaceous, with calcite and dolomite in fracture fillings and pyrite; sandstone, white, moderately cemented, fine-to medium-grained, well sorted, subrounded to rounded, dolomitic, very slightly porous.

12,710-13,010'

300'

Dolomite, light-to medium-gray, moderately hard, generally fine-crystalline, siliceous, shaly, argillaceous, some sandy and oolitic fragments in 12,710-12,890', with calcite and dolomite in fracture fillings and minor pyrite; samples contain a few fragments of limestone and sandstone (contamination); samples 12,800-12,810' and 12,820-12,830' contain a few fragments of white chert; samples 12,910-12,940' contain mostly dark-gray calcareous dolomite, dolomite, and fragments of flat-pebble conglomerate.

12,720-12,730' - no sample.

VDMR Well No: W-1432

13,010-13,160'	150'	Limestone, siliceous in part, generally medium dark-gray, hard, microcrystalline to very fine-crystalline, shaly, slightly argillaceous, with calcite and calcite in fracture fillings and rare pyrite; samples contain fragments of dolomite (contamination ?), sample 13,070-13,080' contains a few fragments of sandstone; sample 13,150-13,160' contains a few fragments with slickensides and is darker gray.
13,160-13,830'	670'	Limestone, medium dark-gray to dark-gray, hard, mostly microcrystalline, some very fine-crystalline, slightly siliceous and argillaceous, some shaly, with calcite and calcite in fracture fillings, and rare pyrite; samples 13,210-13,270' and 13,300-13,330' contain a few fragments with dark-gray chert; samples 13,270-13,480' are mainly medium dark-gray; sample 13,370-13,380' contains fragments with slickensides; samples 13,480-13,530' are mainly dark-gray and microcrystalline; samples 13,670-13,790' are mainly medium-gray with some tan-gray fragments.
13,830-13,840'	10'	Dolomite, medium-to dark-gray, hard, slightly siliceous, argillaceous, with calcite; sample contains a few fragments of tan-gray limestone.
13,840-13,860'	20'	Dolomite and limestone; dolomite is medium-to dark-gray, hard, slightly siliceous, argillaceous, shaly, with calcite in fracture fillings; limestone is light-gray, tan-gray, moderately hard, microcrystalline, slightly argillaceous, shaly, with calcite in fracture fillings.
13,860-13,900'	40'	Limestone with dolomite; limestone, dolomitic in part, very light-gray to medium light-gray, tan-gray, moderately hard, microcrystalline, slightly argillaceous and shaly, with calcite in fracture fillings and minor pyrite; dolomite, medium light-gray to medium-gray, hard, slightly argillaceous, some shaly, with calcite in fracture fillings.
13,900-13,910'	10'	Limestone, dolomite, and shale; limestone, medium-gray, some tan-gray, moderately soft, microcrystalline, slightly argillaceous; dolomite, medium-to dark-gray, hard, argillaceous, shaly; shale, dark-gray, moderately hard, brittle, platy, dolomitic, with rare pyrite; sample contains a few fragments of flat-pebble conglomerate.

VDMR Well No: W-1432

13,910-14,176'

266'

Limestone, with dolomite; limestone, dolomitic in part, very light-gray to medium light-gray, tan-gray, moderately hard, microcrystalline, slightly argillaceous and shaly, with rare pyrite and calcite in fracture fillings; dolomite, medium light-gray to medium-gray, hard, slightly argillaceous, some shaly, with calcite in fracture fillings and rare pyrite.

Comments:

In the lower Middle Ordovician sequence, questions as to the stratigraphic order may arise. Possible alternate interpretations are:

- (1) At 8720-8870' a sliver of New Market Limestone could be faulted into the Martinsburg; thus making the 8870-8900' sequence Martinsburg, and overlying what may be called the Edinburg Formation; this faulting may account for a thin sequence of Edinburg and the total absence of the Lincolnshire Formation.
- (2) The sequence could read from the bottom of the Martinsburg to top of Beekmantown as:

8720-8870'	McGlone Formation
8870-9610'	Big Valley Formation
9610-9690'	Lurich Formation Five Oaks Member