High Magnesian Limestones and Dolostones of Northwest Georgia

Michael S. Friddell

GEORGIA DEPARTMENT OF NATURAL RESOURCES
ENVIRONMENTAL PROTECTION DIVISION
GEORGIA GEOLOGIC SURVEY

Atlanta
1995

BULLETIN 126

High Magnesian Limestones and Dolostones of Northwest Georgia

Michael S. Friddell

GEORGIA DEPARTMENT OF NATURAL RESOURCES
Joe D. Tanner, Commissioner
ENVIRONMENTAL PROTECTION DIVISION
Harold F. Reheis, Director
GEORGIA GEOLOGIC SURVEY
William H. McLemore, State Geologist

Atlanta
1995

BULLETIN 126

TABLE OF CONTENTS

APPENDICES

LIST OF FIGURES

TABLES

ABSTRACT

The Valley and Ridge Province of Georgia contains large deposits of high-magnesian limestone and dolostone. The potential uses for these materials include aggregate, agricultural lime, refractory material, flux in steel making, and glass manufacture. The primary objective of this study is to evaluate the potential of the Valley and Ridge Province for the commercial production of high-magnesium limestones and dolostones.

During this investigation 27 quarries and 91 prospects were evaluated. These quarries and prospects are generally within one of the following geologic units: 1) The Knox Group, 2) the Shady Dolomite, and 3) a dolomitic facies of the Conasauga Group. One locality was cored to a depth of 331 feet and is judged to be one of the more promising sites within the state. The core also revealed mineralization of the dolostone including sphalerite, fluorite, barite, and galena.

The results of this study indicate that of the three rock units investigated, the Knox holds the most promise for mining. In particular, four areas are favorable for further exploration. These areas are: (1) Peavine Ridge, which is present as a sinuous ridge, extending from the Georgia-Tennessee border through Catoosa, Walker and Chattooga Counties, (2) Missionary Ridge in Walker County, (3) Boynton Ridge which winds through Catoosa and Walker Counties, and 4) the Cedar Creek-Vanns Valley area in northern Polk and southern Floyd Counties.

INTRODUCTION

Carbonate rocks consisting chiefly of dolostones (dolomites) and limestones occur throughout the Valley and Ridge Province of northwestern Georgia. For the purposes of this report, high magnesian limestones are those containing between 50 and 90 percent calcite with <10 percent of other minerals and dolostones contain >90 percent dolomite and <10 percent other minerals (Figure 1).

The carbonate rock types of northwestern Georgia have the potential to be economically important if three criteria are met: 1) favorable chemistry, 2) sufficient quantity, and 3) favorable location (i.e. proximity to transportation, little overburden). Of these factors, purity and quantity are most important.

The purpose of this study is to evaluate the potential for mining of high magnesian limestones and dolostones and to identify specific areas that have commercial potential as well as to exclude those areas where there is little or no chance of locating an economic deposit. A secondary purpose is to provide a geochemical and geological data base for future studies. It should be noted that mining of carbonate rock requiring lowering of the water table may require sinkhole mitigation.

The study area encompasses approximately 3,500 square miles in the northwestern portion of the state (Figure 2, p. 2) and includes the whole of Dade, Walker, Catoosa, Whitfield, Chattooga, and Floyd Counties as well as portions of Polk, Paulding, Bartow, Gordon, and Murray Counties. The study area comprises the entirety of the Valley and Ridge Physiographic Province that lies within Georgia (Figure 3, p. 3).

USES OF HIGH MAGNESIAN LIMESTONES AND DOLOSTONES

Uses of high magnesian limestones and dolostones can be assigned to four categories: agricultural, aggregate, chemical, and others. Specialty limestones and dolostones, such as flux stones, agricultural limes, and so forth have specific requirements. Figure 4 (p. 4), a graph modified from Hershey and Maher (1985), shows some of these chemical/mineralogical requirements. Agricultural products include soil conditioners (high magnesian limestones and dolostones are superior to ordinary limestone), poultry grit, dusting material, and neutralizers. Aggregate uses include abrasives, fine and coarse concrete aggregate, roofing granules, asphalt filler, fine to coarse road base, and rip rap. Chemical uses include the production of metallic magnesium and as fluxes for both the steel and glass manufacturing industries. Other uses include fillers, pigments, ceramics, filter sands, specialty cements, and refractories.

Specifications vary depending on the end use for the material. For example, the amount of SiO_2 present as either quartz or chert makes little difference in aggregate used for rip rap, but in concrete aggregate, the presence of SiO_2 as chert is detrimental, as there is an undesirable reaction between the chert, $CaCO_3$, and H_2O due to the large surface area of porous chert. In many uses, the industry restrictions are even more stringent. According to Boynton (1966), for

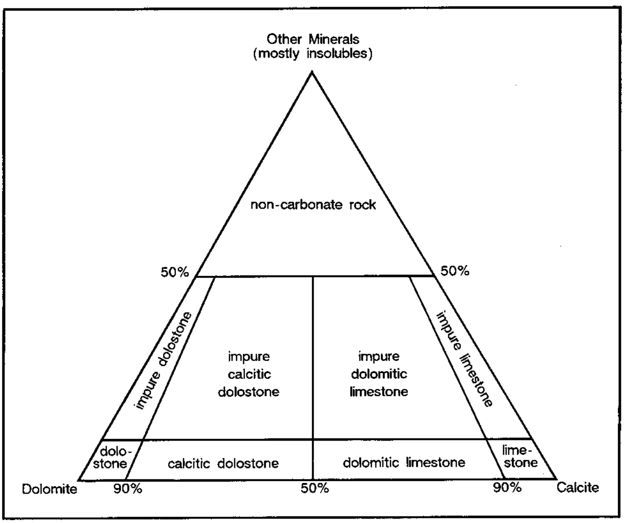

Figure 1. Mineralogical classification of carbonate rocks (Carr and Rooney, 1983).

flux used in glass making, the material must meet the requirements for a chemical grade limestone (≥95 percent carbonate). In addition, Carr and Rooney (1983) mention some glass manufacturers who require Fe_2O_3 <0.01 percent and silica <1.0 percent.

Neutralization of soil acidity is the largest agricultural use of high magnesian limestones and dolostones. The requirement for neutralizing is expressed in terms of CCE (calcium carbonate equivalent: the number of units of $CaCO_3$ required to equal one unit of the material used). The CCE required in Georgia (Georgia Liming Act, 1963) is 85, which means that a maximum of 100 pounds of the liming material is required to equal 85 pounds of $CaCO_3$. High magnesian limestones and dolostones, the focus of this report, slowly release magnesium to the soil for plant growth and also have neutralizing properties.

COMPOSITION AND ORIGIN

The two basic minerals under consideration in this study are calcite ($CaCO_3$) and dolomite ($CaMg(CO_3)_2$). Both limestone and dolostone are biogenic in origin with the vast majority of dolostones resulting from the introduction of magnesium rich brines into previously deposited carbonates with magnesium replacing calcium.

The generally accepted definition of dolomite (rock) or dolostone is any rock composed of > 50% carbonate (calcite + dolomite) in which the percentage of dolomite is greater than the percentage calcite. Conversely, if calcite comprises >50% of the carbonate fraction, the rock would be termed a limestone. This 50th percentile separates calcitic dolomite from dolomitic or magnesian limestone. For the purposes of this report the classification modified after Carr and Rooney (Figure 1) is used.

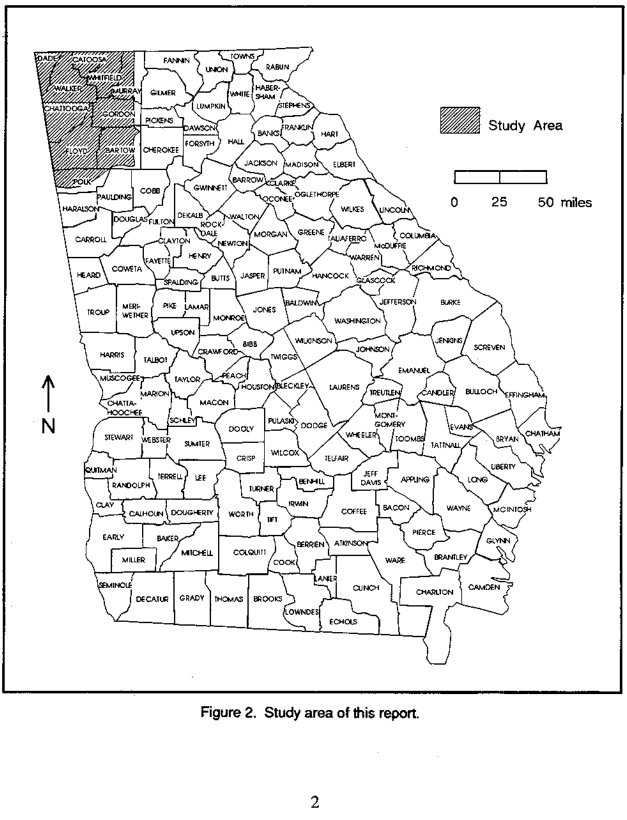

Figure 2. Study area of this report.

METHODS

Following a review of the literature, the units selected for investigation were the Knox Group, the Shady Dolomite, and dolomitic portions or facies of the Conasauga Group. These rock units were considered to be the most likely to contain deposits that could be commercially mined. Geologic contacts from existing geologic maps, locations of measured sections, and sites of active and inactive quarries were transferred to 1:24,000 scale topographic maps. After review of these maps, sites were selected for field investigation based on proximity to a known active or inactive quarry and proximity to geomorphic features, such as bluffs and knolls, that suggest the possibility of an extensive outcrop or exposure of the targeted units.

A large amount of data, including chemical analyses, were compiled from previously published material (Maynard, 1912; Kesler, 1950b; McLemore and Hurst, 1970; and Foote, 1986). Unless otherwise stated, all chemical analyses are from the current study and were performed by Skyline Laboratories, Wheat Ridge, Colorado. Reserve estimates for the deposits discussed in this report are those of the authors of published reports or of sites visited by the author of this report. Throughout this report, the property or property owner's names in bold are those of McLemore and Hurst (1970).

Field Methods

After selection of the sites to be visited was completed, rock samples were taken from both natural and man-made outcrops as well as core. Hand specimens were collected by channel sampling, using chips representative of sub-units of the total outcrop. Every effort was made to avoid any weathering rind and to obtain as fresh a sample as possible. One site, Q-1, (Catoosa County) was cored using a Failing CF-1500 rotary table drill equipped with a Christensen NX wire line.

Each sample, with the exception of the core, was labeled with the 7.5 minute quadrangle name where the sample was gathered and a station number assigned. In the event that more than one sample was taken or a specific subunit sampled, that sample was identified by an alphabetical subscript. Estimates of reserves represent the outcrop exposure. These estimates are minimal estimates and do not consider quarrying below grade.

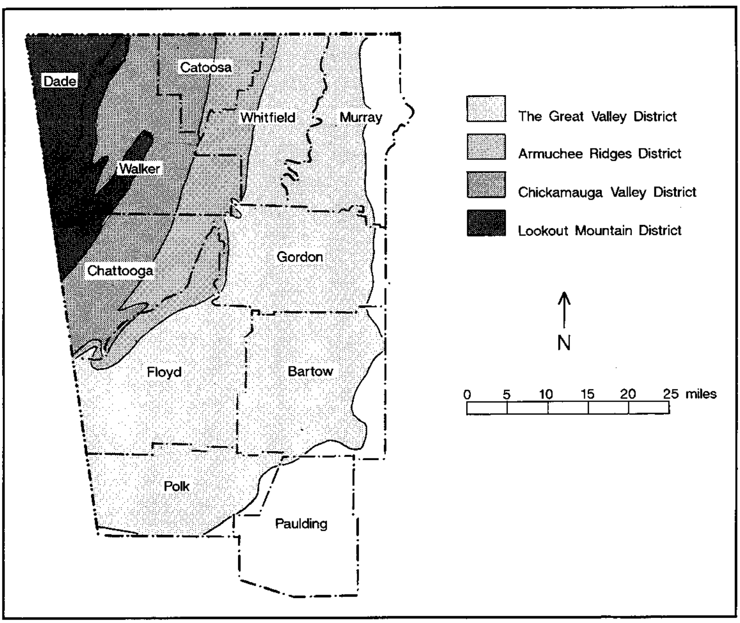

Figure 3. Physiographic districts within the study area.

Laboratory Methods

Chemical analyses of the samples (approximately 50 g) were performed by Skyline Laboratories of Wheat Ridge, Colorado. The methods used for the analyses were ICAP (inductively coupled argon plasma spectrometry), atomic absorption, specific ion probe, and gravimetric. The gravimetric method was used to obtain the amount of insolubles and LOI (loss on ignition). A specific ion probe was used to measure the amount of fluorine present. Molybdenum and barium concentrations (Table A-1) were measured using atomic absorption. The concentrations of the remainder of the elements were measured using the ICAP method.

A comparison of a semiquantitative X-ray diffraction method of analysis and chemical analysis was carried out to ascertain as to whether or not a rapid and less expensive method (X-ray diffraction) could be consistently relied upon to estimate the relative amounts of dolomite and calcite in the samples of this study. The procedures used and results of these comparisons indicate that X-ray peak heights can be used to accurately estimate relative percentages of dolomite and calcite in carbonate rock samples (see Appendix B).

PREVIOUS WORK

There have been many contributors to our understanding of the regional geology of the Valley and Ridge of Georgia. Among the earliest works are those of C.W. Hayes (1891, 1894, 1902) and J.W.W. Spencer (1893). Charles Butts and Benjamin Gildersleeve (1948) published a bulletin on the stratigraphy, paleontology, and mineral resources of the Valley and Ridge Province of Georgia. The most recent works are those of Croft (1963a, 1963b), Cressler (1963, 1964a, 1964b, 1970, 1974), and Cressler and others (1979).

Previous works dealing specifically with the economic aspects of the carbonate rocks are relatively few. These include Maynard (1912), Furcron (1942), Butts and Gildersleeve (1948), and McLemore and Hurst (1970). Maynard's work consists of a review of the carbonate units of the northwest Georgia area that were suitable, at the time of his report (1912), for use as cement materials or as flux for steel manufacture. Included are a general description of the geology of the area, description of the properties and prospects of the area, uses of materials, and chemical analyses of samples collected from prospects and proper-

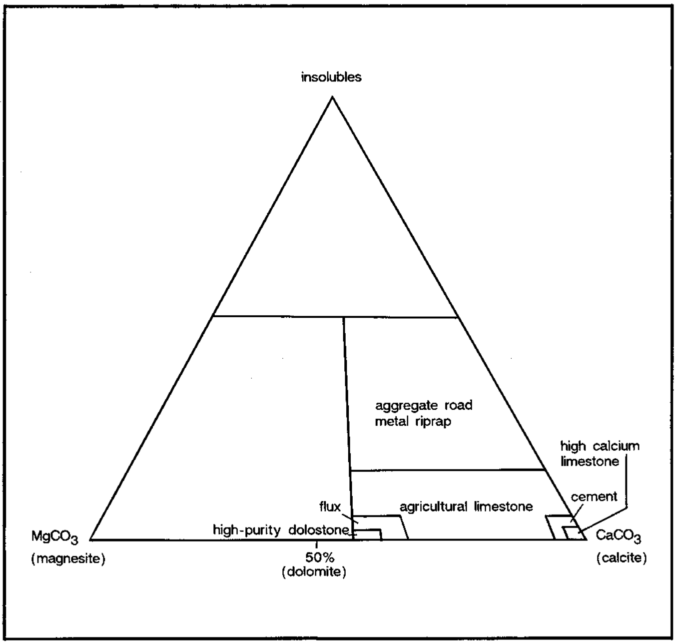

Figure 4. Generalized purity requirements for various limestone-dolostone products.

ties. Furcron (1942) emphasizes the magnesium [magnesian] limestones and dolomites of northwestern Georgia as well as the marbles and calcareous units of the Piedmont and the magnesium limestones of the Coastal Plain Province. This publication provides descriptions and locations of the properties with chemical analyses. The work of McLemore and Hurst (1970) provides a review of the carbonates of the Valley and Ridge of Georgia. Descriptions of outcrops, past and present quarry sites, and prospects, along with chemical analyses, are included. [Note: according to McLemore (1994, oral communication), the reserve estimates made by McLemore and Hurst (1970) are only estimates of reserves that could be actually measured but do not take into account quarrying below grade or into the hillsides. Therefore, their reserve estimates should be considered minimum estimates.]

PHYSIOGRAPHY

The study area lies within the Valley and Ridge Province. This province is further subdivided into the Chickamauga Valley District, the Armuchee Ridges District, and the Great Valley District (Figure 3). Clark and Zisa (1976) characterized the districts as follows:

> "The Great Valley District is typically broad and open with a few scattered ridges and hills. Elevations throughout the area range from 700-800 feet above sea level with relief of 50 to 100 feet. The floor of the valley is underlain by shales, dolomites and limestones of Cambrian and Ordovician age. The eastern boundary of the Great Valley follows the escarpment of the Great Smoky-Cartersville Fault."
>
> "Armuchee Ridges District - A series of prominent, narrow, chevron-shaped ridges dominate the Armuchee Ridges District. These ridges rise abruptly 600-700 feet above the Chickamauga Valley District to the northwest and the Great Valley District to the south and east. The southern and eastern boundary closely parallels the Rome Fault. These ridges, capped predominantly by the Red Mountain sandstone of Silurian age, stand at elevations of 1400-1600 feet. Intervening valley floors are generally underlain by shales and limestones of Mississippian and Cambro-Ordovician age respectively."
>
> "The Chickamauga Valley District is characterized by a series of gently rolling, discontinuous, northeast-trending valleys interrupted by low, linear, parallel ridges. The valley floors are predominantly limestone and dolomite of Cambro-Ordovician age while the ridges are capped by the more resistant cherty units of the Knox Group, also of Cambro-Ordovician age. The ridge tops are approximately 1000 feet in elevation and stand 200-300 feet above the intervening valleys. Rectangular drainage patterns in this district are indicative of structural control."

GENERAL GEOLOGY

In general, the rocks present within the study area are sandstones, shales, siltstones, limestones, dolostones and cherts. In some cases, the hills are synclinal in structure whereas the valleys are anticlinal. The explanation for this disparity between topography and structure is that the anticlines were in many cases breached and therefore more subject to weathering whereas the synclines were often protected by a capping of resistant sandstone layer. In general, shales, siltstones, and carbonate rocks form the valleys whereas sandstones and cherts underlie the ridges. The aforementioned rocks are folded into a series of NNE trending anticlines and synclines which are broken by SE dipping thrust faults (Chowns, 1989).

Rock units pertinent to this study are Cambro-Ordovician in age and include the Shady, Conasauga, and Knox carbonates and associated clastic units such as the Chilhowee, Rome, and parts of the Conasauga. Chowns (1990) provides a review of the stratigraphy of the Valley and Ridge.

Lower Cambrian

The Chilhowee Group was originally named by Safford (1856) for Chilhowee Mountain in Sevier and Blount Counties, Tennessee. In Georgia, this group is represented by the Weisner Quartzite of Kesler (1950b). The Weisner in Georgia consists of gray shales interbedded with generally fine-grained (locally conglomeratic) micaceous quartzites with an approximate thickness of 2,000 feet (Kesler, 1950). Cressler (1974) described the Chilhowee as a conglomeratic quartzite of Cambrian age, attaining a thickness of 300 feet in Whitfield, Gordon, and Murray Counties.

The term Shady Dolomite was first introduced by Keith (1903) for carbonate rocks in Shady Valley in Johnson County, Tennessee. Where fresh or unweathered, the Shady is a thinly interbedded, hematitic blue gray, medium to coarsely crystalline dolomite. In Georgia, the Shady is restricted to the Cartersville area. The Shady is predominantly found, where weathered, as an ocher and barite-rich clayey residuum. Locally, the Shady is fossiliferous and conformably overlies the Weisner. Cressler and others (1979) reported the Shady to be between 300 and 500 feet thick in the Cartersville area and described it as being a highly siliceous, dark to light gray, thinly to massively bedded dolomite to dolomitic limestone with a dark gray shale in the upper portion.

The Rome Formation, named for exposures near Rome, Georgia, was first formally used by Smith (1890). This unit consists of variegated, interbedded, gray and maroon shales, siltstones, claystones, and sandstones, with occasional thin limestone layers. Cressler (1963) states that the maximum thickness of the Rome is 5,000 feet.

Middle Cambrian

The Conasauga Group, named for the exposures along the Conasauga River in the Dalton quadrangle, Georgia, was first introduced by Hayes (1891) for a series of fossiliferous, greenish-gray shales and interbedded, impure, blue gray limestones and calcareous siltstones. The shales weather to a yellowish-gray to pink color. Munyan (1951) states that no unconformity seems to exist between the Conasauga and the underlying Rome or the overlying Knox Group. The Conasauga Group, as presented here (Cressler, 1970), includes four units: 1) a lower unit, which is composed predominantly of a shale and sandstone unit with a lower dolostone, 2) a middle unit,which is predominantly a limestone and shale unit, 3) an upper unit of limestone and shale with subordinate beds of dolostone, and 4) an upper carbonate unit known as the Maynardville Limestone. Also included in the Conasauga Group is the Maynardville limestone as its uppermost unit. Hayes (in Butts, 1948) estimated the thickness of the Conasauga to be between 1,500 and 4,000 feet.

Upper Cambrian-Lower Ordovician

The Knox Dolomite or Group was named by Safford (1869) for exposures in Knox County, Tennessee. The Knox is divided into four formations in Georgia. These formations are the Copper Ridge Dolomite, Chepultepec Dolomite, the Longview Limestone, and the Newala Limestone. The lowest member of the Group, the Copper Ridge Dolomite, is believed to be Cambrian and is a thinly to massively bedded, brownish-grey to blue gray, fine to coarsely crystalline cherty dolostone which has a sulfurous odor when crushed. Allen (1953) measured a thickness of 2,380 feet for the Copper Ridge Dolomite in Catoosa County, Georgia. Chowns (personal communication, 1993) described the total thickness of the Knox as approximately 4,000 feet.

The middle member of the Knox Group, the Chepultepec Dolomite, is lower Ordovician and is characterized lithologically as a dolostone which is blue-gray to light grey, medium to coarsely crystalline, sparsely fossiliferous, thick bedded with occasional limestone beds, and which contains considerably more and thicker cherts than the Copper Ridge Dolomite. Allen (1953) reported the thickness of the Chepultepec to be 1,400 feet with chert beds as thick as eight feet.

The Longview Limestone, lower Ordovician, is a thickly bedded, light to medium gray, fine to coarsely crystalline dolostone which contains occasional chert layers and nodules. Allen (1953) estimated the thickness of the Longview as 560 feet and a total thickness of the Knox Group as being in excess of 4,300 feet.

The Newala Formation, early Ordovician, was named for the Newala Post Office in Shelby County, Alabama. Although Butts (1948) placed the Newala within the lower portion of the Chickamauga, most succeeding workers (Chowns, 1989) have placed the Newala within the Knox Group. The Newala is a thinly to thickly bedded, fossiliferous, fine-grained, blue gray, limestone with subordinate beds of dolomite. The Newala contains occasional chert nodules and stringers of chert. Butts (1948) estimated the thickness of the Newala to be 250 feet.

COUNTY REPORTS

Bartow County

Bartow County, which is in the southeastern part of the study area, has a population of 55,911 (1990 census) and a land area of 470.7 square miles. Bartow County contains portions of two districts of two physiographic provinces. Southeastern Bartow County is in the Cherokee Uplands District of the Piedmont Province whereas the remainder of the county is within the Great Valley District of the Valley and Ridge Province.

The Piedmont portion of Bartow County contains outcroppings of quartzites, phyllites, and gneisses of probable Precambrian to Paleozoic age. The Valley and Ridge portion of Bartow contains dolostones, limestones, and slates of Cambrian and Ordovician ages. The units of major interest are the Shady Group, the Knox Group, and the Conasauga Group.

Quarries and Prospects

There are two active quarries, seven abandoned quarries, and 36 prospects within the targetted units in Bartow County (see Figure 5).

Q-1

McLemore and Hurst (1970) described the location of the **M.E. Painter Quarry** as being 2.6 miles east of Adairsville on Georgia Highway 140. The quarry is described as having a 40 foot high face of fine to medium grained dolostone. They collected two samples, one representing the lower portion of the quarry face and one representing the upper portion of the face. The results of chemical analyses were as follows (McLemore and Hurst, 1970):

		Wt. (%)	
Oxide		**Lower**	**Upper**
CaO		28.3	29.1
MgO		19.9	20.5
SiO_2		4.9	3.1
Al_2O_3		2.2	1.4
Fe_2O_3		0.8	0.8
CO_2		43.8	45.1
	Total	100.0	100.0

From the analyses given by McLemore and Hurst (1970) the carbonate is moderately low in silica and high in total carbonate. McLemore and Hurst state that the quarry reserves appear to be large and that the material could be used for aggregate, road metal, and aglime. This quarry, which is now abandoned, could be reopened as a source of dolostone.

Q-2

McLemore and Hurst (1970) reported a lime quarry **(Clifford Lime and Stone Company Quarry)** located 3.7 miles north of Kingston and 0.2 miles west of the W&A and L&N Railroad. The dolostone is described as fine grained and pearl gray. Known reserves are a minimum of 200,000 tons, although, according to McLemore and Hurst (1970), a greater tonnage could be produced from this deposit. A chemical analysis of the dolostone was reported by McLemore and Hurst (1970) as follows:

Oxide	Wt. (%)
CaO	27.8
MgO	21.3
SiO_2	4.4
Al_2O_3	1.0
Fe_2O_3	0.5
CO_2	45.0
Total	100.0

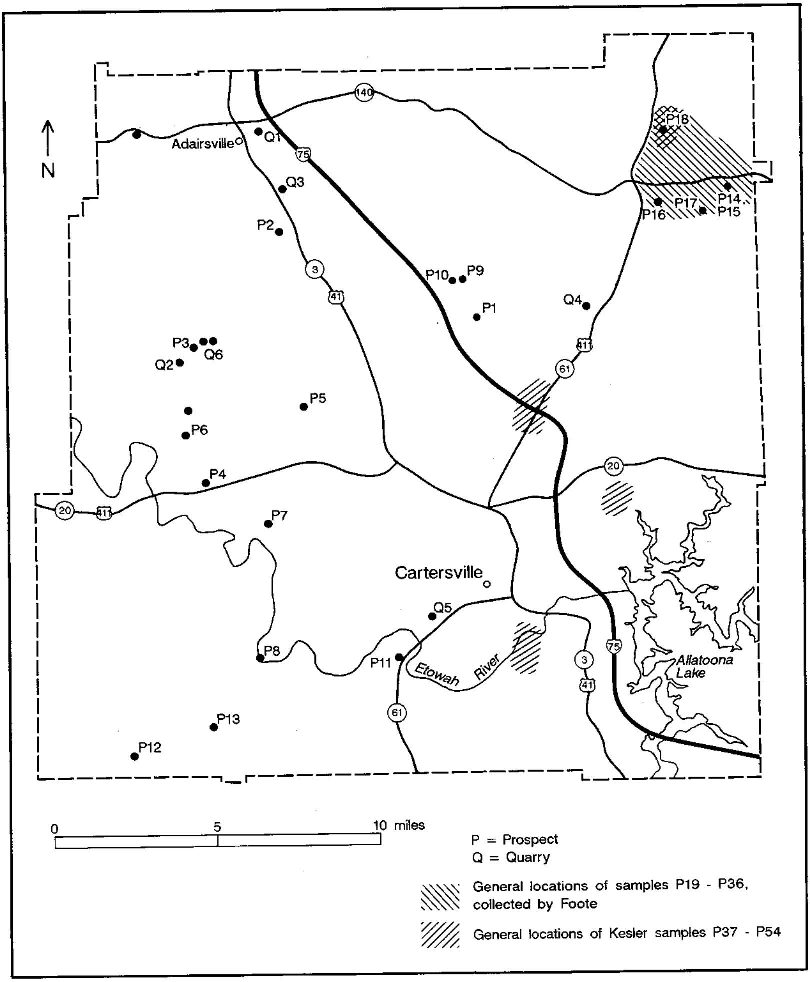

Figure 5. Map of Bartow County showing magnesium limestone and dolomite prospects and quarries.

This abandoned quarry could not be located during the current study. The information provided here is for historical value.

Q-3

The **Charles F. Jarrett Quarry** was reported by McLemore and Hurst (1970) to be within the Conasauga Group and located 3.5 miles south of Adairsville on old U.S. Highway 41. The quarry produced crushed stone from a bluish-gray, fine-grained dolostone. An analysis of the stone from McLemore and Hurst (1970) is:

Oxide		Wt. (%)
CaO		30.2
MgO		21.0
SiO_2		1.2
Al_2O_3		0.6
Fe_2O_3		0.3
CO_2		46.6
	Total	99.9

This quarry currently contains several feet of water, however, it could be reopened as a source of aglime and aggregate.

Q-4

McLemore and Hurst (1970) report the location of the **Stockbridge Stone Company Quarry (Shinall)** as being one mile north of White and adjacent to the L & N Railroad. The quarry is currently filled with water. Between 1947 and 1970 the quarry produced approximately 2,000,000 tons of stone, some of which was sold as agricultural stone. McLemore and Hurst analyzed two samples from the quarry, one from the east side and one from the west. The analysis is as follows:

Oxide		Wt. (%)	
		West	East
CaO		30.1	30.4
MgO		21.4	21.2
SiO_2		0.6	0.9
Al_2O_3		0.4	0.7
Fe_2O_3		0.5	0.5
CO_2		46.9	47.0
	Total	99.9	100.7

The fact that the quarry is now under water may remove it from economic consideration. Any dewatering efforts at this or any other quarry might induce sinkholes, thus requiring sinkhole mitigation.

Q-5

Ladd Quarry, probably one of the oldest lime producing quarries within the state, is located within the Knox Group approximately 2.5 miles west of Cartersville and 0.2 miles northwest of the community of Ladds. The quarry is located in the southeastern end of Quarry Mountain. According to McLemore and Hurst (1970), the quarry opened in or about 1867 and closed about 1958. Since 1965, some crushed stone has been produced for county use. The quarry face extends in excess of 1,000 feet horizontally and approximately 270 feet vertically. The dolostone at Ladd Quarry is light gray to blue gray, very fine- to fine-grained, massively to thinly bedded, fractured, and contains chert nodules. As McLemore and Hurst state, "Millions of tons of dolomite still could be produced from this site." An analysis of a composite sample of this material by McLemore and Hurst is:

Oxide		Wt. (%)
CaO		29.9
MgO		22.3
SiO_2		0.3
Al_2O_3		0.2
Fe_2O_3		0.3
CO_2		47.7
	Total	100.7

A sample collected from the lower portion of the quarry during the present study analyzed:

Oxide		Wt. (%)
CaO		27.80
MgO		18.50
SiO_2		10.50
Al_2O_3		0.33
Fe_2O_3		0.10
LOI		42.60
	Total	99.83
SO_3		<0.05
P_2O_5		<0.02
Insol.		10.80

The analyses of samples from this quarry demonstrate the variability of the stone, specifically in the amount of silica. Nevertheless, stone from this quarry could produce an excellent aglime or crushed stone. Minimum reserves are estimated to be in excess of one million tons.

Q-6

Maynard (1912) discussed a seven foot thick bed of dolomite within the Conasauga Group in the Howard Hydraulic Cement Company Quarry. The Howard Quarry was located on the L&N Railroad in the community of Cement. An analysis (from Maynard 1912) of this dolomite is as follows:

Oxide		Wt. (%)
CaO		29.50
MgO		16.30
Al_2O_3		3.59
Fe_2O_3		1.55
SiO_2		7.15
LOI		41.91
	Total	100.00

This prospect probably is not of economic importance because the bed is only seven feet thick.

Q-7

Blue Circle Aggregate operated a quarry approximately 2 miles north of Kingston along and east of the L&N Railroad. The quarry was operated for cement manufacture. No chemical analyses are available. This quarry could be reopened.

Qa-1

One active crushed limestone quarry is the Adairsville Quarry operated by Vulcan Materials. The quarry is located approximately 0.25 mile south of Georgia Highway 140. The quarry, located in the Conasauga Formation, currently produces only aggregate but an analysis provided by Vulcan Materials indicates that quarry could produce aglime.

Oxide	Wt. (%)
LOI	45.34
SiO_2	1.72
CaO	30.75
MgO	21.24
Al_2O3	0.33
Fe_2O_3	0.40
Na_2O	0.22
K_2O	0.08
Cr	0.016
Cu	0.006
Zn	0.009
S	0.001
S_3	0.00
MnO	0.01
P_2O_5	0.02
TiO_2	0.05
$CaCO_3$	54.71
$MgCO_3$	44.41

Qa-2

The other active quarry in Bartow County in the Conasauga Formation is the Cartersville quarry of the Stone Man, Inc. The quarry is located one mile east of the Cassville-White exit off I-75 on Spring Road. Currently the operation consists of one large 100 foot deep pit producing crushed limestone for use as aggregate.

P-1

The Sophia Prospect, as described by McLemore and Hurst (1970) is located 3.6 miles west of White and immediately east of the South Fork of Two Run Creek, on a county road. The prospect is described as approximately 30 feet of bluish gray, fine-grained dolomite contained within the Rome Formation. The published analysis of this dolomite is:

Oxide		Wt. (%)
CaO		30.80
MgO		19.70
SiO_2		1.80
Al_2O_3		0.70
Fe_2O_3		1.30
CO_2		45.70
	Total	100.00

The prospect, as described by McLemore and Hurst, apparently has very limited reserves and, although low in silica and relatively high in total carbonate content, it is not considered to be of economic importance.

P-2

P-2 is a carbonate outcrop located on the west side of U.S. Highway 41, 2.65 miles southeast of Adairsville. Exposed at this locality is fourteen feet of medium gray, oolitic to pelletoidal dolostone. The upper three to four feet contain intraclasts with dimensions as large as 0.5 inch. Overlying this dolostone is a cherty residuum, as much as 40 feet thick, that is typical of the Knox Group. An analysis of this sample is as follows:

Oxide		Wt. (%)
CaO		31.20
MgO		21.10
SiO_2		0.49
Al_2O_3		0.29
Fe_2O_3		0.12
LOI		46.80
	Total	100.00
SO_3		<0.05
P_2O_5		<0.02
Insol.		0.50

P-2, which is within the Knox Group, is not considered to be important economically due to the excessive thickness of overburden present within the immediate area of the outcrop.

P-3

Locality P-3 is located 0.7 mile north of Cement and 0.2 miles southeast of Connesena Church on a paved road. The outcrop consists of a lower, middle, and upper section. The lower section consists of eight feet of light gray, fine- to very fine-grained dolostone containing chert nodules as thick as two inches. The middle section consists of three feet of medium gray dolostone, which is in turn overlain by ten feet of cherty rubble. An analysis of a composite sample of the lower and middle units is as follows:

Oxide		Wt. (%)
CaO		30.80
MgO		16.70
SiO_2		8.60
Al_2O_3		0.92
Fe_2O_3		0.25
LOI		42.20
	Total	99.51
SO_3		<0.05
P_2O_5		0.04
Insol.		9.50

This outcrop near Cement exposes approximately 21 feet of carbonate but there is considerable overburden nearby. The amount of silica is moderately high. This carbonate is probably best suited for crushed stone.

P-4

Locality P-4 is 1.45 miles east of the Etowah River on the north side of U.S. Highway 411. This outcrop is a road cut through a low lying hill of Knox Dolomite. It consists of a five foot exposure of light gray, coarse-grained dolostone, overlain by four feet of chert. An analysis of this dolostone is as follows:

Oxide		Wt. (%)
CaO		30.5
MgO		20.8
SiO_2		1.7
Al_2O_3		0.4
Fe_2O_3		0.1
LOI		46.2
	Total	99.7
SO_3		<0.05
P_2O_5		<0.02
Insol		1.80

This outcrop near the Etowah River consists of only five feet of Knox Dolomite and, although the analysis is quite good, there does not appear to be enough material at this site for commercial operation.

P-5

P-5 is an outcrop of the Knox Group and is located along Lime Kiln Branch 1.6 miles east of the city limits of Kingston and approximately 250 feet north of Georgia Highway 20. This outcrop consists of two units: a lower 12 foot thick section, and an upper 31 foot thick section. The lower 12 feet of this outcrop is a variegated, light to very light gray, siliceous dolostone, containing thin laminae and sparry eyes approximately 0.125 inch in diameter. The upper 31 feet of this section consist of a variegated, light to medium gray, very fine-grained dolostone which contains a 0.5 inch thick shale and some cherty horizons ranging up to three inches. Analyses of this section are as follows:

	Wt. (%)	
	5-A	5-B
Oxide	(lower section)	(upper section)
CaO	30.60	29.20
MgO	20.10	19.10
SiO_2	2.40	6.90
Al_2O_3	0.45	0.67
Fe_2O_3	0.11	0.19
LOI	45.80	43.10
Total	99.46	99.16
SO_3	<0.05	<0.05
P_2O_5	<0.02	<0.02
Insol.	2.60	7.40

This is the site of a former lime kiln and has an exposed section with a thickness of 43 feet. A chemical analysis of composite samples from this section shows the silica content to be relatively low and the total carbonate to be rather high. From field evidence, P-5 appears to have some reserves and could produce aglime and crushed stone. The estimated reserves of this deposit are in excess of 250,000 tons.

P-6

Locality P-6 is located on the south side of Georgia Highway 20, 0.4 mile west of the city limits of Kingston. Approximately eight feet of cherty, somewhat weathered, very fine-grained dolostone of the Knox Group is present in this road cut. A prominent chert bed divides the outcrop approximately in half. Analyses of samples above (sample 6-A) and below (sample 6-B) the chert zone are as follows:

	Wt. (%)	
Oxide	6-A	6-B
CaO	30.60	30.00
MgO	20.00	19.50
SiO_2	3.40	4.30
Al_2O_3	0.34	0.62
Fe_2O_3	0.09	0.19
LOI	45.70	44.70
Total	99.73	99.31
SO_3	<0.05	<0.05
P_2O_5	<0.02	<0.02
Insol.	3.50	4.80

This is an outcrop with eight feet of Knox Dolomite exposed. Although the chemical analysis of this outcrop is promising, there do not appear to be sufficient amounts of stone to warrant economic interest.

P-7

P-7 is located approximately 2.3 miles southeast of Kingston on an unnamed dirt road 0.7 mile north of Sugar Valley Road and approximately 0.3 mile west of Ashpole Creek. About 30 feet of light gray to medium gray, fine-grained Knox Dolomite is exposed at the entrance to Salt Peter Cave. The analysis of this dolostone is:

Oxide	Wt. (%)
CaO	31.00
MgO	20.30
SiO_2	0.73
Al_2O_3	0.36
Fe_2O_3	0.13
LOI	47.10
Total	99.62
SO_3	<0.05
P_2O_5	<0.02
Insol.	0.73

The section exposed at P-7 consists of 30 feet of Knox Dolomite. The chemical analysis of the composite sample from P-7 shows that the dolostone is very low in silica and very high in total carbonates. This locality could produce high quality aglime based on the chemical analysis, however, it is a doubtful economic prospect due to the presence of the cave.

P-8

Locality P-8 is located just within the western city limits of Euharlee on the western bank of the Etowah River at Milam's Bridge. An approximately 30 foot exposure of medium gray, siliceous, fine-grained Knox dolostone is exposed at the old bridge. The analysis of the sample from P-8 is as follows:

Oxide	Wt. (%)
CaO	26.10
MgO	17.00
SiO_2	14.90
Al_2O_3	1.50
Fe_2O_3	0.38
LOI	39.30
Total	99.18
SO_3	<0.05
P_2O_5	<0.02
Insol.	16.70

The site of this prospect is a pinnacle exposure along the Etowah River. The chemical analysis of a composite sample shows it to be quite high in insolubles and only moderately high in magnesium content. The stone from P-8 is probably suited for crushed stone. The overburden within the area sampled is quite thick and would probably prohibit economic development.

P-9

Locality P-9 is a pinnacle exposure in sandy clay residuum. This site is located 0.95 mile northwest of Simpson Crossroads on an unnamed light duty road. The carbonate that crops out is a light gray, very fine to fine-grained, sucrosic dolostone. The residuum and outcrop appear to be Conasauga Group. The analysis of a sample from P-9 is:

Oxide		Wt. (%)
CaO		30.50
MgO		17.00
SiO_2		14.90
Al_2O_3		0.39
Fe_2O_3		0.10
LOI		46.20
	Total	99.49
SO_3		<0.05
P_2O_5		<0.02
Insol.		1.90

The chemical analysis of a sample from P-9 is quite high in silica and only moderately high in magnesium. The amount of residuum in the area prevents further consideration of this site.

P-10

P-10 is located directly behind the Crowe Spring Church 1.05 miles northwest of Simpson Crossroads on an unnamed light duty road. The exposed section of Knox is three feet of brecciated, cherty, light gray, dolostone which is overlain by four feet of light to medium gray, fine- to medium-grained dolomite containing minor chert layers which is further overlain by 12 feet of dark gray, fine- to medium-grained dolomite containing minor chert layers. A composite sample from Crowe Spring had the following analysis:

Oxide		Wt. (%)
CaO		29.70
MgO		19.50
SiO_2		4.50
Al_2O_3		0.57
Fe_2O_3		0.15
SO_3		<0.05
P_2O_5		<0.02
LOI		45.30
	Total	99.72
Insol.		4.70

The prospect consists of a hillside exposure of 19 feet of dolomite with additional carbonate outcrops further up the hillside. The chemical analysis of a composite sample is relatively low in insolubles and high in magnesium content. Crushed stone and aglime could be produced from this locality, but probably only on a minor scale.

P-11

Locality P-11 is located 0.9 mile southwest of the Etowah River on the north side of Georgia Highway 61, approximately 2.5 miles southwest of Cartersville. This is a pinnacle exposure of Knox Dolomite just outside the floodplain of the Etowah River. The section consists of eight feet of light to dark gray dolostone containing thin wisps of calcite filling in fractures. An analysis of this Knox outcrop is as follows:

Oxide		Wt. (%)
CaO		31.10
MgO		17.50
SiO_2		5.40
Al_2O_3		1.10
Fe_2O_3		0.26
LOI		44.00
	Total	99.36
SO_3		<0.05
P_2O_5		<0.02
Insol.		6.70

Although its chemical analysis is promising, the overburden present is too thick for this site to be considered further.

P-12

P-12 is located 0.27 mile northwest of the city limits of Taylorsville on the south bank of Euharlee Creek. The outcrop of probable Knox is at creek level and consists of approximately five feet of light gray, sandy dolostone containing an eight inch thick bed of chert. An analysis of the carbonate at P-12 is as follows:

Oxide		Wt. (%)
CaO		26.20
MgO		16.50
SiO_2		15.60
Al_2O_3		1.50
Fe_2O_3		0.58
LOI		38.70
	Total	99.08
SO_3		<0.05
P_2O_5		<0.02
Insol.		18.00

P-12 is not considered to be of economic importance due to the limited areal extent of the carbonate body and the very high silica content.

P-13

P-13 is on the east side of Euharlee Creek at the bridge on County Road 32. This outcrop was previously mapped as Knox Group (Cressler, 1970) and consists of light gray, cherty, thinly bedded, fine-grained, laminated limestone. An analysis of a sample from P-13 is:

Oxide		Wt. (%)
CaO		53.70
MgO		1.20
SiO_2		1.10
Al_2O_3		0.20
Fe_2O_3		0.15
LOI		43.70
	Total	100.05
SO_3		<0.05
P_2O_5		<0.02
Insol		1.00

This site contains a nearly pure limestone and could produce aglime if sufficient reserves of this material could be located.

P-14 and P-15

P-14 is located on the southeast side of a hill south of Georgia Highway 140, 3.0 miles east of the intersection of Georgia Highway 140 and U.S. Highway 411. Three to four feet of Shady Dolomite are exposed at this locality. The Shady consists of a light gray, very fine-grained dolostone, containing veinlets of quartz. A partial whole rock analysis of a sample from P-14 as reported by Foote (1986) is:

Oxide		Wt. (%)
CaO		27.90
MgO		19.70
SiO_2		2.42
Al_2O_3		5.80
Fe_2O_3		1.00
	Total	56.82

Locality P-15 is on the southeast side of a hill, south of Georgia Highway 140, approximately 3.0 miles east of the intersection of Georgia Highway 140 and U.S. Highway 411. Three feet of quartz-veined, light gray, very fine-grained dolostone is exposed here. Chemical analysis of the sample from P-15, as reported by Foote (1986) is:

Oxide		Wt. (%)
CaO		29.10
MgO		20.90
SiO_2		1.87
Al_2O_3		0.10
Fe_2O_3		1.12
	Total	53.09

P-14 and P-15 are three foot thick outcrops of Shady Dolomite from the same hillside. The two samples have a high magnesium content and a low silica content. Therefore, these localities are attractive from a chemical standpoint. The hillside from which these two samples were taken could support a quarry operation if sufficient reserves could be proven through drilling.

P-16

P-16 is located on the southern and eastern flanks of a small hill north of Sugar Hill Creek, 0.3 mile south of Pleasant Olive Church, and 1.1 miles east of the community of Rydal. Approximately four feet of Shady Dolomite are exposed at this locality. Partial whole rock analysis of two samples from this outcrop, provided by Foote (1986), shows:

Oxide		Wt. (%)	
CaO		29.0	28.00
MgO		22.0	20.60
SiO_2		0.72	4.94
Al_2O_3		0.80	0.70
Fe_2O_3		0.75	0.95
	Total	53.27	55.19

Chemical analyses show this sample to be of excellent purity, high in magnesium content and very low in silica. Unfortunately, the limited exposure does not suggest an economic significance for this locality.

P-17

Locality P-17 is in Smith's Bull Pasture, just east of Sugar Hill Creek, approximately 1.75 miles east of Rydal on Landers Road. The six feet of Shady Dolomite exposed here is a light gray, fine- to medium-grained dolostone. Partial whole rock analysis of a sample of this material (Foote, 1986) is:

Oxide		Wt. (%)
CaO		28.70
MgO		19.20
SiO_2		7.57
Al_2O_3		0.84
Fe_2O_3		1.66
	Total	57.97

The analysis of this sample shows it to be high in magnesium content but also moderately high in silica. The moderately high silica content coupled with the fact that field evidence shows the Shady exposure to be only six feet thick makes this prospect economically unappealing.

P-18

P-18 is located in a stream bed 0.7 mile east of the community of Bolivar on a light duty road. The section of Shady exposed at this locality consists of approximately 10 feet of light gray, laminated, very fine- to fine-grained dolostone. The published analysis of this dolostone (Foote, 1986) is:

Oxide		Wt. (%)
CaO		32.20
MgO		21.90
SiO_2		0.79
Al_2O_3		0.11
Fe_2O_3		1.52
	Total	56.52

Analysis reveals the sample to be high in magnesium content and very low in silica. Although appealing from a chemistry stand point, this exposure is of insufficient size to warrant further economic consideration.

P-19 thru P-36

The following partial whole rock analyses are of outcrops of the Shady Dolomite published by Foote (1986). These prospects cannot be properly evaluated because they were not accompanied by lithologic descriptions. For locations of these samples, the reader is referred to Foote (1986). The analyses are as follow:

		Wt. (%)		
Oxide		**P-19**	**P-20**	**P-21**
CaO		30.60	31.20	30.10
MgO		21.90	21.00	20.10
SiO_2		0.82	0.80	4.52
Al_2O_3		0.45	0.48	1.14
Fe_2O_3		0.86	1.49	1.59
	Total	54.67	54.97	57.45

		Wt. (%)		
Oxide		**P-22**	**P-23**	**P-24**
CaO		28.50	29.00	27.30
MgO		19.60	20.00	19.20
SiO_2		9.93	3.84	5.72
Al_2O_3		2.26	0.11	1.99
Fe_2O_3		2.06	2.19	1.42
	Total	62.35	55.14	55.63

		Wt. (%)		
Oxide		**P-25**	**P-26**	**P-27**
CaO		28.80	29.70	28.70
MgO		20.20	19.60	19.20
SiO_2		3.34	7.61	7.57
Al_2O_3		1.12	0.74	0.84
Fe_2O_3		2.23	0.58	1.66
	Total	55.69	58.23	57.97

		Wt. (%)		
Oxide		**P-28**	**P-29**	**P-30**
CaO		28.00	28.00	29.80
MgO		20.40	19.40	21.20
SiO_2		0.34	0.20	1.20
Al_2O_3		3.00	1.73	0.26
Fe_2O_3		1.20	1.34	0.36
	Total	52.94	50.67	52.82

		Wt. (%)		
Oxide		**P-31**	**P-32**	**P-33**
CaO		27.80	28.00	27.40
MgO		18.50	20.90	21.00
SiO_2		5.20	1.80	3.80
Al_2O_3		5.70	3.90	2.50
Fe_2O_3		0.40	0.95	1.40
	Total	57.60	55.55	56.10

		Wt. (%)		
Oxide		**P-34**	**P-35**	**P-36**
CaO		27.20	27.70	29.20
MgO		18.20	17.90	18.40
SiO_2		6.80	9.00	2.00
Al_2O_3		0.42	0.67	0.82
Fe_2O_3		1.87	1.49	1.38
	Total	54.49	56.76	51.80

* corresponds to Kessler's numbering system

Because of the relatively large number of samples having high magnesium concentrations, each of the three areas warrants further exploration.

Another prospective area is that from the work of Kesler. The following partial whole rock analyses and descriptions are Kesler's (1950b) from three separate areas (Figure 5). Although originally assigned to the Rome Formation, the locations of these prospects are within the outcrop area of the Shady as mapped by Cressler (Georgia Geologic Survey, 1976). Due to the fact that no lithologic thicknesses and only brief descriptions were published, these prospects cannot be fully evaluated based on the published data. For locations, the reader is referred to Kesler (1950b).

Oxide		Wt. (%)	
	K-1*	K-2	K-3
	P-37	P-38	P-39
CaO	29.30	18.67	30.13
MgO	20.36	11.75	19.79
FeO	0.57	1.61	2.69
Total	50.23	38.60	52.61
Insol.	4.71	1.61	0.55

Oxide		Wt. (%)	
	K-4	K-5	K-6
	P-40	P-41	P-42
CaO	30.38	30.79	30.45
MgO	21.04	19.88	20.79
FeO	0.24	1.77	0.70
Total	51.66	52.44	51.49
Insol.	0.87	0.29	0.79

Oxide		Wt. (%)	
	K-7	K-8	K-9
	P-43	P-44	P-45
CaO	30.49	29.89	30.52
MgO	21.70	20.36	20.68
FeO	0.56	0.77	0.43
Total	52.75	51.02	51.63
Insol.	0.12	2.76	1.14

Oxide		Wt. (%)	
	K-10	K-11	K-14
	P-46	P-47	P-48
CaO	28.97	29.50	50.87
MgO	19.19	20.37	3.40
FeO	0.08	0.75	0.20
Total	48.22	50.62	54.40
Insol.	7.65	3.68	1.68

Oxide		Wt. (%)	
	K-15	K-16	K-17
	P-49	P-50	P-51
CaO	23.75	29.19	30.69
MgO	13.22	20.25	21.50
FeO	2.17	0.31	0.04
Total	39.14	49.75	52.23
Insol.	26.40	5.42	0.71

Oxide		Wt. (%)	
	K-18	K-53	K-54
	P-52	P-19	P-20
CaO	54.33	28.08	28.86
MgO	0.55	19.52	18.81
FeO	0.29	0.80	2.05
Total	55.17	48.40	49.72
Insol.	1.63	7.93	3.56

Catoosa County

Catoosa County, which shares its northern border with Tennessee, has a population of approximately 42,464 (1990 census) and an area of 162.4 square miles. Catoosa County is divided along a north-south line into two districts of the Valley and Ridge Province. The two districts present in Catoosa County are the Armuchee Ridges and the Chickamauga Valley. Rocks ranging in age from Cambro-Ordovician through Upper Pennsylvanian crop out in Catoosa County. The only unit suitable for sampling for high-magnesian carbonates in Catoosa County is the Knox Group.

Quarries and Prospects

Quarrying in Catoosa County has primarily been in the vicinity of Graysville. Lime (agricultural) was produced from a number of quarries under various ownerships from 1869 until 1910 (Maynard, 1912; McLemore and Hurst, 1970). There are five inactive quarries, one active, and eight prospects within the targetted units in Catoosa County.

Q-1

This quarry was originally opened by John Gray of Graysville. Maynard (1912) described a magnesium rich upper 95 foot section of this quarry as being composed of cherty (nodular), light gray to dark blue, thin to massive dolostones of the Knox Group. The analysis of this section from two samples (Maynard, 1912) is:

Oxide	Wt. %	
	Lower 65.3'	Upper 30'
CaO	25.60	31.02
MgO	16.00	16.00
Fe_2O_3	2.60	1.52
SO_3	0.00	0.01
P_2O_5	0.01	0.02
SiO_2	15.40	5.86
Clay bases	2.86	3.00
LOI	37.53	42.57
Total	100.00	100.00

A recent analysis of a composite sample from this same quarry yielded the following:

Oxide	Wt. (%)
CaO	28.70
MgO	19.20
Fe_2O_3	0.20
Al_2O_3	0.49
P_2O_5	0.05
SiO_2	7.90
LOI	43.30
Total	99.84
SO_3	<0.05
Insol.	8.00

Site Q-1 contains significant amounts of dolostone. Chemical analysis shows the deposit to be high in silica in the lower 65 feet but it decreases to a more acceptable level in the upper 30 feet. The magnesium content of the sample is relatively high, however, overburden thickness within the immediate area may be excessive and the site is currently within a residential area.

Q-2

A second quarry (Q-2) was opened south of the first quarry by the **Graysville Mining and Manufacturing Company.** This was within the Maynardville and produced lime for agricultural purposes (McLemore and Hurst, 1970). The magnesium content from this quarry averaged less than 3%, but stone suitable for agricultural purposes could be produced from this quarry. Following the abandonment of this quarry, new quarries were opened along and north of Chickamauga Creek.

This quarry site is within the Maynardville and is low in magnesium. The same restrictions to economic development apply to this quarry site as site Q-1.

Q-3

This quarry, opened in the Knox by the Graysville Mining and Manufacturing Company, is located 0.5 mile east of Graysville and 0.1 mile north of Chickamauga Creek. The section at this quarry was described by Maynard (1912) as consisting of 35 feet of light to dark blue, cherty, massively to thinly bedded, fine-grained dolomites [dolostones]. Two composite samples representing this quarry were analyzed by Maynard (1912) as follows:

	Wt. (%)	
Oxide	**Lower 24.4'**	**Upper10.6'**
CaO	28.56	30.26
MgO	20.98	18.64
Fe_2O_3	1.08	0.94
SO_3	0.00	0.00
P_2O_5	0.01	tr.
SiO_2	1.85	3.25
Clay Bases	0.51	1.68
LOI	47.01	45.23
Total	100.00	100.00

This same quarry site was visited during the current study and consists of 40 feet of light bluish-gray to medium brownish-gray, very fine- to medium-grained dolostones which contain occasional chert nodules and stromatolites. Overburden at this locality is moderate, varying from five to 25 feet in thickness. Three samples representing the lower, middle, and upper thirds of this section analyzed as follows:

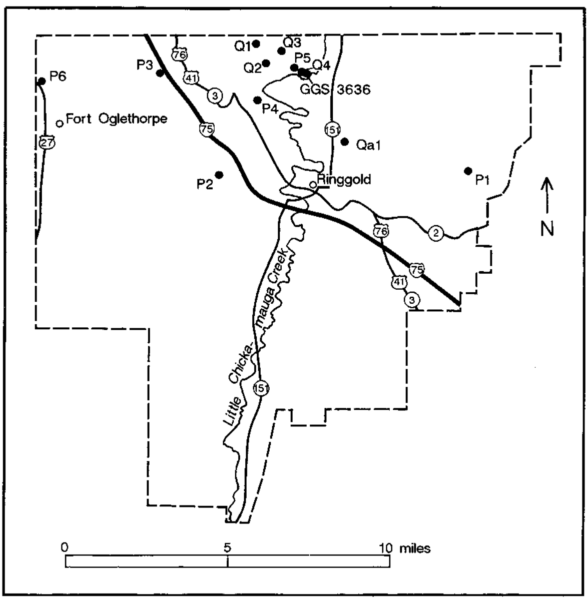

Figure 6. Map of Catoosa County showing magnesium limestone and dolomite prospects and quarries.

Oxide	Wt. (%)		
	Lower (A)	Middle (B)	Upper (C)
CaO	30.80	30.90	31.00
MgO	20.80	20.90	21.00
SiO_2	0.89	0.91	0.46
Al_2O_3	0.38	0.39	0.27
Fe_2O_3	0.16	0.14	0.08
P_2O_5	0.04		
LOI	46.50	46.70	47.10
Total	99.57	99.94	99.91
SO_3	<0.05	<0.05	<0.05
P_2O_5	---	<0.02	<0.02
Insol.	1.10	1.10	0.48

This abandoned quarry (Q-3) contains very high quality, although somewhat cherty, dolostone and may have relatively large reserves. Overburden within the area is moderate and varies from 5 to 25 feet. With its economic potential, this site warrants further sampling and investigation. Minimum reserves are estimated to be in excess of one million tons.

Q-4

The Hale Quarry is located approximately 1.4 miles due east of Graysville, just north of the CSX Rail Line. This quarry, which is entirely within the Knox, has a 120' south-facing quarry wall approximately 250 feet long. The stone exposed in this quarry is a light gray to medium gray, very fine- to medium-grained, medium to thickly bedded dolostone with occasional chert nodules and cherty limestone zones as much as 1.5 feet thick. The overburden exposed within the quarry varies from five to 20 feet in thickness.

McLemore and Hurst (1970) examined this locality and noted that very large reserves of nearly pure dolostone remained to be quarried. An analysis of material from the quarry yielded the following:

Oxide	Wt. (%)
CaO	22.6
MgO	17.1
SiO_2	22.4
Al_2O_3	0.8
Fe_2O_3	0.8
CO_2	36.4
Total	100.1

They noted that the high silica values probably were the result of biased collection of more resistant layers. Maynard's analyses and section from the Hale quarry (1912) are shown in Table 1 (p. 17).

During the current study, three samples corresponding to the previously unanalyzed units 1, 3, and 4 of Maynard's section were analyzed in order to provide a more complete sampling of the quarry. The results of these analyses are as follows:

Height above quarry floor	35'	50'	70'
Maynard's corresponding unit	1	3	4
Oxide		Wt. (%)	
CaO	29.30	30.30	32.20
MgO	19.30	19.90	16.60
SiO_2	6.90	4.00	6.10
Al_2O_3	0.86	0.58	1.30
Fe_2O_3	0.22	0.12	0.21
SO_3	<0.05	<0.05	<0.05
P_2O_5	<0.02	0.03	<0.02
LOI	43.20	45.10	43.30
Total	99.78	100.03	99.71
Insol.	7.80	4.10	7.10

GGS-3636 was drilled on property adjacent to the Hale Quarry. The core obtained represents the quarry section as well as additional footage. The results of the study of this core are presented in Appendix A.

The Hale Quarry contains large reserves of high quality dolostone, in excess of one million tons, and only moderate thicknesses of overburden (5-25 feet). This quarry is considered to be one of the best localities for dolostone in the study area and could be reopened.

Qa1

The Stone Man, Inc. quarry is within the Knox Group (Pond Spring Formation) and is located 2 miles north of Ringgold on Georgia Highway 151. The quarry currently produces aggregate. No analyses were available.

P-1

P-1 is an outcrop located along the north bank of Tiger Creek 1.25 miles northeast of the community of Keith, on an unnamed light-duty road parallel to Tiger Creek. This prospect has a 25 foot exposure of Knox, consisting of light gray to light brownish-gray, very fine- to fine-grained dolostone containing chert nodules as much as 10 inches thick. The analysis from this outcrop is:

Oxide	Wt. (%)
CaO	30.20
MgO	19.40
SiO_2	3.40
Al_2O_3	0.90
Fe_2O_3	0.26
LOI	45.60
Total	99.76
SO_3	<0.05
P_2O_5	<0.02
Insol.	3.90

The quality of the carbonate at this prospect is considered to be quite good. The silica content is relatively low and the magnesium content is high. The outcrop does

Table 1
Section, Hale Quarries, 1 1/2 Miles Southeast of Graysville

Sample No.	Unit No.	Description of Units	Thickness (Feet)	Total Thickness (Feet)
	23	Heavy-bedded and massive gray dolomite, containing in the upper portion several thin layers of chert	18.5	202.1
296	22	Heavy-bedded gray dolomite, somewhat arenaceous, containing numerous thin beds of chert	10	183.6
297	21	Heavy-bedded and massive dolomite	8	173.6
298	20	Massive dolomite containing several layers of chert at the top. The lower 6' contains calcite of circular form interspersed throughout	7	165.6
	19	Massive gray nodular dolomite with rounded nodules of chert	4.5	158.6
	18	Bluish-gray heavy-bedded dolomite	5	154.1
	17	Cherty dolomite	2	149.1
	16	Dark-blue massive dolomite	9	147.1
	15	Bluish-gray massive dolomite, speckled throughout with secondary calcite and some few chert nodules	3.8	138.1
	14	Dark grayish-blue heavy-bedded and massive dolomite; some chert in the upper part	11	134.3
299	13	Massive gray cherty dolomite; chert parallel to the bedding more abundant near the top and bottom	13.5	123.3
	12	Massive and heavy-bedded dolomite, dark-blue at the top, grayish-blue towards the middle with considerable chert; lower portion grayish-blue and dark blue	9	109.8
300	11	Gray heavy-bedded and massive dolomite	10	100.8
301	10	Grayish-blue, heavy-bedded and massive dolomite; slightly impure near top	5	90.8
		Bottom of quarry; section is continued along the W. & A. Railroad		
	9	White and bluish-flint with dolomite, galena, flourite, and barite	5	85.8
	8	Gray dolomite	4.7	80.8
	7	Chert containing galena	1.5	76.1
	6	Fine-grained massive gray dolomite	5.5	74.6
	5	Interbedded dolomite with chert		
	4	massive gray heavy-bedded dolomite with considerable chert throughout	11.3	69.1
	3	Massive gray fine-grained dolomite with considerable chert	18.8	57.8
	2	White and blue chert	4	39
	1	Heavy-bedded gray dolomite with some thin beds. A large amount of chert in thin layers parallel to the bedding with some nodular chert	35	35

The following analyses show the composition of the individual beds described in the above section:

Analyses of Dolomite from Hale Quarries

Sample No.	296	297	298	299	300	301
Unit No.	22-23	21	20	12-18	11	10
Lime (CaO)	28.62	31.50	31.20	33.12	27.28	30.16
Magnesia (MgO)	16.60	18.30	17.80	16.60	17.60	18.70
Ferric oxide (Fe_2O_3)	1.28	0.90	1.32	0.92	0.90	0.68
Sulphur trioxide (SO_3)	0.03	0.01	0.01	tr.	0.02	0.02
Phos. pentoxide (P_2O_5)	0.02	0.02	0.02	0.02	0.02	0.02
Silica (SiO_2)	8.54	3.60	3.40	3.43	11.76	4.64
Clay bases	4.10	1.37	1.70	1.46	0.82	1.23
Loss on ignition	40.81	44.30	44.97	44.05	41.58	44.55
	100.00	100.00	100.00	100.00	100.00	100.00

contain occasional chert nodules, however. The reserves of this deposit are estimated to be in excess of 325,000 tons.

P-2

P-2 is an outcrop of the Knox Group located along Peavine Ridge just north of a secondary highway at Ellis Spring, approximately 0.25 mile east of the community of East Boynton. Exposed here is a 100 foot section of the Knox Dolomite consisting of a light gray to brownish gray, very fine- to fine-grained dolostone, the lower half of which contains nodules and beds of chert as much as 1.5 feet thick. Residuum within the immediate area is in excess of 40 feet. An analysis of sample P-2 is as follows:

Oxide	Wt. (%)
CaO	30.10
MgO	19.20
SiO_2	4.00
Al_2O_3	0.46
Fe_2O_3	0.09
LOI	45.60
Total	99.45
SO_3	<0.05
P_2O_5	<0.02
Insol.	4.00

The sample from this prospect is of good quality. The overburden (in excess of 40 feet) and proximity of a residential area (within 0.2 mile) probably reduce the possibility of economic development.

P-3

P-3 is located along the western edge of Boynton Ridge northwest of the intersection of I-75 and Georgia Highway 146. The sample from P-3 represents 20 feet of discontinuously exposed Knox Dolomite, however, due to the proximity of this site to the interstate and a residential area, this prospect would be uneconomical to develop; therefore this sample was not analyzed.

P-4

P-4 is from an outcrop of Knox exposed on the flank of the Backbone (a portion of Peavine Ridge) approximately 0.6 mile north of Georgia Highway 2 and U.S. Highways 41 and 76 on the east side of Ross Hollow Road. The sample taken from locality P-4 represents a 40 foot high section of medium to light gray, very fine- to fine-grained dolostone, which contains occasional chert nodules. An analysis of sample P-4 is as follows:

Oxide	Wt. (%)
CaO	28.70
MgO	18.30
SiO_2	9.90
Al_2O_3	0.30
Fe_2O_3	0.15
LOI	42.90
Total	100.25
SO_3	<0.05
P_2O_5	<0.02
Insol.	9.80

The sample from this prospect is moderately high in silica and high in magnesium. Little overburden was apparent at this site. Uses for this material could include crushed stone products and agricultural lime. The reserves of this deposit are estimated to be in excess of 325,000 tons. This site probably could be opened as a source of dolostone.

P-5

The outcrop represented by sample P-5 is located approximately 0.25 mile east of South Chickamauga Creek along the north side of the CSX Rail Line. Approximately 50 feet of Knox, consisting of a medium gray, fine- to very fine-grained cherty dolostone is intermittently exposed along a hillside at the site. An analysis of this sample is as follows:

Oxide	Wt. (%)
CaO	32.24
MgO	18.10
SiO_2	3.80
Al^2O_3	0.51
Fe_2O_3	0.24
LOI	45.20
Total	100.09
SO_3	<0.05
P_2O_5	<0.02
Insol.	3.90

The sample from P-5 is relatively low in silica and high in magnesium and is adjacent to the Hale Quarry. Reserves of this deposit are estimated to be in excess of 325,000 tons. This site probably could be opened as a source of dolostone.

P-6

Site P-6 is located 0.2 mile west of U.S. Highway 27, 0.1 mile southwest of the community of Midway. The sample from P-6 is from a boulder or possible pinnacle exposure of light gray, very fine - to fine-grained dolostone of the Knox

Group. This possible pinnacle exposure is contained within a 40 foot exposure of cherty, sandy clay to clayey sand residuum of the Knox. The sample analysis is as follows:

Oxide		Wt. (%)
CaO		29.10
MgO		15.40
SiO_2		11.40
Al_2O_3		2.60
Fe_2O_3		0.95
LOI		40.20
	Total	99.65
SO_3		<0.05
P_2O_5		<0.02
Insol.		14.40

Prospect P-6 is relatively high in silica and moderately high in magnesium. However, this deposit is in a residential area and is overlain by too much overburden to be considered for economic development.

P-7

P-7 is located at Leet Springs in the community of Beaumont along the flank of Peavine Ridge. The sample is from an approximately 25 foot exposure of probable Knox near the contact with the Conasauga. This exposure consists of a medium gray, very fine- to fine-grained, thinly bedded carbonate which crops out discontinuously for approximately 125 feet along Peavine Creek. Analysis of a sample from P-7 is as follows:

Oxide		Wt. (%)
CaO		50.90
MgO		2.80
SiO_2		2.00
Al_2O_3		0.60
Fe_2O_3		0.38
P_2O_5		0.03
LOI		42.50
	Total	99.21
SO_3		<0.05
Insol.		2.50

The sample is low in silica and also very low in magnesium. This material is suited for crushed stone and aglime use, however, there is too much overburden in the immediate area for economic consideration.

P-8

A sample from P-8 represents an approximately 75 foot thick discontinuous outcrop of medium gray, fine- to very fine-grained, slightly cherty, laminated limestone. This outcrop dips into the hillside, which has a mantle of residuum. Analysis of this limestone is as follows:

Oxide		Wt. (%)
CaO		51.80
MgO		2.20
SiO_2		0.10
Al_2O_3		0.45
LOI		42.90
	Total	99.45
SO_3		<0.05
P_2O_5		<0.02
Insol.		2.50

The sample is relatively low in silica and magnesium content. This site does appear to offer moderate reserves, assuming the mantle of residuum present does not increase in thickness into the hillside. The minimum reserves of this deposit are estimated to be in excess of 500,000 tons. This site probably could be opened as a source of aglime and crushed stone.

Chattooga County

Chattooga County, located in the central portion of the study area bordering Alabama, has a population of 22,242 (1990 census) and a land area of 313.4 square miles. Chattooga County contains portions of three physiographic districts of the Valley and Ridge Province. Eastern and southern Chattooga County lies within the Armuchee Ridges district while central and extreme northwestern Chattooga County contain portions of the Chickamauga Valley and the Lookout Mountain Districts. Paleozoic sedimentary rocks ranging in composition from cherts and limestones to shales to sandstones crop out in Chattooga County. The ages of these rocks range from Cambrian through Upper Pennsylvanian. The major unit for consideration in Chattooga County is the Knox Group.

Quarries and Prospects

There are eight prospects and one inactive quarry in the targetted units in Chattooga County.

Q-1

Site Q-1 is an abandoned quarry in the Knox Group. It is located 1.6 miles north of the center of Trion south of Ridgeway Road and between the Central of Georgia Railroad and Cane Creek.

The quarry face is approximately 200 feet wide by 60 feet high with 20 feet of overburden. The exposed section consists of 60 feet of light gray to pinkish-gray, very fine-grained dolostone. It has a 1-2 foot thick shaly zone eight feet from the base of the section and is overlain by 20 feet of the orangish-red, cherty, clayey sand residuum typical of the Knox Group.

The lower portion, approximately 20 feet, was mined underground along dip via three roughly rectangular openings (11 feet high by 16 feet wide), two of which connect a short distance into the hillside. According to McLemore and Hurst (1970), terrazzo chips were produced from this quarry, apparently because of the natural coloration of the stone. Two samples were collected from the quarry. Sample 4a is a composite of the material above the shaly zone and 4b a composite of the material below it. Chemical analyses of these samples are as follows:

		Wt. (%)	
Oxide		**4a**	**4b**
CaO		32.50	54.70
MgO		16.90	0.29
SiO_2		6.50	1.10
Al_2O_3		0.60	0.33
Fe_2O_3		0.17	0.07
LOI		43.40	42.90
SO_3		<0.05	<0.05
P_2O_5		<0.02	<0.02
	Total	100.07	99.39
Insol.		6.8	1.10

The upper 52 feet of the section could be used to produce crushed stone or aglime. The major limiting factor affecting this prospect is its location in a valley with a stream adjacent to the quarry. Thus, dewatering could pose serious prob-

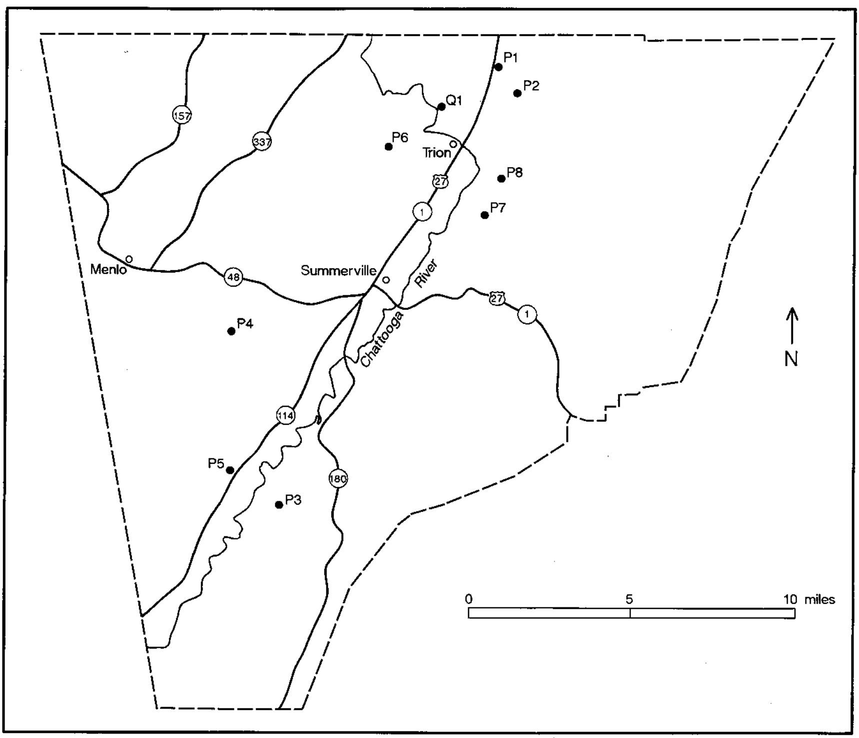

Figure 7. Map of Chattooga County showing magnesium limestone and dolomite prospects and quarries.

lems if quarrying below grade were considered. The minimum reserves of this deposit are estimated to be in excess of 250,000 tons.

P-1

Outcrops of gray, fine-grained dolostone of the Knox Group present along the hillsides 2.25 miles northeast of Trion were reported by McLemore and Hurst (1970). McLemore and Hurst's analysis of the Knox from this area is:

Oxide		Wt. (%)
CaO		30.7
MgO		19.9
SiO_2		2.4
Al_2O_3		0.8
Fe_2O_3		0.4
CO_2		45.7
	Total	99.9

The analysis of the sample from this site is high in magnesium and low in silica and could produce a good aglime if large enough reserves could be found.

P-2

Site P-2 is a 25 foot exposure of very fine-grained Knox limestone containing chert nodules and lenses up to 4.5 inches thick. It is located 2.6 miles northeast of Trion on the south side of Chapel Creek and on Ridgeway Road, 1.25 miles east of U.S. Highway 27. An analysis of this material is as follows:

Oxide		Wt. (%)
CaO		51.40
MgO		2.50
SiO_2		3.30
Al_2O_3		0.27
Fe_2O_3		0.05
LOI		42.50
	Total	100.02
SO_3		<0.05
P_2O_5		<0.02
Insol.		3.10

Locality P-2 is apparently in a limy portion of the Knox. While the analysis is relatively low in insolubles, it is also low in magnesium. This particular outcrop does not, in and of itself, have any economic significance.

P-3

P-3 is located at the intersection of Holland Road and an unnamed road at Taliaferro Springs, approximately 1.7 miles southeast of Lyerly. Between 12 and 60 feet of Knox dolostone are exposed at this location. The Knox here is a light gray to light brown, fine-grained dolostone containing occasional chert nodules as much as 4 inches thick. Other fresh exposures of the Knox were noted approximately 0.1 mile north of this outcrop.

Two samples representing the upper (3a) and lower (3b) half of the 12 foot thick outcrop were taken. The samples analyzed as follows:

		Wt. (%)	
Oxide		3a (upper)	3b (lower)
CaO		30.70	31.10
MgO		20.80	20.70
SiO_2		1.40	0.83
Al_2O_3		0.33	0.31
Fe_2O_3		0.09	0.09
	Total	100.92	100.03
SO_3		<0.05	<0.05
P_2O_5		<0.02	<0.02
LOI		47.60	47.00
Insol.		1.00	0.52

An outcrop very near this locality was examined by McLemore and Hurst (1970). Their analysis was:

Oxide		Wt. (%)
CaO		29.3
MgO		19.7
SiO_2		4.1
Al_2O_3		2.0
Fe_2O_3		0.4
CO_2		44.6
	Total	100.1

The sample from P-3 is very high in total carbonate and low in insolubles and could produce an excellent quality aglime, assuming sufficient reserves can be confirmed. Residuum is present within the immediate area and may be a limiting factor to development. The minimum reserves of this deposit are estimated to be in excess of 30,000 tons.

P-4

P-4 is represents a composite sample of 40 feet of medium gray, fine- to medium-grained dolostone of the Knox. It is located at Perennial Springs, 0.4 mile northwest of the community of Perennial. An analysis of the sample is:

Oxide		Wt. (%)
CaO		30.60
MgO		16.60
SiO_2		7.70
Al_2O_3		0.45
Fe_2O_3		0.10
LOI		43.10
	Total	98.55
SO_3		<0.05
P_2O_5		<0.02
Insol.		7.30

P-4 could produce aglime or crushed stone and is one of the better prospects within the county. Some chert rubble was noted uphill from the outcrop and may indicate an increasing overburden thickness. The minimum reserves of this deposit are estimated to be in excess of 300,000 tons.

P-5

P-5 is located in a stream gap through a low ridge 0.5 mile west of Lyerly on Oak Hill Road. Ten to 15 feet of medium gray, very fine- to fine-grained, cherty dolostone of the Knox Group is exposed here. An analysis of the carbonate is:

Oxide		Wt. (%)
CaO		30.90
MgO		19.60
SiO_2		1.10
Al_2O_3		0.30
Fe_2O_3		0.10
LOI		46.30
	Total	98.30
SO_3		<0.05
P_2O_5		<0.02
Insol.		0.95

The sample analyzed from this site is has a high magnesium content, however, the thickness of overburden in the area probably makes this prospect uneconomic.

P-6

P-6 is located 0.7 mile west of the city limits of Trion on the south side of Broomtown Road. An outcrop six to eight feet high consisting of very fine-grained limestone of the Knox Group is exposed here. An analysis of this material is as follows:

Oxide		Wt. (%)
CaO		48.30
MgO		0.76
SiO_2		9.50
Al_2O_3		1.80
Fe_2O_3		0.71
P_2O_5		0.06
LOI		38.60
SO_3		≤0.05
	Total	99.73
Insol.		10.80

Locality P-6 is considered only to be of marginal interest due to excessive insolubles and low magnesium content.

P-7

P-7 is located 0.10 mile west of the intersection of Alexander Road and a road connecting Alexander Road with Penn Bridge Road. A medium gray to grayish brown, very fine- to fine-grained dolostone containing chert layers as thick as five inches is exposed here. This material extends approximately 30 feet up the hillside as discontinuous outcrops. A chemical analysis for a sample from this locality is as follows:

Oxide		Wt. (%)
CaO		27.10
MgO		18.20
SiO_2		13.50
Al_2O_3		0.41
Fe_2O_3		0.11
LOI		40.70
	Total	100.02
SO_3		<0.05
P_2O_5		<0.02
Insol.		13.20

The sample from P-7 was too high in insolubles to be considered further.

P-8

P-8 is located on Alexander Road 0.2 mile south of the intersection of Alexander Road and Spring Creek Road. A very fine-grained dolostone containing thin chert layers is discontinuously exposed for a distance of 40 feet up the hillside at locality P-8. An analysis of this dolostone is :

Oxide		Wt. (%)
CaO		34.20
MgO		17.10
SiO_2		3.00
Al_2O_3		0.33
Fe_2O_3		0.14
LOI		45.20
	Total	99.97
SO_3		<0.05
P_2O_5		<0.02
Insol.		2.80

The sample has good chemical characteristics (low insolubles and high magnesium) and there appears to be a minimum thickness of 40 feet at this site. Assuming the overburden is not too excessive, this locality could produce small amounts of stone for local use as aglime and crushed stone. Reserves of this deposit are estimated to be in excess of 130,000 tons.

Dade County

Dade County lies in the extreme northwestern portion of the study area. The population of Dade County is 13,147 (1990 census) and the land area is 176 square miles. Dade County lies entirely within the Lookout Mountain District of the Appalachian Plateau Province. Cambrian through Pennsylvanian age sedimentary rocks crop out within Dade County. The unit of most interest to this study is the Knox Group, which is present only in the southern portion of the county.

Quarries and Prospects

Dade County has one prospect. The prospect containing high magnesian limestone or dolomite is represented by sample P-1.

P-1

Locality P-1 lies at the northern tip of Big Ridge approximately 0.3 mile south of the community of Cloverdale on a road parallel to the rail line. It consists of approximately 62 feet of the Knox Group. The Knox at this location consists of medium bedded, fine- to medium-grained, light gray limestone and contains some exposed chert nodules. The analysis of this material is as follows:

Oxide		Wt. (%)
CaO		50.90
MgO		1.20
SiO^2		5.60
Al_2O_3		0.69
P_2O_5		0.02
Fe_2O_3		0.22
LOI		40.90
	Total	99.53
Insol.		6.40

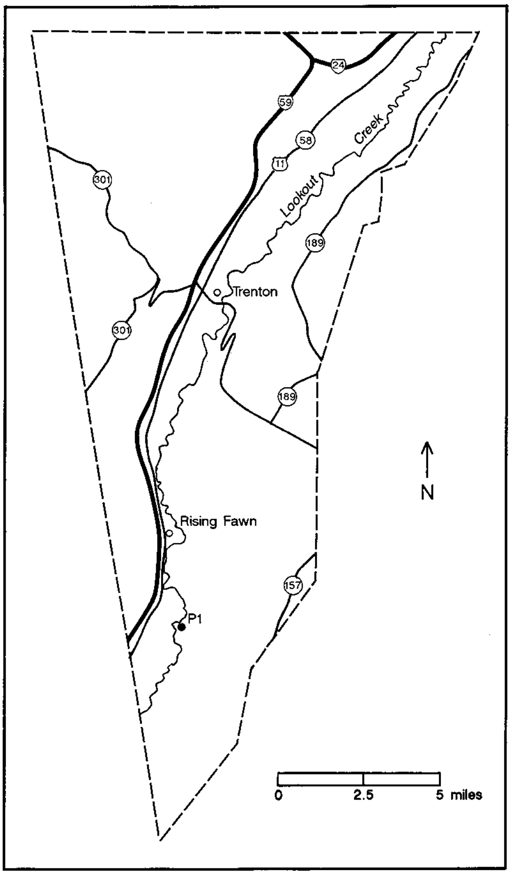

Figure 8. Map of Dade County showing magnesium limestone and dolomite prospects and quarries.

This site appears to have been quarried in the recent past. Although reserves at this site are small, other exposures along Dry Creek (just north of the quarry site) indicate that there may be a potential for small scale quarries within this area. Rock similar to that in the quarry could produce agricultural lime, even though low in magnesium content. The minimum reserves of this deposit are estimated to be in excess of 35,000 tons.

Floyd County

Floyd County lies within the southwest portion of the study area. Floyd County has a population of 81,251 (1990 census) and an area of 519 square miles. Floyd County lies within the Great Valley and the Armuchee Ridges Districts of the Valley and Ridge Province. The Armuchee Ridges District occupies the extreme northern and northwestern portion of the county and the Great Valley District occupies the remainder of the county. Sedimentary rocks ranging in age from Cambrian through Upper Pennsylvanian crop out in Floyd County. The rocks specifically selected for sampling within Floyd County are the Knox Group and the dolomitic phases of the Conasauga Group.

Prospects

There are no active or inactive quarries in Floyd County but there are eight prospects.

P-1

Maynard (1912) reported a 10 foot exposure of Knox Dolomite [Group] approximately 1.0 mile northwest of Vans Valley along the north side of Big Cedar Creek. Maynard described three 10 foot beds, of which the lower two were assigned to the Conasauga Limestone and the uppermost was assigned to the Knox Dolomite [Group]. Analyses of these beds are as follows:

	Wt. (%)		
Oxides	**Lower**	**Middle**	**Upper**
CaO	15.40	14.18	48.30
MgO	10.96	3.20	20.00
Fe_2O_3	1.76	4.18	2.44
SO_3	tr.	tr.	0.00
P_2O_5	0.05	0.04	0.02
SiO_2	30.24	31.95	1.97
K_2O	3.41	4.48	0.15
Na_2O	0.31	0.35	0.06
Clay Bases	10.71	12.68	0.39
LOI	27.17	28.94	26.67
Total	100.01	100.00	100.00

McLemore and Hurst (1970) mentioned the occurrence of an approximately 30 foot outcrop of limestone and dolomite located 1.2 miles north of Vans Valley on the north side of Cedar Creek. This outcrop is believed to be the same as the previous P-1, hence the same designation. McLemore and Hurst's analysis of a representative sample of the outcrop was as follows:

Oxide	**Wt. (%)**
CaO	26.0
MgO	11.4
SiO_2	23.4
Al_2O_3	13.6
Fe_2O_3	2.8
CO_2	22.6
Total	99.8

The majority of the outcrop represented by the sample is too high in silica for use other than road metal. The upper bed of this exposure of the Knox Group is high in magnesium and relatively low in silica but represents only a small portion of the outcrop.

P-2

Maynard (1912) reported the following analysis of some thinly bedded, grayish-blue limestone of the Conasauga comprising a 100 foot section located on the Henry Bass property. The Bass Property is located 500 feet south of the Etowah Bridge (Georgia Highway 101 and U.S. Highway 27) within the city limits of Rome.

Oxide	**Wt. (%)**
CaO	32.44
MgO	11.62
Fe_2O_3	4.36
SO_3	0.30
P_2O_5	0.02
SiO_2	6.51
K_2O	1.35
Na_2O	0.37
Clay Bases	4.50
LOI	38.53
Total	100.00

The outcrop reported as the Bass Property (P-2 of this report) is now located in a developed area within the city limits of Rome and is therefore not considered further.

P-3

Maynard (1912) described scattered exposures of a blue gray to light gray dolomite (probably Knox Group) that contains chert nodules on the J. Scott Davis Property north of Cave Springs. The analysis is as follows:

Oxide	**Wt. (%)**
CaO	29.24
MgO	19.46
Fe_2O_3	1.60
SO_3	0.00
P_2O_5	tr.
SiO_2	4.22
K_2O	0.16
Na_2O	0.08
Clay Bases	0.71
LOI	44.53
Total	100.00

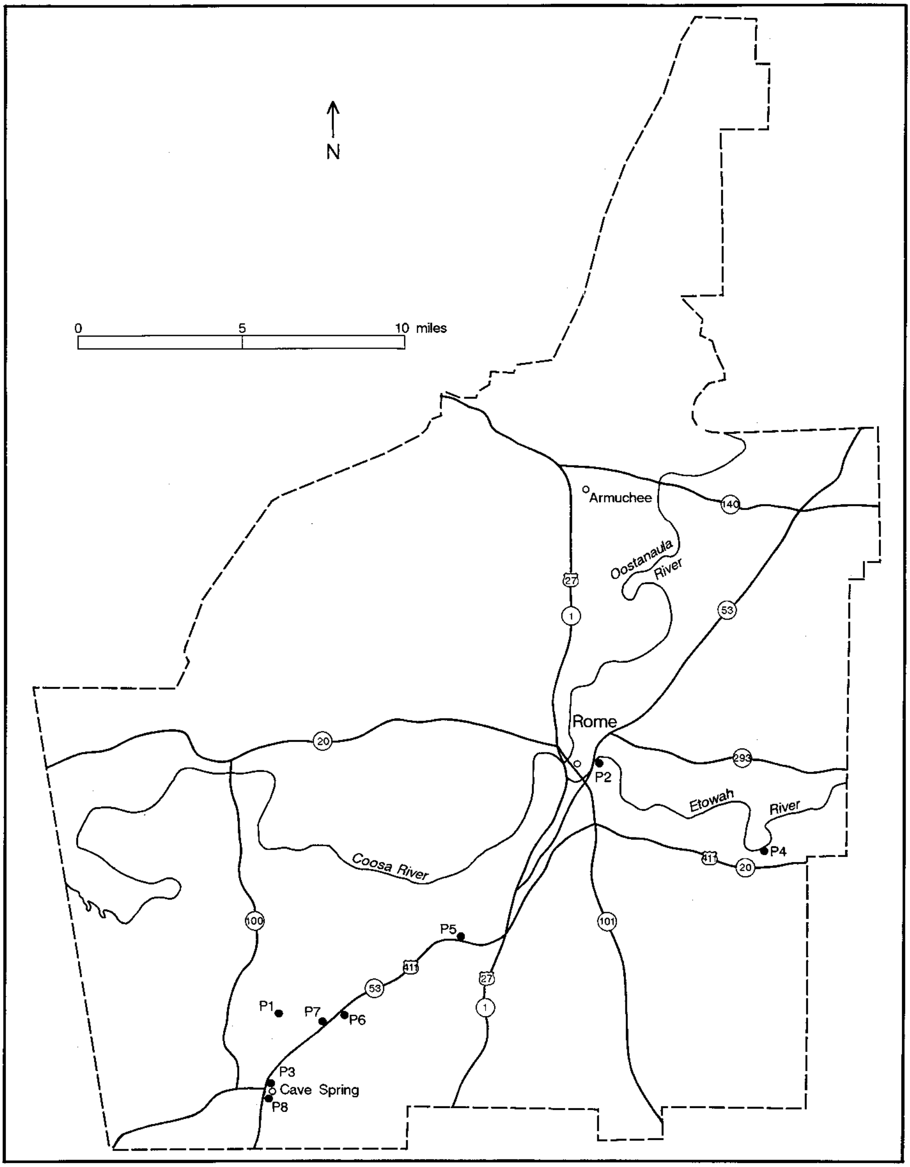

Figure 9. Map of Floyd County showing magnesium limestone and dolomite prospects.

This sample is from an exposure that does not appear to have sufficient reserves to be considered.

P-4

P-4 is located on a north-facing bluff of the Etowah River at Reynolds Bend, approximately 0.5 mile north of U.S. Highway 411, Georgia Highway 311, and 5.8 miles west of Rome, Georgia. The outcrop consists of 25 to 30 feet of massively bedded, dense, medium to dark gray, calcitic dolostone of the Knox Group. The exposure begins at river level. An analysis of the dolostone is as follows:

Oxide		Wt. (%)
CaO		31.40
MgO		20.70
SiO_2		0.75
Al_2O_3		0.27
Fe_2O_3		0.25
LOI		47.00
	Total	100.37
SO_3		<0.05
P_2O_5		<0.02
Insol.		0.53

This sample represents a 25 to 30 foot thickness of dolostone. The analysis for this material is high in magnesium content and low in both iron and silica, however, the material is immediately adjacent to the river and water could pose a problem in any quarrying operation. The possibility exists that other deposits of similar quality could exist within the area. According to a local farmer, carbonate was encountered while putting in footings for the Woodlawn Church, approximately two miles west of P-4 and north of U.S. Highway 411. Minimum reserves of this deposit are estimated to be in excess of 140,000 tons.

P-5

P-5 is an eight foot exposure of light to medium gray, medium-grained carbonate of the Conasauga Group. The sample was taken from a hillside exposure behind an unnamed church north of U.S. Highway 411, approximately 1.5 miles west of the community of Six Mile. The analysis of this limestone is as follows:

Oxide		Wt. (%)
CaO		51.40
MgO		1.50
SiO_2		3.50
Al_2O_3		1.20
Fe_2O_3		0.66
LOI		41.09
	Total	99.35
SO_3		<.05
P_2O_5		<.02
Insol.		4.40

This sample is quite low in magnesium and is therefore not considered further.

P-6

This prospect in the Knox Group is a pinnacle outcrop approximately five feet thick. It is on the east side of U.S. Highway 411, 1.2 miles north of Big Cedar Creek. The sample is of a fractured, fine- to medium-grained, light gray dolostone with a red iron staining along the fractures. The analysis is as follows:

Oxide		Wt. (%)
CaO		30.80
MgO		20.60
SiO_2		2.10
Al_2O_3		0.35
Fe_2O_3		0.22
LOI		46.00
	Total	100.07
SO_3		<0.05
P_2O_5		<0.02
Insol.		1.80

Sample P-6 is high in magnesium and relatively low in silica, but the overburden at this location probably precludes economic development.

P-7

P-7 is a representative sample of an exposure of the dolomitic phase of the Conasauga Group. It is located on an isolated hill just north of Big Cedar Creek and west of U.S. Highway 411. The section contains an 11.5 foot zone of discontinuously exposed very fine- to fine-grained, laminated cherty dolostone which immediately overlies a 21.0 foot covered zone, which overlies 5.5 feet of very fine grained, medium gray dolostone, which overlies eight feet of fine grained, medium to light gray dolostone. A composite sample yields the following chemical analysis:

Oxide		Wt. (%)
CaO		27.20
MgO		18.10
SiO_2		13.40
Al_2O_3		0.35
Fe_2O_3		0.31
LOI		0.60
	Total	99.96
SO_3		<0.05
P_2O_5		<0.02
Insol.		13.40

Maynard (1912) also examined and sampled this same exposure. He noted a thickness of the Conasauga of approximately 30 feet excluding the cherty limestone from the upper unit. He described the section as consisting of three units: 1) a lower ten foot thick exposure of light bluish-gray limestone (sample 76) overlain by, 2) ten feet of shaly limestone (sample 77) which is in turn overlain by, 3) a ten foot thick dolomitic limestone (sample 78). Maynard's analyses are as follows:

Oxide	Wt. (%) 76	77	78
CaO	15.40	14.18	48.30
MgO	10.96	3.20	20.00
Fe_2O_3	1.76	4.18	2.44
SiO_2	30.24	31.95	1.97
K_2O	3.41	4.48	0.15
Na_2O	0.31	0.35	0.06
Clay Bases	10.73	12.68	0.39
LOI	27.17	28.94	26.67
Total	100.00	100.00	100.00
SO_3	tr.	tr.	0.00
P_2O_5	0.02	0.04	0.02

This sample is representative of a 24 foot exposure of Conasauga which crops out intermittently over a 100 foot high hill which covers an area of approximately 40 acres. Due to the high percentage of silica, this material is probably only suited for use as a local source of road metal. The minimum reserves of this deposit are estimated to be in excess of 300,000 tons. This quarry could be reopened.

P-8

P-8 is a 25 foot exposure of the Knox Group at Cave Spring in the community of Cave Spring. The dolostone here is fine- to medium-grained and medium gray. The analysis of the dolostone yields the following:

Oxide	Wt. (%)
CaO	29.60
MgO	19.90
SiO_2	4.90
Al_2O_3	0.48
Fe_2O_3	0.14
LOI	44.70
Total	99.72
SO_3	<0.05
P_2O_5	<0.02
Insol.	5.00

Sample P-8 is from a 25 foot outcrop of Knox dolostone at Cave Spring. A small quarry could be opened here. However, this location is not under consideration because the spring provides water for the community of Cave Spring.

Gordon County

Gordon County, with a population of 35,072 (1990 census), is located in the central-eastern portion of the study area and has an area of 355.2 square miles. Portions of Gordon County lie within three districts of two major physiographic provinces. The districts are the Armuchee Ridges District and the Great Valley District of the Valley and Ridge Province and the Cherokee Upland District of the Piedmont Province. The Armuchee Ridges District occupies the extreme western portion of Gordon County, whereas the Great Valley District and the Cherokee Upland Districts occupy the central and extreme eastern portion of the county, respectively.

Both sedimentary and metamorphic rocks are present in Gordon County. Metagraywackes, slates, phyllites, schists, and minor amphibolites of the Piedmont portion of the county crop out in the east. Sedimentary rocks including sandstones, shales, cherts, and carbonates and ranging in age from Cambro-Ordovician to Mississippian, crop out in the central and western portions of Gordon County. The carbonates of major interest for this study occur entirely within the Knox Group.

Prospects

There is only one prospect in Gordon County.

P-1

Site P-1 is located 1.7 miles southwest of the community of Cash on a light-duty road at the southwestern end of Dews Lake. At the spring there is 30 feet of blue gray, very fine- to fine-grained, laminated to cross laminated, thinly to medium bedded, cherty (up to 6 inch thick beds) dolostone. This dolostone yields the following analysis:

Oxide	Wt. (%)
CaO	28.50
MgO	18.90
SiO_2	7.40
Al_2O_3	0.85
Fe_2O_3	0.28
LOI	43.70
Total	99.63
SO_3	<0.05
P_2O_5	<0.02
Insol.	8.10

The relief in Gordon County is low, although large areas are underlain by the Knox Group. Thus, as a result of weathering, the Knox is covered by a mantle of cherty, sandy clay to clayey sand residuum and outcrops are poor. Prospect P-1 is slightly high in silica but could be used for agricultural lime. However, due to the small size of the deposit and the importance of the spring as a source of water, it is not considered to be of economic significance.

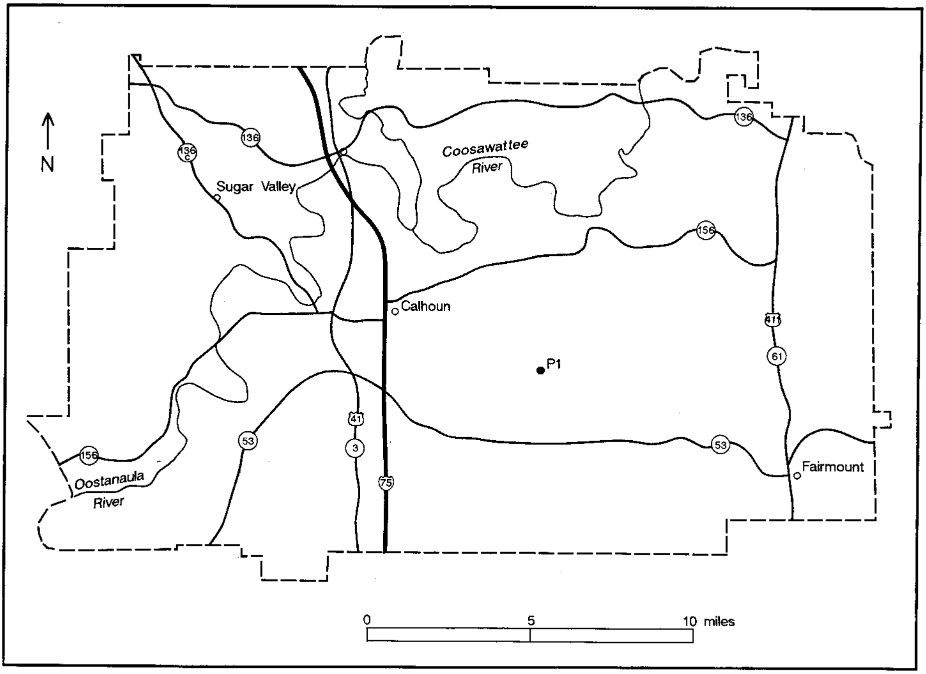

Figure 10. Map of Gordon County showing magnesium limestone and dolomite prospects and quarries.

Murray County

Murray County, in the northeastern portion of the study area, has a population of 26,147 (1990 census) and has a land area of 347 square miles. The county contains portions of three districts of two physiographic provinces. These districts are the Cherokee Upland and Cohutta Mountain Districts of the Piedmont Province and the Great Valley District of the Valley and Ridge Province.

The Piedmont portion of the county, which is underlain by Precambrian slates, quartzites, and conglomerates, occupies the eastern one-third of the county. The Valley and Ridge portion occupies the western two-thirds of the county and is underlain by Cambrian and Ordovician shales and carbonates. The rock unit of interest for this study is the Knox Group.

Prospects

There are four prospects in Murray County.

P-1

McLemore and Hurst (1970) describe a prospect of magnesium rich limestone within the Newala Limestone on the property of **D.O. Baxter**. The Baxter property is approximately 9.5 miles north of Chatsworth and west of U.S. Highway 411. The carbonate was described as a gray, fine- to medium-grained limestone with interbedded sugary, medium-grained dolostones. McLemore and Hurst estimated the available reserves at 300,000 tons. The analysis of a composite sample collected by McLemore and Hurst showed:

Oxide		Wt. (%)
CaO		40.8
MgO		11.5
SiO_2		1.6
Al_2O_3		1.0
Fe_2O_3		0.5
CO_2		44.6
	Total	100.0

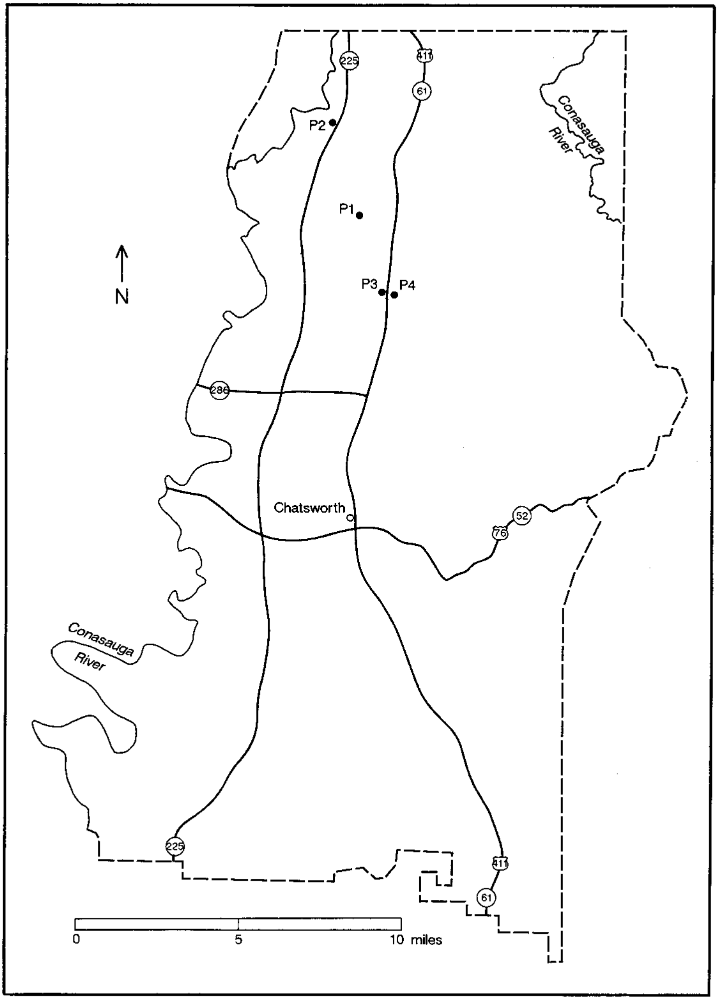

Figure 11. Map of Murray County showing magnesium limestone and dolomite prospects.

Locality P-1 offers a reasonable tonnage as estimated by McLemore and Hurst. Chemically, the material appears to be suitable for aglime production, being high in total carbonates and low in insolubles. Reserves of this deposit are estimated to be in excess of 300,000 tons.

P-2

This prospect is a nine foot pinnacle exposure of light brownish-gray, fractured, medium- to coarse-grained dolostone, located approximately 3.9 miles northeast of Beaverdale and about 0.15 miles north of the intersection of Georgia Highways 225 and 2. A chemical analysis of a composite sample of this carbonate is:

Oxide		Wt. (%)
CaO		31.00
MgO		20.30
SiO_2		0.84
Al_2O_3		0.33
Fe_2O_3		0.09
LOI		46.60
	Total	99.16
SO_3		<0.05
P_2O_5		<0.02
Insol.		0.91

P-2 is a pinnacle exposure and thus offers little in the way of a large natural exposure suitable for a quarry. The sample analysis from this site is interesting due to its excellent purity: high in total carbonate and low in insolubles. If nothing else, this sample shows that there is a definite possibility for the occurrence of high-magnesium deposits within the area.

P-3

Site P-3 is located 0.9 mile north of Crandall and 0.05 mile west of U.S. Highway 411 and Georgia Highway 61. It is a 30 foot exposure of Knox which forms an isolated knoll. The material sampled is a light gray, very fine- to fine-grained dolostone which analyzes:

Oxide		Wt. (%)
CaO		31.40
MgO		17.90
SiO_2		3.90
Al_2O_3		0.78
Fe_2O_3		0.29
LOI		44.60
	Total	98.87
SO_3		<0.05
P_2O_5		<0.02
Insol.		4.40

This site could provide a local source for aglime and crushed stone, because it is very high in total carbonate and moderately low in insolubles. Minimal reserves of this deposit are estimated to be 100,000 tons.

P-4

Site P-4 is from a three foot exposure of light gray, medium-grained dolostone. It is located in Fairy Valley, 8.25 miles north of Chatsworth on the west side of U.S. Highway 411 at the juncture of North Prong and Sumac creeks. Analysis of a sample from this exposure yielded:

Oxide		Wt. (%)
CaO		31.80
MgO		16.30
SiO_2		6.40
Al_2O_3		1.10
Fe_2O_3		0.26
LOI		43.30
	Total	99.16
SO_3		<0.05
P_2O_5		<0.02
Insol.		7.40

Analysis of a sample from this location shows that the material is relatively high in magnesium but also high in insolubles. Due to the high insoluble content, this site is not considered further.

Paulding County

Most of Paulding County lies within the Piedmont Province, with only a small area in the extreme northwestern corner of the county containing sedimentary rocks. The Knox Group crops out only as a residuum in Paulding County and as a result, no outcrops suitable for sampling and examination were found.

Polk County

Polk County is the southernmost county within the Valley and Ridge Province of Georgia. The county has a population of approximately 33,815 (1990 census) and covers 312 square miles. With the exception of the southern and eastern portions, which lie within the Piedmont Province, Polk County lies within the Great Valley District of the Appalachian Plateau Province.

Devonian, Mississippian, Ordovician, and Cambrian age sedimentary rocks, which include limestones, sandstones, shales, and cherts, crop out within the county. The sedimentary rocks specifically selected for sampling within Polk County include the Knox Group (Cambro-Ordovician) and the dolomitic phases of the Conasauga Group and Chickamauga Group. Other rocks present within the Piedmont Province of Polk County include pelitic, metamorphic rocks consisting of phyllites and quartzites.

Quarries and Prospects

There are four inactive quarries, one active quarry, and seven prospects in Polk County.

Q-1

Analyses of portions of the Chickamauga Group [Knox Group] within the quarry of Georgia Portland Cement and Slate Company were reported by Maynard (1912). Maynard noted approximately 100 feet of high magnesian limestone within the quarry. The magnesium content of the beds making up the 100 foot thickness were 13.48%, 12.94%, and 7.54%.

McLemore and Hurst (1970) reexamined this prospect and reported that it is currently located too close to an actively used road for consideration for economic development and that it contained too much magnesium for use in portland cement. The quarry is located 4.0 miles northeast of Rockmart, on the eastern side of Georgia Highway 101. An analysis of the Newala Limestone present in this quarry provided by McLemore and Hurst is as follows:

Oxide	Wt. (%)
CaO	43.4
MgO	7.5
SiO_2	3.0
Al_2O_3	2.2
Fe_2O_3	1.1
CO_2	42.8
Total	100.0

Q-2

Maynard (1912) reported that the upper 37 feet of the quarry face of the Southern Lime Manufacturing Quarry, approximately 0.5 mile east of Aragon Station, were high in magnesium. These dark blue limestones are what is now considered to be Newala. The limestones analyses of Maynard (1912, sample numbers 49 and 51) are as follows:

	Wt. (%)	
Oxide	#49	#51
CaO	41.96	35.46
MgO	10.24	14.74
Fe_2O_3	0.72	1.24
SO_3	0.00	0.27
P_2O_5	0.01	0.02
SiO_2	1.11	2.65
K_2O	0.14	0.30
Na_2O	0.20	0.20
Clay Bases	0.71	0.84
LOI	44.91	44.28
Total	100.00	100.00

The probable site of this quarry was located and it appears that it has limited reserves, but could be reopened.

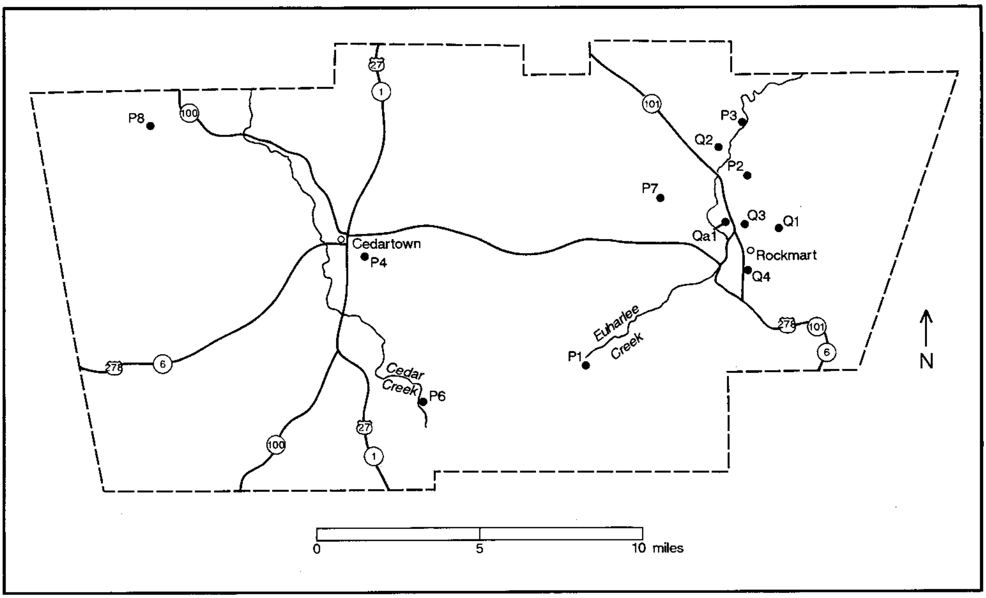

Figure 12. Map of Polk County showing magnesium limestone and dolomite prospects and quarries.

Q-3

McLemore and Hurst (1970) reported that a section of the Newala Limestone within the quarry formerly owned by **Southern States Portland Cement Company** could produce large tonnages of high magnesium limestone and dolomite. The Southern States Quarry site is located east of Georgia Highway 101 and 1.5 miles north of Rockmart. Chowns (personal communication, 1992) states that the old quarry site is now partly flooded and also contains fly ash. The analysis provided by McLemore and Hurst (1970) is as follows:

Oxide	Wt. (%)
CaO	34.5
MgO	15.8
SiO_2	3.0
Al_2O_3	1.2
Fe_2O_3	1.2
CO_2	44.2
Total	99.9

Q-4

The Marble Hill area, located within the present city limits of Rockmart, contained two quarries and attendant kilns on the south side of the hill just south of the Southern Railroad depot. These quarries were already abandoned at the time of Maynard's review of limestone properties. Maynard described the quarry face as having in excess of 148 feet of magnesium-rich limestone. Analyses of the two beds which comprise this upper 148 feet are reported by Maynard (1912, samples 26 and 27) as follows:

	Wt. (%)	
Oxide	Bed 6	Bed 4
CaO	44.64	43.58
MgO	8.08	7.04
Fe_2O_3	0.90	0.64
SO_3	0.00	0.00
P_2O_5	0.01	0.02
SiO_2	0.97	1.47
K_2O	0.20	0.20
Na_2O	0.08	0.08
Clay bases	0.67	1.29
LOI	44.45	0.68
Total	100.00	100.00

Furcron (1942) noted a 0.3 foot thick bed of magnesium limestone at the Marble Hill Quarry. The chemical analysis (Furcron, 1942) is:

Oxide	Wt. (%)
CaO	35.86
MgO	15.26
Fe_2O_3	0.64
P_2O_5	0.00
SiO_2	2.50
K_2O	0.15
Na_2O	0.07
Total	100.00

The quarry site could not be located during the current study. This information is included for historical value.

Qa-1

The only active crushed limestone quarry in Polk County is that of C.W. Mathews Construction Company. The quarry which is in the Newala Limestone is located approximately one mile north of the city limits of Rockmart on the west side of Georgia Highway 101. This quarry currently produces only crushed limestone for aggregate. No chemical analyses are available.

P-1

Maynard (1912) reported high magnesium limestones within the Chickamauga [Newala] limestone from three hills (Morgan Hills) to the southwest of the town of Rockmart and south of a road which parallels Euharlee Creek. He noted an occurrence of 50 feet of limestone beginning at the creek level and overlain by phyllite. Analyses of several beds of the limestone revealed the following percentages (Maynard, 1912, samples 26-29):

	Wt. (%)			
Oxide	#26	#27	#28	#29
CaO	44.64	43.58	51.56	35.86
MgO	8.08	7.04	2.36	15.26
Fe_2O_3	0.90	0.64	0.66	0.64
SO_3	0.00	0.00	0.00	0.00
P_2O_5	0.01	0.02	0.01	0.00
SiO_2	0.97	1.47	1.24	2.50
K_2O	0.20	0.20	0.15	0.15
Na_2O	0.08	0.08	0.15	0.07
Clay bases	0.67	1.29	0.63	0.92
LOI	44.45	0.68	43.24	44.60
Total	100.00	100.00	100.00	100.00

Maynard's site could not be located during the current study and is included for historical value.

P-2

Maynard (1912) reported a 45 foot section of high magnesian limestone of the Newala Limestone located approximately 0.75 mile northeast of Red Ore. The analyses are as follows:

Oxide	Wt. (%)	
CaO	40.34	50.86
MgO	10.36	3.14
Fe_2O_3	1.00	0.16
SO_3	0.00	0.00
P_2O_3	0.03	tr.
SiO_2	2.84	1.15
K_2O	0.16	tr.
Na_2O	0.08	tr.
Clay Bases	1.08	0.34
LOI	44.13	44.35
Total	100.00	100.00

This site could not be located during the current study and is included for historical value.

P-3

Maynard (1912) reported the presence of a high magnesium, Chickamauga [Newala] limestone in excess of 100 feet in thickness on the Davitte Property which is located about 0.75 mile south of the Bartow County line on the road that goes north from Aragon into Bartow County. The thicknesses of the units A, B, and C are 60, 20, and 30 feet respectively. Analyses of the magnesian rich limestones from Maynard (1912) are as follows:

	Wt. (%)		
Oxide	**A**	**B**	**C**
CaO	36.34	3.08	40.52
MgO	12.92	5.48	9.14
Fe_2O_3	0.88	0.48	0.72
SO_3	0.00	0.00	0.00
P_2O_5	0.02	0.01	0.01
SiO_2	4.30	5.77	3.88
K_2O	0.20	0.20	0.18
Na_2O	0.14	0.10	0.16
Clay Bases	0.82	1.47	0.69
LOI	44.38	43.41	44.70
Total	100.00	100.00	100.00

The general area described by Maynard does not appear to have been quarried. However, only 40 to 50 feet of carbonate is currently exposed. This area appears to have significant reserves and should be further explored through drilling.

P-4

Maynard (1912) also noted the occurrence of magnesium rich Chickamauga Limestone [Newala?] at the intersection of Tanyard Branch and the road leading from Cedartown to Young's Station. The analysis of this limestone is as follows:

Oxide	**Wt. (%)**
CaO	42.30
MgO	7.60
Fe_2O_3	0.78
SO_3	0.03
P_2O_5	0.01
SiO_2	4.99
K_2O	0.06
Na_2O	0.03
Clay Bases	1.70
LOI	42.44
Total	100.00

The site described by Maynard could not be located during the current study and is included for historical value.

P-5

Maynard (1912) reported 12 feet of dolostone of the Knox Dolomite [Group] located at Young's Station on the Central of Georgia Railway, approximately five miles southeast of Cedartown (Fig. 12). The analysis of this blue gray, fine-grained dolostone is as follows:

Oxide	**Wt. (%)**
CaO	28.72
MgO	18.98
Fe_2O_3	0.68
SO_3	tr.
P_2O_5	0.02
SiO_2	4.12
K_2O	0.10
Na_2O	0.13
Clay Bases	1.40
LOI	45.85
Total	100.00

The site described by Maynard could not be located during the current study and is included for historical value.

P-6

P-6 is approximately 1.65 miles west of Aragon on the north side of Lowery Road. At this location, approximately 0.65 mile west of the intersection of Lowery Road with Prospect Road (see Fig. 12), there is an 18 to 20 foot exposure of medium gray, fine- to medium-grained, brecciated, somewhat cherty dolostone containing veins of recrystallized calcite and dolomite. The angular breccia fragments within the dolostone vary in size from approximately 0.12 to 3 inches and are composed of limestone and dolostone fragments. The chert present within the outcrop occurs as thin discontinuous layers up to four inches in thickness.

Elsewhere along this east-west trending hillside, the dolostone is unbrecciated. Laterally along the outcrop, the dolostone is weathered to the typical orangish-brown to brownish-orange cherty, sandy, silty residuum. Particle size of the typical residuum varies from sand size to boulder size. Several other exposures, similar to the one described above, occur along this road for a distance of approximately 0.1 mile. Analysis of representative samples of this outcrop revealed the following:

	Wt. (%)	
Oxide	**brecciated**	**unbrecciated**
CaO	30.20	28.70
MgO	19.70	18.90
SiO_2	2.30	6.10
Al_2O_3	0.86	1.30
Fe_2O_3	0.28	0.34
LOI	46.10	43.70
Total	99.44	99.04
SO_3	<0.05	<0.05
P_2O_5	<0.02	<0.02
Insol.	3.10	7.60

Outcrop P-6, a brecciated zone within the Knox, is probably of little economic value due to excessive overburden within the immediate area, as revealed by field reconnaissance.

P-7

P-7 is located approximately 1.3 miles south of the Floyd-Polk County line, along the east side of Georgia

Highway 100 (see Fig. 12). This outcrop of probable Knox lies at the foot of a west facing hill with an abandoned railway grade lying less than 0.1 mile to the west. The outcrop consists of pinnacles, as large as 5 feet across, of medium to coarsely crystalline, light gray dolostone in an orangish-red, silty clay to clayey silt, cherty residuum typical of the Knox.

Within 0.5 mile of the above outcrop, the residuum of the Knox overlying the fresh dolostone is as much as 35 feet thick. A chemical analysis of a sample of the pinnacle outcrop yields:

Oxide		Wt. (%)
CaO		31.00
MgO		20.60
SiO_2		2.00
Al_2O_3		0.29
Fe_2O_3		0.29
LOI		45.80
	Total	101.88
SO_3		<.05
P_2O_5		<.02
Insol.		1.90

Outcrop P-7 is limited in areal extent and is in a developed area, limiting the possibility of economic development.

Walker County

Walker County has a population of 58,340 (1990) and a land area of 446.4 square miles. Two physiographic districts of the Valley and Ridge Province (Chickamauga Valley and Armuchee Ridges) and one physiographic district of the Appalachian Province (Lookout Mountain) are present in Walker County. Rocks cropping out in Walker County include carbonates, sandstones, shales, and cherts ranging in age from Cambrian through Pennsylvanian.

Quarries and Prospects

There are 13 prospects and one inactive quarry within the targetted units in Walker County. Although there are some references to high magnesian limestones in Walker County (e.g. McLemore and Hurst 1970, Table 41, samples 10-5, 10-2), these limestones are in general too thin to be of economic consequence.

Q-1

McLemore and Hurst (1970) noted a dolostone unit within the Newala at the **Burl Hall Quarry**. This quarry is located approximately 1.8 miles northeast of Kensington, and 0.1 mile east of a paved road. According to McLemore and Hurst, the Hall quarry was worked for only three years. An analysis of a composite sample from this quarry yields:

Oxide		Wt. (%)
CaO		31.7
MgO		18.1
SiO_2		4.3
Al_2O_3		1.0
Fe_2O_3		0.3
CO_2		44.6
	Total	100.0

The chemistry of the material, as reported by McLemore and Hurst, was high in magnesium and relatively low in silica. Although no further information is available on this old quarry site, it appears that the material could be used to produce aglime and crushed stone if reserves are sufficient.

P-1

McLemore and Hurst (1970) reported that very large tonnages could be produced from a magnesian limestone of the Chickamauga Group on the property of **Mr. H.R. Perry**. The property is located 0.2 miles east of McLemore Cove Road, 2.5 miles southeast of Chickamauga. Chemical analysis of a composite sample yields:

Oxide		Wt. (%)
CaO		38.7
MgO		8.4
SiO_2		10.8
Al_2O_3		1.8
Fe_2O_3		0.9
CO_2		39.2
	Total	99.8

Site P-1, at the time of McLemore and Hurst's study (1970), contained large tonnages of limestone. This material has a relatively low MgO and a relatively high SiO_2 content. The best uses for this material are as aglime or crushed stone.

P-2

Maynard (1912) reported a 100 foot thick section of Mississippian (Bangor) magnesian limestone on the Brum property, located along the north side of Pigeon Mountain. A chemical analysis of this limestone is as follows:

Oxide	Wt. (%)
CaO	30.88
MgO	11.90
Fe_2O_3	2.72
SiO_2	13.24
Clay Bases	2.88
LOI	38.38
Total	100.00

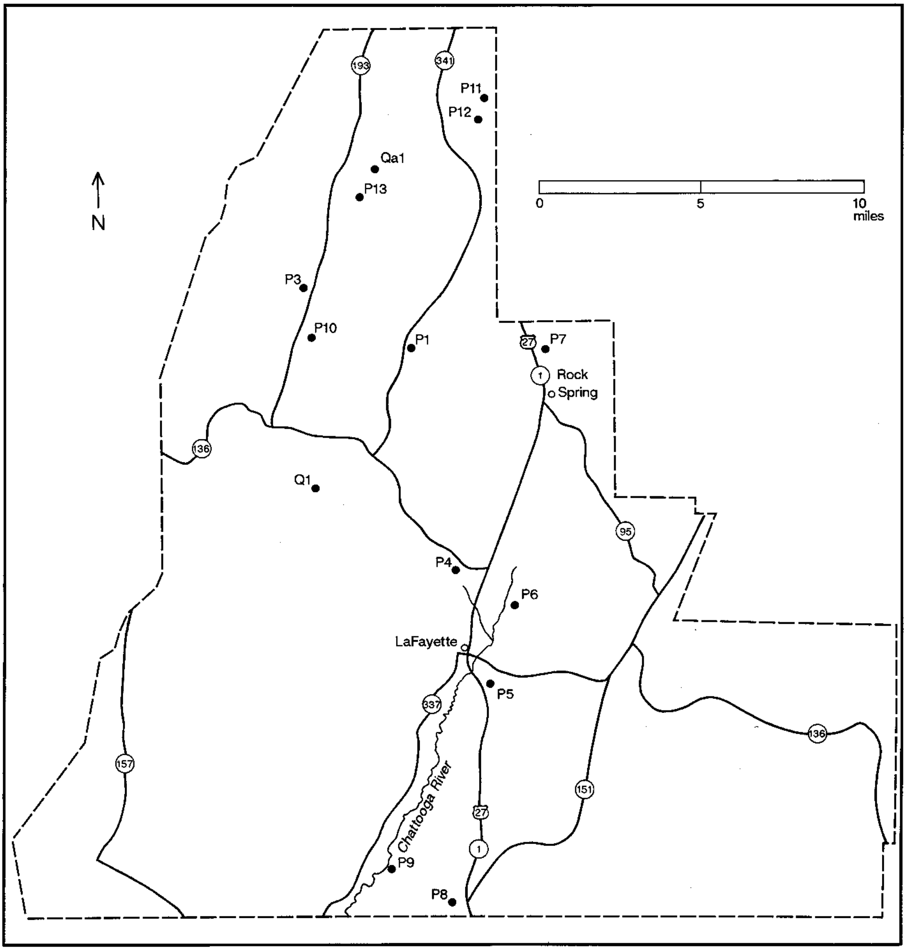

Figure 13. Map of Walker County showing magnesium limestone and dolomite prospects and quarries.

Maynard also noted that an upper 80 foot thick bed of overlying limestone contained abundant chert which would limit economic development of this deposit. It should be noted that the location of this prospect is very general.

Site P-2 is relatively high in silica and the overburden present in the immediate area is in excess of 70 feet. Because of the excessive overburden and the high silica content, this site is of no current economic value.

P-3

Maynard (1912) mentioned the occurrence of a light-gray, fine-grained, "limestone" on the property of the Southern Iron and Steel Company. The property is approximately 0.5 mile northwest of the community of High Point. The material sampled by Maynard had 15.92% MgO, thus making it a dolostone.

Site P-3, which was reported by Maynard (1912), is quite high in magnesium but is of insignificant thickness

(1.4 feet). For this reason, this site is not considered to have economic significance.

P-4

P-4 is a 20 foot exposure of medium to light gray, very fine-grained dolostone. This exposure of the Knox Group is located approximately 0.05 mile south of the intersection of Straight Gut Road and Georgia Highway 136, on the east side of Straight Gut Road. A sample taken at this locality yielded the following results:

Oxide		**Wt. (%)**
CaO		28.50
MgO		18.20
SiO_2		9.00
Al_2O_3		1.20
Fe_2O_3		0.31
LOI		42.10
	Total	99.31
SO_3		<0.05
P_2O_5		<0.02
Insol.		16.00

Site P-4 has limited economic value due to a lack of reserves and its relatively high silica content.

P-5

P-5 represents a 10 foot thick section of light gray to light brownish-gray, laminated, cherty, very fine-grained dolostone which crops out as a pinnacle exposure. The outcrop is located at the crest of Peavine Ridge on the east side of U.S. Highway 27 and Georgia Highway 1, 1.35 miles south of the intersection of U.S. Highway 27 and Georgia Highway 136 southeast of Lafayette. The section of Knox Group represented by the sample is overlain by approximately 25 feet of typical cherty Knox residuum. An analysis of this sample reveals the following:

Oxide		**Wt. (%)**
CaO		31.00
MgO		20.30
SiO_2		1.90
Al_2O_3		0.53
Fe_2O_3		0.33
LOI		45.70
	Total	99.83
SO_3		<0.05
P_2O_5		<0.07
Insol.		2.20

Site P-5 is a pinnacle exposure along Peavine Ridge. Although its chemistry appears to be good, being very high in magnesium and low in silica, the lack of exposure and the presence of significant thicknesses of overburden make this site of little economic interest. However, it is possible that more favorable deposits of similar chemical purity could be located elsewhere along Peavine Ridge.

P-6

P-6 is a seven foot section of light gray, fine- to medium-grained limestone of the Knox Group exposed on the north side of Stanfield Branch at the intersection of Stanfield Branch and an unnamed light duty road off Warthen Road, approximately 1.5 miles northeast of Lafayette. An analysis of the sample is as follows:

Oxide		**Wt. (%)**
CaO		51.00
MgO		3.10
SiO_2		1.50
Al_2O_3		0.26
Fe_2O_3		0.10
LOI		43.50
	Total	99.46
SO_3		<0.05
P_2O_5		<0.02
Insol.		1.80

This prospect is too thin and the overburden is excessively thick (60 feet) for it to be of economic interest.

P-7

P-7 is from a pinnacle exposure of very fine-grained, medium gray Knox dolostone in a residuum of chert-rich, orange-red, clayey sand to sandy clay, located approximately 1.0 mile north of Rock Spring on the western flank of Boynton Ridge. A chemical analysis of this carbonate yields:

Oxide		**Wt. (%)**
CaO		45.70
MgO		5.90
SiO_2		5.20
Al_2O_3		0.98
Fe_2O_3		0.28
P_2O_5		0.02
LOI		41.80
	Total	99.88
SO_3		<0.05
Insol.		16.10

This site is of little economic value due to the nature of its limited reserves and the low magnesium content.

P-8

P-8 is a 10 foot thick section of light gray, fine-grained, nodular (chert) dolostone of the Knox Group. It is located approximately 0.2 mile south of the community of Oakton along the east side of the Central of Georgia Railroad. This outcrop is overlain by 10 to 15 feet of residuum. The analysis of this sample is as follows:

Oxide		Wt. (%)
CaO		30.70
MgO		20.50
SiO_2		2.00
Al_2O_3		0.52
Fe_2O_3		0.12
LOI		45.90
	Total	99.74
SO_3		<0.05
P_2O_5		<0.02
Insol.		2.10

P-9

P-9 is a 20 foot section of limestone exposed in a road cut on the north side of an unnamed light-duty road leading from Ridgeway Road (Ridgeway Church area) to Chattooga Creek. This outcrop is overlain by several tens of feet of Knox residuum. An analysis of this limestone yields:

Oxide		Wt. (%)
CaO		51.10
MgO		3.70
SiO_2		1.30
Al_2O_3		0.15
Fe_2O_3		0.13
P_2O_5		0.03
LOI		43.70
	Total	100.11
SO_3		<0.05
Insol.		1.20

This site is a 20 foot exposure of limestone. The magnesium content is low and the overburden is several tens of feet thick, thereby severely limiting the economic potential for this site.

P-10

P-10 is from a steeply dipping 150 foot section of interlayered fine- to very fine-grained dolomites and limestones of the Knox. The section is located on the western side of Missionary Ridge at Phillips Spring, approximately 1.5 miles south of the community of High Point. The lower half of the section is predominantly dolomitic whereas the upper half of the section is predominantly calcitic. Chert occurs throughout the section as nodules and beds up to one foot in thickness. An analysis of samples from this section is:

		Wt. (%)	
Oxide		Lower	Upper
CaO		50.00	33.50
MgO		0.86	17.30
SiO_2		7.60	4.30
Al_2O_3		1.10	0.36
Fe_2O_3		0.20	0.12
LOI		39.80	44.70
	Total	99.56	100.28
SO_3		<0.05	<0.05
P_2O_5		<0.02	<0.02
Insol.		8.70	4.10

The upper half of this exposure is low in magnesium, whereas the lower portion of the section is relatively high. The presence of nodules and beds of chert as much as one foot in thickness may limit the economic potential of this prospect. The minimum reserves of this deposit are in excess of 80,000 tons.

P-11

P-11 is a small former dolostone quarry located 0.5 mile due west of the intersection of Georgia Highway 2 and U.S. Highway 27 & Georgia Highway 1, just within the city limits of Fort Oglethorpe. At the present time the quarry site is overgrown and exposures are scarce. There is in excess of 20 feet of overburden in the immediate vicinity of the quarry. A chemical analysis of a sample from the floor of the quarry gives the following results:

Oxide		Wt. (%)
CaO		32.80
MgO		18.10
SiO_2		3.00
Al_2O_3		0.39
Fe_2O_3		0.12
LOI		45.50
	Total	99.91
SO_3		<0.05
P_2O_5		<0.02
Insol.		3.10

The quarry is currently within a residential area and is not considered further.

P-12

P-12 represents a 25 foot exposure of scattered outcrops of Knox Dolomite. The dolostone is very fine- to medium grained, medium bedded, light gray, and contains chert beds as thick as 10 inches. The site is located on the boundary of Chickamauga National Military Park, at the intersection of McFarland Avenue and White Row. The composite sample collected analyzes:

Oxide		Wt. (%)
CaO		37.80
MgO		12.20
SiO_2		6.00
Al_2O_3		0.44
Fe_2O_3		0.11
LOI		43.10
	Total	99.65
P_2O_5		<0.02
SO_3		<0.05
Insol.		6.10

Because this site is on the border of the Chickamauga National Battlefield it is not considered further.

P-13

P-13 is a fifteen to twenty foot thick exposure of light gray, cherty, very fine- to fine-grained, dolostone of the Knox Group. Some chert beds are as much as 10 inches thick. The outcrop is located 0.7 mile southeast of Cenchat on the Cenchat-Wallaceville Road. An analysis of this dolostone is as follows:

Oxide		Wt. (%)
CaO		30.60
MgO		16.90
SiO_2		7.50
Al_2O_3		0.95
Fe_2O_3		0.16
LOI		43.00
	Total	99.11
SO_3		<0.05
P_2O_5		<0.02
Insol.		8.00

The overburden thickness within the immediate area probably precludes any further consideration.

Whitfield County

Whitfield County has a population of 72,462 (1990 census) and has a land area in excess of 290 square miles. Located in the northeastern portion of the study area, it contains portions of two districts of the Valley and Ridge Province. The western one-third of Whitfield County is occupied by the Armuchee Ridges District, while the eastern two-thirds of the county is occupied by the Great Valley District. Rock ranging in age from Cambro-Ordovician to Mississippian crop out in Whitfield County. The specific rock units of most economic interest are the Knox Group and the dolomitic facies of the Conasauga Group. The Knox typically crops out as cherty residuum. Therefore, there are relatively few samples from the Knox.

Quarries and Prospects

There are four inactive quarries, one active quarry, and five prospects in Whitfield County.

Q-1

Maynard (1912) described an abandoned quarry in the Conasauga, on the west side of Cedar Ridge to the south of U.S. Highway 76. The limestone as described was bluish-gray, thinly to heavily bedded, and somewhat cherty. Maynard noted a vertical thickness of 110 feet. He also noted that two openings had been made in the hillside and that some agricultural lime had been produced from the site. An analysis of the limestone revealed the following (Maynard, 1912):

Oxide		Wt. (%)
CaO		44.06
MgO		5.40
Fe_2O_3		0.70
SO_3		0.01
P_2O_5		tr.
SiO_2		6.40
Clay bases		2.89
LOI		40.54
	Total	100.00

The deposit represented by Q-1 could not be located for a reevaluation. The locality is probably within a residential area.

Qa-1

The only active limestone quarry in Whitfield County is Vulcan Materials, located 4.25 miles northeast of Dalton and 2.25 miles east of Georgia Highway 71 in the Conasauga Group. The quarry produces aggregate and aglime. No chemical analyses are available.

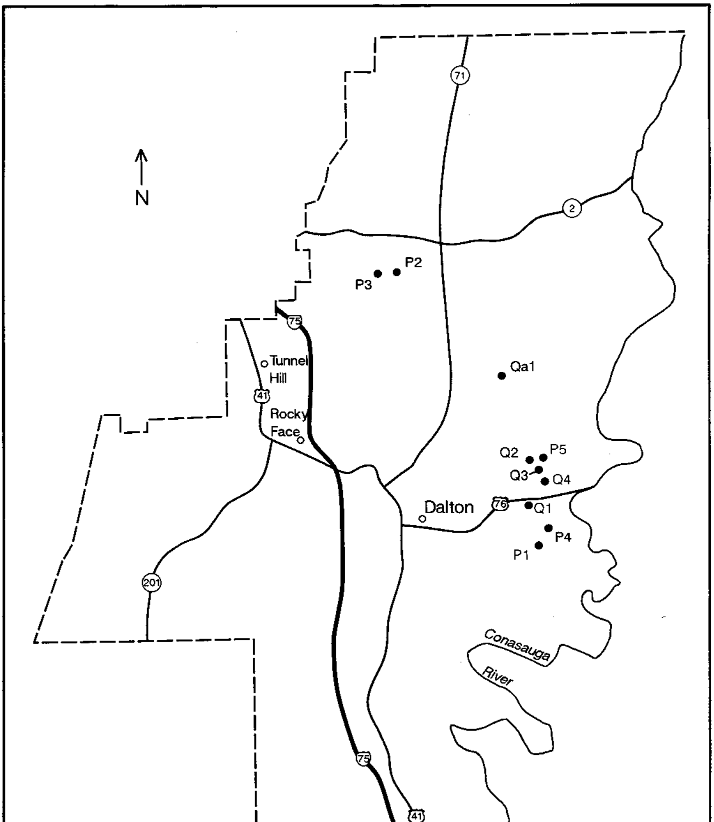

Figure 14. Map of Whitfield County showing magnesium limestone and dolomite prospects and quarries.

P-1

Maynard (1912) described in excess of 34 feet of shaly, heavy bedded, dark blue to black limestone [Conasauga] on the property of I.S. Duckett, 4.0 miles east of Dalton on the east side of Coahulla Creek. The section is located on the south side of the Dalton-Spring Place Road and extends for a horizontal distance of 360 feet. An analysis of a composite sample showed:

Oxide		Wt. (%)
CaO		38.78
MgO		9.40
Fe_2O_3		1.46
SO_3		<0.02
P_2O_5		<0.05
SiO_2		6.02
Clay bases		2.78
LOI		41.51
	Total	99.95

The deposit represented by P-1 is relatively high in insolubles. It is probably best suited for use as a crushed stone, however, it could be used as a source of aglime. The location of this deposit is in question and is not considered further.

P-2

This site is a pinnacle exposure of gray, very fine-grained dolostone in a hillside of residuum typical of the Knox Group. This location is approximately 0.05 mile east of site P-3. A chemical analysis of a sample from P-2 is as follows:

Oxide		Wt. (%)
CaO		30.70
MgO		20.30
SiO_2		1.70
Al_2O_3		0.39
Fe_2O_3		0.12
LOI		46.30
	Total	99.31
SO_3		<0.05
P_2O_5		<0.02
Insol.		1.80

The sample from this site is relatively low in insolubles and the magnesium content is relatively high. However, the sample is from a pinnacle exposure and overburden within the immediate area would prevent economic development.

P-3

P-3 is located in a road cut through Clay Ridge, along Stone Branch near an old mill site. The material sampled is a very light to light gray, fine-grained dolostone. P-3 is approximately 1.0 mile south of the intersection of Georgia Highway 2 and Georgia Highway 201, and 0.6 mile east along a light duty road. An analysis of this sample revealed:

Oxide		Wt. (%)
CaO		30.90
MgO		19.90
SiO_2		3.00
Al_2O_3		0.53
Fe_2O_3		0.14
LOI		45.70
	Total	100.17
SO_3		<0.05
P_2O_5		<0.02
Insol.		3.40

This sample is relatively high in magnesium content and relatively low in insolubles, however, the same restrictions to economic development apply to this locality as to locality P-2.

P-4, P-5, Q-2, Q-3, Q-4

Five sites (P-4, P-5, Q-2, Q-3, Q-4) are from Cedar Ridge, a north-south trending ridge which is bisected by U.S. Highway 76 and Georgia Highway 52, located just west of the Connasauga River in extreme eastern Whitfield County. P-4 is from the Knox Group whereas the remainder are possibly from the Conasauga Group.

From the evaluation of the samples representing the general site of Cedar Ridge, only the sub-site P-5 appears to have sufficient reserves to be considered further, and the presence of a power line on the ridge may preclude economic development.

P-4

P-4 is located near the southern extremity of Cedar Ridge approximately 0.05 mile east of Coahulla Creek. This outcrop consists of a two to three foot thick exposure of medium gray, fine- to medium-grained dolostone which is exposed as a pinnacle in typical Knox residuum. A chemical analysis gives the following:

Oxide		Wt. (%)
CaO		26.80
MgO		17.40
SiO_2		10.60
Al_2O_3		2.50
Fe_2O_3		0.64
LOI		40.60
	Total	98.54
SO_3		<0.05
P_2O_5		<0.02
Insol.		14.00

The high silica content and the overburden present in the area of site P-4 probably preclude its economic development.

Q-2

Q-2 is from an abandoned quarry located on the eastern side of the third knob of Cedar Ridge north of Georgia Highway 52 and U.S. Highway 76. The sample collected at this site represents a composite sample of approximately 30 feet of medium gray, very fine- to medium grained, blocky, medium bedded, cherty dolomitic limestone. Very few chert nodules or beds were noted in the outcrop, although the chemical analysis shows a high percentage of silica. The chemical analysis of a sample from Q-2 is:

Oxide		Wt. (%)
CaO		17.70
MgO		9.30
SiO_2		46.90
Al_2O_3		0.45
Fe_2O_3		0.93
LOI		24.20
	Total	99.48
SO_3		<0.05
P_2O_5		<0.02
Insol.		47.50

The high silica content of the sample representing site Q-2 would allow it to be used only for road metal.

P-5

This location has a 100 foot exposure of light to medium gray, fine- to medium-grained limestone with bedding averaging five feet in thickness. A chemical analysis of a sample from this locality is as follows:

Oxide		Wt. (%)
CaO		43.60
MgO		9.30
SiO_2		1.70
Al_2O_3		0.41
Fe_2O_3		0.21
LOI		44.90
	Total	100.12
SO_3		<0.05
P_2O_5		<0.02
Insol.		1.80

P-5 represents a 100 foot exposure of limestone. Reserves are estimated to be in excess of 480,000 tons. This site probably could be opened as a source of aglime.

Q-3

Q-3 is from a shallow quarry pit. The quarry wall from which the sample was taken is approximately eight feet in height. The material sampled was a dark gray, fine-grained limestone. The analysis is as follows:

Oxide		Wt. (%)
CaO		49.80
MgO		1.20
SiO_2		6.10
Al_2O_3		1.40
Fe_2O_3		0.31
LOI		40.30
	Total	99.11
SO_3		<0.05
P_2O_5		<0.02
Insol.		7.80

Site Q-3 is not considered to be economically feasible due to its low magnesium content and limited reserves.

Q-4

This sample is from an inactive quarry 0.15 mile south of Ketcham Cave along the west side of Harmony Church Road. At this location there is a 25 to 30 foot high exposure of medium to dark gray, fine- to very fine grained magnesian limestone containing some laminar bedding. The analysis of the material is as follows:

Oxide		Wt. (%)
CaO		45.00
MgO		4.20
SiO_2		7.40
Al_2O_3		1.90
Fe_2O_3		0.58
LOI		39.60
	Total	98.68
SO_3		<0.05
P_2O_5		<0.02
Insol.		10.00

Site Q-4 is not considered further due to its relatively high silica and low magnesium content.

SUMMARY

The following sites appear to have promise as sources of high-magnesian limestone and or dolostone. They are as follows:

Bartow County: Q-5, P-5
Catoosa County: Q-3, Q-4, P-1, P-4, P-5
Chatooga County: Q-1, P-4
Floyd County: P-7
Murray County: P-1
Whitfield County: P-5

REFERENCES

Allen, A.T., 1953, Measured sections of Knox Dolomite near Graysville, Georgia in Short contributions to the geology, geography and archaeology of Georgia: Georgia Geologic Survey, Bulletin 60, 336 p.

Bates, Robert L., 1969, Geology of the Industrial Rocks and Minerals, Dover Publications, New York, 459 p.

Boynton, R. S., 1966, Chemistry and Technology of Lime and Limestone, John Wiley and Sons, New York, 520 p.

Butts, C., 1926, Alabama Geological Survey Special Report 14, p. 95, map.

_______, and Gildersleeve, B.,1948, Geology and mineral resources of the Paleozoic area in northwest Georgia: Georgia Geologic Survey, Bulletin 54, 176 p.

Bystron-Asklund, A. M., 1966, Sample cups and a technique for sideward packing of X-ray diffraction specimens, American Minerologist, v. 51, p. 1233-1237.

Campbell, M.R., 1894, Geologic Atlas of the United States, Estillville, Ky.-Va.-Tenn., U.S. Geolological Survey, Folio, 12, p. 2.

Carr, D.D., and Rooney L.F., 1983, Limestone and Dolomite in Lefond, Stanley J. ed., Industrial Minerals and Rocks, 5th ed., v. 2, p. 833-868.

Cattermole, J.M., 1960, Geology of the Bearden Quadrangle, Tenn., U.S. Geological Survey Geologic Quadrangle Map CQ-126.

Chowns, T.M., 1989, in Excursions in Georgia Geology, Georgia Geological Society Guidebooks, v. 9, no. 1, p. 211-227.

Clark, W.Z., and Zisa, A.C., 1976, Physiographic Map of Georgia, 1:2,000,000: Georgia Geologic Survey.

Crawford, T.J., 1989, Geology of the Pennsylvanian System of Georgia: Georgia Geologic Survey, Geologic Atlas 2, 16 pl.

Cressler, C.W., 1963, Geology and ground-water resources of Catoosa County, Georgia: Georgia Geologic Survey, Information Circular 28, 19 p.

_______________, 1964, Geology and ground-water resources of the Paleozoic Rock Area, Chattooga County, Georgia: Georgia Geologic Survey, Information Circular 27, 14 p.

______________, 1964a, Geology and ground-water resources of Dade County, Georgia: Georgia Geologic Survey, Information Circular 26.

______________, 1964b, Geology and ground-water resources of Walker County, Georgia: Georgia Geologic Survey, Information Circular 29.

______________, 1970, Geology and ground-water resources of Floyd and Polk Counties, Georgia: Georgia Geologic Survey, Information Circular 39.

______________, 1974, Geology and ground-water resources of Gordon, Whitfield, and Murray Counties, Georgia: Georgia Geologic Survey Information Circular 47, 56 p.

Cressler, C.W., Blanchard H.E., Jr., and Hester, W.G., 1979, Geohydrology of Bartow, Cherokee, and Forsyth Counties, Georgia: Georgia Geologic Survey, Information Circular 50, 45 p.

Croft, M.G., 1963a, Geology and ground-water resources of Dade County, Georgia: Georgia Geologic Survey, Information Circular 26, 17 p.

___________, 1963b, Geology and ground-water resources of Bartow County, Ga.,: U.S. Geological Survey, Water Supply Paper 1619-FF, p. FF1-FF32.

Foote, L.E., 1986, Geology of the Pine Log Area, Georgia Geologic Survey, Open File Report 86-2, 31 p.

Furcron, A.S., 1942, Dolomites and magnesian limestones in Georgia: Georgia Geologic Survey, Information Circular 14, 30 p.

Georgia Geologic Survey, 1976, Geologic Map of Georgia, 1:500,000.

Georgia State Senate No.411 (Senate Bill No. 27), Georgia Liming Materials Act of 1963, Atlanta, Georgia.

Griffin, G.M., Interpretation of X-ray Diffraction Data, 1971, (p. 557-560) in Procedures in Sedimentary Petrology, Carver, R.E., ed., Wiley-Interscience, New York, 653 p.

Hayes, C.W., 1891, The Overthrust Faults of the Southern Appalachians: Geological Society of America, v. 2, p. 143, 144-148.

___________, 1894, Geologic Atlas of the United States, Kingston Folio Tenn.: U.S. Geological Survey, Folio 4, p. 2.

___________, 1902, Geologic Atlas of the United States, Rome Folio, Georgia-Alabama,: U.S. Geological Survey, Folio 78, p. 3.

Keith, A., 1895, Geologic Atlas of the United States, Knoxville Folio, Tenn.-N.C.: U.S. Geological Survey, Folio 16.

_________1903, Geologic Atlas of the United States, Cranberry Folio, N.C.-Tenn.: U.S. Geological Survey, Folio 90.

Kesler, T.L., 1950a, Geol. Reconn. Tennessee 1st Report, p. 149, 152-153.

____________ 1950b, Geology and Mineral Deposits of the Cartersville District Georgia, U.S. Geological Survey, Professional Paper 224, 97 p.

Maynard, T.P., 1912, A report on the limestones and cement materials of North Georgia, Georgia Geologic Survey, Bulletin 27, 293 p.

McLemore, W.H., Hurst, V.J., 1970, The carbonate rocks in the Coosa Valley Area, Georgia: U.S. Department of Commerce, Technical Assistance Project, 170 p.

Munyan, A.C.,1951, Geology and mineral resources of Dalton Quadrangle, Georgia-Tennessee: Georgia Geologic Survey Bulletin 57, 128 p.

Niskanen, Eric, 1964, Reduction of Orientation Effects in the Quantitative X-ray Diffraction Analysis of Kaolin Minerals, Amer. Min. v. 49, May-June 1964, p. 705-714.

O'Driscoll, M., 1988, Dolomite: More than Crushed Stone, Industrial Minerals, September, 1988, #252, p. 37-63.

Pettijohn, F.J.,1975, Sedimentary Rocks, Harper and Row, New York, 628 p.

Rodgers, J., 1952, Geology of the Athens Quadrangle, Tennessee (1:24,000), U.S. Geological Survey Quadrangle Map.

__________, 1953, Tennessee Division of Geology, Bulletin 58, pt. 2, p. 55,56, (Table 5), plates.

Safford, J.M., 1856, Geol. Reconn. Tennessee 1st Rept. p.149, 152-153.

____________, 1869, Geology of Tennessee, Nashville, Tenn., S.C. Mercer, 550 p., p.151, 158-159, 203-226.

____________, and Killebrew, 1876, Elements of Geology of Tennessee, p. 108, 123, 130-131, 137.

Smith, E.A., 1876, Alabama Geological Survey Rept. Prog. for 1876, p. 11, 23, 25, 42, 207-208.

__________, 1890, Alabama Geol. Rept. on the Cahaba Coal Field, p.149.

Spencer, 1893, The Paleozoic Group- The geology of ten counties of northwestern Georgia: Georgia Geologic Survey Bulletin 0.

Stuart, A.W., 1956, Dolomitic Limestone and Shale in the Fairmount Area, Georgia Mineral Newsletter, v. 9, p. 85-89, 1956.

Swanson, R.G., 1981, Sample examination manual: American Association of Petroleum Geologists, Tulsa, Oklahoma.

Willis, B., 1893, The Mechanics of Appalachian Structure:, U.S. Geological Survey, 13th Annual Report pt. 2, plates 60, 61.

APPENDIX A

WRITTEN LITHOLOGIC DESCRIPTION OF CORE FROM GGS # 3636

Note: The Munsell Color Chart was used for the color determination. The grain size classification used is that of R.G. Swanson (in Sample Examination Manual, published by AAPG). The abbreviations are as follows:

fL: 62-88 microns
fU: 88-125 microns
Fl: 125-177 microns
F: 177-250 microns
Ml: 250-350 microns
Mu: 350-500 microns
crsL: 500-710 microns

In general, the Knox core GGS # 3636 consists of a light gray, laminated, fractured, styolitic, very fine- to fine-grained dolostone containing occasional chert beds as much as 3 feet thick.

The core contains two mineralized zones, both of which are associated with highly fractured to brecciated chert zones. The two mineralized zones occur at 225 feet and 274 feet. The upper mineralized zone at 225 feet contains barite (major), galena, sphalerite, pyrite, and fluorite. The lower mineralized zone at 274 feet contains fluorite with minor pyrite. Pyrite is also associated with fracture surfaces at various intervals within the core.

Overall, the dolostone is very high in magnesium, and moderately to occasionally high in SiO_2. Stone from this prospect should (assuming the chert zones are avoided) provide a good source for high quality aglime and/or crushed stone. From field observations, the reserves appear to be sufficient for a quarry operation.

GGS # 3636
Elevation 738 feet
Location: 34°58'00" Longitude
85°06'55" Latitude

Depth in feet From	To	Description
0	11.0	Residuum: cherty, sandy, clayey.
11.0	17.8	Dolostone, N-4, fU to Fl, laminated to mottled (burrowed?) vuggy, styolitic.
17.8	21.0	Dolostone: as above.
21.0	21.17	Chert: N-8, fractured, (green in color at 21.0).
21.17	26.5	Dolostone: N-7, Fl to Fu, thin bedded to laminated, styolitic, contains occasional chert nodules.
26.5	28.17	Dolostone: N-5, fL to fU, thin bedded, contains occasional chert nodule.
28.17	30.00	Dolostone: N-7, fL to fU, thin to laminated, styolitic, contains an unidentified green mineral along some styolites.
30.0	31.0	Dolostone: N-6.5, fL to fU, cherty (nodular).
31.0	39.5	Dolostone: N-7, fL to fU, thin bedded to laminated cherty (nodular), laminated and burrowed in the upper 0.75 foot.
39.5	40.0	Dolostone: N-6, Fl to Fu, laminated to thin bedded, the upper 0.2 feet of this unit is ml to mu and is sucrosic.
40.0	41.25	Dolostone: N-6, Fu to Ml, laminated to mottled (burrowed?), fractured.
41.25	44.17	Dolostone: N-4 to N-5, Fu to Ml, thin bedded to laminated, fractured, contains large (2 in) chert fragment at 43.5 feet.
44.17	46.25	Dolostone: N-7 to N-9, Fu to Ml, intraclastic zone, styolitic.
46.25	47.25	Chert: N-7 to N-9, fractured.
47.25	49.5	Chert: N-6 to N-8, fractured, contains pelletoid zone at 47.8 feet.
49.5	51.75	Dolostone: N-8 to N-9, Ml to Mu, cherty, calcitic.
51.75	57.33	Dolostone: N-9 with streaks of N-7, fL to Fu, laminated to disrupted thin bedding, contains high angle fractures.
57.33	69.5	Dolostone: N-5 to N-6, fL to Fu, laminated to disrupted laminated bedding, styolitic, burrowed in the upper 3 feet, high angle fracturing is present, shaly partings are present in the lower 0.5 foot.
69.5	70.75	Dolostone: N-5, Fl, pelletoidal, and shale clasts, styolitic.
70.75	71.0	Dolostone: N-6 to N-7, fL to fU, thin bedded.
71.0	73.75	Dolostone: N-6, Fl, thin bedded to laminated.
73.75	77.0	Dolostone: N-4 to N-5, Fl, styolitic, porous.
77.0	79.0	Dolostone: N-4, Fl, laminated to thin bedded, styolitic, somewhat fractured.
79.0	89.0	Dolostone: N-4, fU to Fl, thin bedded to laminated, disrupted from 88.5 feet), cherty (nodular), styolitic.
89.0	91.0	Dolostone: N-5 to N-6, fL to Fu, laminated (ripple marks?), high angle fracturing, vuggy.
91.0	97.0	Dolostone: N-5 to N-6, fL to Fu, laminated to thin bedded, styolitic, contains chert patches and nodules (up to 3/4 in); contains rounded clasts of white chert (93.0-93.8).
97.0	98.3	Dolostone: N-4 to N-5, Fl to Fu, laminated (disrupted), contains clasts, and high angle fracturing.
98.3	99.8	As above, with more chert.
99.8	109.0	Dolostone: N-5, fL, thin bedded to laminated,styolitic, high angle fracturing present.
109.0	110.0	Dolostone: N-6 to N-8, fL, burrowed, laminated, with some laminae disrupted.
110.0	117.5	Dolostone, N-6 to N-8,fL thin bedded to laminated, styolitic, very porous at 117.0, some burrowing present at 115.0 feet.
117.5	121.0	Dolostone: N-4 to N-5, Fl, thin bedded to laminated, (bioturbated zone from 118-120).
121.0	128.0	Dolostone: N-7, Fl to Fu, thin bedded styolitic, cherty, fine - grained pyrite is present along high angle fractures from 122-122.75 feet.
128.0	130.5	Dolostone: N-7, fu to fl, thin bedded to laminated, cherty.
130.5	137.0	Dolostone: N-5 to N-6, fU to fL thin bedded to laminated (some disrupted), contains high angle fractures, styolitic.

Depth in feet From	To	Description
137.0	140.0	Dolostone: N-6, fU to Fl, laminated (disrupted), contains occasional chert nodule.
140.0	147.0	Dolostone: fU to Fl, laminated, contains calcite filled high angle fractures.
147.0	149.0	Dolostone: N-4 to N-5, fL, laminated (some disturbed), contains small chert nodules, also contains high angle fractures.
149.0	157.0	Dolostone: N-4 to N-5, fL, laminated (some disturbed), styolitic, some pelletoidal layering (156-157 feet).
157.0	164.0	Dolostone: N-4 to N-7, fU to Fl, contains occasional chert nodules, very fractured, vuggy, occasional pink dolomite filled vugs, contains fine-grained pyrite and hema tite? at 163.7 feet.
164.0	165.3	Dolostone: N-5 to N-7, Fl, chaotic bedded (almost paisley design), laminated (appears to be replacement of anhydrite.
165.3	167.0	Dolostone: N-5,Fu to Fl, laminated (wavy) to disrupted laminar bedding.
167.0	176.0	Dolostone: N-5 to N-6, fU to Fl, thin bedded to laminated, contains occasional chert nodules.
176.0	178.5	Dolostone: N-5 to N-7, fu to fl, mottled bedding (possibly due to burrowing)
178.5	179.0	Dolostone: N-4 to N-5, fl, cherty, styolitic, fractured.
179.0	185.5	Dolostone: N-4 to N-5, fu to fl, laminated, styolitic, contains a pelletoidal zone (181-183.75), nodular chert is present in the lower 15 inches of the core.
185.5	193.6	Dolostone: N-4 to N-7, fl to fu, laminated (disturbed), styolitic.
193.6	195.16	Dolostone: N-6 to N-7, fl to fu, laminated to thin bedded.
195.16	197.0	Dolostone: N-3 to N-4, fU to Fl thin bedded to laminated, cherty, contains high angle fractures, styolitic.
197.0	201.0	Dolostone: N-5 to N-7, fu to fl, mottled texture present.
201.0	204.75	Dolostone: N-7, fU to Fl, thin bedded to laminated, styolitic, becomes darker (to N-3) towards the bottom of this section.
204.0	208.7	Dolostone: N-4 to N-6, fu, mottled to disrupted laminae.
208.7	214.0	Dolostone: N-6, fU, thin bedded, mottled texture, (especially 211.5-212.5).
214.0	218.5	Dolostone: N-6, fl to fu, thin bedded to disrupted laminae, styolitic, chert rip ups are present (217-217.25 feet).
218.5	224.0	Dolostone: N-6 to N-7, fL to fU, thin bedded to laminated, contains occasional small chert lenses.
224.0	226.5	Dolostone: N-5 to N-7, Fl, thin bedded, with chert predominant in the lower 2 feet, mineralized zone is present from 226.3 to 226.5 feet. The mineralized zone consists of a 2 inch thick zone of brecciated chert containing, barite (major), galena (cubes up to 0.25 in.) fluorite (purple), sphalerite, and very minor pyrite.
226.5	231.16	Dolostone: N-9, fl, interbedded with chert (chert predominates in the upper foot), contains minor amounts of sphalerite (227.0).
231.16	234.3	Dolostone: N-5 to N-9, fl to fu, mottled texture, vuggy, (vugs contain dolomite and calcite).
234.3	235.16	Dolostone: N-4 to N-5, fl to fu, contain 0.25 in. layers with carbonaceous seams (appears to be a replacement of anhydrite).
235.16	239.0	Dolostone: N-5 to N-6, fu to mu, irregularly bedded to pelletoidal, contains white powdery mineral between grains.
239.0	245.0	Dolostone: N-5 to N-7, fl to fu, irregularly bedded to mottled (burrowed ?), styolitic, 244.5 to 244.75 is wavy bedded to laminated.
245.0	245.8	As above with carbonaceous seams.
245.8	248.7	Dolostone: N-7, fu to fl, thin indistinct bedding accented by darker seams of dolomite, styolitic.
248.7	253.0	Dolostone: N-5 to N-6, fu to fl, thinly bedded (disrupted), to mottled, styolitic.
253.0	259.0	Dolostone: N-3 to N-6, fu to fl, thin bedded (disrupted), styolitic, contains pinch and swell structures.
259.0	261.0	As above.
261.0	263.0	Dolostone: N-5 to N-6, fu to fl, thin bedded to mottled, styolitic.
263.0	268.75	As above.
268.75	269.0	Dolostone : fu to fl, N-5 to N-6, thin bedded, contains flaser bedding.

Depth in feet		Description
From	To	
269.0	271.5	Dolostone: N-4 to N-5, fu, thin bedded (disrupted), contains occasional chert nodules.
271.5	275.16	Dolostone: N-7 to N-8, brecciated (clasts up to 1.5 in), vuggy, contains fluorite up to 0.25 in.
275.16	279.75	Dolostone: N-6 to N-7, fl to fu, laminated to thin bedded, contains occasional chert nodules (up to 0.5 in.), contains high angle fractures, styolitic.
279.75	284.75	Dolostone: N-5 to N-7, fu to ml, porous to vuggy, somewhat fractured, contains pinch and swell structures.
284.75	286.5	Chert: medium bluish-gray 5B 5/1, contains high angle fracturing.
286.5	293.0	Dolostone: N-4 to N-6, fu to fl, thin bedded, contains chert nodules, vugs present are filled with calcite and dolomite.
293.0	308.5	Dolostone: N-6 to N-8, fu to fl, thin bedded, to laminated, contains occasional chert nodules.
308.5	311.5	Dolostone: N-6 to N-7, fu to fl, bedding has mottled appearance, styolitic, fine-grained pyrite is present at 309.0 feet.
311.5	312.16	Chert: blue-gray, highly fractured.
312.16	313.0	Dolostone: N-5 to N-7, fl, thin bedded, styolitic.
313.0	331.0	Dolostone: N-5 to N-7, fl, thin bedded (disrupted), contains fine-grained pyrite at 320.0 feet, vuggy (vugs filled with calcite and dolomite).

TABLE A-1

Chemical Analyses of Selected Core Samples from GGS 3636

sample	depth	SiO_2	Al_2O_3	Fe_2O_3	MgO	CaO	LOI	Insol.	P_2O_5	SO_3	Mo	Ba	F	Sr	Pb	Zn
	feet	%	%	%	%	%	%	%	%	%	ppm	%	%	ppm	ppm	ppm
A	20.00	4.50	0.71	0.16	18.00	31.80	44.60	4.70	0.02	0.04						
B	43.00	11.20	0.81	0.21	18.20	27.30	44.30	11.70	<.02	<.04						
C	84.00	11.10	1.30	0.48	16.30	29.30	40.70	12.30	0.05	0.8						
D	120.00	15.30	1.20	0.34	16.90	26.50	39.50	15.90	0.04	0.04						
E	160.00	2.60	0.31	0.21	19.90	30.60	46.20	2.40	<.02	<.04	<2	0.06	0.025		<5	<5
F	170.00	7.40	1.70	0.44	17.00	30.20	42.40	8.90	0.02	0.2						
G	190.00	5.50	0.94	0.22	18.10	31.30	44.00	5.80	0.04	<.04						
H	214.00	4.20	0.50	0.16	19.30	30.10	45.00	4.20	0.05	<.04	<2	0.06	0.039		<5	<5
I	224.00	15.10	0.53	0.18	17.20	26.70	40.00	15.10	0.03	<.04	<2	0.06	0.028	110	<5	25
J	224.50	23.70	0.45	0.60	15.30	24.00	35.60	23.20	<.02	0.04	4	0.15	0.032	110	5	2050
K	225.00	64.90	0.26	0.36	0.44	0.72	1.80	95.50	<.02	7.9	<2	16.00	0.088	2150	100	420
L	226.75	99.70	0.16	0.51	0.14	0.27	0.58	97.50	<.02	<.04	<2	0.01	0.035	<10	<5	40
M	228.50	31.00	0.35	0.31	14.40	21.30	33.70	30.10	<.02	<.04	<2	0.05	0.036	35	<5	<5
N	231.50	34.70	1.10	0.74	12.90	20.00	31.40	33.90	0.02	<.04	<2	0.07	0.057	65	<5	10
O	233.50	28.70	0.44	0.32	15.00	22.10	34.30	28.00	<.02	0.04						
Q	252.00	4.90	1.20	0.67	18.20	30.60	44.60	5.20	0.03	0.04						
R	267.00	16.10	2.20	2.00	15.90	24.60	38.70	18.20	0.05	0.08	<2	0.05	0.054	90	<5	10
S	271.35	60.90	0.31	1.10	7.20	13.40	16.70	58.90	<.02	<.04	<2	0.03	1.8	25	30	275
T	273.16	92.20	0.18	0.46	1.60	2.40	4.20	89.80	0.04	0.04	2	0.01	0.13	<10	<5	<5
U	281.50	7.70	0.32	0.17	19.00	29.10	44.10	7.10	0.02	<.04	<2	0.07	0.035	50	<5	<5
V	290.00	6.50	0.91	0.14	18.10	30.10	43.50	6.80	0.04	<.04						
W	305.00	7.10	0.67	0.17	18.50	29.40	43.50	7.10	0.05	<.04						
X	325.00	4.20	0.94	0.16	19.20	29.80	44.30	4.80	0.04	<.04						

APPENDIX B

AN X-RAY STUDY OF SELECTED CARBONATES AND DOLOSTONES

Methods for the semi-quantitative interpretation of relative mineral abundances for both clay and carbonate minerals have been utilized since the early 1950's. The method of Griffin (1971) was used in this current study to estimate the calcite-dolomite ratios.

The reasons for undertaking this comparative study are: 1) the relative low cost of the procedure (assuming an X-ray diffractometer is already owned), 2) the small amount of time required for sample preparation (approximately five to ten minutes per sample) and 3) the relative speed of sample analysis (approximately fifteen minutes). The results of geochemical analyses of samples from this study were compared to those obtained by X-ray diffraction methods.

PROCEDURE

A split of each sample was crushed in a Spex 8510 shatterbox to -325 mesh. The resulting powder was loaded into a side powder pack mount similar to that described by Bystron-Asklund (1966). This method minimizes preferential orientation of the grains (a requirement for quantitative or semiquantitative work). The sample holder consists of a well in a fiberglass blank. A glass slide is used to contain the powder until the well is filled. The powder is loaded into the holder and gently tapped on a firm surface until a smooth sample surface is achieved. The sample holder is then turned so that the sample surface faces upward, and the constraining glass slide is removed. Care is taken to minimize any horizontal motion when removing the glass slide. The sample is then placed in the sample chamber of the diffractometer and is X-rayed.

From the resulting X-ray diffractogram, the heights above background level of the 2.89 Å (30.94° 2 θ) peak of dolomite and the 3.03 Å (29.47° 2 θ) peak of calcite were measured. The height of the dolomite peak was then divided by the height of the calcite peak and the calcite/dolomite ratio read directly from a graph from Griffin (1971). The graph from Griffin (1971), assumes a pure calcite-dolomite mixture. However, since the majority of the samples are very pure carbonates with no mineral peaks interfering with either of the major peaks for dolomite or calcite, this method should be applicable.

The results are shown in figure B-1. As can be seen from figure B-1, the relationship is approximately linear. The clustering of data points at the 6% and the 92% positions along the X-axis is due to the fact that these values represent the maximum and minimum values of Griffin's (1971) curve (this curve is based on the assumption of pure end members of calcite and dolomite). It is obvious that there are variances between the values determined by chemical analysis and those derived via X-ray diffraction. It appeared when reviewing the data in spread sheet form that the percentages derived from X-ray diffraction data were approximately equal to or slightly higher than those determined by chemical means. Figure B-2 shows that SiO_2, by far, constitutes the vast majority of the insoluble component with the exception of one sample which is located at approximately the 43% position on the Y-axis. It is believed that this sample is argillaceous, thus accounting for the amount of insolubles being significantly higher than the % SiO_2 value. In order to determine the relationship of the amount of insoluble material to the calcite/dolomite ratios as determined by geochemical and X-ray diffraction means, the graph presented as figure B-3 was generated. Figure B-3 shows that differences between the values derived from X-ray diffraction data and those determined by chemical analysis are relatively slight or of equal variance.

CONCLUSIONS

The X-ray diffraction method of using peak heights to determine relative abundance of calcite and dolomite can be used to determine percent dolomite and percent calcite with reasonable reliability for samples when coupled with insoluble analysis.

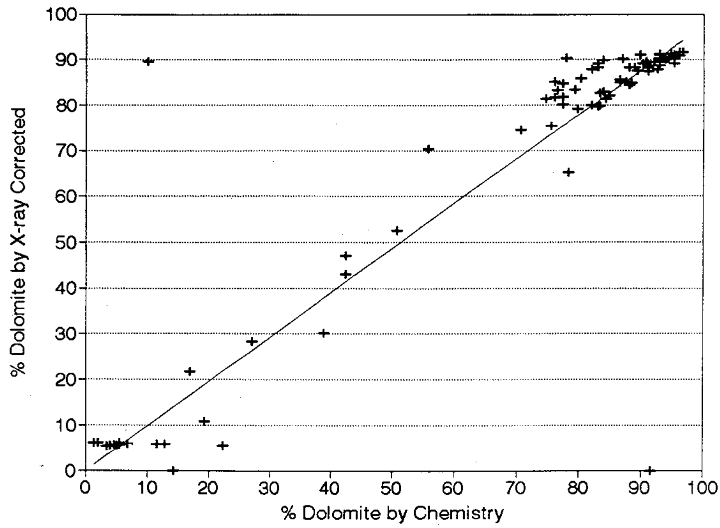

Figure B-1. X-Y plot showing percent dolomite by chemical analysis versus percent dolomite by X-ray diffraction.

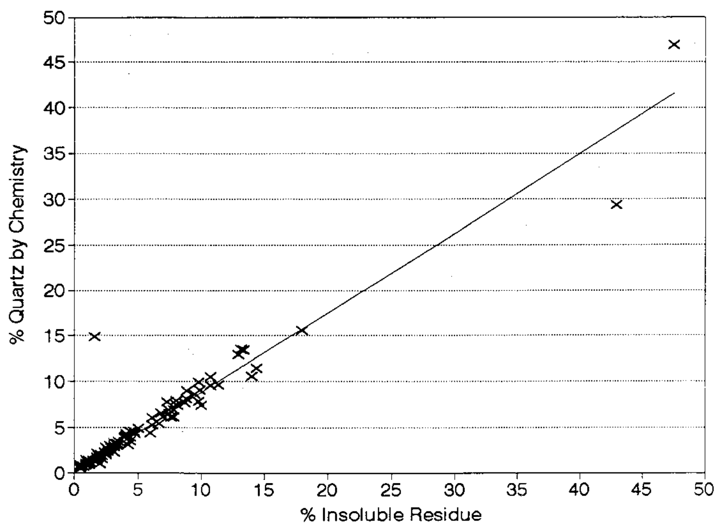

Figure B-2. X-Y plot showing percent insoluble residue versus percent quartz by chemistry.

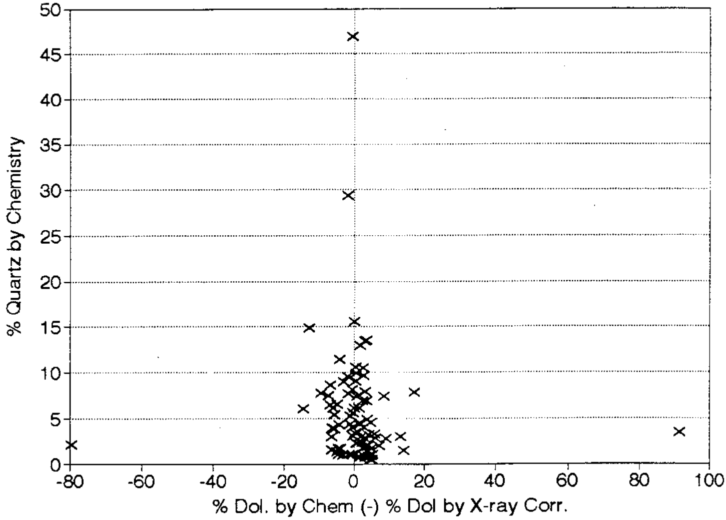

Figure B-3. X-Y plot showing percent quartz by chemistry minus the percent dolomite by X-ray diffraction (corrected for quartz).

For convenience in selecting our reports from your bookshelves, they are color-keyed across the spine by subject as follows:

Red	Valley and Ridge mapping and structural geology
Dk. Purple	Piedmont and Blue Ridge mapping and structural geology
Maroon	Coastal Plain mapping and stratigraphy
Lt. Green	Paleontology
Lt. Blue	Coastal Zone studies
Dk. Green	Geochemical and geophysical studies
Dk. Blue	Hydrology
Olive	Economic geology
	Mining directory
Yellow	Environmental studies
	Engineering studies
Dk. Orange	Bibliographies and lists of publications
Brown	Petroleum and natural gas
Black	Field trip guidebooks
Dk. Brown	Collections of papers

Colors have been selected at random, and will be augmented as new subjects are published.

Editor: Melynda Lewis