6-1971

Petrography of the Roan Village area, Carter County, Tennessee

James Michael Dregne

To the Graduate Council:

I am submitting herewith a thesis written by James Michael Dregne entitled "Petrography of the Roan Village area, Carter County, Tennessee." I have examined the final electronic copy of this thesis for form and content and recommend that it be accepted in partial fulfillment of the requirements for the degree of Master of Science, with a major in Geology.

George D. Swingle, Major Professor

We have read this thesis and recommend its acceptance:

Accepted for the Council:
Carolyn R. Hodges

Vice Provost and Dean of the Graduate School

(Original signatures are on file with official student records.)

142

May 3, 1971

To the Graduate Council:

I am submitting herewith a thesis written by James Michael Dregne entitled "Petrography of the Roan Village Area, Carter County, Tennessee." I recommend that it be accepted for nine quarter hours of credit in partial fulfillment of the requirements for the degree of Master of Science, with a major in Geology.

George D. Swingle
Major Professor

We have read this thesis and recommend its acceptance:

Don W. Byerly

Ragel M. Perkins

Accepted for the Council:

Hilton A. Smith
Vice Chancellor for
Graduate Studies and Research

PETROGRAPHY OF THE ROAN VILLAGE AREA, CARTER COUNTY, TENNESSEE

A Thesis
Presented to
the Graduate Council of
The University of Tennessee

In Partial Fulfillment
of the Requirements for the Degree
Master of Science

by
James Michael Dregne

June 1971

ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. George D. Swingle, Professor of Geology at The University of Tennessee, for suggesting and supervising the study. Gratitude is also expressed to Dr. Ralph M. Perhac, Associate Professor of Geology, and Dr. Don W. Byerly, Assistant Professor of Geology, for their valuable advice and assistance. Their comments have greatly improved the quality of the manuscript.

Appreciation is expressed to Mr. Ben Bryan of The University of Tennessee for his valuable assistance in the production of the photomicrographs.

Special acknowledgment is given to the writer's wife, Donna. Her patience, assistance, and secretarial work throughout the period of study made the task easier.

ABSTRACT

The area considered in this study encompasses a twenty-five square mile portion of the White Rock Mountain and Iron Mountain quadrangles in the vicinity of Roan Village, Tennessee. The Roan Village area is composed of metamorphic and igneous rocks of Precambrian age, which were thrusted to the northwest over younger Precambrian and Cambrian rocks. The two major formations are the Cranberry Gneiss and the Beech Granite.

The Cranberry Gneiss is Precambrian metasediments. The gneiss is a layered rock of varied composition. Texturally the Cranberry ranges from equigranular to porphyroblastic. Perthitic microcline, albite, quartz, and biotite are major constituents.

The Beech Granite is a Precambrian igneous rock which is intrusive into the Cranberry Gneiss. The Beech is an inequigranular, holocrystalline, pink granite. Microperthitic microcline, albite and quartz are major constituents. Minerals commonly show signs of alteration and deformation.

The Cranberry Gneiss has been cut by numerous intrusions of granitic, diabasic, aplitic and ultramafic composition. The Beech is cut by many diabase dikes.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF PLATES

CHAPTER I

INTRODUCTION

Location and Extent

The area described in this report encompasses approximately 25 square miles in the southern part of Carter County, Tennessee. Parts of two 7.5 minute quadrangle maps cover the area: White Rocks Mountain (TVA 208-NE) and Iron Mountain (TVA 208-NW) (Figure 1).

The present study is concerned with the area along State Highway 19E from Roan Village to Tiger Valley, a distance of approximately 7 miles.

Previous Geological Investigation

The first description of rocks in this area was made by Keith (1907) in his 30 minute Roan Mountain Folio. Keith described the rocks as part of a Precambrian igneous complex thrust over Cambrian rocks. This area has not been mapped in detail since the work done by Keith in 1907.

Rocks similar to those found in the study area have been described by King and Ferguson (1960) in their "Geology of Northeasternmost Tennessee." The area described in this paper is located north and west of the study area. This paper is complicated by the fact that King and Ferguson do

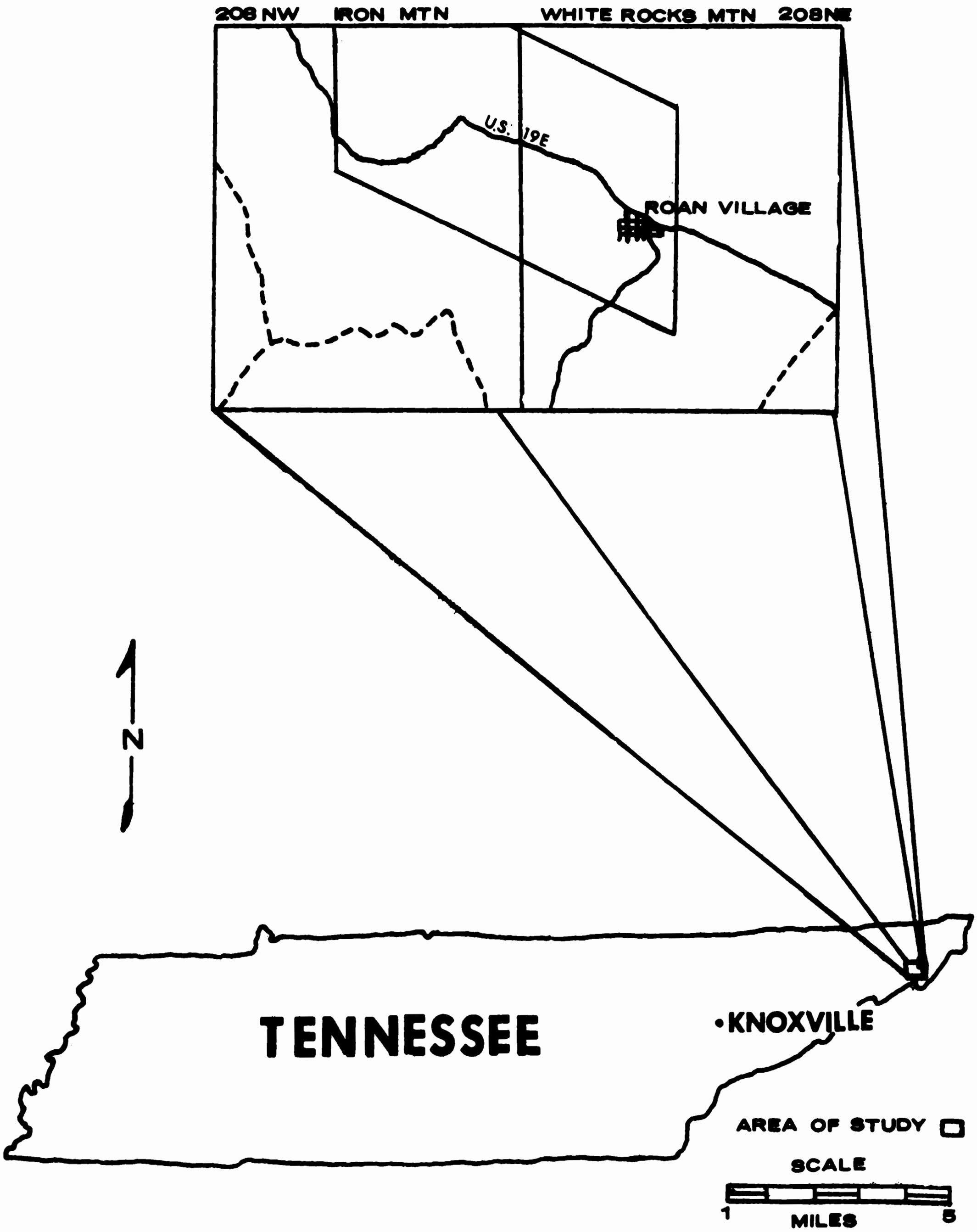


Figure 1. Index Map of Study Area.

not use the formation names used by Keith, but use geographic names for each area Precambrian rocks outcrop.

Kulp and Brobst (1956) and Bryant (1963) mapped in detail the geology of the Linville North Carolina quadrangle. This quadrangle which adjoins the White Rocks Mountain quadrangle on the east contains rocks like those found in the study area.

Nature and Purpose of the Investigation

The primary purpose of this investigation is to make a detailed study of the Precambrian rocks in the vicinity of Roan Village. The geology of the area from Roan Village to Tiger Valley was mapped on a scale of 1:24,000 (Plate I, in pocket). The White Rocks Mountain and Iron Mountain topographic maps, of the TVA 7.5 minute series, were used as base maps.

A petrographic study was made of rocks found in the study area. When feasible, minerals were identified optically by placing grains in emmersion oils; however, the x-ray defractometer was used to identify minerals comprising the finer grained rocks. Color designations are based on the Munsell system.

Physiography

The area is in the Blue Ridge physiographic province of the southern Appalachians. This province consists of a mountainous belt extending from northern Georgia into southern Pennsylvania. The Blue Ridge of northeast Tennessee is comprised of mountains known as the Unakas. The Unakas are divided into three ridges which trend northeast. The three ridges from west to east are Holston, Iron, and Stone mountains. The study area is located four miles east of Stone Mountain.

Topography and Drainage

The most prominent topographical feature in the area is White Rocks Mountain which borders the area on the north and reaches an elevation of 4,200 feet. The average elevation of White Rocks Mountain along its crest is 3,900 feet. The topography of the southern half of the area is dominated by a series of three north striking ridges. These three ridges, Ripshin, Chestnut, and Big Ridge, have an average elevation of 4,000 feet. Bisecting the area is Doe River Valley which strikes northwest at an average elevation of 2,500 feet.

The largest stream in the area is Doe River. It flows northwest into Watauga River. The general drainage pattern in the area is dendritic with small streams draining into Doe River.

Culture and Vegetation

The people of this area are mostly farmers of Anglo-Saxon ancestry. Most of the farms in the area are small with small crops of tobacco and vegetables. Livestock in the area is mainly dairy cows and pigs. Small lumbering operations are being carried on in the area.

The land along White Rocks Mountain is heavily forested, making it undesirable for cultivation. The study area is in Cherokee National Forest.

State Highway 19E follows Doe River Valley through the area and provides the main access to the area. The area is well traversed with secondary roads.

CHAPTER II

STRATIGRAPHY

Local Stratigraphy

The rocks found in the study area are mainly gneisses and granites of Precambrian age. The rocks in the area are entirely allochthonous having been thrust northwest along the Linville Falls Fault over younger Precambrian and Cambrian rocks. The younger rocks below the thrust sheet are not exposed in the study area, but can be seen in the Grandfather Mountain Window in the Linville, North Carolina quadrangle. The rocks in the window belong to the Ocoee Series and Chilhowee Group.

The overthrust sheet is composed of metamorphic and igneous rocks. There are two major formations exposed in the study area, the Cranberry Gneiss and Beech Granite (Plate I, in pocket). The older formation is the Cranberry Gneiss which is a mixed rock unit. The Beech Granite is intrusive into the Cranberry Gneiss. The Beech is an easily recognizable medium to coarse grained, pink granite.

The major rock units of the study area have been cut by numerous small igneous intrusions. The intrusions are granitic, diabasic, aplitic and ultramafic bodies.

Description of Metamorphic Rocks

Cranberry Gneiss

The Cranberry Granite was named by Keith (1903) for exposures found in the Linville, North Carolina quadrangle. The name Cranberry Granite has since been changed to Cranberry Gneiss (Bryant, 1963) because of the general gneissic structure to most of the unit. Excellent outcrops of the Cranberry occur in the southern and western parts of the study area.

Lithologically the Cranberry Gneiss is a mixed rock unit. The three most abundant rock types are a nonbanded quartzofeldspathic rock, a biotite-hornblende gneiss, and a biotite schist. These lithologies typically occur in layers which range in thickness from a few inches to several tens of feet.

The nonbanded quartzofeldspathic layers are medium grained, equigranular rocks composed chiefly of quartz and feldspar. Color ranges from light gray (N8) to light pink (5R 7/4). The biotite-hornblende gneiss is also a quartzofeldspathic rock with thin layers of biotite and hornblende. The contact between the light and dark bands is very sharp. The dark layers of biotite and hornblende are usually intensely folded. The third type of rock, biotite schist, is an olive gray (5Y 4/1) schist which ranges in thickness from two inches to about ten feet.

Shearing is a common feature in the Cranberry Gneiss. The shearing has caused extensive fracturing and crushing of mineral grains. These cataclastic features can be readily observed in the field and in thin section. Streaking of biotite and hornblende grains is common. A large outcrop of pink cataclastic granitic gneiss exhibiting streaking, fracturing, and granulation is located 50 yards north of Magill Memorial Church beside Highway 143. Shearing causes the Cranberry to weather readily, which makes identification difficult.

The Cranberry is cut by numerous igneous intrusions. The most common intrusions are diabase dikes which average 5 feet in width. Other intrusions include irregularly shaped granitic bodies, aplitic dikes, and a small, irregularly shaped ultramafic intrusion.

Petrographic studies show that the Cranberry Gneiss has a varied texture ranging from porphyroblastic (Figure 2) to equigranular (Figure 3). The porphyroblastic texture is related to rocks that have been cataclastically deformed. Mineral composition for the texturally different forms of Cranberry are basically the same. The average modal analysis for the Cranberry Gneiss is given in Table I. Microcline, plagioclase feldspar, quartz, and biotite are major constituents and account for more than 90 percent of the rock. Chlorite, epidote, hornblende, and sericite occur in minor

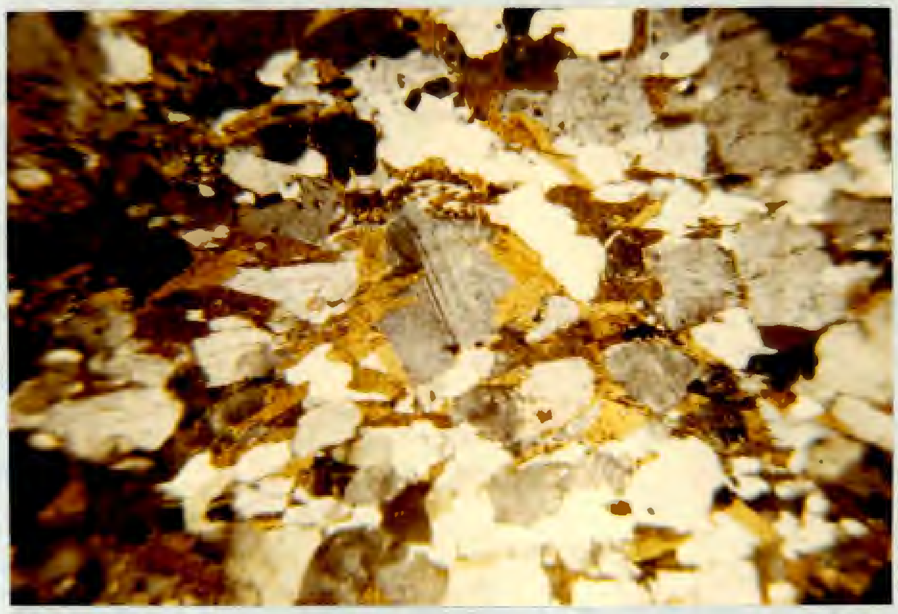


Figure 2. Photomicrograph of Cranberry Gneiss. Equigranular Texture.

Note the general lack of granulation of quartz and feldspar grains. X 2.7, crossed nicols.

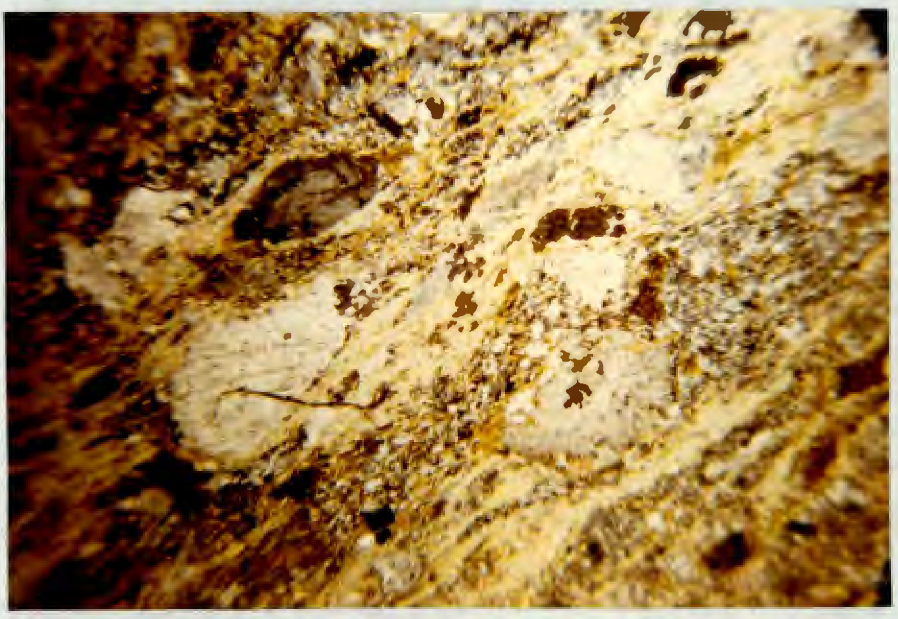


Figure 3. Photomicrograph of Cranberry Gneiss. Porphyroblastic Texture.

The porphyroblasts are quartz and feldspar grains. Note the sericite flow structure. X 2.7, crossed nicols.

TABLE I

AVERAGE MODAL COMPOSITION OF CRANBERRY GNEISS

Mineral	Range Percent	Average Percent
Perthitic Microcline	32.0 - 45.2	37.2
Quartz	27.3 - 43.5	35.4
Albite	11.7 - 26.1	17.1
Biotite	1.5 - 18.0	4.2
Chlorite	TR - 3.2	1.2
Hornblende	TR - 1.1	0.3
Epidote	TR - 2.3	0.8
Sericite	0.5 - 4.2	2.9
Calcite	TR - 0.3	0.2
Apatite	TR - 0.2	TR
Garnet	TR - 0.3	TR
Zircon	TR - 0.2	TR
Magnetite	0.1 - 1.2	0.4

NOTE: Modal composition is based on point counts from eight thin sections. Two thousand points were used on each thin section.

amounts. Accessory minerals include calcite, garnet, zircon, apatite, and an opaque mineral, probably magnetite.

The most abundant mineral is microperthitic microcline which occurs as euhedral to subhedral, poikilitic grains. Perthite is string and vein variety. The microcline commonly exhibits fracturing and granulation along grain boundaries, and it occurs as porphyroblasts in the porphyroblastic textured Cranberry. Also, the microcline contains small euhedral grains of apatite and small blebs of quartz.

The polysynthetically twinned plagioclase occurs as euhedral to subhedral grains. The plagioclase is albite with an average composition of Ab_{92}. In the equigranular textured Cranberry there appears to be little granulation or sericitization of albite; however, in the porphyroblastic Cranberry the albite shows extensive granulation and a high degree of alteration to sericite.

Quartz occurs as anhedral grains with most grains exhibiting prominent undulatory extinction. Quartz in the porphyroblastic sections occurs as porphyroblasts and small interstitial grains. The interstitial grains form a quartz mozaic comprising a majority of the groundmass. Quartz is extensively granulated along its grain boundaries (Figure 4).

Biotite occurs as euhedral, phleochroic, light brown to reddish brown laths. Most grains show minor alteration to chlorite. Normally associated with the biotite is brown

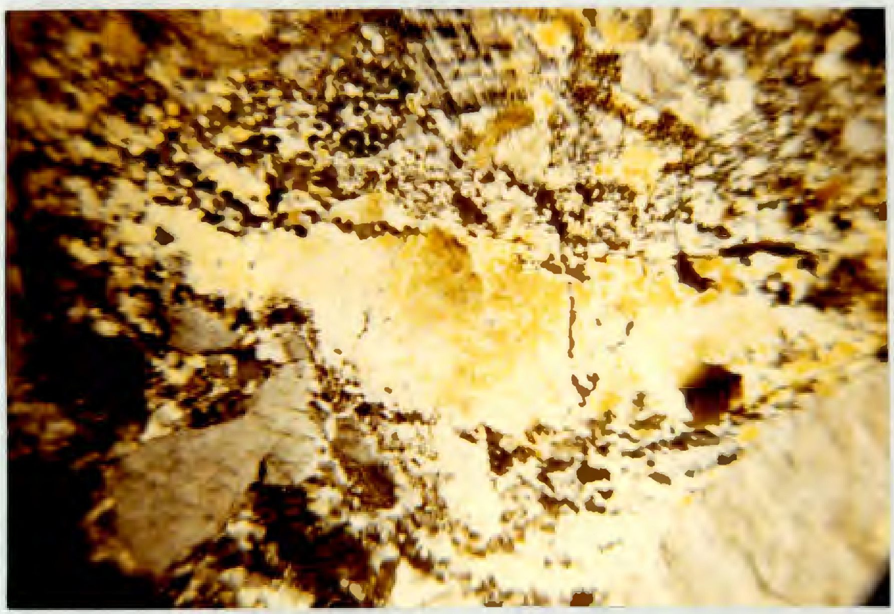


Figure 4. Photomicrograph of Cranberry Gneiss. Quartz Porphyroblast.

Note the extensive granulation along boundary of quartz porphyroblast. Large grain at bottom right is microperthitic microcline. X 10, crossed nicols.

hornblende, zircon, and magnetite. The magnetite probably formed as the result of alteration of biotite.

Accessory minerals include zircon, garnet, and calcite. Garnet occurs as six sided euhedral grains. Most grains are highly fractured. All zircon grains that were observed were round.

All rocks show some degree of alteration. Nearly all biotite shows some alteration to chlorite, with the possibility that magnetite is also a result of biotite alteration. Albite, in the porphyroblastic textured rocks, demonstrates extensive alteration to sericite.

Foliation is exhibited in all rocks. Foliation is demonstrated by bands of biotite, chlorite, and sericite. Porphyroblastic textured rocks show trains of granulated quartz and feldspar.

Description of Igneous Rocks

Beech Granite

The Beech Granite was named by Keith for exposures on Beech Mountain in the northcentral part of the Linville, North Carolina quadrangle. Excellent exposures of the Beech Granite crop out in the area along White Rocks Mountain.

The Beech Granite, unlike the Cranberry Gneiss, is a homogeneous rock body which is easily recognizable in the field. Beech in the area is a coarse to medium grained, inequigranular, pink granite. The majority of Beech Granite on White Rocks Mountain is very coarse grained. In hand specimen, microcline, plagioclase, quartz, and biotite can be recognized. The most abundant mineral in hand specimen is euhedral to subhedral grains of pink microcline measuring up to 5 mm in length. Brown biotite flakes occur in clusters which show a definite linear orientation. Measurements made on these biotite clusters show a general northwest strike to the lineation. The Beech Granite found in the quarry at Roan Village is indicative of the coarse grained Beech found in the area.

One mile west of Roan Village on Highway 19E is a large outcrop of dark gray banded biotite gneiss. This outcrop is surrounded by exposures of Beech Granite. The writer identified the gneiss as Cranberry. The gneiss is believed to be an inclusion of Cranberry in Beech Granite. There are several exposures of ellipsoidal inclusions of a mafic gneiss in Beech Granite in the Linville quadrangle (Bryant, 1963).

The Beech Granite is easily recognizable in the field at fresh outcrops; however, these are rare due to the fact that the Beech weathers readily due to the presence of large feldspar grains and biotite clusters. Except for good exposures of Beech Granite in road-cuts or quarries, most mapping was based upon the weathered product. The coarse grained

Beech breaks down easily to a quartz pebble sand which can be identified as float. The medium grained Beech weathers readily to a reddish-brown soil.

Petrographic studies show that the Beech is a holocrystalline, inequigranular granite. Perthitic microcline, plagioclase, and quartz are major constituents and account for over 90 percent of the rock. Biotite occurs in minor amounts. Accessory minerals include apatite, chlorite, epidote, hornblende, magnetite, sericite, and zircon. An average modal analysis is given in Table II.

The most abundant mineral present is subhedral poikilitic grains of microperthitic microcline. The degree of perthitic intergrowths varies from a few percent to almost 25 percent albite. The perthite is string and vein variety. Microcline twinning is common, but is often masked by the perthite. The microcline has been fractured, with many of the fractures being healed by quartz. Quartz occurs as small anhedral inclusions.

Plagioclase occurs as polysynthetically twinned euhedral to subhedral grains. It is albite with an average composition of Ab_{91}. Evidence of strain is the most outstanding feature of the albite. Some grains show prominent undulatory extinction. Albite grains have been fractured and healed by quartz (Figure 5). Other grains have been bent without being fractured (Figure 6). Plagioclase shows minor alteration to sericite.

TABLE II

AVERAGE MODAL COMPOSITION OF BEECH GRANITE

Mineral	Range Percent	Average Percent
Perthitic Microcline	56.2 - 62.7	58.5
Albite	63.0 - 30.2	14.1
Quartz	13.7 - 24.2	18.8
Biotite	4.2 - 11.8	6.1
Apatite	TR - 0.3	TR
Chlorite	0.2 - 1.4	0.5
Hornblende	TR - 0.2	TR
Magnetite	TR - 0.7	0.2
Sericite	0.4 - 2.0	1.1
Zircon	TR - 0.3	TR
Epidote	TR - 0.5	0.3

NOTE: Modal composition is based on point counts from seven thin sections. Two thousand points were used on each thin section.

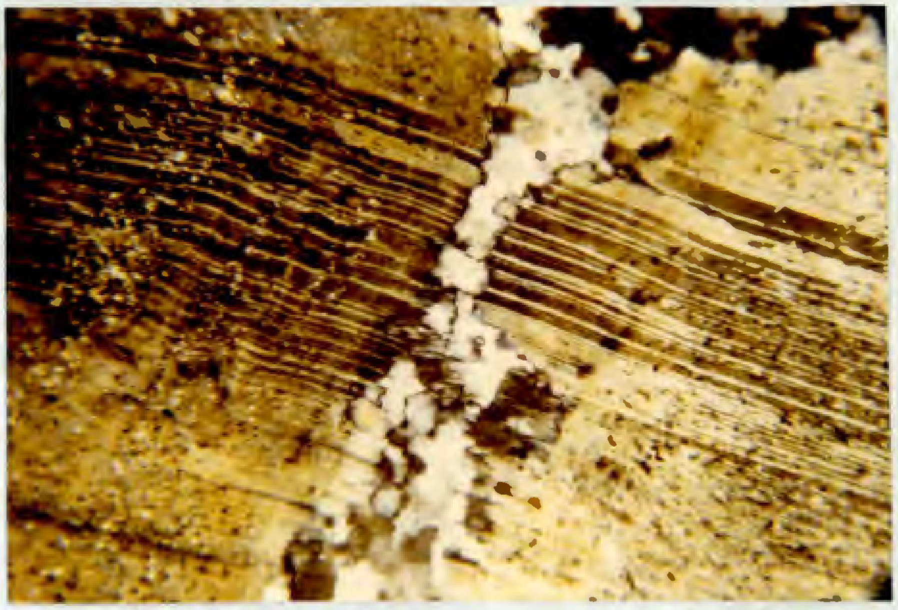


Figure 5. Photomicrograph of Beech Granite. Fracture in Albite.

The polysynthetically twinned feldspar is fracture and healed by small quartz grains. X 10, crossed nicols.

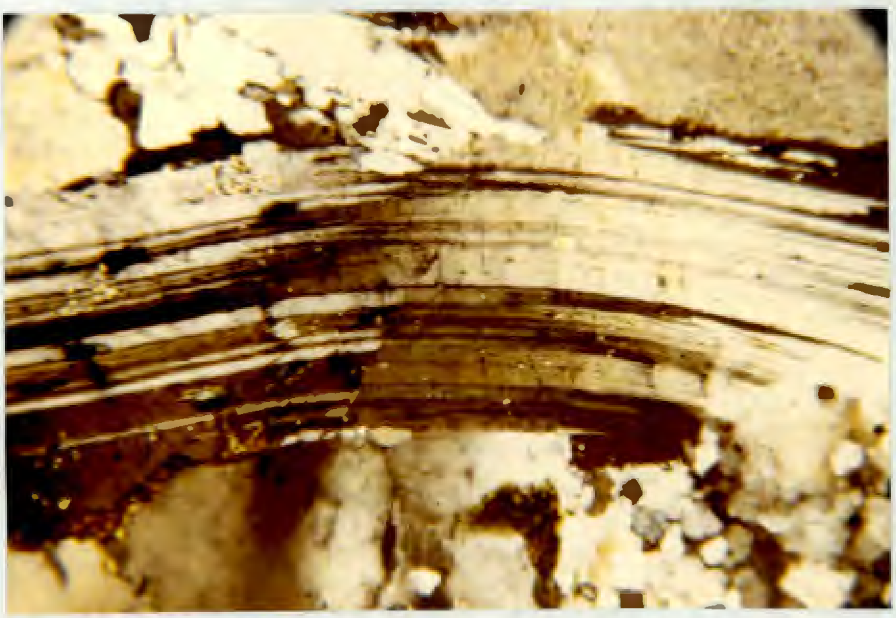


Figure 6. Photomicrograph of Beech Granite. Bending of Twin Lamella.

Note the bending of plagioclase twin lamella. X 10, nicols crossed.

Quartz occurs as anhedral interstitial grains with prominent undulatory extinction. Large grains of quartz show extensive fracturing and granulation along grain boundaries. Small grains commonly fill fractures in feldspar grains.

Biotite occurs as distorted and altered poikilitic flakes. It is strongly pleochroic green to brown. All flakes contain inclusions of apatite, epidote and an opaque mineral believed to be magnetite. Some biotite grains show a reddish-brown fiberous alteration product. There is minor alteration of biotite to chlorite. The biotite shows a preferred orientation as the result of apparent flowage.

Accessory minerals include apatite, epidote, magnetite, and zircon. Apatite, epidote, and magnetite are usually found associated with biotite. Apatite occurs as small euhedral grains in biotite. Magnetite occurs as subhedral grains in biotite. Epidote is found as granular aggregates in biotite and disseminated throughout the interstitial quartz. Zircon occurs as large euhedral grains. Some show minor fracturing.

Alteration in the Beech Granite is noticeably less than that observed in the Cranberry Gneiss. Albite shows minor alteration to sericite. Some biotite flakes have been chloritized.

Granite Intrusions

Numerous rocks of granitic composition were observed intruding the Cranberry Gneiss. A majority of these intrusives are located in the western half of the study area. The intrusives are light pink (10R 7/4), medium to coarse grained granites. Width varies from a few inches to as much as 50 feet. Shape varies from narrow dikes to irregular shaped bodies.

The contact between the pink granite and the Cranberry Gneiss is generally gradational. On the northern tip of Hampton Creek Ridge is a gradational contact between a dark banded gneiss and a coarse grained granite. The rock formed is a migmatite.

The writer observed a swarm of small granitic dikes in a dark weathered mafic rock. The mafic rock is believed to be a weathered diabase intrusive. The exposure is located 1.5 miles east of Tiger Valley on Highway 19E. Dikes range in width from 1 inch to 18 inches. The contacts between the granitic dikes and dark mafic rocks are very sharp. The dikes are converging and diverging with no dikes observed cross-cutting one another. The writer concluded the dikes are intrusive into the mafic rock.

In hand specimen quartz, white to pink feldspar and biotite can be recognized. Biotite is a minor constituent in most granite intrusives. The intrusives weather rapidly to a light pink soil.

Petrographic studies show that the rock is a holocrystalline, equigranular granite. Microperthitic microcline, plagioclase (Ab_{90}), and quartz are major constituents and account for more than 90 percent of the rock. Other minerals include apatite, epidote, biotite, sericite, magnetite and zircon.

The most abundant mineral is anhedral grains of microperthitic microcline. Perthite is string and vein variety. Albite present shows some polysynthetic twinning, but most twinning is obscured by sericite alteration.

There is some evidence of cataclastic deformation. All quartz demonstrates prominent undulatory extinction. Quartz and feldspar grains are fractured and commonly show granulation along grain boundaries.

Alteration is extensive. Most biotite grains show some alteration to magnetite. Albite shows extensive sericitization.

Aplite Dikes

Two aplite dikes are located in Doe River Gorge, one half mile east of Tiger Valley on Highway 19E. The dikes have sharp intrusive contacts with lighter granitic material of Cranberry origin. Average width of the two dikes is thirty feet. No aplite dikes were observed in the Beech Granite.

The aplites are white, fine grained, saccharoidal rocks. Quartz and feldspar can be recognized in hand specimen.

Petrographic studies show that the aplites have a holocrystalline, hypidiomorphic granular texture. Plagioclase (Ab_{90}), microcline, and quartz are major constituents and account for more than 90 percent of the rock. Other minerals include apatite, epidote, muscovite, sericite, tourmaline, and an opaque mineral believed to be magnetite. Identification of major constituents was confirmed by use of the x-ray defractometer.

The two aplite dikes are located within fifty feet of each other and are essentially parallel. One of the dikes shows a high concentration of euhedral to subhedral grains of dark tourmaline. Pleochroism is dark blue to olive drab. The second dike shows only a trace of tourmaline.

Metadiabase Intrusions

The metadiabase occurs as dikes and irregular shaped bodies intrusive in the Cranberry Gneiss and Beech Granite. Contacts between the metadiabase and country rock is sharp.

Inclusions of country rock are commonly round trapped in the metadiabase intrusives.

Physical appearance of the intrusives varies drastically as the result of differing degrees of weathering and metamorphism. Color ranges from black (N2) to olive gray (5Y 4/1). The metadiabase weathers readily to a dark brown soil. Several dikes located in the Roan Village quarry have been intensely metamorphosed and exhibit slaty cleavage. They weather readily to a light brown soil with small brown chips. The quarry dikes have often been mistaken for remnants of shale beds. Most dikes were observed at road-cuts. Due to the fact that these dikes weather readily, they could not be traced beyond the outcrop.

Several dikes and irregularly shaped bodies of porphyritic metadiabase are found in the Cranberry Gneiss. The intrusives are very similar to the metadiabase intrusives previously cited. In hand specimen the plagioclase phenocrysts reach a length of 7 inches. The phenocrysts commonly weather out of the diabase forming small white chips.

Petrographic studies show that the texture varies. While some metadiabase intrusives show good diabasic textures, most rocks only show relics of the original texture. The dikes in the Roan Village quarry have been intensely metamorphosed, forming a porphyroblastic texture (Figure 7). Mobilization of mafic minerals caused formation of a general flow

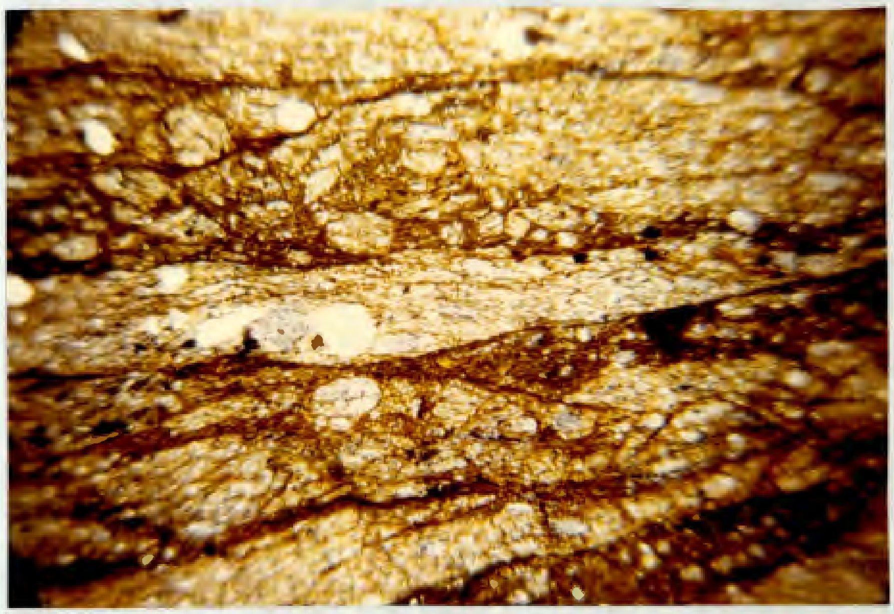


Figure 7. Photomicrograph of Metadiabase Intrusions. Porphyroblastic Texture.

Note the general mobilization of mafic constituents. Porphyroblasts are feldspar grains. X 10, crossed nicols.

structure. Altered albite, actinolite, chlorite, and sericite are major constituents and make up a majority of the rock. Other minerals include hornblende, epidote, calcite, and magnetite. Identification of major consitutents was confirmed by use of the x-ray defractometer.

Actinolite occurs as subhedral, faintly pleochroic green to brown. Associated with the actinolite are small grains of brown hornblende.

Albite occurs as altered, euhedral, polysynthetically twinned grains. Most grains are extensively altered to sericite, making identification extremely difficult.

Ultramafic Intrusions

One ultramafic intrusion is located 50 yards north of Magill Memorial Church along Highway 143. The exposure is circular shaped, intrusive into a pink cataclastic variety of Cranberry Gneiss. The intrusive contact is sharp. In hand specimen the only mineral that can be identified is a black amphibole or pyroxene.

Petrographic studies show that the rock has a holocrystalline, equigranular texture. Actinolite, chlorite, and talc are major constituents and account for more than 90 percent of the rock. Other minerals include apatite, biotite and magnetite. Identification of major constituents was confirmed by use of the x-ray defractometer.

The most abundant mineral is euhedral to subhedral, poikilitic grains of actinolite with pleochroism ranging from pale green to yellow. Also, the actinolite commonly exhibits carlsbad twinning. The talc occurs as small euhedral to subhedral grains and the chlorite occurs as small slightly pleochroic flakes. The chlorite pleochroism is green to pale green. Biotite occurs as small brown euhedral laths.

The group of minerals found in the ultramafic intrusive are commonly found in contact metamorphic rocks (Winkler, 1967). Talc and actinolite probably formed as the result of extreme metamorphic alteration. Talc formed at the expense of olivine and actinolite formed from hornblende or a pyroxene.

CHAPTER III

ORIGIN OF ROCKS

Cranberry Gneiss

The Cranberry Gneiss was originally thought to be igneous (Keith, 1903). Today the Cranberry Gneiss is generally considered sedimentary in origin. This evidence is based on mineralogical and stratigraphic evidence.

The Cranberry Gneiss in the study area is a layered metamorphic rock. The layers are compositional units. The three most common types of rocks are quartzofeldspathic, quartzofeldspathic with thin bands of biotite and hornblende, and biotite schist. The contacts between the compositional layers are usually very sharp. The consistent layering makes it appear that the Cranberry Gneiss is a metasedimentary rock.

Eckelmann and Kulp (1956) found several outcrops which show a conformable contact between the Cranberry Gneiss and overlying known metasedimentary rocks. The outcrops are located in the Linville, North Carolina quadrangle. Contact between the Cranberry and overlying metasediments is gradational. The contact consists of interbedded Cranberry Gneiss and Roan-Carolina Schist.

Petrographic studies of the Cranberry rocks from the study area show that zircon grains are usually rounded. This fact can be used as a weak argument for a sedimentary origin.

Beech Granite

There are two primary interpretations for the origin of the Beech Granite. The first interpretation is that the Beech is an igneous rock intrusive into the Cranberry Gneiss. This interpretation is based primarily on field evidence. The Beech Granite on White Rocks Mountain is a very homogeneous rock unit. The contact between the Beech and Cranberry usually appears to be gradational, but several contacts are sharp. No sharp contacts were found in the study area. Sharp contacts between the Beech Granite and Cranberry Gneiss have been observed in the Linville, North Carolina quadrangle (Bryant, 1963). Two exposures are located on Highway 194 north of Heaton. The contacts at these outcrops are sharp but extensively sheared.

Further evidence for an igneous origin is based on radioactive age determinations and petrographic studies. Age determinations done by the Lamont Geological Observatory (1959) show that the Beech is 500 million years younger than the Cranberry Gneiss. Petrographic studies of the Beech in the area show that the zircon grains are euhedral. Euhedral zircon grains can be used as weak evidence for an igneous origin.

A second interpretation is that the Beech Granite is metosomatic. Carlisle (1956) concluded that the Beech Granite was not igneous because of the low anorthite content, increased anorthite content toward the interior of White Rocks Mountain, and the lack of zoning in plagioclase feldspar. According to Gates and Clabaugh (Emmons et al., 1953), the anorthite content for a normal granite should fall into the 23 to 26 percent range. The anorthite content calculated by Carlisle for the Beech falls in the 8 to 10 percent range.

The writer believes that the Beech Granite is intrusive into the Cranberry Gneiss. This conclusion is based on field evidence, euhedral zircon grains, and the large age difference between the Beech and Cranberry. The Beech does have a low anorthite content, but the Beech is not a normal granite. The study area is a sodium rich area with most rocks showing low anorthite contents.

CHAPTER IV

AGE OF THE ROCKS

Cranberry Gneiss

Relative age of the Cranberry Gneiss can be determined on the basis of field evidence. The Cranberry is older than the Beech Granite. A sharp intrusive contact between the two units can be found in the Linville, North Carolina quadrangle, north of Heaton. Outside the study area, the Cranberry Gneiss has a conformable stratigraphic position below Precambrian Roan-Carolina Gneiss (Eckelmann, Kulp, 1956). Therefore, field evidence shows that the Cranberry is older than the Beech Granite and Roan-Carolina Gneiss.

Radioactive age determinations on the Cranberry Gneiss have been made over a wide area of Tennessee and North Carolina. Rubidium 87 - strontium 87 and potassium 40 - argon 40 methods were used to date biotite grains (Long, _et_ _al_., 1959). Results using these two methods range from 357 my ± 13 my on Roan Mountain to 892 my ± 30 my at Pardee Point, Tennessee. Reason for the wide variation in ages is blamed on diffusion in biotite grains during metamorphism. In view of the different ages, and allowing for minor diffusion in the 892 my age, the Cranberry Gneiss was probably initially formed 1100 my ago. Younger ages indicated periods of metamorphism. Long, _et_ _al_.

(1959) indicated that the area in the vicinity of Roan Village lies in a ten mile wide transition belt which shows some effects from a period of intense metamorphism. The period of metamorphism is dated at 350 my.

Beech Granite

Field evidence in the vicinity of White Rocks Mountain indicates that the Beech Granite is younger than the Cranberry Gneiss. This conclusion is based on contact relationships between the two units. A sharp intrusive contact is located north of Heaton, North Carolina.

Radioactive age determinations have been made on the Beech Granite in the vicinity of the study area. The work was done by the Lamont Geological Observatory as reported by Long, _et_ _al_. (1959). The samples of Beech were taken along Highway 19E near Hopson, Tennessee. Rubidium 87 - strontium 87 methods were used to date feldspar and biotite grains. Biotite is 439 my ± 17 my and the age of feldspar is 572 my ± 29 my. The apparent age discrepancy between the two minerals indicates that during stages of metamorphism, effective diffusion occured more readily in biotite grains. Taking into account minor diffusion in feldspar, the age of the Beech Granite is estimated at 600 my.

CHAPTER V

SUMMARY AND CONCLUSION

The Cranberry Gneiss is a mixed rock made up of different compositional layers. The compositional layers are a biotite schist, banded gneiss and a nonbanded quartzo-feldspathic rock. Petrographically the Cranberry has a texture ranging from equigranular to porphyroblastic. The porphyroblastic texture resulted from cataclastic deformation. Perthitic microcline, albite, quartz and biotite are major constituents. Other minerals include apatite, epidote, hornblende, chlorite, garnet, calcite, sericite and magnetite.

The Beech is a homogeneous, medium to coarse grained pink granite intrusive into the Cranberry Gneiss. Biotite flakes occur in clusters which show a lineation to the northwest. Petrographically the Beech is an inequigranular, holocrystalline granite. Fracturing, bending, and granulation of minerals is common. Microperthitic microcline, albite, and quartz are major constituents. Other minerals include apatite, epidote, chlorite, hornblende, magnetite, zircon, and sericite.

The Beech Granite and Cranberry Gneiss are cut by many diabasic intrusions. Due to extensive metamorphism, the diabasic texture is usually destroyed. Actinolite, altered albite, chlorite and sericite are major constituents. Other minerals include hornblende, apatite, epidote, calcite and magnetite.

The Cranberry is also cut by granitic bodies, aplite dikes and a small circular ultramafic body.

No aplite or granitic intrusives were observed in the Beech Granite. The writer believes that some of the granitic and aplitic intrusives in the Cranberry Gneiss are genetically related to the Beech. Mineral composition of the Beech and granitic intrusives are similar.

Mineralogical and stratigraphic evidence indicates that the Cranberry Gneiss is a metasedimentary rock. Field evidence indicates the Beech Granite has an igneous origin.

Radioactive age determinations show that the Cranberry is 1100 my old and the Beech is about 600 my old.

LIST OF SELECTED REFERENCES

LIST OF SELECTED REFERENCES

Billings, M. P., 1942, Structural Geology: Englewood Cliffs, New Jersey, Prentice-Hall, Inc., 514 p.

Bryant, B., 1963, Geology of the Linville Quadrangle, North Carolina-Tennessee: U.S. Geol. Survey Bull. 1121-D, 30 p.

Carlisle, J. T., 1956, A Laboratory Study of the Beech Granite Plagioclase: Unpublished Master's Thesis, The University of Tennessee, Knoxville.

Eckelmann, F. D., and Kulp, J. L., 1956, The sedimentary origin and stratigraphic equivalence of the so-called Cranberry and Henderson granites in Western North Carolina: Am. Jour. Sci., v. 254, p. 288-315.

Eckelman, W. R., and Kulp, J. L., 1957, Uranium-lead method of age determination, Part 2: Geol. Soc. America Bull., v. 68, no. 9, p. 1117-1140.

Emmons, R. C., et al., 1953, Selected Petrogenic Relationships of Plagioclase: Geol. Soc. America Mem. 52, 142 p.

Keith, Arthur, 1903, Description of the Cranberry quadrangle, North Carolina-Tennessee: U.S. Geol. Survey Geol. Atlas, Folio 99.

Keith, Arthur, 1907, Description of the Roan Mountain quadrangle: U.S. Geol. Survey Geol. Atlas, Folio 151.

King, P. B., and Ferguson, H. W., 1960, Geology of Northeasternmost Tennessee: U.S. Geol. Survey Prof. Paper 311, 168 p.

Kulp, J. L., and Brobst, D. A., 1956, Geology of the Bakersville-Plumtree area, Spruce Pine district, North Carolina: U.S. Geol. Survey Mineral Inv. Field Studies Map MF 97. Scale: 1:24,000.

Kulp, J. L., and Poldervaart, Arie, 1956, The metamorphic history of the Spruce Pine District: Am. Jour. Sci. v. 254, p. 393-403.

Long, L. E., Kulp, J. L., and Eckelman, F. D., 1959, Chronology of major metamorphic events in the southern United States: Am. Jour. Science, v. 257, p. 585-603.

Rogers, John, 1953, Geologic map of East Tennessee with explanatory text: Tenn. Divison Geology Bull. 58, 168 p.

Williams, H., Turner, F., and Gilbert, C., 1954, Petrography: San Francisco, W. H. Freeman and Company, Inc., 406 p.

Winkler, H. G. F., 1967, Petrogenesis of Metamorphic Rocks, Springer-Verlag New York, Inc., 237 p.

VITA

James Michael Dregne was born in Birmingham, Alabama, on April 15, 1946. He graduated from Wheelus High School, Tripoli, Libya, in June 1964. In April, 1968, he received a Bachelor of Science degree in Geology from the University of Dayton. Following completion of his undergraduate studies he was commissioned as a Second Lieutenant in the United States Army Reserves. He enrolled at The University of Tennessee in September, 1968, and received a Master of Science degree in Geology in June, 1971. There he was a member of Sigma Gamma Epsilon. He was married to the former Donna M. Malloy of Dayton, Ohio, on September 8, 1969.

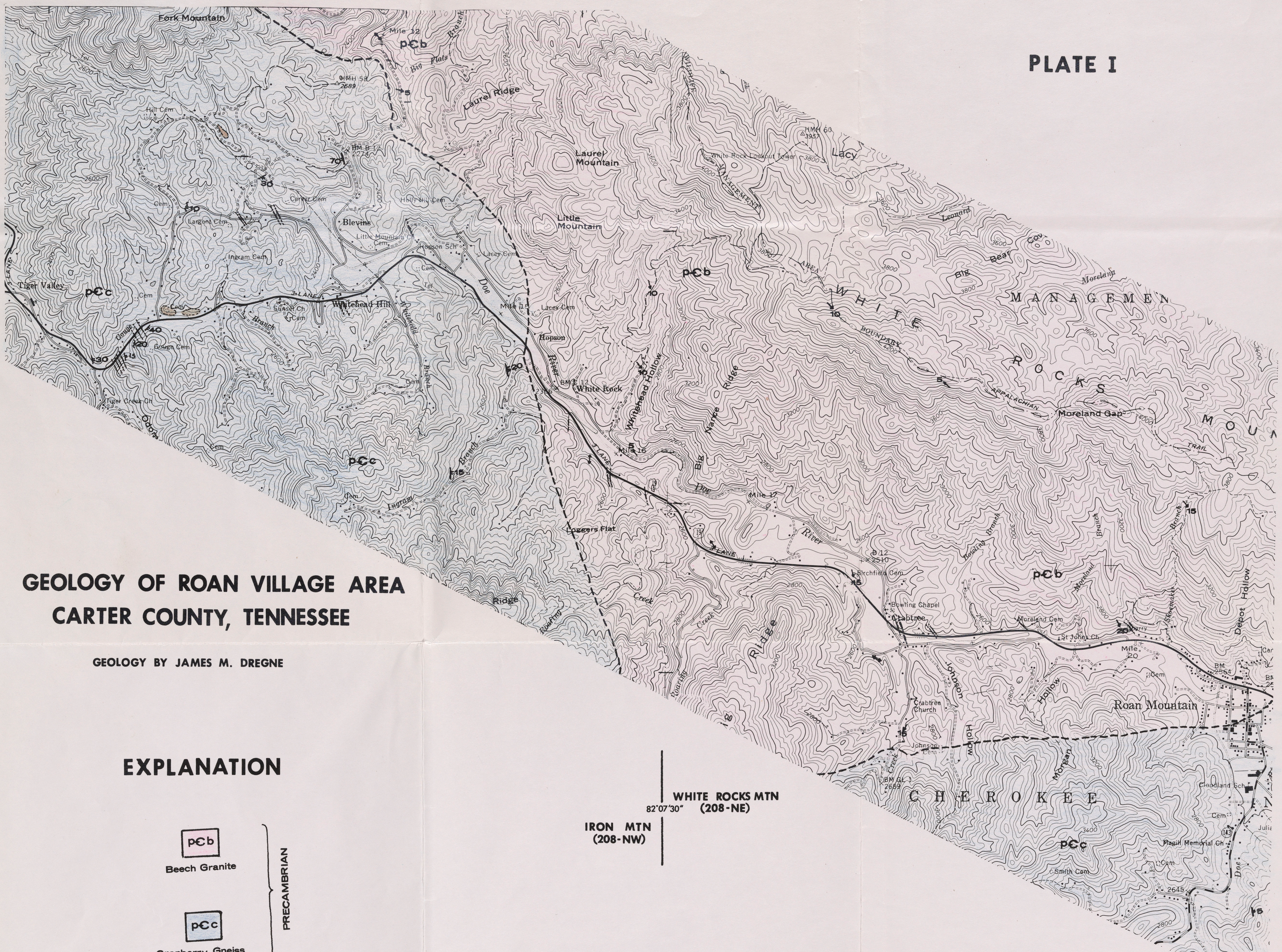


PLATE I

GEOLOGY OF ROAN VILLAGE AREA
CARTER COUNTY, TENNESSEE

GEOLOGY BY JAMES M. DREGNE

EXPLANATION

PRECAMBRIAN

pЄb — Beech Granite

pЄc — Cranberry Gneiss

Metadiabase: Dike

Intrusives: Irregularly Shaped

Contact — Dashed where approximately located.

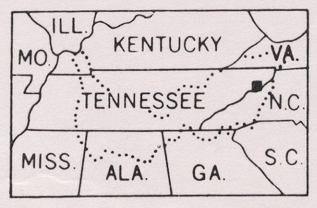
Linear Features — Horizontal; Plunging. Bearing and plunge of mineral alinement, streaking.

Planar Features — Inclined; Generalized. Strike and dip of compositional layering

CONTOUR INTERVAL 20 FEET

SCALE 1:24 000

1 MILE



QUADRANGLE LOCATION

MN
GN
2°
36 MILS
0°38'
11 MILS

UTM GRID AND 1968 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET