CORRELATION OF THE FALKIRK AND FIDDLERS GREEN MEMBER OF THE BERTIE FORMATION

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The Bertie formation of New York, according to Rickard (1962, p. 17-22), consists of the following members:

*Western New York	Central New York
Williamsville	Oxbow (new name by Rickard)
Scajaquada	Forge Hollow (new name by Rickard)
Falkirk	Fiddlers Green

He recognized that the members in western New York may correlate with those in central New York but, because this had not been demonstrated due to a covered interval between, he preferred to give them different names.

To try to help resolve this problem of correlation, the writer (Craft 1963) undertook a field and laboratory study of the Falkirk (Chadwick, 1917) and Fiddlers Green (Hopkins, 1914) members throughout most of their extent in the state. Observations also were made on adjacent members.

Numerous exposures of the Falkirk and Fiddlers Green members were examined and measured between Bertie, Ontario and Sharon, New York, and suites of samples were collected for analysis from six localities (see table l). The laboratory work involved study of thin sections, examination of etched surface and stained surfaces, and analyses for calcium, magnesium, iron, and insoluble material.

The Falkirk in the western part of the state is divisible into lower and upper thin-bedded units and a middle massive unit. Traced eastward, the middle massive unit thins and the upper thin-bedded unit thickens (figure 1). East of Morgansville the middle massive unit is no longer distinguishable and the whole member is thin bedded.

Near Syracuse the Fiddlers Green is very thin bedded to thin bedded with a few medium-bedded lenses. These lenses are somewhat more resistant to weathering and commonly protrude slightly from exposed surfaces. Generally the upper 7 to 10 feet is more regularly bedded than the rest of the member. Laminae 0.2mm to 0.5mm in thickness are visible on the weathered surfaces of many of the beds. The top few inches of the Fiddlers Green member is thinly laminated, dark gray (N4) to medium dark gray (N5), very fine-grained argillaceous dolomite with well-developed mud cracks. This mud-cracked zone has been observed as far east as Passage Gulf (near Cedarville), and in the Falkirk as far west as Akron Falls Park (near Akron).

In the Syracuse area the Fiddlers Green member is exposed in numerous places. The best and most complete exposure is in the gorge of Butternut Creek (Stop 5, Trip C), on the north side of the village of Jamesville, where it is 27 to 30 feet thick. Here, as elsewhere, most of the member is medium dark gray (N4) to light brownish gray ((5YR6/1) on fresh surfaces and brownish gray (5YR6/1) to light olive gray (5Y6/1) on weathered surfaces.

*The Oatka shale (Chadwick 1917, p. 173) is not present in central New York and, as its inclusion with the Bertie is questioned by some, it is omitted here.

TABLE 1

AVERAGE COMPOSITION OF THE
FALKIRK-FIDDLERS GREEN UNIT

	$MgCO_3$ % *	$CaCO_3$ % *	Carbonate Total % *	Theoretical % ** Calcite	Theoretical % ** Dolomite	Fe_2O_3 % * (Soluble Iron)	Insoluble Material Percent *
Western Region:							
Akron Falls	41.31	53.52	94.83	4.40	90.40	.91	4.26
Morgansville	40.84	52.63	93.47	4.10	89.40	1.31	5.20
East Victor	41.00	54.26	95.26	5.60	89.70	.82	3.92
AVERAGE	41.05	53.47	94.52	4.80	89.70	1.52	4.46
Central-Eastern Regions:							
Jamesville	40.83	51.94	92.78	3.40	89.40	1.22	6.00
Passage Gulf	35.70	49.23	85.93	5.60	80.30	2.44	11.63
Sharon Center***	38.12	49.35	87.47	4.00	83.50	1.14	11.39
AVERAGE	38.55	50.18	87.73	4.30	83.40	1.60	9.67
AVERAGE OF ENTIRE AREA	39.80	51.83	91.63	4.50	87.10	1.56	6.81

* (Calculated from analyses after Cheng, et al., 1952)
** (Calculated from molecular weight of $CaMg(CO_3)$;
excess $CaCO_3$ is assumed to be Calcite)
*** (Average of shaly layers sampled)

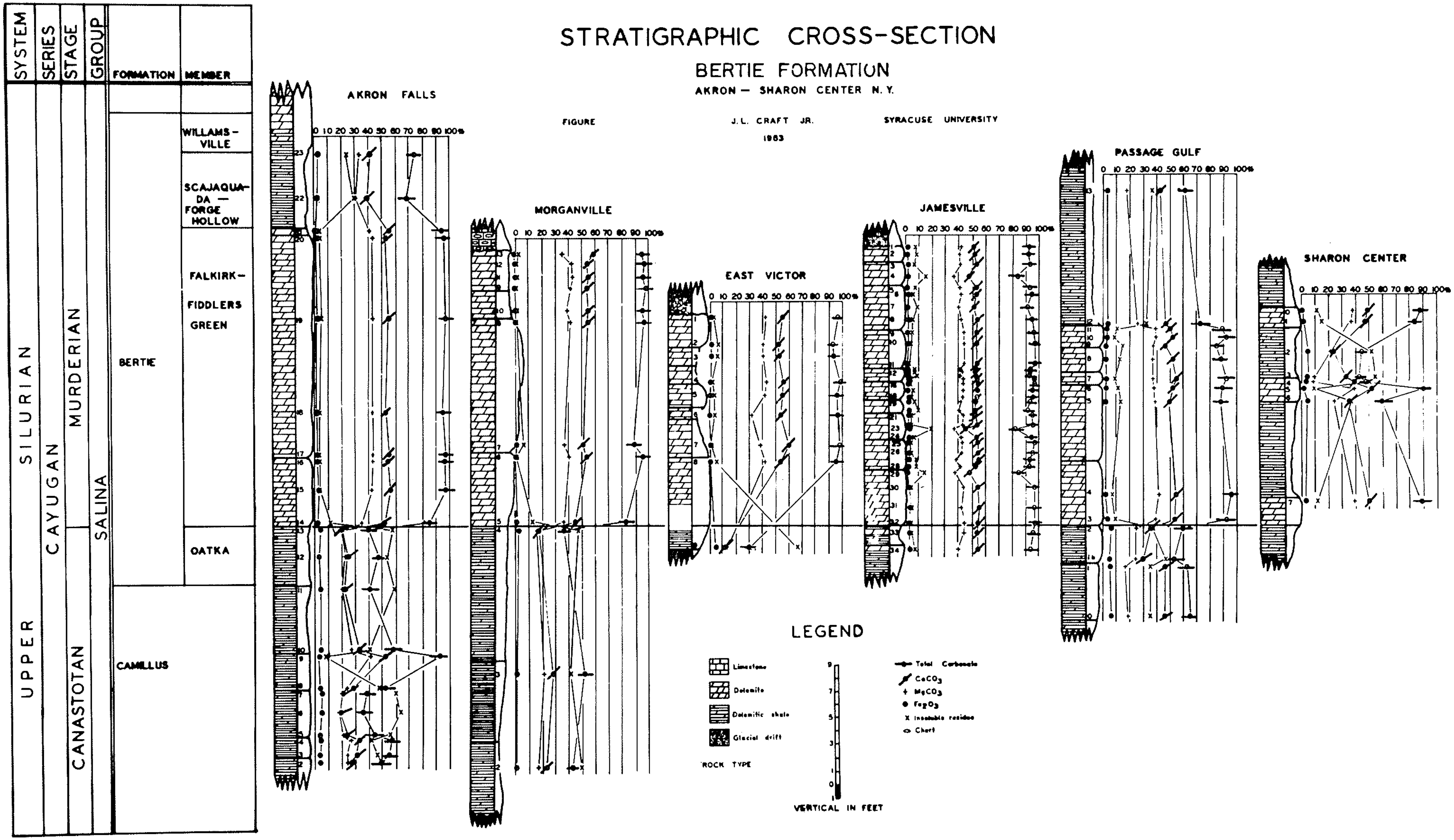
STRATIGRAPHIC CROSS-SECTION
BERTIE FORMATION
AKRON — SHARON CENTER N. Y.
FIGURE
J.L. CRAFT JR.
1963
SYRACUSE UNIVERSITY
SYSTEM
SERIES
STAGE
GROUP
FORMATION
MEMBER
UPPER SILURIAN
CAYUGAN
MURDERIAN
CANASTOTAN
SALINA
BERTIE
CAMILLUS
WILLAMS-VILLE
SCAJAQUADA — FORGE HOLLOW
FALKIRK-FIDDLERS GREEN
OATKA
AKRON FALLS
MORGANVILLE
EAST VICTOR
JAMESVILLE
PASSAGE GULF
SHARON CENTER
0 10 20 30 40 50 60 70 80 90 100%
LEGEND
Limestone
Dolomite
Dolomitic shale
Glacial drift
ROCK TYPE
VERTICAL IN FEET
Total Carbonate
$CaCO_3$
$MgCO_3$
Fe_2O_3
Insoluble residue
Chert

Figure 1.

The Fiddlers Green and Falkirk are poorly fossiliferous. Ostracodes, concentrated in a few thin layers, are most common. Eurypterids have been found near the top of the member, particularly at Passage Gulf and near Buffalo. Algal colonies, some of which appear to be stromatolites, are present near the middle of the member in a few places. The largest known are east of Nottingham Road near the west end of the Boy Scout Camp in Rams Gulch (east end of Rock Cut Channel) between Syracuse and Jamesville. Others have been reported west of Syracuse near Marcellus Falls (Allenson 1955, p. 19), and east of Syracuse in the Oneida (Sachs, 1959, p.21) and Vernon quadrangles (Rhodes, 1959, p. 25).

In the Syracuse area, the Fiddlers Green is a relatively pure fine-grained dolomite, with an average composition, as shown by table 1, of 92.78 per cent total carbonates, 6 per cent insoluble material, and 1.22 per cent soluble iron calculated as Fe_2O_3 (EDTA titration after Cheng, Kurtz, and Bray, 1952). The composition of the Falkirk, as determined at three localities in western New York, is very similar to the composition of the Fiddlers Green of the Syracuse area, (see table 1), Impurities increase gradually eastward (Figure 2) until, between Van Hornsville and Sharon, the Fiddlers Green grades into the Brayman shale.

The insoluble residues of the Fiddlers Green member consist predominantly of clay minerals, quartz, small crystals of pyrite and some heavy minerals. The clay minerals, as determined by X-ray diffraction, are illite, montmorillonite, chlorite and traces of kaolinite (Seide, 1964, personal communication).

The results of this study indicate that the Falkirk dolomite member of western New York and the Fiddlers Green dolomite member of central New York are the same rock unit. The writer's data on the Scajaquada (Chadwick, 1917) and Forge Hollow (Rickard, 1953) members, although less complete than for the Falkirk and Fiddlers Green, indicate that they also are the same rock unit (Figure 3). No systematic study was made of the Williamsville and the Oxbow members, but it is probable that they too are the same unit..

The data now available is believed sufficient to justify correlating the members of the Bertie in the western part of the state with those used by Rickard for the central part. The member names to be retained, based on priority of usage, should be: Fiddlers Green, Scajaquada, and Williamsville.

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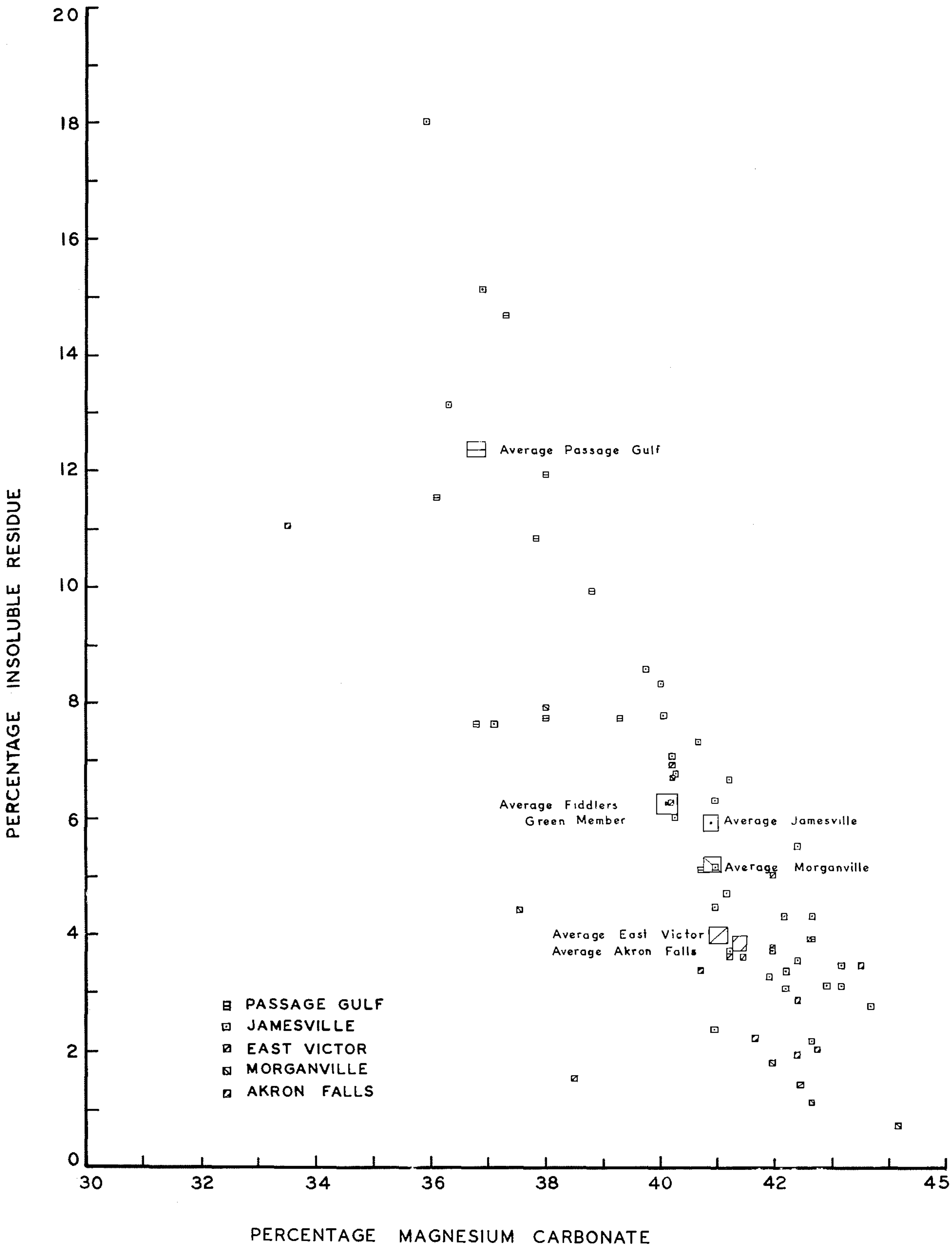

Fig. 2. RELATIONSHIP OF INSOLUBLE RESIDUES AND MAGNESIUM CARBONATE, FIDDLERS GREEN MEMBER

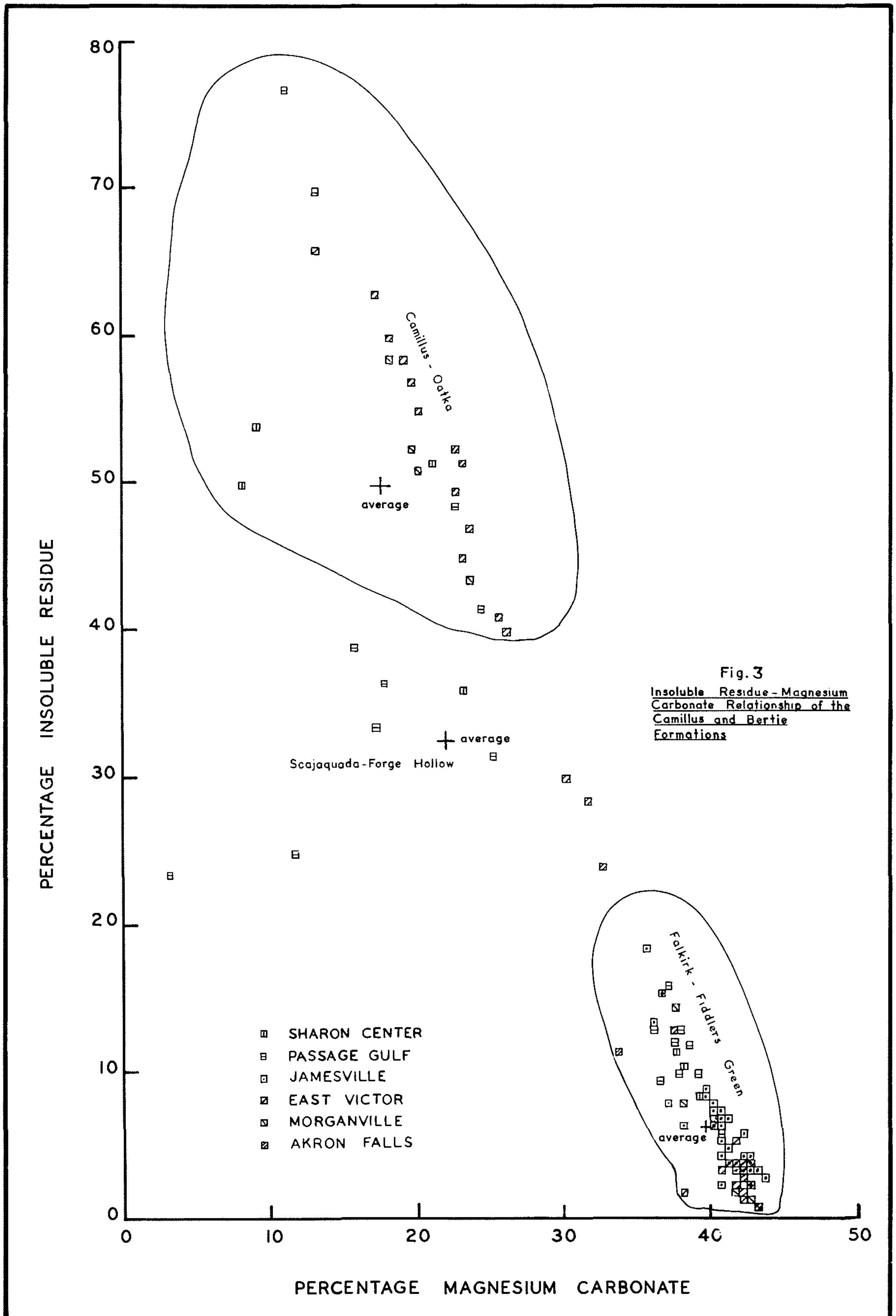

Fig. 3

Insoluble Residue-Magnesium Carbonate Relationship of the Camillus and Bertie Formations

PETROLOGY OF THE SILTSTONES IN THE LUDLOWVILLE FORMATION (MIDDLE DEVONIAN), ONONDAGA COUNTY, NEW YORK

by
Herman S. Muskatt

Introduction

The Ludlowville formation of the Hamilton Group contains a number of siltstone units that are difficult to differentiate in isolated outcrops and hand specimens. A study of these units was undertaken with one of its purposes the establishment of criteria for their recognition. For this study about 800 samples, from which 87 specimens were selected for thin-section, heavy-mineral, and carbonate analyses, were collected from 36 localities in Onondaga County.

The rock classified as siltstone in the field is flaggy to massively-bedded, and has a distinctly gritty feel. It is more difficult to break than shale and commonly develops conchoidal fractures. The laboratory work showed that silty shale contains up to about 35 percent quartz silt and that above 35 percent the rock assumes the appearance of siltstone. It also showed that between 30 and 35 percent quartz, the average modal diameter of the silt-sized quartz grains changes fairly abruptly from 0.025 to 0.035 mm. (see Table 1). The siltstones examined by the writer contain from 50 to 80 percent of silt-sized material by volume.

STRATIGRAPHY

Smith (1935, p. 44) divided the Ludlowville formation in the Skaneateles quadrangle into the Otisco, Ivy Point, Spafford, and Owasco members listed in ascending stratigraphic order. For paleontologic reasons Cooper (1930, p. 223), placed the lower contact of the Ludlowville formation at the bottom of the Centerfield. Due to the fact that the bottom contact of the Centerfield is gradational and difficult to locate whereas the top contact is sharp, the writer prefers to follow Smith and put the lower contact of the Ludlowville at the top of the Centerfield. A description of the Centerfield is included for completeness.

Skaneateles Formation

Centerfield Member

The Centerfield member overlies the Butternut member of the Skaneateles formation and is overlain by the Otisco member of the Ludlowville formation (See plate 1). In New York it extends from the Chenango Valley to Lake Erie (Cooper, 1930, p. 218-219). At Lake Erie the unit is a thin limestone, but it thickens and becomes a calcareous shale and siltstone to the east. In the Syracuse area the Centerfield is about 30 feet thick. The basal part is shaly to flaggy, unevenly bedded, calcareous, silty shale that is gradational with the underlying Butternut member of the Skaneateles formation. These basal beds grade upward into flaggy to massive, calcareous, partly cross-bedded siltstone of the middle and upper parts of the member. The top contact is marked by an abrupt change to the soft shales of the Otisco. Approximately 80 percent of the Centerfield is siltstone and because of this it forms benches and falls.

Calcareous concretions are common in zones from 2 to 8 inches thick. The concretions occur in five zones, but not more than three were observed at any one place. The five zones are, near the top; 3, 8, and 13 feet from the top; and at the bottom of the member.

Table 1.--Quartz and calcite frequency and average modal diameter of quartz. Stratigraphic distribution showing number of samples in 5 percent groupings.

%	Calcite					Quartz					Av. Modal Diam. mm
	Ce	Ot	IvP	Sp	Ow	Ce	Ot	IvP	Sp	Ow	
5		4									
10	10	21	11	3	2						
15	2		7	2	3		1				0.020
20	2					2	2	1	4		0.024
25	2		3				2		1		0.021
30		1				1	7		1		0.025
35		1		1		4	1	2			0.035
40						2	6	5			0.036
45	1					2	1	5		1	0.038
50						2	6	4			0.039
55						2		1			0.042
60						2	1	2		4	0.046
65								1			0.048

Explanation: Ce = Centerfield
Ot = Otisco
IvP = Ivy Point
Sp = Spafford
Ow = Owasco

Dashed line, based on field classification, divides the silty shale above from the siltstone below.

The Centerfield member is composed chiefly of quartz, mica, and calcite. In addition, a number of accessory minerals, listed in Table , are present. Mica decreases and quartz and calcite increase upward (Pl. 1). The modal grain size of the quartz also increases upward.

Ludlowville Formation

Otisco member

Smith (1935, p. 45) proposed the name Otisco for the shale unit, approximately 150 feet thick, which overlies the Centerfield. Although it consists mainly of silty shale and shale, it also contains about 20 feet of siltstone strata and two coral biostromes (Pl. 1). A flaggy to massive, calcareous siltstone layer, 6 to 8 feet thick, underlies the Staghorn Point coral biostrome submember of Smith (1935, p. 46), about 50 feet above the base of the Otisco. Because of its superior resistance to erosion, this siltstone unit commonly forms waterfalls and benches and is a useful horizon marker.

Another siltstone layer, about 2 feet thick, is approximately 20 feet above the base of the member. Other, thinner siltstone layers occur at various horizons within the Otisco.

Ivy Point Member

This member was divided by Smith (1935, p. 47,50) into lower and upper siltstone units and a middle silty shale unit which total about 50 feet in thickness. The lower contact of the Ivy Point with the underlying Otisco member is gradational in places. The upper contact is relatively sharp as a result of the abrupt change from siltstone to the soft shales of the Spafford member.

The lower siltstone unit is about 18 feet thick and is flaggy to massive, calcareous, and locally cross bedded. Spheroidal, calcareous concretions 3 to 18 inches in diameter are present in places. The middle unit is a shaly to flaggy, silty shale that contains a few zones of large, spheroidal, calcareous concretions. The upper siltstone unit is about 15 feet thick and resembles the lower siltstone unit in lithology and color (see Plate 1) but is less commonly cross-bedded. A zone of large concretions averaging about 8 inches in diameter, occurs in places approximately 10 feet below the top of the unit. Yellowish brown limonite spots, as much as an inch in diameter, caused by weathering of pyrite, are common in both this and the lower siltstone unit. Plant fragments are larger and more abundant in these siltstone units than in the other siltstone units of the Ludlowville formation.

The Spafford shale member is about 25 feet thick and is mostly a fissile to shaly-bedded, shale and silty shale. A flaggy siltstone, approximately 2 feet thick, is commonly present in the middle of the unit. Both the lower contact with the Ivy Point member and the upper contact with the Owasco member are relatively sharp. The upper contact may be a diastem.

This member is easily eroded and is poorly exposed except in ravines where it crops out in the reentrant under waterfalls capped by the Owasco siltstone and Portland Point limestone.

Owasco Member

The Owasco is a flaggy to massive, calcareous siltstone, commonly cross bedded, with well-defined top and bottom contacts. Thin, discontinuous, highly fossiliferous zones usually are present. Its thickness increases westward from 1 foot to about 2 feet.

PETROGRAPHY

The siltstones of the Ludlowville formation are very similar mineralogically. The same mineral species, of which quartz, mica, and calcite are the most abundant, were found in all the sections studied. A few thin-sections and heavy-mineral mounts of the Butternut member of the Skaneateles formation and the Portland Point member of the Moscow formation also were examined and found to contain the same minerals. Although the proportions of the mineral constituents vary somewhat, no consistent differences were found that are of value for identifying individual siltstone units.

Woodruff (1942, p. 69) found the same mineral assemblage in the Upper Devonian rocks of the Wellsville quadrangle. However, no fragments of quartzite and schist, such as reported by him, are known in the Ludlowville. The mineral assemblage reported by Sutton (1960, p. 30) for siltstones of the Naples Group (Upper Devonian) also is similar except for a somewhat greater amount of carbonate and chlorite.

Estimated percentages of calcite and quartz in the Centerfield and the members of the Ludlowville are shown in Table 1, and of the heavy detrital minerals in Table 2 Table also shows the average modal diameter of quartz for different quartz percentages. Other minor constituents, not listed in Tables 1 and 2, include feldspar, pyrite, mica, and carbonaceous matter.

The mineral composition of the shales is similar to that of the siltstone. The shales, however, show smaller percentages of quartz and more mica, carbonaceous matter, and pyrite. The kinds and percentages of the heavy minerals are approximately the same in both.

Light Minerals

Quartz

The siltstones contain from 35 to 65 percent quartz, ranging in modal grain diameter from 0.035 to 0.048mm. The modal grain diameter generally increases with an increase in the quartz content (Table 1), it also increases eastward toward the source of the sediment. In nearly all thin sections examined, the largest quartz grains present range from 0.05 to 0.09mm in diameter.

The quartz grains are colorless and transparent. Most contain minute mineral inclusions and also liquid or vapor inclusions. Many show undulose extinction, probably inherited from the parent rocks. Although a few of the grains are subrounded, most are angular to subangular. No secondary quartz outgrowths were observed. A few euhedral authigenic quartz crystals formed by replacing the margins of calcite shell material.

Some of the detrital grains of quartz are in contact with other quartz grains, but most are separated by calcite and mica flakes. The quartz grains are fairly evenly distributed and seldom are concentrated in laminae.

Table 2.--Stratigraphic variation of heavy-mineral frequencies in percent.

	Centerfield	Otisco	Ivy Point	Spafford	Owasco
Zircon[a] (range)	40-88	44-92	44-81	13-79	55-84
(mode)	60	53	55	45	60
Garnet[a]	0-28	0-32	0-19	12-84	2-65
	14	20	12	40	8
Leucoxene[a]	4-15	1-12	1-8	1-5	5-10
	13	7	8	2	6
Tourmaline[b]	0-16	0-13	5-21	0-10	0-5
	5	5	12	3	4
Rutile[b]	0-10	0-8	0-17	0-5	0-9
	5	4	7	3	5
Sphene[b]	0-6	0-11	0-4	0-3	0-3
	3	8	4	2	2
Epidote[c]	0-4	0-3	0-2	0-3	0-2
	2	2	1	2	1
Apatite[c]	0-2	0-2	0-4	0-3	0-1
	1	1	2	1	1
Amphibole[c]	0-2	0-6	0-8	0-1	0-1
	2	4	3	1	1
Clinopyroxene[d]		0-4	0-10	0-5	0-1
		2	3	2	1
Monazite[d]	0-3	0-3	0-2		0-1
	1	2	1		1
Kyanite[d]	0-3	0-1	0-3	0-1	
	1	1	2	1	
Corundum[d]	0-2	0-2	0-1		
	1	1	1		
Sillimanite[d]	0-2			0-1	
	1			1	

[a]Present in more than 80 percent of 87 heavy-mineral mounts.
[b]Present in 51 to 79 percent of the heavy-mineral mounts.
[c]Present in 20 to 50 percent of the heavy-mineral mounts.
[d]Present in less than 10 percent of the heavy-mineral mounts.

Calcite

The shales and siltstones of all the members studied contain calcite as cement, fossils, and fillings of open spaces such as the body cavities of fossils. As shown in Table 1, most of the samples contain from 10 to 15 percent calcite. The calcite cement, where abundant, forms irregular interlocking grains, several millimeters in diameter, that enclose numerous silt grains. These calcite grains are distinguishable in thin section under polarized light. The calcite that fills the body cavities of fossils commonly is in clear, relatively coarse anhedral grains, a few of which show polysynthetic twinning.

Feldspar

A small amount of feldspar, generally less than 1 percent by volume, is present in all thin sections examined. The feldspar is polysynthetically twinned plagioclase within the albite and andesine range. No potash feldspar was found.

Mica

The fine-grained mica (illite or sericite?) is ubiquitous. It forms 15 to 45 percent of the siltstones and larger amounts of the shales. Most of the flakes of this mica are oriented approximately parallel to the stratification, particularly in the shales. Some are bent around adjacent detrital silt grains, and others are at relatively high angles to the stratification.

The siltstones and shales also contain scattered larger flakes of muscovite and biotite. The muscovite content ranges from a trace to 5 percent and the biotite ranges from a trace to 1 percent by volume as estimated from thin sections.

Chlorite

The chlorite content of the siltstones and shales ranges from a trace to about 5 percent by volume as estimated from thin sections.

Heavy Minerals

The average heavy-mineral content of the shales and siltstones studied is about 0.01 percent by weight. One specimen of siltstone contained about 0.45 percent. The relative frequencies of the 15 heavy minerals found, exclusive of pyrite, are shown in Table 2.

Zircon, garnet, tourmaline, rutile, and sphene are the most abundant nonopaque heavy minerals. Epidote, apatite, and amphibole are less abundant. Monazite, clinopyroxene, kyanite, corundum, and sillimanite are comparatively rare. Leucoxene is the most common opaque heavy mineral. The lack of magnetite and ilmenite among the heavy minerals of these rocks is noteworthy.

Zircon

Zircon is one of the most abundant of the heavy minerals and, as is shown by Table 2, occurs in all of the members studied. Most of the zircon is colorless, but some is pink. Minute mineral inclusions are common. Except for one well-rounded zircon grain with an optically continuous overgrowth of zircon, no authigenic zircon was found.

Approximately 3 percent of the zircon grains are doubly terminated euhedral crystals, 15 percent are slightly-worn euhedral crystals, and 30 percent are well-worn crystals with only parts of one or two crystal faces ramaining. The rest are rounded and have ellipsoidal to globular shapes. The average modal diameter of the zircon crystals normal to the "C" axis is 0.02mm.

Garnet

Most of the garnet ranges from nearly colorless to various shades of yellow, some is light pink or brown. The garnet grains vary in shape from subangular to rounded. No euhedral crystals were observed.

Tourmaline

The tourmaline grains are predominantly green or brown but a few colorless, pink, and blue grains were noted. Minute inclusions are common. One slightly worn euhedral crystal of green tourmaline was observed in the Ivy Point member. All of the other grains of tourmaline are rounded to well rounded and many have nearly colorless authigenic overgrowths at one end. Most of these overgrowths also show wear indicating that they formed before the grains were deposited.

Rutile

The rutile grains are red, reddish-brown, or yellow. They are generally elongated parallel to the "C" axis and, except for a few irregular grains, are subrounded to well rounded. Euhedral grains are lacking.

Amphibole

Blue-green to greenish-brown clinoamphibole was found in 14 of the 87 heavy-mineral mounts examined. A few grains of dark brown amphibole, with extinction angles of only 2 to 5 degrees, possibly lamprobolite, also were found. Most of the amphibole grains have refractive indices close to or above the aroclor (R.I. 1.66) used for mounting the heavy minerals.

Pyroxene

Pale-green to colorless clinopyroxene is present in only 8 of the 87 heavy-mineral mounts. These grains are angular to subangular. Many of the grains have extinction angles up to 38°, and may be diopside. This is uncertain, however, as the exact orientation of the grains is unknown.

Leucoxene

Leucoxene, the only opaque heavy mineral present, is common in every specimen examined, and, generally, is the third most abundant of the heavy minerals, exceeded only by zircon and garnet (see Table 2). The leucoxene commonly occurs as subangular to subrounded grains.

The origin of the leucoxene is in doubt. Rutile and sphene are the only primary titanium minerals now present in the sediments, and these do not show any alteration to leucoxene.

Pyrite

Pyrite is common in the siltstones and ranges from a trace to 0.40 percent by weight. Although the greatest amount was found in two of the coarsest siltstones, the quantity generally increases as the quartz content and grain size decrease.

Pyrite occurs in isolated euhedral crystals, in spongy masses composed of minute cubes or spheres — some with a smooth surface and others faceted, and replacing microfossils pseudomorphically. Most of the pyrite tends to border or impregnate organic material.

Other heavy minerals

Sphene, apatite, epidote, monazite, corundum, kyanite, and sillimanite are present in small amounts as heavy-detrital minerals in the siltstones and shales studied (see Table). The kyanite and sillimanite are scarce, and the few grains seen are angular. The other minerals are somewhat more abundant and occur in subrounded to well-rounded grains.

Organic Material

Isotropic, brownish or black, opaque carbonaceous material occurs as streaks, patches, or specks in the shales and siltstones. It is estimated to form from 0.5 to 2.0 percent of the rock by volume. This material is more abundant in the shales than the siltstones.

PROVENANCE

The detrital minerals present in the rocks studied came from the east or southeast and probably were derived from metasedimentary and possibly some sedimentary and igneous rock. The high degree of rounding of most of the more stable minerals such as zircon, tourmaline, and the worn overgrowths on the tourmaline, and rutile, indicate that they have passed through at least one previous sedimentary cycle. These grains, therefore, could have been derived from reworked sediments. The doubly-terminated, euhedral, zircon crystals, and angular grains of clinopyroxene, garnet, amphibole, kyanite, and sillimanite indicate the presence of some metamorphic and, possibly, igneous rocks in the source area.

DEPOSITIONAL HISTORY

Repetition of shale and siltstone in the members studied is suggestive of cyclic deposition. Ecch cycle is composed of shale grading upward into siltstone (see Plate). Five such cycles of deposition can be recognized in the Ludlowville and upper part of the Skaneateles formations.

The first cycle is represented by the Butternut shale and the Centerfield siltstone; the second by the lower part of the Otisco and the siltstone platform under the Staghorn Point coral biostrome; the third by the upper Otisco beds above the platform and the lower siltstone unit of the Ivy Point; the fourth by the silty shale middle unit of the Ivy Point and the upper siltstone unit of that member; and the fifth by the Spafford shale and the Owasco siltstone. The fifth cycle is in doubt, however, as the Owasco and Spafford may be separated by a diastem.

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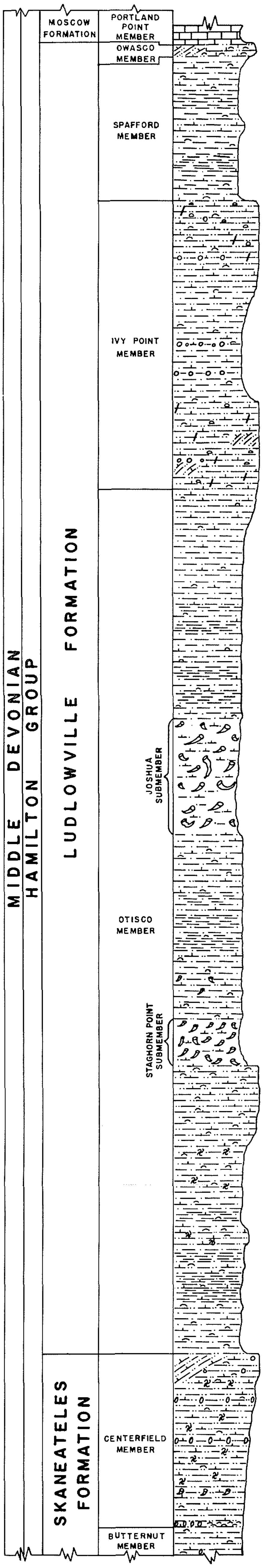

CALCITE %	QUARTZ %	QUARTZ MODAL DIAM mm	DESCRIPTION	COLOR FRESH DRY	COLOR FRESH WET	COLOR WEATHERED DRY	COLOR WEATHERED WET
			FLAGGY HIGHLY FOSSILIFEROUS CALCAREOUS SILTSTONE LOCALLY CROSS-BEDDED.				
15	60	.035		N5	N3	10 YR 6/2	2/2
15	20	.0225	SILTY SHALE				
			FISSILE TO SHALY BEDDED SILTY SHALE AND SHALE				
			FLAGGY CALCAREOUS SILTSTONE ABOUT 2 FEET THICK PRESENT LOCALLY	N5	N3	10 YR 6/2	4/2
15	20	.02	FISSILE TO SHALY BEODEO SILTY SHALE AND SHALE				
15	60	.045	FLAGGY CALCAREOUS SILTSTONE LARGE SPHEROIDAL CALCAREOUS CONCRETIONS PRESENT LOCALLY. PLANT FRAGMENTS AND LARGE PELECYPODS COMMON	N5	N3	10 YR 6/2	3/2
10	45	.04				5 Y 6/1	4/1
			SHALY TO FLAGGY SILTY SHALE AND SILTSTONE				
10	20	.015	SHALY TO FLAGGY SILTY SHALE WITH ZONES OF LARGE SPHEROIDAL CALCAREOUS CONCRETIONS	N4	N3	5 Y 6/1	4/1
			SHALY TO FLAGGY SILTY SHALE				
15	45	.04	FLAGGY EVENLY BEDDED CALCAREOUS SILTSTONE LOCALLY CROSS-BEDDED. LARGE SPHEROIDAL CALCAREOUS CONCRETIONS PRESENT. PLANT FRAGMENTS AND LARGE PELECYPODS COMMON.	N5	N3	10 YR 6/2	4/2
15	45	.035				10 YR 5/2	3/2
			SHALY TO FLAGGY CALCAREOUS SILTSTONE AND SILTY SHALE				
			SILTY SHALE <u>MEGASTROPHIA CONCAVA</u> COMMON TO ABUNDANT				
10	40	.03	SILTY SHALE AND SHALE. SOME FLAGGY BEDS	N5	N3	5 Y 6/1	4/1
			ZONE OF CORALS MOSTLY CYATHOPHYLLOID TYPE THICKNESS 0 TO 50 FEET				
10	50	.03	FLAGGY SILTY SHALE SOME SILTSTONE LAYERS	N5	N3	5 Y 6/1	4/1
			SILTY SHALE AND SHALE. <u>ATHYRIS SPIRIFEROIDES</u> COMMON TO ABUNDANT				
			SHALY TO FLAGGY SILTY SHALE AND SILTSTONE				
			ZONE OF CORALS MOSTLY CYATHOPHYLLOID TYPE THICKNESS 5 TO 11 FEET				
10	50	.0425	MASSIVE CALCAREDUS SILTSTONE THICKNESS 6 TO 8 FEET <u>SPINOCYRTIA GRANULOSA</u> ABUNDANT	N5	N3	5 Y 5/1	3/1
10	40	.03				6/1	4/1
			FLAGGY TO MASSIVE CALCAREOUS SILTSTONE				
10	30	.02	FLAGGY SILTSTONE AND SILTY SHALE <u>TAONURUS CAUDIGALLI</u> LOCALLY COMMON	N5	N3	5 Y 6/1	4/1
10	20	.0175	SHALY TO FLAGGY SILTY SHALE	N5	N3	5 Y 6/1	4/1
			FLAGGY FOSSILIFEROUS SILTSTONE				
			FISSILE TO SHALY BEDDED SHALE AND SILTY SHALE. SILTSTONE LOCALLY PRESENT				
			HIGHLY FOSSILIFERDUS SILTY SHALE				
15	55	.045	FLAGGY TO MASSIVE CALCAREOUS SILTSTONE LOCALLY CROSS-BEDDED. SPHEROIDAL CALCAREOUS CONCRETIONS 3 TO 6 INCHES IN DIAMETER COMMON IN PLACES	N5	N3	5 Y 5/1	4/1
15	35	.04	FLAGGY TO MASSIVE UNEVENLY BEDDED SILTSTONE. ZONES OF ELLIPSOIDAL CALCAREOUS CONCRETIONS COMMON. <u>TAONURUS CAUDIGALLI</u> LOCALLY PRESENT	N5	N3	5 Y 6/1	3/1
15	35	.035	FLAGGY UNEVENLY BEDDED SILTSTONE ZONE OF SMALL CORALS PRESENT IN PLACES				
10	20	.02	SHALY TO FLAGGY UNEVENLY BEDDED SILTY SHALE TRANSITIONAL FROM BELOW	N4	N3	5 Y 6/1	3/1
10	10	.02		N4	N2		

GENERALIZED SECTION OF THE LUDLOWVILLE FORMATION AND CENTERFIELD MEMBER OF THE SKANEATELES FORMATION IN ONONDAGA COUNTY

VERTICAL SCALE: 1" = 10'

LEGEND

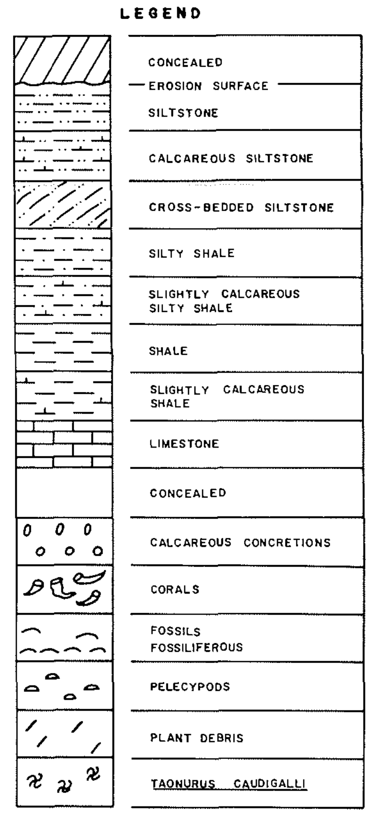

PLATE 1

APPENDIX

STRATIGRAPHIC SECTION OF THE SYRACUSE AREA

Period	Group	Formation	Member	Thick-ness	Description
Upper Devonian		Tully	West Brook	10'	shaly limestone
			Apulia	18'	limestone
			Tinkers Falls	2'	shaly limestone
------disconformity ? ------					
Middle Devonian	Hamilton	Moscow	Windom	180'	shale & siltstone
			Portland Point	9-10'	limestone & shale
		Ludlowville	Owasco	1-3'	siltstone
			Spafford	25'	shale
			Ivy Point	50-60'	siltstone & shale
			Otisco	160-180'	shale & siltstone
		Skaneateles	Centerfield	30'	calcareous siltstone
			Butternut	100-200'	shale & siltstone
			Pompey	60'	shale & siltstone
			Delphi Station	100'	shale & siltstone
		Marcellus	Mottville	45'	limestone & shale
			Cardiff	125-200'	shale
			Chittenango	100'	black shale
			Cherry Valley	3'	limestone
			Union Springs	13-15'	shale & limestone
		Onondaga	Seneca	25'	limestone with Tioga bentonite at base
			Moorehouse	20-25'	limestone
			Nedrow	10-15'	shaly limestone
			Edgecliff	8-23	limestone, Springvale sandstone at base
--------disconformity ----------					

Period	Group	Formation	Member	Thickness	Description
Middle Devonian		Oriskany?		0-20'?	sandstone, may all be of Onondaga age
		----------	disconformity --	--------	---------------- - - - - -
Lower Devonian	Helderberg	Bishop Brook (Coeymans)		0-5'	limestone
		----------	disconformity --	--------	---------------- - - - - -
		Manlius	Pools Brook	0-30'	limestone
			Jamesville	0-20'	limestone
			Clark Reservation	0-5'	oolitic limestone
			--diastem ----	--------	---------------- - - - - -
			Elmwood C	2-4'	dolomite, argillaceous
			--	diastem	---------------- - - - - -
			Elmwood B	2-3'	dolomitic limestone
			Elmwood A	4-6'	dolomite, argillaceous
			Olney	30-35'	limestone
			Thacher	9-26'	limestone
		Rondout		30-40'	dolomite
? Upper Silurian		Cobleskill		15-25'	dolomite
	Salina	Bertie	Williamsville or Oxbow	7'	shaly dolomite
			Scajaquada or Forge Hollow	30-60'	gypsum, shale, dolomite
			Fiddlers Green	27-30'	dolomite
		Camillus		160-190'	shale, dolomite, gypsum
		Syracuse	Upper dolomite	8-24'	shaly dolomite
			Upper clay	10-20'	clay, gypsum, dolomite
			Middle dolomite	35-40'	impure dolomite
			Lower clay	10-15'	clay, gypsum, dolomite
			Transition	90-120'	dolomite and shale
		------------	diastem ------	--------	---------------- - - - - -
		Vernon		500-600'	red & green shale, shaly dolomite