ORGONICIAN LIMESTONES IN THE VICINITY OF
HOGES STORE, GILES COUNTY, VIRGINIA

by

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MASTER OF SCIENCE
in
Geology

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The contents of this thesis are to be held in confidence for a period of six months, beginning September 1955, in consideration of the interests of the supervisor.

B. N. Cooper

Supervisor,

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Project 220
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Plate 3. Geologic Section 1. Ordovician limestones and shales at locality 7, about 1.5 miles northwest of Hoges Store, Giles County, Virginia.

Plate 4. Map of Hoges Store and Vicinity, showing 900-acre area (shaded in blue) believed to be underlain by two zones of chemical-grade limestone in minable quantities aggregating 80 to 100 million tons.
Abstract

In the vicinity of Hoges Store, Giles County, Virginia, certain portions of the Five Oaks and Elway limestones containing more than 97 per cent calcium carbonate crop out near the crest of the Thessalia anticline and John’s Creek syncline and underlie an extensive area where dips probably are less than 20 degrees. Locally, part of the Benbolt, Gratton, and Witten are also high-calcium limestone.

Sites for core drilling and possible subsequent mining or quarrying are inferred from study of exposed rocks, by chemical analyses of channel samples of selected zones of high-calcium limestones and by detailed geologic mapping. The report includes columnar sections showing the character and thickness of the limestone units.

One large deposit of chemical-grade limestone was found about 1.5 miles northeast of Hoges Store, which is believed to underlie a large area wherein dips of the minable strata are less than 15 degrees. The amount of recoverable stone is estimated to be 80 million tons. Suggested locations for core drilling are shown.

An anticline, two synclines and an imbricate structure are the structural features of the area of study. The major structural features of Giles County are delineated on a sketch map.

Introduction

This investigation involved the detailed mapping and stratigraphic study of Middle Ordovician limestone formations in the
vicinity of Hoges Store, Giles County, Virginia. The chief purpose was to expand the studies of the high-calcium limestones of this area initiated by B. N. Cooper (1944).

The principal purpose of the study was to obtain information concerning changes in lithology and thickness within the different formation units in order to locate suitable sites for core drilling and possible subsequent mining or quarrying operations in the high-calcium limestones. Ranges in thickness of each formation were determined by measurement. Channel samples were collected in areas thought to be representative of the limestones. Chemical analyses were made for each channel sample.

The general lithology of each formation is sufficiently consistent so that detailed mapping was possible without the use of fossils. Biostratal beds proved helpful and were utilized for determining the top boundary of the Benboli limestone in many localities.

The geologic mapping was done with the aid of United States Forest Service 1:7920 air photographs and photo-enlargements of a part of the Pearisburg quadrangle of the United States Geological Survey.

Methods of Collection and Preparation of Limestone Samples

Channel samples were collected across the outcrops of limestone. A sample weighing approximately 300 grams was collected for each foot of thickness of strata. Larger samples were collected for thin beds
Location of Area of Study
of questionable purity. The weathered surface was removed from the specimens. The samples were reduced to about pea size with a jaw crusher and quartered with a Jones sample splitter.

Acknowledgments

The writer expresses his appreciation to those who have aided in this investigation. The writer is especially indebted to Dr. B. N. Cooper who supervised the study and gave helpful suggestions in the field and read and criticized the manuscript. Dr. R. V. Dietrich and Dr. W. D. Lowry read and criticized the manuscript and gave aid concerning special problems. Professors C. E. Sears, Jr. and W. E. Moore gave valuable suggestions during the course of the field work. The investigation was financed by the Norfolk and Western Railway Company.

Previous Work

Mathews (1934) made a sketch map showing the distribution of rocks and major structural features in Giles County and discussed the economic possibilities of the marble. B. N. Cooper (1944) published a report of the industrial limestones and dolomites of the New River-Roanoke River District, Virginia. The purpose of this study was to obtain information concerning the location, character, thickness and chemical composition of deposits of limestone and dolomite. A sketch map was included showing the general distribution of Cambrian and Ordovician limestones in Giles County.
Stratigraphy

**General.** The Middle Ordovician limestones in the vicinity of Hoges Store, Giles County, Virginia, comprise 10 lithologic units with a total thickness averaging about 800 feet. These formation units consist mainly of cherty, nodular, impure limestones that differ in thickness and minor characteristics within short distances. Calcareous zones of variable purity are also present.

The basal Middle Ordovician unit is the Blackford which lies unconformably on the Beekmantown dolomite of Canadian age. The Middle Ordovician limestones are overlain by shale, limestone, and sandstone of middle and late Ordovician age.

**Elway Limestone**

**Name.** — The Elway limestone was named by Cooper (1945) for a settlement near Lebanon, Russell County, Virginia.

**Character and distribution.** — The Elway limestone is commonly a dark-gray, fine-grained limestone with numerous layers and nodules of black chert. The Elway weathers light bluish-gray. Freshly broken rock commonly has a petrolierous odor. Locally, the Elway is composed in part of chemical-grade calcilutite identical to the Five Oaks limestone. About 1.5 miles northeast of Hoges Store (locality 7) this portion is about 50 feet thick. The top of this zone in the Elway limestone occurs 67 feet below the base of the Five Oaks limestone. This member of the Elway thins to the southwest and is covered to the
north along Doe Creek. Another local thickening of the high-calcium limestone member of the Elway is present 1.25 miles northwest of Hoges Store (locality 2). A similar limestone in the Elway is exposed about 0.25 mile north of Lucas Memorial Church (locality 13) but it is not as low in silica and magnesia as the high-calcium beds at locality 7.

Five Oaks Limestone

**Name.** - The Five Oaks limestone was named by Cooper and Frouty (1944) for its occurrence at Five Oaks, Tazewell County, Virginia.

**Character and distribution.** - The Five Oaks limestone is a dove-gray to brownish-gray, thick-bedded calcilitite that weathers with a light-gray chalky crust. The Five Oaks limestone contains widely spaced stylolitic seams, and fresh surfaces show clear calcite insets giving the rock a glittering appearance. The Five Oaks limestone is exposed best along the southwest base of Doe Mountain and about 1.5 miles northeast of Hoges Store. The Five Oaks reaches a maximum thickness of about 75 feet along the southwest base of Doe Mountain about 1.5 miles northwest of Hoges Store (locality 1), and the limestone is not less than 60 feet thick 1.25 miles to the east (locality 4). The Five Oaks limestone is over 50 feet thick 1.5 miles northeast of Hoges Store (locality 7). About 0.20 mile to the north (locality 6) the Five Oaks calcilitite is 30 feet thick and contains a thin layer of chert in the middle. The Five Oaks thins south of locality 7 and is mostly covered except along Sinking
Creek, where the thickness is less than 35 feet.

Lincolnshire Limestone

**Name.** - The Lincolnshire limestone was named by Cooper and Prouty (1944) from Lincolnshire Branch west of Five Oaks, Tazewell County, Virginia.

**Character and distribution.** - The Lincolnshire limestone is a dark bluish-gray, fine-grained limestone with nodules of black chert and a "worm eaten" appearance. The Lincolnshire limestone is about 60 feet thick 1.5 miles northwest of Hoges Store (locality 1). About 0.75 mile to the east (locality 3) the Lincolnshire is 45 feet thick, and 1 mile farther to the east (locality 5) the Lincolnshire thickens to 60 feet. The Lincolnshire limestone is 60 feet thick 0.50 mile to the southeast (locality 7). The Lincolnshire reaches a maximum thickness of about 75 feet along the northwest base of Spruce Run Mountain.

Ward Cove Limestone

**Name.** - The Ward Cove limestone was named by Cooper and Prouty (1944) from Ward Cove, Tazewell County, Virginia.

**Character and distribution.** - The Ward Cove limestone is a medium-to-dark-gray, coarse-grained limestone with an abundance of crinoids and bryozoans. Locally, the Ward Cove contains nodules of black chert, in which case the limestone is generally finer grained.
The Ward Cove is about 27 feet thick along the southwest base of Doe Mountain, and there it contains nodules of black chert. About 1.5 miles northeast of Hoges Store (locality 7) the Ward Cove is 27 feet thick and free of chert. The Ward Cove limestone attains a maximum thickness of 45 feet along the northwest base of Spruce Run Mountain (locality 14).

Peery Limestone

Name. — The Peery limestone was named by Cooper and Prouty (1944) for the Peery Limestone Company’s quarry in Tazewell, Tazewell County, Virginia.

Character and distribution. — The Peery limestone is a dark bluish-gray limestone that contains nodules of black chert. The Peery is generally thicker than the Lincolnshire, but the two have similar lithologies. About 1.5 miles northwest of Hoges Store (locality 1) the Peery is 75 feet thick, and about 0.75 mile to the east it thickens to 93 feet. The Peery is about 125 feet thick 1.25 miles northeast of Hoges Store (locality 5). The section 1.5 miles northeast of Hoges Store (locality 7) contains 102 feet of cherty, dark bluish-gray limestone. A maximum thickness of about 175 feet of Peery limestone was noted along the northwest base of Spruce Run Mountain (locality 14).
Benbola Limestone

Name. - The Benbola limestone was named by Cooper and Frouty (1944) for a historic homestead in Tazewell, Tazewell County, Virginia.

Character and distribution. - The Benbola limestone is a dark-gray, fine-to coarse-grained limestone of variable lithology. Typically, the Benbola limestone has many argillaceous seams and weathers with a nodular appearance. The Benbola is very fossiliferous and commonly contains biostromal beds. It is only 120 feet thick 1.5 miles northwest of Hoges Store (locality 1), but the limestone thickens to 186 feet 0.75 mile to east of Hoges Store (locality 7). The Benbola limestone is about 175 feet along the northwest base of Spruce Run Mountain. About 0.50 mile northwest of Boyd Chapel the top of the Benbola contains 70 feet of light-gray, very coarse-grained limestone that can be traced more than 1500 feet along the strike. This deposit probably represents a bank of indurated shell sand, where myriads of invertebrate tests were ground up and deposited by wave and current action.

Gatton Limestone

Name. - The Gatton limestone was named by Cooper and Frouty (1944) from Gatton, Tazewell County, Virginia.

Character and distribution. - The Gatton limestone is a dove-gray calcilutite that crops out prominently because of its purity and thick-beded nature. The Gatton commonly contains at the bottom
beds of fine-grained magnesian limestone. About 1.5 miles northwest of Hoges Store (locality 1) the calcilutite zone of the Gratton is 30 feet thick and is underlain by about 20 feet of dolomitic rock. About 0.75 mile to the east (locality 3) the calcilutite zone is 51 feet thick and underlain by 13 feet of dolomitic beds. About 1.5 miles northeast of Hoges Store (locality 7) the calcilutite beds are 45 feet thick and are overlain by four feet of light-gray, coarse-grained limestone. The calcilutite zone is about 60 feet and has dolomitic beds at both top and bottom 1.25 miles east of Hoges Store (locality 10). About 0.50 mile to the southeast (locality 11) the calcilutite layers are 43 feet thick and are underlain by dolomitic beds. About 0.60 mile to the northeast (locality 12) the calcilutite zone is 50 feet thick and is underlain by 30 feet of argillaceous, dolomitic limestones. Along the northwest base of Spruce Run Mountain the Gratton is 35 to 40 feet thick and does not contain dolomitic beds.

Witten Limestone

Name. - The Witten limestone was named by Cooper and Prouty (1944) from Witten Valley, Tazewell County, Virginia.

Character and distribution. - The Witten limestone is a light-gray, fine-grained limestone that commonly contains argillaceous, dolomitic seams at the base. The Witten limestone contains 60 feet of argillaceous beds overlain by 43 feet of high-calcium limestone. In Geologic Section 2 about 1.25 miles northeast of Hoges Store
(locality 5) the Witten is composed of 70 feet of argillaceous layers. About 1 mile to the southeast (locality 7) the Witten contains 15 feet of argillaceous beds overlain by 38 feet of high-calcium limestone. The Witten is an argillaceous, dolomitic limestone 80 feet thick about 1.25 miles east of Hoges Store (locality 10). About 0.50 mile to the southeast (locality 11) the Witten contains more than 25 feet of clayey beds overlain by 40 feet of high-calcium limestone, and 0.60 mile to the east (locality 12) the lower ten feet are very dolomitic beds and the upper 35 feet are high-calcium limestone. Along the base of Spruce Run Mountain the Witten is commonly a clayey, slightly magnesian limestone not more than 60 feet thick.

**Moccasin Formation**

**Name.** - The Moccasin formation was named by Campbell (1894) from Moccasin Creek, near Moccasin Gap, Scott County, Virginia.

**Character and distribution.** - The Moccasin is mainly a red mudstone with well developed fracture cleavage. It is about 75 to 100 feet thick. Several feet of mottled red and green marble underlying the mudrock forms the basal member of the Moccasin. The Moccasin is the first impermeable formation above the Ordovician limestones, and it probably forms together with the higher formations a protective roof under which the high-calcium limestones are relatively free of solution cavities.
Eggleston Formation

Name. — The Eggleston formation was named by Mathews (1934) for Eggleston, Giles County, Virginia.

Character and distribution. — The lower part of the Eggleston is composed of a bluish-gray shale with a basal sandy layer. The Eggleston formation only was mapped south of Sinking Creek.

Structure

In the area mapped the structural features are an anticline, two synclines and an imbricate structure. The Thassalia anticline plunges about 10° to the northeast, and the axial trace tends to follow Doe Creek in the vicinity of Hoges Store and to the northeast. The Little Meadows syncline lies northwest of the anticline, and the John's Creek syncline is southeast with its axial trace between Hoges Store and Lucas Memorial Church. The area along the northwest base of Spruce Run Mountain has an imbricate structure that includes several thrust faults and drag folds associated with the Saltville fault to the southeast. The fault zone consists of three essentially strike faults trending about N 80° E and dipping 60-80° to the southeast.

Occurrences of Limestone of Chemical Grade

The area in the vicinity of locality 8 about 1.5 miles northeast of Hoges Store is believed to be a favorable site for future
mining zones of high-calcium limestone. The beds lie near the crest of a major anticline and dip about 80° northeast. At this locality the Elway contains 29 feet of chemical-grade limestone which is separated from a 20-foot thickness of high-calcium Five Oaks limestone by 100 feet of impure beds. The 100 feet of rock between the two calcilutite zones would necessitate quarrying or mining on two levels. The high-calcium Five Oaks limestone does not crop out far to the southwest of locality 9. At locality 6, the Five Oaks contains at least 30 feet of calcilutite with impure beds in the middle. The abnormally thick development of calcilutite in the Elway was exposed completely only in the vicinity of locality 8. Test drilling will have to be done to determine the character and thickness of the Five Oaks and Elway calcilutites beneath the cover of over-lying beds. Suggested locations for core drilling are indicated on Plate 4. Assuming persistence of the quality of limestone indicated from surface samples, the amount of recoverable limestone is estimated to be 60 million tons; the estimate based on the assumption that the total thickness of the two calcilutite zones averages 50 feet and that only 50 per cent of the good stone could be recovered.

About 0.50 mile northwest of Boyd Chapel (locality 12), 70 feet of coarse-grained, high-calcium limestone occurs in the upper part of the Benbolt formation. The beds dip about 15° northwest, and they can be traced more than 1500 feet along the strike. Assuming
persistence of the coarse-grained Benbolt for 150 feet down dip, more than 800 tons could be mined for every foot it maintains 70 feet of thickness along the strike. Only by test drilling will it be possible to determine the extent of the coarse-grained limestone along the strike and down the dip.

A body of high-calcium limestone occurs about 1 mile north of Hoges Store (locality 4) previously described by Cooper (1944). There is at least 60 feet of limestone, but much of the interval is covered and only core drilling will reveal its true character.
### Table 1 - Analyses of Limestones in the Vicinity of Hopes Store, Giles County, Virginia

<table>
<thead>
<tr>
<th>Locality</th>
<th>Location</th>
<th>Formation and Rock Character</th>
<th>Thickness Feet</th>
<th>Chemical Composition</th>
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<td>CaCO₃</td>
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<td>Giles County; 1.5 miles northeast of Hopes Store</td>
<td>Five Oaks limestone; very fine grained, compact, dove-gray</td>
<td>14</td>
<td>97.58</td>
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<td>Giles County; 1.5 miles northeast of Hopes Store</td>
<td>Elway limestone; very fine grained, compact dove-gray</td>
<td>10</td>
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<td>18</td>
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<td>Giles County; 1.5 miles northeast of Hopes Store</td>
<td>Five Oaks limestone; very fine grained, compact, dove-gray</td>
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<td>95.40</td>
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<td>5</td>
<td>94.99</td>
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<td>Witten limestone</td>
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<td>Bluish-gray limestone, dolomitic</td>
<td>12</td>
<td>81.98</td>
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<td>Grafton limestone</td>
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<td>Dove-gray limestone, fine grained</td>
<td>55</td>
<td>96.03</td>
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<td>Gray limestone, nodular, clay</td>
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<td>80.07</td>
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<td>Gray limestone, fine grained</td>
<td>15</td>
<td>95.23</td>
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<td></td>
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<td>Benoit limestone; gray, coarse grained</td>
<td>70</td>
<td>95.03</td>
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References Cited


Appendix I

Geologic Sections

Geologic Section 1.— Ordovician limestones along the southwest base of Doe Mountain, at locality 1, about 1 mile northwest of Hocus Store, Giles County, Virginia.

<table>
<thead>
<tr>
<th>Thickness</th>
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</table>

Moccasin formation

Witten formation (64 feet)

| 11. Limestone, light-gray, fine grained, thin bedded | 43 |
| 10. Limestone, light-gray, fine grained, dolomitic seams | 21 |

Gratton limestone (64 feet)

| 9. Calciolitite, dove-gray, thick bedded | 51 |
| 8. Limestone, medium-gray, fine grained, thin bedded, dolomitic | 13 |

Benbalt limestone (186 feet)

| 7. Limestone, dark-gray, fine grained, dolomitic seams | 56 |
| 6. Limestone, dark-gray, fine grained, nodular, argillaceous, very fossiliferous | 24 |

1 Described intervals in italics indicate beds where chemical compositions are shown on Table 1.
5. Limestone, medium- to dark-gray, fine grained with intercalation of coarse grained limestone 31

4. Limestone, gray, nodular, argillaceous seams 75

Peary limestone (93 feet)

3. Limestone, dark bluish-gray, fine grained, cherty 93

Ward Cove limestone (27 feet)

2. Limestone, dark-gray, medium to coarse grained, cherty 27

Lincolnshire limestone (45 feet)

1. Limestone, dark bluish-gray, fine to medium grained, cherty 45

Five Oaks limestone

Geologic Section 2.—Ordovician limestone along the southwest base of Doe Mountain, at locality 2, about 1.4 miles northeast of Moss Store, Giles County, Virginia.

Moccasin Formation

Witten limestone (70 feet)

9. Limestone, light-gray, fine grained, thin bedded, buff dolomitic seams 70

8. Calcilitite, dove-gray, thick bedded 51

7. Limestone, medium-gray, fine grained, dolomitic 11

Benbolk limestone (174 feet)

6. Limestone, gray, nodular, argillaceous 174
Peery limestone (125 feet)

5. Limestone, dark bluish-grey, fine grained, cherty  125

Ward Cove limestone (27 feet)

4. Limestone, dark-grey, coarse grained, cherty  27

Lincolnshire limestone (60 feet)

3. Limestone, dark bluish-grey, fine grained, cherty  60

Five Oaks limestone (35 feet)

2. Calcilutite, dove-grey, calcite inlets, widely spaced stylolitic seams  35

1. Limestone, dove- and dark-grey, fine grained, cherty; base not exposed  200

Geologic Section 3. Ordovician limestone at locality 2, about 1.5 miles northeast of Rose Store, Giles County, Virginia.

Moccasin formation

Witten limestone (53 feet)

14. Limestone, light-grey, fine grained, medium bedded  38

13. Limestone, medium-grey, fine grained, buff dolomitic stringers  15

Grattox limestone (49.5 feet)
12. Limestone, light-gray, coarse grained, very fossiliferous 4.5

11. Calcareous, medium-gray, medium bedded, somewhat argillaceous 4.5

Benzbdt limestone (200 feet)

10. Limestone, medium-gray, fine grained, argillaceous 8.0

9. Limestone, dark bluish-gray, fine grained, cherty 7.5

8. Limestone, gray, nodular, argillaceous 4.5

Feery limestone (102 feet)

7. Limestone, dark bluish-gray, fine grained, cherty 10.2

Ward Cove limestone (27 feet)

6. Limestone, medium-gray, coarse grained 2.7

Lincolnshire limestone (52 feet)

5. Limestone, dark bluish-gray, medium bedded, cherty 5.2

Five Oaks limestone (51 feet)

4. Calcareous, dove-gray, calcite inets, widely spaced stylolitic seams 5.1

Elway limestone (126 feet, base not exposed)

3. Limestone, dove- to dark-gray, fine grained cherty 6.7
2. Calcilutite, dove-gray, calcite insets
   widely spaced stylolitic seams 49
1. Limestone, dark-gray, fine grained, cherty;
   base not exposed 10

Geologic Section 4.—Ordovician limestone at locality 11, about 0.75 miles northwest of Boyd Chapel, Giles County, Virginia.

Moccasin formation

Witten limestone (67 feet)

5. Limestone, light-gray, fine grained, nodular,
   argillaceous seams 16
4. Limestone, light- to dove-gray, medium to thick
   bedded, a few argillaceous seams 35
3. Limestone, medium-gray, thin bedded, nodular,
   argillaceous stringers 26

Gratton limestone (55 feet)

2. Calcilutite, dove-gray, thick bedded 43
1. Limestone, medium-gray, medium bedded,
   somewhat argillaceous 12

Benbolt limestone

Geologic Section 5.—Ordovician limestone at locality 8, about 1.5 miles northeast of Horse Store, Giles County, Virginia.

Five Oaks limestone
Elway limestone (106+ feet, base not exposed)

3. Limestone, dove- to dark-gray, fine grained, cherty 67

2. Calcilutite, dove-gray, calcite inets, widely spaced stylolitic seams 29

1. Limestone, dark-gray, fine grained, cherty; base not exposed 10+

Geologic Section 6.—**Ordovician limestone at locality 6, about 1.75 miles northeast of Hayes Store, Giles County, Virginia.**

Lincolnshire limestone

**Five Oaks limestone** (30+ feet, base not exposed)

4. Calcilutite, dove-gray, calcite inets, widely spaced stylolitic seams 14

3. Limestone, dark- to dove-gray, small calcite inets 3

2. Limestone, dark- to dark gray, dolomic 3

1. Calcilutite, dove-gray, calcite inets, widely spaced stylolitic seams 10

Geologic Section 7.—**Ordovician limestone at locality 2, about 1.5 miles northeast of Hayes Store, Giles County, Virginia.**

Lincolnshire limestone

**Five Oaks limestone** (27 feet)
3. Calcilutite, dove-gray, calcite inlets widely spaced stylolitic seams 20
2. Limestone, dark-gray, dolomitic seams 2
1. Calcilutite, dove-gray, calcite inlets, widely spaced stylolitic seams 5

Geologic Section 8.— Ordovician limestone at locality 12, about 0.50 mile northwest of Boyd Chapel, Giles County, Virginia.

Moccasin formation

Within limestone (47 feet)

66. Limestone, gray, fine grained, dolomitic and clayey seams 35
5. Limestone, bluish-gray, dolomitic, clayey 12

Gratton limestone (85 feet)

4. Limestone, dove-gray, fine grained, thick bedded 55
3. Limestone, gray, nodular, clayey, dolomitic 15
2. Limestone, gray, fine grained 15

Benbolt limestone (70+ feet)

1. Limestone, gray, coarse grained 70

Thickness
Feet
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ORDOVICIAN LIMESTONES IN THE VICINITY OF HOGES STORE, GILES COUNTY, VIRGINIA

EXPLANATION

- Eggleston formation
  (Only mapped south of Sinking Creek)
- Moccasin formation
- Witten formation
- Gratton formation
- Benbolt formation
- Peery, Ward Cove and Lincolnshire limestones
- Five Oaks limestone
- Elway limestone

Map from Norrisburg Quadrangle
U.S. Geological Survey (1937)

Scale:

1 0 5000 10000 15000
Miles

5000 10000 15000
Feet

Contour interval 50 feet

Geology by W.H. Shanholtz
Major structural features in the Giles County area, Virginia
Plate 4. Map of Hopes Store and vicinity, showing 900-acre area (shaded in blue) believed to be underlain by two zones of chemical-grade limestone in mineable quantities aggregating 80 to 100 million tons. Recommended core hole locations shown in red.
GEOLOGIC SECTION 1. Ordovician limestones and shales at locality 7, about 1.5 miles northeast of Hoges Store, Giles County, Virginia.