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Field Trip Guidebook

Guide to the Geology of the Mt. Rogers Area, Virginia, North Carolina and Tennessee

by

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GUIDE TO THE GEOLOGY OF THE MT. ROGERS AREA, VIRGINIA, NORTH CAROLINA AND TENNESSEE

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INTRODUCTION

The field trip this year will focus on the Blue Ridge for the first time since 1960. In contrast to many of our recent trips, hardrock exposures are plentiful, and much of the geology in the vicinity of the Mt. Rogers area is well know. The two are perhaps not unrelated! The Martha Washington Inn in Abingdon, Virginia, will be our headquarters. The trip will span an altitude range of 3,700-feet – from 1,800-feet to more than 5,500-feet. In mid-October the higher altitudes can be very cold. Bring warm clothes; gloves may not be amiss. Transportation on Saturday will be by bus exclusively. Please cooperate with this as the trip is over narrow mountain roads and includes a toll road. Saturday morning, there will be a level walk of about a mile; and in the afternoon a hike of about 1-miles near the summit of Whitetop Mountain will include an easy climb of 500-feet. The Sunday trip will be by automobile, will involve a little walking, and will end near West Jefferson, Ashe County, North Carolina.

The Mt. Rogers area includes the junction of Virginia, North Carolina and Tennessee and is in the western half of the Winston-Salem 1° x 2° quadrangle (Figure 1). The area covered by the field trips extends from the unmetamorphosed Paleozoic rocks of the Valley and Ridge belt on the northeast, across the Unaka belt, and into the Precambrian crystalline rocks of the Blue Ridge belt (terminology from King, 1955, p. 338). Rocks of this area include a thick mass of upper Precambrian stratified rocks, the Mount Rogers Volcanic Group, at the northwest edge of the crystalline belt. The Mount Rogers Volcanic Group is atypical of most upper Precambrian rocks in the Appalachians in that it contains abundant rhyolites. In fact, it contains one of the two largest masses of felsic volcanic rocks in the eastern United States. The other is of Devonian age and is in Maine. The Mount Rogers is of further interest because it contains evidence of late Precambrian glaciation. The contact between the Mount Rogers Volcanic Group and the overlying basal Lower Cambrian (?) clastic rocks is well exposed; one of the best exposures will be visited. Several large thrust faults pass through the area. Although no stops are planned to see the thrusting, we will make stops in several tectonic units, and weather permitting, the topographic expression of several thrust sheets will be visible.

All field trips stops will be in the Unaka and Blue Ridge belts. The Saturday trip will emphasize the structural and stratigraphic setting of the Mount Rogers Volcanic Group as well as the internal stratigraphy of the group. The Sunday trip will emphasize the older Precambrian granitic basement on which the Mount Rogers rests and the effects of Paleozoic metamorphism. If time permits, we will visit exposures of the Roan and Carolina Gneisses, of former usage (Keith, 1903) now thought to be higher-grade rocks roughly correlative with the Mount Rogers (Rankin, 1967 a).

My work in the Mt. Rogers area began in 1962 with the mapping of the Whitetop Mountain 7¾-minute quadrangle for the U.S. Geological Survey. In 1965, the detailed mapping was suspended in favor of small-scale reconnaissance mapping of the Winston-Salem (1° x 2°) quadrangle. In 1965, I considered this assignment a dubious honor, but have since become a very enthusiastic 1° x 2° mapper, at least in the Blue Ridge.

A number of earlier studies in and around the Mt. Rogers area have been published and are noted below but the detailed stratigraphy of the Mount Rogers Volcanic Group has never been determined. These earlier studies are indispensable in reconnaissance mapping. Much of the area covered by the field trip is included in the report on the geology of northeastern most Tennessee by King and Ferguson (1960). Although I disagree with some aspects of this report, it has been a major influence on my thinking. A.J. Stose and G.W. Stose did considerable mapping, both detailed and reconnaissance in the Mt. Rogers area, and some of their work has been published recently (Stose and Stose, 1957). Miller (1944) mapped the Paleozoic rocks north of the Mt. Rogers area as part of a World War II manganese study.

On Sunday the field trip will be in the area mapped many years ago by Keith (1903). Finally, this study has been influenced by and is, in fact, an outgrowth of the work of Bryant and Reed in the Grandfather Mountain area to the south (Bryant and Reed, 1962).

REGIONAL GEOLOGY

The following general discussion of Appalachian geology represents and accumulation of information from many sources. It is certainly influenced by the various syntheses of P.B. King.

A major axis of older Precambrian crystalline rocks extends as a chain of anticlinoria along the Appalachian mountain system from the Long Range in Newfoundland through the Green and Berkshire Mountains in New England, the New Jersey Highlands, and the Reading Prong in Pennsylvania to the Blue Ridge in the Southern Appalachians. The older Precambrian rocks are not known with certainty to extend farther southwest than southwestern North Carolina. The anticlinoria with older Precambrian rocks in their cores do extend for a distance of 1,800-miles and are clearly a major feature of Appalachian geology. The axis is close to the western margin of the belt of Paleozoic metamorphism and also corresponds in a general way to the change from miogeosynclinal rocks on the west to eugeosynclinal rocks on the east in the Paleozoic Appalachian geosyncline.

In many places along the axis between the older Precambrian rocks in the cores and the overlying Paleozoic sedimentary rocks are stratified rocks of various metamorphic grade generally assigned a late Precambrian age. These consist mainly of clastic sedimentary rocks. The upper Precambrian rocks rest with profound unconformity upon the older Precambrian, although in some areas this unconformity has only recently been recognized because of the effects of Paleozoic metamorphism. In many areas the upper contact is obscured by faulting, but in the central and southern Appalachians, where these rocks are in stratigraphic contact with the overlying basal Lower Cambrian and Lower Cambrian (?) clastic rocks (the Chilhowee Group) there is commonly no recognizable difference in metamorphic grade or degree of deformation. In Maryland, Virginia, and northwestern North Carolina, the upper Precambrian rocks probably thin to a featheredge not far northwest of the older Precambrian anticlinorium and apparently thicken to the southeast (Brown, 1958; Hopson, 1964; and Rankin, this study).

South of New York, the age of the basement granitic gneisses is now reasonably well established as 1,100 to 1,000 million years (Tilton and others, 1960 and Davis and others, 1962). If we take 550 m.y. as the approximate date of the base of the Cambrian (Glaessner, 1963), that leaves a time interval roughly equivalent to the duration of Phanerozoic (Cambrian to Recent) time for the deposition of upper Precambrian sediments in the Appalachians. It is probably unwarranted, albeit convenient, to consider them all coeval.

In the Blue Ridge belt of northwestern North Carolina, Keith (1903) recognized that granitic rocks predominate along the northwest edge of the crystalline belt and that these rocks are structurally overlain on the southeast by schists, mica gneisses, and amphibolites. There has been much controversy over the origin and mutual relations of these crystalline rocks and whether any or all of them are of late Precambrian age. Mapping of the Winston-Salem 1° x 2° quadrangle has demonstrated that a nonconformity separates older granitic rocks to the northwest from the overlying stratified gneisses, schists, and amphibolites to the southeast. These stratified metamorphic rocks that Keith (1903) called the Carolina and Roan Gneisses are thought to be of late Precambrian age and in part, at least, correlative with the Mount Rogers Volcanic Group that rests nonconformably upon the granitic gneiss to the northwest. The geology in northwestern North Carolina is thus similar to that of the Blue Ridge in northern Virginia: an anticlinorium with a relatively narrow core of older granitic rocks is flanked on both sides by upper Precambrian stratified rocks (Figure 2).

Most obvious structural features in the Mt. Rogers area date from either Paleozoic deformation and accompanying metamorphism, or Paleozoic thrust faulting and accompanying folding. The thermal peak of the metamorphism occurred before the major thrusting because metamorphic isograds are offset by the thrusting.

At least one episode of Paleozoic regional metamorphism, probably roughly the same age as the 350-m.y.-old pegmatites at Spruce Pine, North Carolina, has left its imprint on the Mt. Rogers area. There is a metamorphic gradient across the area from unmetamorphosed Paleozoic rocks of the Valley and Ridge belt to rocks of the kyanite and staurolite zones near West Jefferson, North Carolina. Most rocks of the Mount Rogers Volcanic Group have been metamorphosed to low grade. Mafic rocks of the Mount Rogers Volcanic Group have been metamorphosed to low grade. Mafic rocks in the Mount Rogers are greenschists (albite-epidote-chlorite-tremolite assemblages), and many of the metagraywackes contain stilpnomelane. The metamorphic gradient may be traced across the older granitic gneiss in the core of the anticlinorium by mineralogic changes in mafic dikes cutting the gneisses. Toward the northwest, these dikes are greenschists. Toward the southeast, the dikes are garnet amphibolites.

Cataclastic deformation accompanied the mineralogical changes and also increased in intensity toward the southeast. The effects of shearing are most obvious, however, in the low-grade rocks in the core of the anticlinorium. Further southeast, where the degree of recrystallization is greater, the rocks are deformed in a more homogeneous manner rather than along discrete macroscopic planes.

South of Roanoke, Virginia, the Valley and Ridge belt is characterized by an imbricate structure. Thrust faults are found at least as far east as the edge of the crystalline belt in the Blue Ridge. In northwestern North Carolina, the large Grandfather Mountain window exposing lower grade Cambrian and Precambrian rocks beneath higher grade rocks of the Blue Ridge demonstrates that virtually the entire Blue Ridge is allochthonous here (Bryant and Reed, 1962). Many lines of evidence both in the Blue Ridge and Valley and Ridge belts, such as mineral streaking, overturning of folds, facies of Paleozoic sedimentary rocks, and the offset of metamorphic isograds, indicate that the direction of thrusting was northwest.

In the Mt. Rogers area, most pelitic rocks have a well-developed foliation dating from middle Paleozoic metamorphism. In general, this foliation dips southeast, but it is commonly deformed by northeast-trending crinkles that probably date from the major episode of thrusting. In places, a second, more steeply dipping foliation developed parallel to the axial planes of the crinkles. Over much of the area, a pervasive

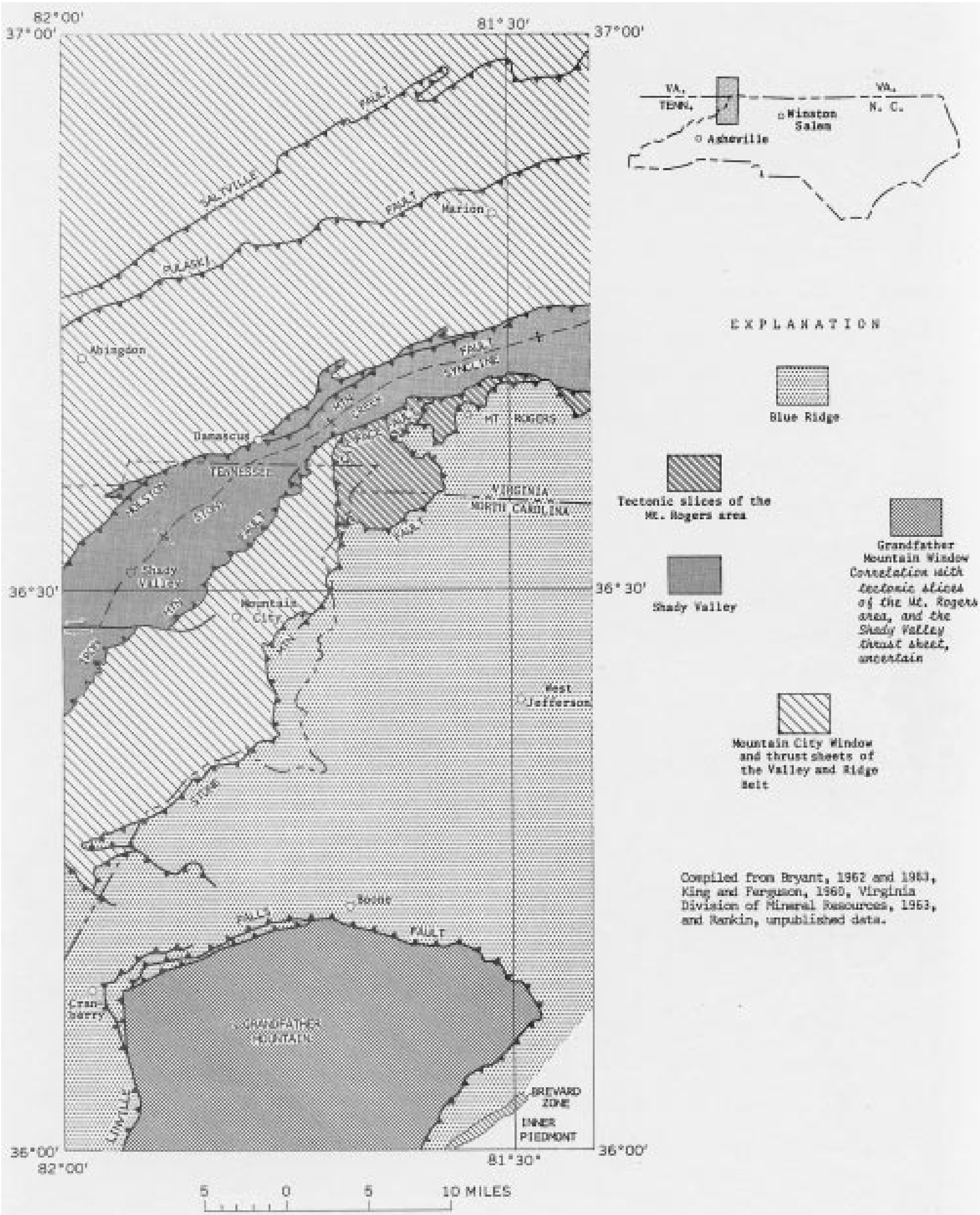


Figure 1. Tectonic units.

southeast-plunging lineation, caused by mineral streaking, grooving and long axes of pebbles and spherulites, also dates from the period of thrusting. Because this lineation is in the same direction as the tectonic transport, it is an a-lineation.

A series of mountain ridges help up by basal Cambrian and Cambrian (?) clastic rocks of the Chilhowee Group lies between the crystalline allochthonous rocks of the Blue Ridge and the unmetamorphosed miogeosynclinal rocks of the Appalachian Valley (eastern carbonate part of the Valley and Ridge belt). This area, called the Unaka belt by King (1955), consists of one or more thrust sheets now thought to be tectonically between the Blue Ridge thrust sheet and the imbricately faulted Valley and Ridge belt. The thrust sheets of the Unaka belt are further distinctive in that they involve both crystalline basement rocks and Paleozoic stratified rocks. Figure 1 shows tectonic units and accompany thrust faults that we will be discussing during the field trip. The large Mountain City window is in northeastern Tennessee between the Shady Valley thrust sheet and the Blue Ridge thrust sheet. King and Ferguson (1960, p.79, 83) concluded that rocks of the Shady Valley thrust sheet were originally deposited southeast of the Mountain City window. Regional

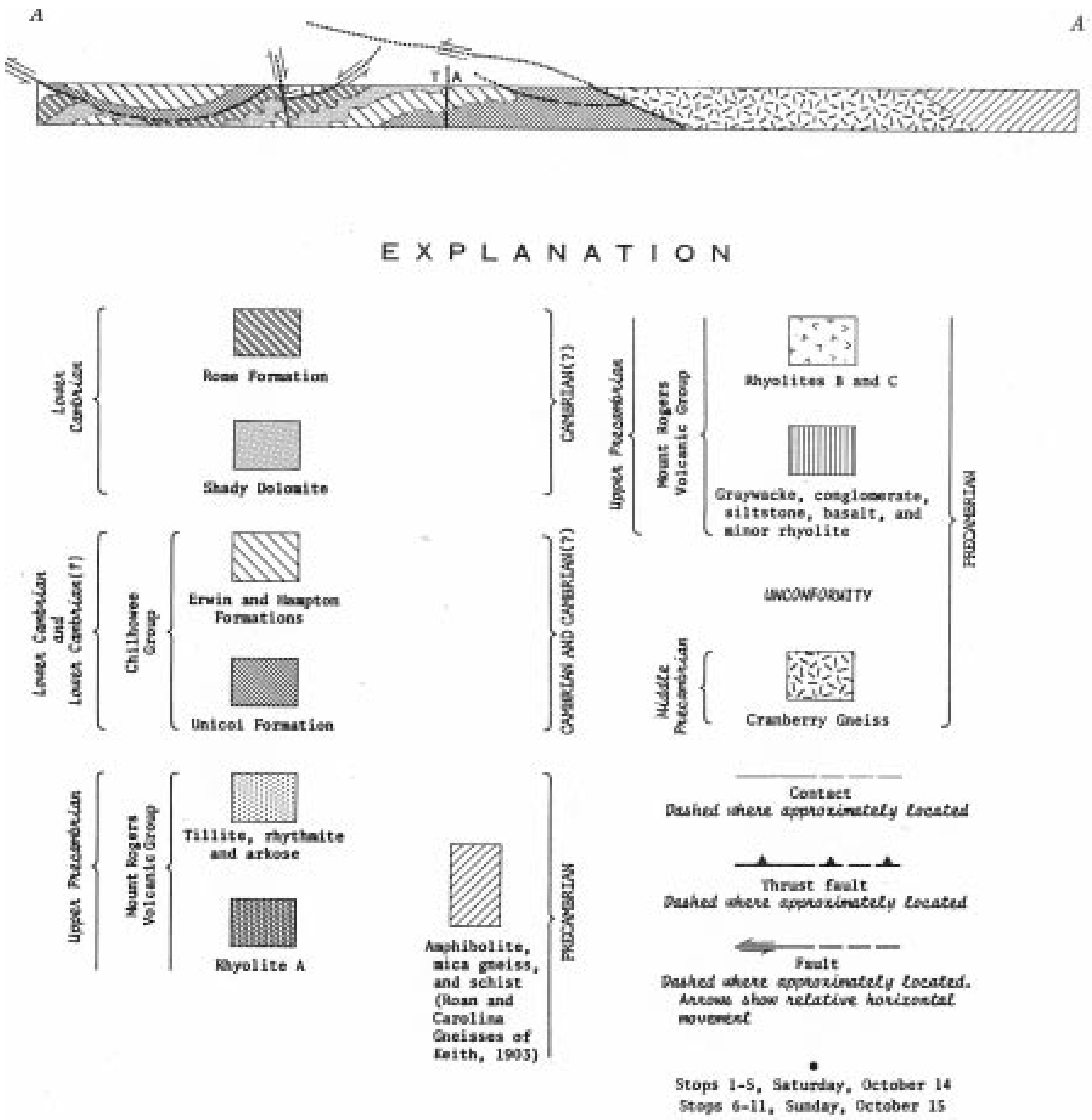
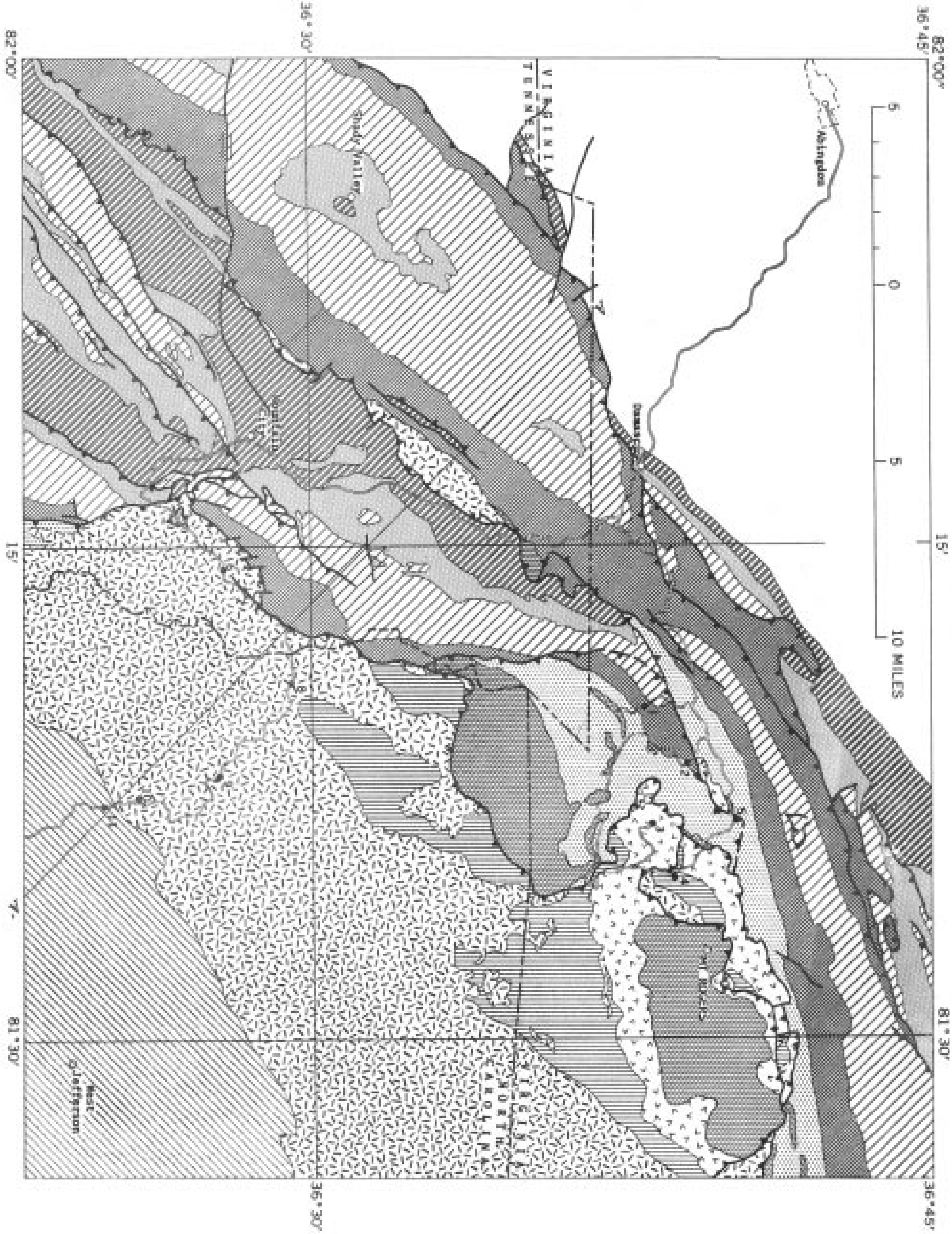


Figure 2. Geologic map of the Mt. Rogers area showing the location of field trip stops. Geology in Tennessee modified from Kingand Ferguson, 1960. Geology in Virginia and North Carolina by D.W.Rankin


82°00'
36°45'
36° 30'
15'
81°30'
VIRGINIA
TENNESSEE
NORTH CAROLINA
Shady Valley
Abingdon
Damascus
West Jefferson
5
0
5
10 MILES

considerations show that the minimum northwest transport of the Shady Valley thrust sheet is 18-miles in the vicinity of longitude 82°W (the west edge of the Winston-Salem 1° x 2°).

King and Ferguson (1960) placed the Mount Rogers Volcanic Group entirely within the Shady Valley thrust sheet. Much of the group is now known to be above the Stone Mountain fault and in the Blue Ridge thrust sheet. Furthermore, the Catface fault is not continuous with the Iron Mountain fault around the northeast end of the Mountain City window, but overrides it (Rankin, 1967 b.) The Catface fault is in turn overridden by the Stone Mountain fault farther to the northeast. The Mountain City window is thus an eyelid window as King and Ferguson concluded it was, but for different reasons.

ROCK UNITS

Core of the anticlinorium

Cranberry Gneiss

The oldest rocks mapped in the Mt. Rogers area are granitic gneisses that are continuous with the Cranberry Gneiss of Cranberry, North Carolina. Where least affected by Paleozoic metamorphism along the northwest edge of the Blue Ridge thrust sheet and in the Shady Valley thrust sheet, the Cranberry is an igneous plutonic rock that occurs in bodies of batholithic size. Compositions range from diorite to granite; most rocks are quartz monzonite. Biotite is probably the primary dark mineral in quartz monzonite. Hornblende, with or without biotite, is the primary dark mineral in diorite and quartz diorite. Sphene is a common accessory in all rocks. Textures range from fine to medium grained and equigranular to porphyritic. Phenocrysts of microcline are commonly as much as one-inch long and rarely as large as 2¾ inches. Where sheared, the equigranular rocks are flaser gneisses and the porphyritic rocks are augen gneisses. The Cranberry Gneiss is about 1,050 m.y. old (Davis and others, 1962), or middle Precambrian in the informal usage of the U.S. Geological Survey.

Intrusive mafic rocks

Irregular bodies of gabbro and dikes of diabase, all more or less metamorphosed, intrude rocks as young as the rhyolite in the upper part of the Mount Rogers Volcanic Group. Similar rocks west of the Grandfather Mountain window were called Bakersville Gabbro by Keith (1903). They are here thought to be intrusive equivalents of the late Precambrian mafic volcanism. Some may be as young as basalt in the Unicoi Formation of Early Cambrian (?) age.

The intrusive mafic rocks range in texture from very fine-grained diabase to coarse gabbro. Some, particularly the finer grained ones, contain relict plagioclase phenocrysts, which may be as large as 2¾ inches across and are texturally similar to porphyritic lavas in the Mount Rogers.

In places the dikes make up as much as 30 percent of the Cranberry terrane over areas as large as three square miles. Where shearing is intense and mafic rocks abundant, cross-cutting contacts are uncommon, and a layering of granitic gneiss and greenstone or amphibolite results. These layered gneisses have been interpreted by some as metasedimentary rocks (Eckelman and Kulp, 1956; Bryant, 1962).

Intrusive felsic rocks

Felsic dikes and sills, though much less common than mafic dikes and sills, are also found in the Cranberry Gneiss and in rocks as young as rhyolites in the middle part of the Mount Rogers Volcanic Group. Some are porphyritic, containing a variety of phenocryst assemblages, mostly including quartz and feldspar. Commonly quartz phenocrysts are embayed and alkali feldspar phenocrysts are highly perthitic, having the patch perthite texture typical of alkali feldspar phenocrysts in rhyolites of the Mount Rogers. The felsic dikes and sills are thought to be related to late Precambrain volcanism

Where shearing is strong, these felsites are sericite phyllites and, like their mafic counterparts, tend to be paraconformable. Some recent workers interpret many of these rocks as phyllonite and mylonite (Hamilton in King and Ferguson, 1960, p.13).

Outside the Mt. Rogers area, larger felsic plutonic bodies intrude the Cranberry Gneiss or correlatives. These include the Beech Granite in Watauga and Avery Counties, North Carolina (Bryant, 1962), the aegirine-augite granite at Crossnore, Avery County, North Carolina (Bryant 1962) and the Striped Rock Granite, Grayson County, Virginia (Riecken 1966). During the present study, I have found a sizeable body (8 square miles) of sodic pyroxene-bearing granite in Watauga County, North Carolina. Although the absolute ages of these granites are uncertain, the rocks have mineralogic features shared by the rhyolites of the Mount Rogers Volcanic Group. Fluorite and zoned allanite are accessory minerals to all, and sodic amphibole occurs in the groundmass of some rhyolites in the Mount Rogers. These granites are, therefore, thought to belong to the same magmatic cycle as the late Precambrian volcanism.

Northwest flank of the anticlinorium

Mount Rogers Volcanic Group

The Mount Rogers Volcanic Group is a sequence about 10,000-feet thick of interbedded and interfingering volcanic and sedimentary rocks all metamorphosed to low grade. The volcanic rocks range in compositions from basalt to rhyolite; intermediate compositions of flow rocks are uncommon. Thick masses of rhyolite constituting about 50 percent of the formation are the most distinctive feature of the formation and hold up the three highest mountains in Virginia. Subdivisions of the group proposed by Stose and Stose (1957) have not proved practicable.

The group may be roughly divided into three parts. The lower part consists of interbedded sedimentary rocks, basalt and rhyolite. Thick masses of rhyolite make up the middle part and sedimentary rock containing minor basalt and rhyolite makes up the upper part. Calcareous sandstone and calcareous shale are sparingly present in parts of the group, but limestones are absent. Most of the sedimentary rocks were formed from poorly sorted, immature sediments.

Sedimentary rocks of the lower part of the group are characterized by somewhat metamorphosed gray or greenish-gray, muddy-matrix conglomerate, gritty graywacke, laminated siltstone, shale, and minor calcareous sandstone. Most of the rocks are semischists, and the conglomerate contains stretched pebbles and boulders. Bedding is poorly defined in the conglomerate and graywacke.

Three rhyolite units have been mapped in the massive rhyolite forming the middle part of the group. Each may be recognized by the phenocryst assemblage and each unit occurs in the same stratigraphic order within each of three tectonic units. The rhyolite units are called here from oldest to youngest C, B and A. Alkali feldspar phenocrysts, where present, are typically highly perthitic and have a patchy texture of the two phases within the crystal outline. Rhyolite C, the oldest and the thinnest, contains 5 to 20 percent phenocrysts of perthite and plagioclase in subequal amounts. On the basis of scattered observations of flow banding, rhyolite C is probably lava. Rhyolite B is either nonporphyritic or contains a few percent small phenocrysts of quartz and perthite. Flow banding, some chaotic, is visible in many outcrops, and the bulk of this unit consists of lava flows. Ash-flow tuffs have been recognized locally but are difficult to trace and are probably minor. The groundmass of some samples of lava is completely spherulitic, and in some, the spherulites are stretched so that the long axes of the ellipsoids plunge southeast parallel to the regional "a" lineation. Rhyolite A, the youngest, contains abundant, commonly 30 percent, phenocrysts of quartz and perthite in subequal amounts. The bulk of rhyolite "A" consists of welded ash-flow sheets suggesting a subaerial environment for this part of the Mount Rogers (Rankin, 1960). The three rhyolites have an aggregate thickness of 5,000-feet or more near Mt. Rogers, thought to be the approximate size of a volcanic center.

Arkose, rhythmite, and laminated pebbly mudstone and tillite, all maroon, characterize the upper part of the group. Numerous examples of soft sediment deformation are preserved. The arkose may be crossbedded, and graded bedding is exceptionally well developed in the rhythmites. Some rhythmites contain outsized clasts of both plutonic and volcanic rocks. Carrington (1961) suggested that the rhythmites were tuffaceous and that the larger fragments in them may be related to volcanic activity. The rhythmites certainly had a volcanic source area in part but are probably of epiclastic origin. Clasts of patch perthite, probably derived from the rhyolite phenocrysts, have been identified in them. Many silt and sand-size clasts of plutonic microcline are also present. Shards, if present, have not been identified. Because most of the clasts are Cranberry Gneiss, they were probably rafted into place. The age of the beds and the size of the clasts (as much as about one-meter across) indicate that ice is the most reasonable mechanism for rafting. Interbedded with and above the rhythmites are massive, poorly sorted, muddy, red-matrix, polymict conglomerate-tillite. The close association of pebbly varied rocks with the conglomerate suggests that both rocks are of glacial origin. Harland and Rudwick (1964) have summarized evidence for a general late Precambrian glaciation.

The age of the Mount Rogers Volcanic Group is fairly well established as late Precambrian (Jonas and Stose, 1939; and Rankin, 1966). The group rests nonconformably on the Cranberry Gneiss and was deposited upon a Precambrian topography that had relief great enough so that at one place or another nearly every unit within the formation form bottom to top is in contact with the Cranberry. Boulder-size clasts of Cranberry Gneiss are found locally in all major sedimentary and volcanic units of the Mount Rogers. The group is in stratigraphic contact with the overlying Unicoi Formation of Early Cambrian (?) age for many miles. Stose and Stose (1957) and King and Ferguson (1960, p.31) thought that the contact was unconformable. I have followed the contact for 30-miles along strike in the Shady Valley thrust sheet and find no evidence for an unconformity.

Chilhowee Group

The Chilhowee Group in the Mt. Rogers area is divided into the Unicoi, Hampton and Erwin Formations following the usage of King and Ferguson (1960). The group is sometimes refereed to as the "basal Lower Cambrian clastic rocks" (King, 1955, p.365) and the age of the group has been the subject of much philosophical discussion. The youngest formation of the group, the Erwin, passes upward through carbonatic sandstone of the Helenmode Member into the sparsely fossiliferous Lower Cambrian Shady Dolomite. *Olenellus* has been reported from the Helenmode Member (see Neuman and Nelson, 1965) and Laurence (Laurence and Palmer, 1963) has discovered Lower Cambrian fossils in Blount County, Tennessee, in rocks correlative with the middle of the Erwin Formation. *Scolithus*, generally thought to be the fillings of worm tubes, occurs in beds as low as the Hampton Formation, but it cannot be used for dating (Neuman and Nelson, 1965). The US Geological Survey includes the Erwin Formation in the Lower Cambrian and Lower Cambrian (?). The Hampton and Unicoi Formations are in the Lower Cambrian (?).

King and Ferguson (1960, p.33) describe the Chilhowee Group as follows: "Rock types are relatively few and are interbedded in frequent alteration. Basal conglomerate and arkose give place gradually to clay shale, siltstone and vitreous quartzite." They give the thickness of the Chilhowee in northeastern most Tennessee as averaging 4,000-feet but reaching a maximum of 7,500-feet on Iron Mountain. In most of their measured sections away from Iron Mountain, however, the base of the Unicoi has been faulted out.

Unicoi Formation — The Unicoi Formation may be conveniently divided into a lower heterogeneous division of conglomerate, sandstone, shale and basalt and an upper more homogeneous division dominantly of sandstone. Rusty-weathering quartz-pebble conglomerate is commonly the lowest rock type in the Unicoi and contrasts markedly with the underlying tillite and maroon rhythmite of the Mount Rogers.

Basalts, some amygdaloidal and porphyritic, occur in the upper part of the lower division. Typically one or two basalts are present in a given section, but three are found in some sections. The uppermost basalt, universally present in the areas I have mapped, occurs at or near the base of the thick section of sandstone that forms the upper division of the Unicoi. I have found it a useful criterion for mapping the contact between the two divisions

The massive upper division of the Unicoi is the most persistent stratigraphic unit of the Chilhowee in this area and is most useful as a mapping unit. The sandstones are typically maroon crossbedded arkoses. Maroon colors are less common toward the top of the formation and some of these higher greenish-gray beds may be equivalent to arkosic sandstone included by King and Ferguson (1960) in the lower part of the Hampton Formation.

Hampton and Erwin Formations — The Hampton and Erwin Formations are composed of the same rock types and are very difficult to differentiate unless there is continuous exposure. They consist of dark clay shale, siltstone and sandstone. The sandstone is in general better sorted and contains less clay matrix than that in the Unicoi. Vitreous quartzites are fairly common but certainly not dominate. The Hampton Formation contains a higher percentage of shale than the Erwin and is commonly separated from the Erwin by a massive quartzite at the base of the latter.

Shady Dolomite

The Shady Dolomite of Early Cambrian age is the lowest of the carbonate units that characterize the Appalachian miogeosyncline below the Middle Ordovician clastic wedge (King, 1959). It consists of light blue, gray or white dolomite with lesser amounts of limestone and carbonatic shale. In the Mt. Rogers area it is about 1,000-feet thick. Fossils are rare. The Shady Dolomite is commonly blanketed with characteristic dark-red or red-brown sticky residual clay that is host to manganese deposits.

Rome Formation

The Rome Formation of Early Cambrian age is the youngest bedrock unit in the Mt. Rogers area southeast of the Holston Mountain fault. It consists of maroon, gray, or green silty shale with lesser amounts of sandstone and some dolomite. Carbonate is commonly present in the clastic rocks. Much of the unit is highly deformed. King and Ferguson (1960) report that the Rome Formation is 1,250 to 1,800-feet thick in the Mountain City-Damascus area. Fossils are rare.

Southeast flank of the Anticlinorium

Amphibolite and Mica Gneiss and Schist

Keith (1903) used the names Roan Gneiss and Carolina Gneiss for amphibolite and layered mica gneiss and schist, respectively, in northwestern North Carolina. These names have been abandoned by the US Geological Survey because they were applied widely throughout the southern Appalachians to lithologically similar but not necessarily correlative rocks (Bryant, 1962; Brobst, 1962). These rocks remain without a formal name here. They are interpreted as metamorphosed interbedded and interfingering mafic volcanic (amphibolite) and clastic sedimentary rocks (mica gneiss and schist) forming a stratigraphic unit whose thickness must be measured in miles.

Some mafic rocks are coarse grained and have relict gabbroic textures; these are probably penecontemporaneous shallow intrusives. The bulk of the mafic rocks, however, are fine grained and occur in layers, that range in thickness from less than an inch to hundreds of feet and that are conformable with compositional layering in the mica gneiss and schist. These were probably lava flows and tuffs. Some fine-grained mafic rocks contain tabular pseudomorphed plagioclase phenocrysts (now largely mosaics of oligoclase-andesine with or without clinozoisite and garnet) that in habit closely resemble plagioclase phenocrysts in basalts of the Mount Rogers Volcanic Group. The mafic rocks are particularly abundant in the rugged mountain terrain west and southwest of the West Jefferson, North Carolina.

The mica gneiss and schist are metamorphosed sulfidic sandstone (mostly fine-grained graywacke) and grit containing shale partings and thick interbeds of shale. The sandstone is locally calcareous. Bedding is variable. Most beds are less than a foot thick but sandstone beds one to two feet thick are common and 10-foot beds are found in places. Both graded bedding and crossbedding are rare.

In Ashe and Watauga Counties, North Carolina, these rocks are in the staurolite-kyanite grade of regional metamorphism. The mafic volcanic rocks are amphibolites and garnet amphibolites. The sedimentary rocks are dominantly fine-grained biotite-muscovite gneisses, commonly sulfidic, and with or without garnet. Pelitic rocks are commonly staurolite-kyanite-garnet schists.

From evidence obtained near Galax, Virginia, the amphibolites and mica gneisses and schists rest nonconformably upon the Cranberry Gneiss. They are thought to be of late Precambrian age and correlative at least in part with the Mount Rogers Volcanic Group and the Lynchburg Gneiss of central Virginia (Rankin, 1967a).

ROAD LOG

The field trips Saturday and Sunday will be entirely within the Winston-Salem 1° x 2° quadrangle (scale 1:250,000). The following 7¾-minute quadrangles will be useful:

Saturday

Abingdon, VA.
Damascus, VA.
Konnarock, Va.*
Grayson, Tenn. – N.C.– VA.*
Park, N.C. – Va.
Whitetop Mountain, VA.*

Sunday

Laurel Bloomery, Tenn.– Va.
Mountain City, Tenn. *
Baldwin Gap, N.C. – Tenn. *

*Stops will be made in these quadrangles. In addition, there will be some stops in parts of the Cranberry 30-minute quadrangle for which there are no published 7¾-minute quadrangles.

Saturday, October 14, 1967

Buses will leave from in front of the Martha Washington Inn, Abingdon, Virginia, at 8:00 A.M.

Mileage

0.0 Buses leave Martha Washington Inn (elevation 2,090-feet) heading northeast on US 11 (main street of Abingdon). From Abingdon to Damascus our route takes us across the Appalachian Valley, here underlain mostly by various carbonates of the Conasauga and Know Groups of Middle Cambrian to Early Ordovician age, but including synclines of Middle Ordovician rocks dominated by clastics. I am not familiar with these rocks and will not try to describe them. Structurally these rocks are in the Pulaski fault block, i.e., above the Pulaski thrust fault. Twenty miles or so to the northeast the Pulaski fault cuts rocks as young as Mississippian. (See Virginia Division of Mineral Resources, 1963). The next higher tectonic unit, the Shady Valley thrust sheet, involves rocks only as young as Middle Ordovician and is in turn overridden by the Blue Ridge thrust sheet. What is the age of movement of the Blue Ridge thrust sheet?

2.6 Underpass, Interstate 81. Approaching the underpass on a clear day, Mt. Rogers and Whitetop Mountain may be seen over Iron Mountain (held up by the Chilhowee Group) more or less straight ahead.

3.0 Junction of US 11 and US 58. Turn right toward Damascus.

5.5 Bridge over Middle Fork Holston River. Elevation 1,791-feet, lowest point on trip.

9.9 Bridge over South Fork Holston River.

12.5 Damascus corporate limit.

13.0 Roadside ledges right, on curve of Rome Formation.

13.4 Follow US 58, right-angle turn left across Norfolk and Western Railroad tracks and across bridge over Beaverdam Creek onto the main street of Damascus. Exposures of Shady Dolomite in Beaverdam Creek under bridge are the last exposures below the Holston Mountain fault. After passing through Damascus we leave the relatively open country of the Appalachian Valley and enter the mountainous Unaka and Blue Ridge provinces.

13.9 Follow US 58 around a right-angle turn right, and then, shortly around right-angle turn left, all within the town of Damascus.

14.3 Exposures at top of bank on left of sandstone in the upper division of the Unicoi Formation. We are now above the Holston Mountain fault and in the Shady Valley thrust sheet.

15.0 Bear left on US 58 at Junction with VA 91. Note cautionary road sign. Here and for the next ¾ mile, exposures on left are the Hampton Formation. Hydrous iron sulfate efflorescence on some surfaces.

15.9 Sharp curve left. Exposures on left and all exposures for next 1.7 miles around several sharp turns are of the upper division of the Unicoi Formation. The Shady Valley thrust sheet has been folded into a syncline called the Stony Creek syncline by King and Ferguson (1960). In Johnson County, Tennessee, to the southwest, the syncline is broad and open and locally carries Shady Dolomite and Rome Formation in its trough (Figure 2). Typically more than five miles separates the top of the Unicoi Formation on opposite limbs. To the northeast in Virginia, the syncline is much tighter, commonly asymmetric, and in places the southeast limb is overturned. Typically a mile or less separates the top of the Unicoi on opposite limbs, and the youngest unit exposed in the trough is the Erwin Formation. There are also structural basins along the synclinal axis caused by slight variations in the direction of plunge of the axis. Our route across the Shady Valley thrust sheet crosses a saddle between two structural basins. We are here about in the trough of the Stony Creek syncline and near the northeast end of the Sutherland basin of King and Ferguson (1960). Bedding dips very gently west. Whitetop Laurel Creek, the stream on the right, is the only stream between the New River and the Watauga River, a distance of 75 miles, that cuts completely through Iron Mountain. It is significant that it does so where the Shady Valley thrust sheet is narrowest because of the high saddle in the trough.

17.6 High cut on left is the last exposure here of the upper division of the Unicoi. Bench mark 2,214-feet in the southwest corner of the Konnarock quadrangle is between the road and Whitetop Laurel Creek. Just ahead on far side of stream are exposures of chewed-up basalt followed by quartz pebble conglomerate of the lower division of the Unicoi.

17.9 Exposures, left, or alternating thin beds of sandstone and shale of the Hampton Formation, also containing a 20-foot quartzite bed. We have now re-crossed the Holston Mountain fault and are in a fairly large fault slice northeast of Damascus made up of Unicoi and Hampton that is structurally between the Shady Valley thrust sheet and the Appalachian Valley (Figures 1 and 2).

18.2 Picnic tables on right, exposures of more shaly Hampton on left. The road now leaves Whitetop Laurel Creek and follows a tributary called Straight Branch (surely an attempt at humor by the mapmakers). The railroad follows Whitetop Laurel Creek. We shall rejoin the railroad 700-feet higher in about 9 miles.

18.6 First of many bridges over Straight Branch.

18.8 Re-cross Straight Branch on sharp curve. Exposures, left, inside curve are tightly folded sandstones in the upper Unicoi. (Still in large slice below Holston Mountain fault). Folds overturned to the northwest. It takes considerable imagination to see these folds from a moving bus, but they are there. On slope above right side of stream at bridge are ledges of quartz pebble conglomerate of the lower Unicoi. These are in the Shady Valley thrust sheet. Therefore, the Holston Mountain thrust fault passes through the bridge.

19.0 Road cut on left in the Upper Unicoi in slice below Holston Mountain fault.

19.2 Exposures on left are grit of the lower Unicoi above the Holston Mountain fault. We have now finished playing hide-and-seek with the Holston Mountain fault and will be in the Shady Valley thrust sheet for several miles.

19.4 Road cuts on right and ledges in stream on left of basalts separating the upper and lower division of the Unicoi. There are two basalts here separated by about 45-feet of crossbedded sandstone. The lower basalt is about 50-feet thick and the upper basalt is about 70-feet thick. Amygdules are abundant in the upper part of each basalt. Most workers have thought that these basalts are lava flows. (See King and Ferguson, 1960). I have seen no diagnostic features.

20.0 Highway sign indicating mileage to Independence. For the next 0.7-mile there is almost continuous exposure of sandstone of the upper Unicoi dipping about 20× ESE. We are on the northwest limb of the Stony Creek syncline. Cliffs of this sandstone are visible on the ridge ahead.

20.3 Sharp curve to right and massive white crossbedded quartzite in the upper Unicoi. Enter narrow part of gorge cut in upper Unicoi.

20.7 Top of gorge.

21.3 Sharp curve right at BM 2,874-feet on the Konnarock quadrangle. Ledges of upper Unicoi.

21.4 Road left to Feathercamp Lookout Tower from which there is an excellent view.

21.5 Exposures in stream on left at sharp bend to left are of sandstone and shale of the Hampton Formation, as are all exposures for the next mile.

22.5 Cross small fault that cuts out the Hampton on the southeast limb of Stony Creek syncline. Exposures on right are of the upper division of the Unicoi Formation.

22.6 Bear Tree Gap, elevation about 3,050-feet, on the crest of Straight Mountain (the southeast ridge of Iron Mountain. Exposures on left of crossbedded sandstone of the upper Unicoi overturned to northwest. We are now on the southeast limb of the Stony Creek syncline. Saprolite of the upper basalt is exposed in road cut about 200-feet east of gap. **View:** Prominent high mountain straight ahead with open fields on right side is Whitetop Mountain, elevation approximately 5,530-feet, where we will have lunch. Partly visible to the left of this is the rounded, wooded Mt. Rogers, elevation 5,729-feet. The low country between Bear Tree Gap and Whitetop Mountain is underlain mostly be sedimentary rocks in the upper part of the Mount Rogers Volcanic Group and is drained by Whitetop Laurel Creek, the same stream we were following earlier. The wooded ridges to the right, across Whitetop Laurel Creek are held up by the Chilhowee Group in a tectonic unit above the Shady Valley thrust sheet.

22.8 Sharp curve right. Exposures of the two basalts in the Unicoi followed by many deeply weathered exposures of the lower division of the Unicoi Formation containing many beds of quartz pebble conglomerate.

Bedding dips steeply northwest or is overturned. These road cuts continue for 0.7-miles around several sharp curves.

23.5 - More Curves. The contact between rusty weathering quartz pebble

23.7 conglomerate of the lower Unicoi and maroon tillite and shale of the Mount Rogers is crossed three times. The color change should be obvious even from the bus and the middle of the three contact localities may be easily located exactly by digging.

24.2 Spectacular exposure on left of fresh maroon matrix tillite in more weathered laminated shale and sandstone, Mount Rogers Volcanic Group. If time permits, we may stop here on the way back this afternoon.

24.5 Side road right to Creek Junction, one of the best places to see large scale faulting. Long road cut on left in upper maroon sedimentary rocks of the Mount Rogers. Some rocks are calcareous.

24.9 Exposures on left are tillite. **Turn right** onto dirt road (Co. Rd. 600) and cross Whitetop Laurel Creel (Figure 3). This is an old railroad bed.

25.1 Long strike ledge on left of sandstone in the Mount Rogers. Beds are overturned and dip 45× SE. We are now stratigraphically below the lowest tillite.

25.3 - Scatter roadside exposures of maroon shale, rhythmite and pebbly rhythmite in

26.1 The upper part of the Mount Rogers.

26.1 Approximate location of the Catface thrust fault that carries a large fault slice beneath the Blue Ridge thrust sheet over the Shady Valley thrust sheet. Here sandstones of the upper division of the Unicoi Formation override maroon sedimentary rocks of the Mount Rogers.

26.2 Road cut on left is in the Hampton Formation.

26.3 Sheared quartz pebble conglomerate of the lower Unicoi in fault contact with Hampton. The Unicoi is here in a different small tectonic slice (Figure 3).

26.4 Beginning of a long stratigraphic section in the large slice above the Catface fault that begins here in the Erwin Formation and continues without repetition down through the Hampton and Unicoi and into the upper sediments and then rhyolites of the Mount Rogers Volcanic Group. The section contains several thousand feet of rock and is inverted. In places, primary sedimentary features in addition to gross stratigraphy demonstrate that, although beds dip southeast, tops are to the northwest.

26.6 Long cleft-like cut blasted through the Erwin; bedding markedly overturned. The next several exposures are also Erwin.

27.0 Exposures on left of shaly Hampton.

27.1 Prominent sandstone rib marking the top of the Unicoi Formation.

27.3 **STOP 1:** Country Road 600 crosses the West Jefferson branch of the Norfolk and Western railroad and both road and railroad cross Green Cove Creek. Leave buses and walk about one-mile along railroad. Buses will move ahead to the terminus of our walk. An excellent section from the upper Unicoi down to the highest rhyolite in the Mount Rogers is exposed along this stretch of the railroad. The letters below refer to letter locations on Figure 3.

(a)A resistant, steeply dipping sandstone bed in the upper division of the Unicoi Formation forms the north abutment of the highway bridge and continues as a rock rib up the steep slope of Lost Mountain. Bedding dips 75× SE (upstream) but crossbedding in the rocks under the bridge indicates that the beds are overturned. Note peculiar series of funnel shaped depressions on the bedding surfaces. Does anyone have a good explanation for them? Maroon arkose and grit with interbedded maroon shale is exposed in road cuts on the south side of the highway bridge. King and Ferguson mapped these as rocks of the Mount Rogers Volcanic Group probably because of their prominent maroon color. Their interpretation was that the Catface fault forming the southeast frame of the Mountain City window separated these rocks from the upper Unicoi inside the window on the north side of the highway bridge. My interpretation is that that the maroon rocks south of the highway bridge are upper Unicoi and that there is no fault here. Note the detrital micas on the bedding surfaces of the shales. These are characteristic of maroon pelitic rocks in the Unicoi but are unknown in maroon pelitic rocks of the Mount Rogers. Hence, even tiny shale or slate chips in the soil may be used as a mapping criterion. There are excellent loose pieces of maroon crossbedded arkose on the streambank here.

(b)Scattered exposures of upper Unicoi along the railroad.

(c)Two amygdaloidal basalts separated by 3-feet of arkose mark the top of the lower division of the Unicoi here. The upper basalt is about 55-feet thick and about 50-feet of the lower basalt is exposed along the track. The contacts of the basalts are sheared and it is not possible to demonstrate whether they are flows or penecontemporaneous sills.

d)Series of exposures of the lower division of the Unicoi Formation. Quartz pebble conglomerates exhibit rusty weathering and contain interbeds of maroon micaceous shale and fine green sandstone. Crossbedding confirms that although the beds dip steeply southeast, tops are to the northwest. The lower Unicoi is about 600-feet thick here, including the basalts.

(e)Contact between quartz pebble conglomerate of the Chilhowee Group and tillite of the Mount Rogers Volcanic Group. Bedding in the Unicoi is parallel to the contact. The tillite is not bedded and is not particularly impressive in these stained railroad cuts. However, just ahead (south) and to the right along Green Cove Creek are large blocks of both quartz pebble conglomerate from the Unicoi and tillite from the Mount Rogers. The contrast between the two rock types is striking and surely connotes either a difference in source area or climate in the source area or both. A count of clasts 0.2-inches or more in the smallest exposed dimension in conglomerate of the Unicoi at this locality shows that 90 percent of them are essentially monomineralic (bull quartz, pink feldspar and black chert) and 10 percent of them are rock fragments. Three out of four clasts are bull quartz and they reach a maximum length of about 4-inches. In contrast, 95 percent of the clasts in the tillite at this locality are rock fragments, the size range is greater and the clasts are less rounded. Much may be learned from even a quick study of the rock fragments in both the conglomerate and tillite. First, clasts of rocks demonstrably from the Mount Rogers Volcanic Group are universally present in the tillite. Here, these include porphyritic and nonporphyritic rhyolite, greenstone, and maroon pelite, and they constitute about 14 percent of the clasts. The presence of a few percent of similar clasts in the conglomerates of the lower Unicoi should not require an unconformity above the Mount Rogers (see King and Ferguson, 1960, p.31). Second, granitic rocks dominate the clasts in the tillite and these clasts are either nonfoliated or have a crude foliation subparallel to the foliation in the matrix of the tillite. There are no clasts of the typical flaser gneiss and augen gneiss that make up the Cranberry Gneiss beneath the more highly sheared basal parts of the mount Rogers to the southeast. The cataclasis of these basement rocks, therefore, took place in Phanerozoic time. Many of the granitic clasts are porphyritic, containing large phenocrysts of pink feldspar. This supports the concept that augen gneisses in the Cranberry formed from the shearing of porphyritic granitic rocks. Finally, there are very few clasts of metamorphic rocks (schist and gneiss) in the tillite. Note that the matrix of the tillite surrounding many mafic clasts is greenish, indicating an exchange of oxygen between clasts and matrix during low-grade Paleozoic metamorphism.

(f)Cross Star Hill Branch on trestle. Arkose below the lowest tillite crops out just upstream.

(g)Exposure of arkose; Mount Rogers Volcanic Group.

(h)Float and scattered outcrops of porphyritic weld tuff that constitutes rhyolite A, the upper of the three rhyolites in the middle of the Mount Rogers Volcanic Group. The lower two have not been found in this thrust sheet. Collapsed pumice fragments are visible in some thin sections from this vicinity.

(h)Green matrix conglomerate stratigraphically above rhyolite A. Ford stream here and walk a couple hundred feet south along road to junction with side road to Taylors Valley. The buses will be waiting at the intersection.

(j)Roadcut in rhyolite A – This is the same belt of rock that is exposed on the hills near locality (h) above, but here it is more sheared and harder to differentiate from sheared arkose and graywacke. This is a common problem. Typically sheared remnants, embayed quartz, and patch perthite phenocrysts are recognizable in thin sections of sheared rhyolite – even those that are sericite phyllites. Where there is an admixture of detrital material, e.g., plutonic microcline, the problem becomes a semantic one.

For those that have a chance to return someday, the only unequivocal basaltic pillow lava I have seen in the Mt. Rogers area is exposed in a railroad cut about ¼ mile southeast and around the bend of the railroad. Board buses and we will retrace our route out Country Road 600 to US 58.

31.5 **Turn right** onto US 58 at intersection.

31.9 Follow US 58 around right-angle **turn to right** at intersection with County Road 603.

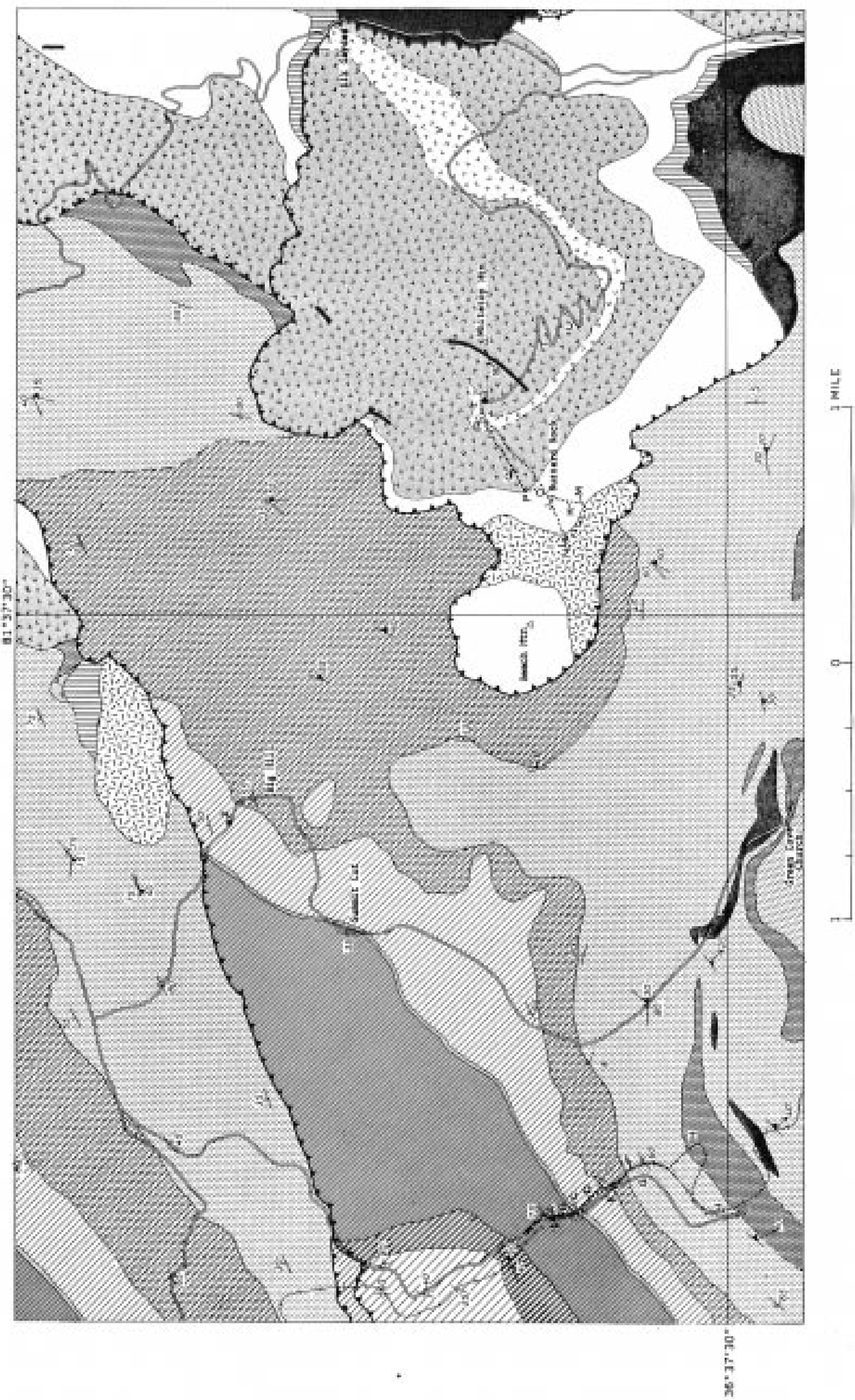
32.1 Exposures on left of maroon rhythmite in the upper part of the Mount Rogers Volcanic Group but below the tillite. You will recall that we have now crossed back into the Shady Valley thrust sheet.

32.2 Exposures on left, or rhythmite and arkose of the Mount Rogers.

32.7 Cross unexposed Catface fault into large fault slice between Blue Ridge and Shady Valley thrust sheets.

32.9 Road cuts on right are quartz pebble conglomerates in the lower division of the Unicoi Formation.

33.0 **STOP 2:** Conformable contact between the Unicoi Formation and the Mount Rogers Volcanic Group on Big Hill. Buses will park in large turnout on right side of road on outside of large curve concave to left. Walk



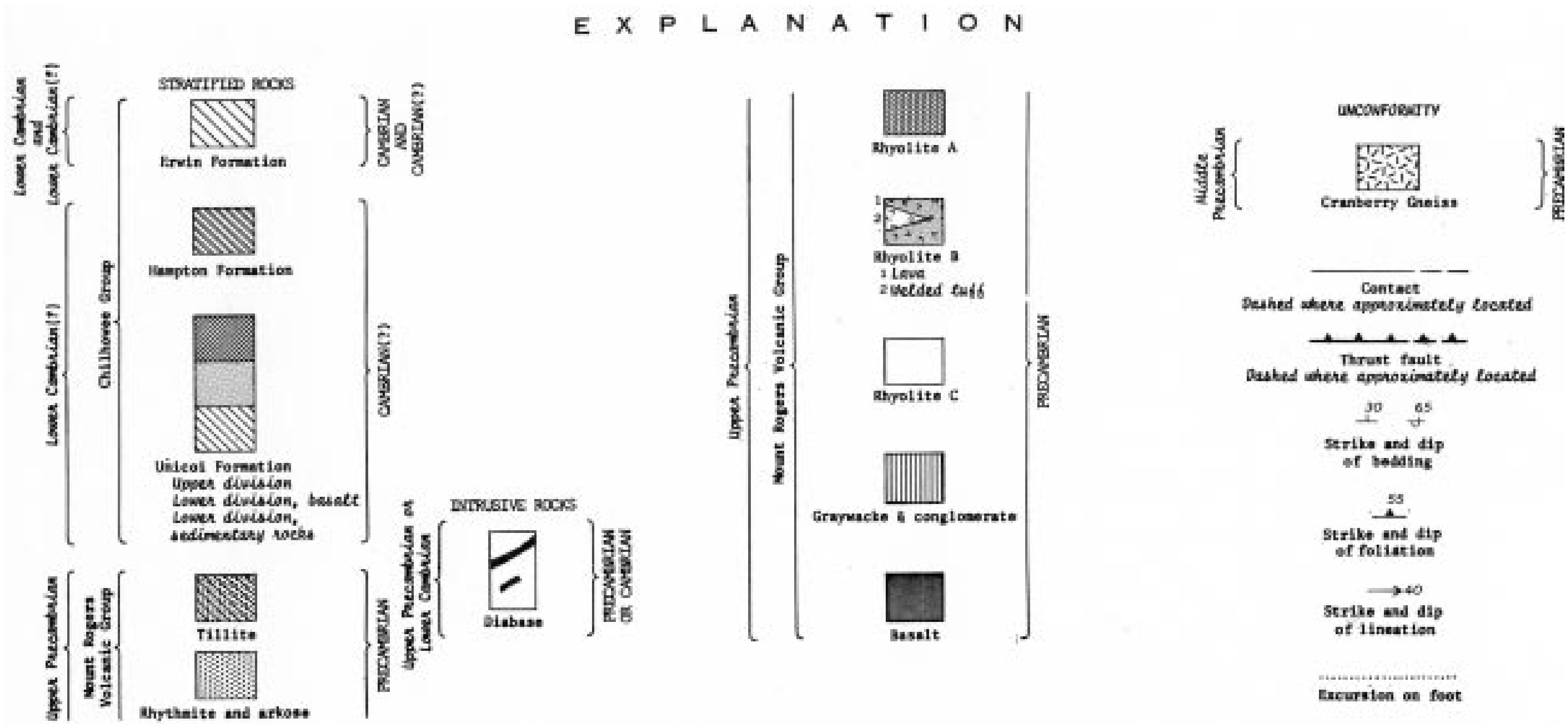


Figure 3. Geologic map of the Green Cove - Whitetop Mountain area showing the location of field trip stops 1-4. Geology by D.W. Rankin.

ahead 400-feet around curve to right to contact. **WATCH OUT FOR TRAFFIC.** Between the buses and the contact are exposures of rusty-weathering quartz pebble conglomerate and arkose of the lower Unicoi. Conglomerate beds are mostly one to 3-feet thick, but some are as thick as 8-feet. Arkose beds are generally thinner. Again, most clasts in the conglomerates are quartz pebbles and average 0.5 to 1-inch in length. The largest one observed here is about 4¾-inches long. Fragments of single feldspar crystals as large as 1-inch occur sparingly. Note that where two quartz pebbles are in contact, one commonly indents the other, presumably a solution phenomenon. The lower 50-feet or so of the Unicoi (around corner to right) consists mostly of feldspathic grit, but includes a bed 1.5-feet thick of quartz pebble conglomerate at its base. This basal bed is atypical in that it contains a higher percentage of small granite pebbles. The contact is knife sharp and although the Virginia Department of Highways has not aided the visiting geologist by their enthusiastic grass planting, the contact may still be uncovered by a little digging. The 1.5-foot thick bed of Unicoi quartz pebble conglomerate here rests on maroon laminated clay shale and arkose of the Mount Rogers. Beds on both sides of the contact dip 60° N. The laminated shale and arkose lack obvious graded bedding and are hence not the typical rhythmites. One graded bed was observed a few inches below the contact and it confirmed that tops are to the north. Several feet from the contact, the Mount Rogers beds are folded locally. Such deformation is certainly to be expected in incompetent beds of this sort beneath thick conglomerates. Maroon tillite crops out about 100-yards up the road. Continue up road as far as the tillite and then return to buses. King and Ferguson (1960, p.31) concluded that this entire section on Big Hill was in the Mount Rogers Volcanic Group and called attention to the similarity of some of the arkoses and conglomerates on Big Hill to those in the lower division of the Unicoi Formation. The latter observation is quite correct! The contact we crossed on big Hill is the same contact we crossed on the railroad at STOP 1 and in fact has been traced to it. Our bus route on US 58 takes us across the contact at two more points between STOPS 2 and 3. However, no additional stops are planned to observe it.

33.3 Crest of Big Hill and sharp turn right of US 58. Low exposures on right of tillite. The high mountains visible ahead just before rounding the bend are Beech (right) and Whitetop (left), the location of our next stop.

33.8 Road cut on left of quartz pebble conglomerate in the lower division of the Unicoi. The road has turned back on itself enough so that we have re-crossed the contact at the base of the Unicoi.

33.9 Summit Cut. Bedding dips 35× E and is overturned. Dip slope on right is feldspathic grit in the upper division of the Unicoi. Red-brown saprolite on left is basalt. Unweathered spherical remnants of basalt protrude from the saprolite. Beds of quartz pebble conglomerate of the lower division of the Unicoi crop out at the top of the cut on left. Numerous exposures of lower Unicoi continue on left to bottom of hill.

34.3 Open field on left. Foot of alluvial fan coming down from Beech Mountain. Most of the material in the fan here is rhyolite C of the Mount Rogers Volcanic Group that caps Beech Mountain.

34.9 Exposures on left of the lower division of the Unicoi Formation. Cross unexposed contact between the Unicoi and Mount Rogers in stream valley. Tillite is exposed in ditch beside road on far (south) side of stream. The railroad along Green Cove Creek (STOP 1) is only about a half-mile downstream to the right.

35.1 Low roadside ledges and float of maroon pebbly rhythmite.

35.8 Side dirt road on right. Rhyolite A of the same unit visited in STOP 1 crops out in the valley to the right. There are poor exposures of greenstone in the road cuts ahead – probably the same pillow basalt exposed along the railroad on Green Cove Creek.

36.4 Green Cove Church. Follow US 58 around right-angle turn to left.

36.8 Roadcuts on right of another flow unit of rhyolite A. Just ahead is a quarry on right in rhythmite. Pelitic parts are slates.

37.6 Exposures on right of rhyolite A as are all exposures for the next half mile.

38.1 Whitetop Gap, elevation about 3,680-feet, on the divide between the Tennessee (Holston) and Ohio (New) drainages. Follow US 58 around sharp turn to left. Exposures of laminated slate (rhythmite) just ahead on right. For the next 2.5-miles exposures are poor but detailed mapping shows that these rocks are rhythmite and rhyolite A in the upper part of the Mount Rogers. Bedding generally dips gently north under Whitetop Mountain and is right-side up.

38.5 Settlement of Park for which the 7¾-minute quadrangle is named. View of Whitetop Mountain above us to the left.

40.5 **Turn left** onto dirt road up Whitetop Mountain.

41.4 Ledges on right of rhyolite C, the lowest of the three rhyolites that made up the middle of the Mount Rogers Volcanic Group. We have now crossed a rather poorly located fault that by my interpretation is the Stone Mountain fault. We are now in the Blue Ridge thrust sheet.

42.4 Quarry on right in rhyolite C.

42.6 **Take left fork** of road in saddle by Bluff Mountain (toward Whitetop Mountain).

43.1 Approximate contact between rhyolite C and overlying rhyolite B. Ledges of both are exposed in proper sequence in woods to left. The road remains in rhyolite B to the summit of Whitetop Mountain.

44.4 Toll gate.

45.8 **STOP 3.** Picnic area just west of the summit of Whitetop Mountain. Lunch. **Please leave no refuse on the ground.** After lunch, walk about ¾-mile down over rough open field to Buzzard Rock. Our lowest point will be about 400-feet below the buses. Jeep transportation can be provided most of the way for those who need it. Use caution in walking down over field. There are many rocks and holes hidden in the grass. If the grass is wet, the walk can be treacherous. In any kind of decent weather the views are superb but don't try to look at view and walk at the same time. The letters below refer to letter location on Figure 3. For reference the saddle between Buzzard Rock and Whitetop Mountain is assumed to be an elevation of 5,100-feet.

j.Buzzard Rock area. Numerous outcrops of rhyolite c which contains a few percent phenocrysts of reddish perthite and greenish-white plagioclase.

k.Elevation about 5,040-feet. Intimate mixture of granitic basement fragments and volcanic material, probably representing local reworked material on the basement. The strong subhorizontal foliation obscures textural relations.

m.Elevation about 4,980-feet. Nonconformity at base of the Mount Rogers Volcanic Group. The contact is not exposed but ledges of volcaniclastic rocks of the Mount Rogers are only 35-feet horizontally from ledges of granitic Cranberry Gneiss. The Cranberry here is a strongly foliated medium-grained falser gneiss roughly of quartz monzonite composition. There is no remaining primary dark mineral here. In addition to sheared and fragmented quartz, microcline and plagioclase, the rock contains chlorite, epidote, abundant sericite and minor stilpnomelane. Rather oddly there is no prominent lineation here. About 300-feet downhill from here are ledges of tillite. What is going on?

n.Recross nonconformity (not exposed) between Cranberry Gneiss and rhyolite C. Note that there are no volcaniclastic rocks here at the base of rhyolite C. Climb back up to Buzzard Rock over numerous ledges of rhyolite C. Note the strange concentric weathering bands on some rocks.

j.Buzzard Rock. Discussion of various geologic megafeatures visible from here. Beech Mountain, across the saddle from Buzzard Rock, is capped by rhyolite C. Tillite underlies rhyolite C on the west side of Beech Mountain and tillite underlies the Cranberry Gneiss both north and south of the saddle between Beech Mountain and Buzzard Rock. Where stratified rocks are associated with the tillite, bedding dips under rhyolite C and the Cranberry Gneiss. The tillite on the slopes of Beech Mountain may be traced around the nose of the anticline and is continuous into the tillite underlying the Unicoi on Green Cove Creek (STOP 1) and Big Hill (STOP 2). A low-angle fault must separate the tillite below from the Cranberry Gneiss and rhyolite C on Beech Mountain and regional mapping has shown this fault to be the Stone Mountain fault forming the sole of the Blue Ridge thrust sheet.

o.Ledges of rhyolite C.

p.Ledges of breccia containing fragments of granite (sparse), rhyolite C, and rhyolite B in a matrix of phenocryst-poor rhyolite. This is a basal breccia of rhyolite B.

q.Scattered outcrops of rhyolite B. Most of these are rather featureless.

r.Lower road loop and picnic table. Tuff breccia in rhyolite B. Note that on some surfaces the fragmental nature of the rock cannot be seen. This tuff breccia is probably ash-flow material continuous with ash-flow tuffs well exposed on the east shoulder of Whitetop Mountain. The ash-flow sheet can be traced to some extent around the south side of Whitetop Mountain but attempts to trace it around the north side of the mountain have not met with success.

s.Diabase dike about 150-feet wide cutting lava flows of rhyolite B. In thin section ophitic or subophitic texture is still visible between plagioclase (strongly altered to sericite and clinozoisite) and clinopyroxene. Actinolite, clinozoisite in larger grains, chlorite and leucoxene are secondary minerals. This dike has been traced about 0.4-miles across the mountain. Rhyolite on both sides of the dike has chaotic flow banding and hence is lava. There are scattered outcrops of lava of rhyolite B from here to the summit of the mountain.

RETURN TO BUSES

The following locations on the way down are noted for future visits. We will not stop at them today.

t. Dike of porphyritic rhyolite (rhyolite A?) in rhyolite B.

u. Rhyolite B containing lithophysae as large as 2-inches across and containing as many as 40 shells.

v. Numerous exposures of welded tuff in rhyolite B.

49.0 Road junction in saddle by Bluff Mountain.

Turn sharp left (150°) toward Elk Garden.

50.4 **STOP 4:** Elk Garden. This stop is conditional upon getting the landowner's permission. Should we stop, **do not climb fences and do not chase cows.** Divide between Holston and New River drainages. Walk through gate to outcrops of greenstone in the lower part of the Mount Rogers Volcanic Group. Whatever the structure here, it is not simple. In the valley to the south, the greenstone is in contact with Cranberry Gneiss, and near the contact, the greenstone and associated graywackes contain fragments of Cranberry. To the north down the slope of Elk Garden Ridge, one crosses successive belts of graywacke grit, rhyolite C and rhyolite B. Foliation dips southeast. Across the road beyond the buses are outcrops of rhyolite B. My interpretation is that the Stone Mountain fault separates the greenstone in Elk Garden from Rhyolite B across the road (see Figure 2). The greenstone is part of an overturned limb of a large recumbent fold in a tectonic slice below the Stone Mountain fault but above the Shady Valley thrust sheet. Because the stratigraphy of this slice is different from that along Green Cove Creek, it is probably a different slice. The greenstone here contains albite, epidote, chlorite, leucoxene and magnetite. Some contain actinolite and some contain relicts of clinopyroxene and small lath-shaped phenocrysts of plagioclase. Locally magnetite is abundant enough to render a compass useless and the Elk Garden area is the locus of a very pronounced positive anomaly found in an aeromagnetic survey of southwestern Virginia (Issacs, 1962). The greenstone also contains veinlets of epidote and quartz and knots of various combinations of epidote, quartz, calcite and chlorite. The knots are probably amygdules. Stratigraphically overlying graywacke grit containing many volcanic and some granitic clasts crops out near the north edge of the pasture.

53.0 Cross probable thrust fault into the tectonic slice we were in at STOPS 1 and 2. Exposures are poor but are of arkose and rhythmite below the tillite. The thick mass of rhyolite A is missing between the arkose and rhythmite and rhyolite B forming most of the north slope of Whitetop Mountain. This is the principal reason for suggesting a fault here.

53.3 Cross Big Branch and descend surface of large alluvial fan on the north side of Whitetop Mountain.

54.5 Elk Garden road dead ends into County Road 603.

STOP 5: Junction of County Roads 600 and 603 on north side of bridge over Big Laurel Creek (Whitetop Laurel Creek of earlier in day). Pebbly rhythmite in the upper part of the Mount Rogers is exposed in a small road material quarry here. We are probably still in the tectonic slice above the Shady Valley thrust sheet but that is very difficult to demonstrate. Certainly rocks a quarter of a mile north of us are in the Shady Valley sheet and pass upward through tillite to the base of the Unicoi Formation at the foot of the steep slope of Iron Mountain. Note the graded bedding with coarser commonly greenish siltstone bottoms grading up into finer maroon tops. Some thin coarser bottoms are very poorly sorted, containing coarse and granule-size clasts. In addition, larger pebbles are scattered throughout the graded beds. Elsewhere in this valley these clasts reach a maximum of 1-meter in diameter. If there were only a few of these dropped pebbles, I would be happy to ignore them but they are all over the place. Because most of them are granitic, it is unlikely that they were emplaced by volcanism. My suggestion is that these are varved sediments deposited in a lake that was ice covered annually. Note also the evidence for soft-sediment deformation, perhaps slumping on the lake bottom. Some arkose beds contain randomly oriented slivers of maroon shale.

55.0 Contact between rhyolite A and overlying maroon rhythmite and arkose. This outcrop is certainly back in the Shady Valley thrust sheet.

56.4 Community of Konnarock. Once the site of a large sawmill and logging operation. Exposures of rhythmite and arkose on right.

56.8 Exposures of tillite on right.

57.4 Intersection with US 58, our route this morning. Continue on USS 58 back to Abingdon for the banquet and annual meeting.

82.7 Martha Washington Inn, Abingdon, Virginia.

Sunday, October 15, 1967

Transportation today will be by automobile and we will be about 50-miles from Abingdon by noon. For most of you, it will be much out of the way to return to Abingdon, so check out before leaving. Because some have expressed interest in spending more than half a day the trip will continue informally in the afternoon. Anyone wishing to spend more than half a day should bring a lunch and others may wish to have a snack along because restaurants are sparse in northwestern North Carolina.

Departure time from the Martha Washington Inn, 8:30AM.

Mileage

0.0 Martha Washington Inn. Retrace yesterday's route on US 58 through Damascus to Junction with VA 91.

15.0 **Turn right on VA91** headed for Mountain City.

15.9 Ledges of the upper division of the Unicoi Formation, as are all ledges for the next mile. For reorientation we are in the Shady Valley thrust sheet on the northeast limb of the Stony Creek syncline.

16.7 Virginia -Tennessee line.

16.9 Exposures of the higher of two basalts in the Unicoi.

17.0 Exposures of the lower of two basalts of the Unicoi, followed by ledges of the lower division of the Unicoi for the next two miles. Quartz pebble conglomerates are readily identifiable.

19.0 Outcrops of Unicoi quartz pebble conglomerate in small streams on left. Slopes above on left are Fodderstack Mountain which is underlain by the Mount Rogers Volcanic Group, as is the northeastern end of Stack Ridge to the right. The Mount Rogers thins to a featheredge on Stack Ridge, and farther southwest the lower division of the Unicoi rests on Cranberry Gneiss. Cross unexposed Iron Mountain fault and enter Mountain City window. The segment of the window we cross is mostly underlain by the Shady Dolomite and the Rome Formation in a rather broad open valley.

19.4 Exposures on left of the Rome Formation, as are all exposures for the next 4.8-miles.

21.0 Community of Laurel Bloomery, Tennessee.

24.2 Exposures on left of the Shady Dolomite. Note the associated dark red-brown residual clay.

26.4 Exposure on left of the Rome Formation.

28.7 Traffic light in center of Mountain City, Tennessee. Continue straight.

29.3 Intersection with US 421. Bear left on US 421 toward Bone.

Use caution.

Sharp ridge on far side of US 421 is held up by the Erwin Formation, part of the complex much-faulted uplift of the Doe Ridges (King and Ferguson, 1960).

31.3 Exposures on left of the Rome Formation.

31.8 Hermit Motel.

32.5 **Turn left** off US 421 onto unmarked paved road. Exposures of Shady Dolomite.

32.7 Pavement ends; bear right.

32.8 Inactive quarry in Shady.

33.0 State Highway Commission active quarry in Shady.

33.5 Water-filled quarry in Shady

33.6 Dirt road dead ends into paved road. **Turn right** toward Payne Gap.

Cross Stone Mountain fault and enter Blue Ridge thrust sheet above the Mountain City window.

33.7 Exposure on left of the Cranberry Gneiss.

34.4 Ledges of white quartzite of the Erwin Formation on right exposed in a small window through the Blue Ridge thrust sheet. Ridge visible to north is Forge Mountain, held up by Chilhowee Group on the southeast side of the Mountain City window.

34.7 Ledges of Cranberry Gneiss on right (back in the Blue Ridge thrust sheet).

35.4 Excellent exposures on left of little sheared quartz monzonite of the Cranberry Gneiss. Some is porphyritic with microcline phenocrysts up to 1.5-inches long.

35.7 Forge School on right.

36.4 **STOP 6:** Parking space is limited here; please use as little as possible. Cranberry Gneiss (quartz monzonite) cut by porphyritic greenstone dikes. Walk up road about 0.4-mile past almost continuous exposure. Much of the Cranberry here is massive fine-grained quartz monzonite (subequal amounts of microcline and sericitized plagioclase). The primary dark mineral is biotite, now altered to chlorite and epidote, which constitutes 5 to 10 percent of the rock. There is also quite a lot of medium-grained quartz monzonite with pink microcline phenocrysts as much as an inch or so across. Note the pegmatitic clots. These probably date from the time of formation of the Cranberry Gneiss rather than Paleozoic metamorphism. The Cranberry is cut by porphyritic mafic dikes. Plagioclase phenocrysts (badly saussuritized) in one dike are as large as 1 x 0.2-inches on the surface. The groundmass mineralogy is now albite, epidote, chlorite, actinolite-tremolite, leucoxene and pyrite. I have seen no pyroxene relicts here, but I have seen them elsewhere in comparable mafic dikes cutting low-grade Cranberry. Assuming that the dikes are of late Precambrian age, these rocks have not been metamorphosed beyond low grade in Phanerozoic time.

37.9 **STOP 7:** Again parking space is limited. Don't be piggy. Fault sliver of Unicoi in Cranberry Gneiss. This kind of an outcrop keeps the geologist on his toes. How many like it do we miss? The layer of quartz pebble conglomerate is 15 to 20-inches thick and is bordered above and below by flaser gneiss of the Cranberry. All rocks have a strong foliation dipping about 35× SE. Quartz pebbles in the conglomerate are both flattened and elongated down the dip of the foliation. The direction of elongation is parallel to the direction of tectonic transport on the thrust fault and is hence an a-lineation. The upper end of this valley, starting about a mile northeast of here is the locus of the Stone Mountain fault, on which Cranberry is thrust upon Unicoi. Apparently a branch of this fault continues down the valley at least this far.

38.9 Cross Stone Mountain fault into Mountain City window. Outcrop of quartz pebble conglomerate of the lower division of the Unicoi in Forge Creek on left.

39.2 Outcrop of quartz pebble conglomerate of lower Unicoi on right. Cross Stone Mountain fault back into Blue Ridge Thrust sheet. Road cuts between here and Payne Gap are deeply weathered or saprolite and are in flaser gneiss of the Cranberry cut by greenstone and sparse metarhyolite.

40.2 Payne Gap. Enter Ashe County, North Carolina and the New River drainage. Saprolite of flaser gneiss of the Cranberry.

40.9 **STOP 8:** Cranberry Gneiss. Good exposure of medium-grained flaser gneiss. Note the strong foliation dipping about 45× SE and the downdip lineation in the plane of foliation caused by mineral streaking. The lineation is in the direction of tectonic transport and is hence an a-lineation. The flaser gneiss is roughly a quartz monzonite in composition and is though to be a sheared and somewhat recrystallized equivalent of the medium-grained quartz monzonite exposed at STOP 6. Metamorphic minerals here include biotite, stilpnomelane (minor). epidote, sericite and calcite. Augen gneiss, greenstone and metagabbro are exposed in the next outcrop along the road. The augen gneiss differs from the flaser gneiss only in containing megacrysts of microcline. The augen gneiss probably is a sheared and somewhat recrystallized equivalent of the porphyritic quartz monzonite of STOP 6. The greenstone and metagabbro are thought to be younger intrusives, now sheared and recrystallized, of the same age as the mafic dikes at STOP 6.

The outcrops here (STOP 8) are typical of the plutonic rocks in the core of the anticlinorium over many, many square miles, from Cranberry, North Carolina, to Fries, Virginia. Exposures for the next 4.7-miles are various aspects of the Cranberry Gneiss with varying amounts of younger mafic intrusives.

45.6 **STOP 9:** Metagabbro with chilled contact, intrusive into Cranberry Gneiss. About 5-feet of the metagabbro are exposed, including the lower contact, which is subparallel with the foliation. A finer grained zone about 6-inches thick occurs at the base of the metagabbro and is interpreted as a chilled margin. Small pseudomorphed plagioclase phenocrysts occur both in the metagabbro and in the chilled margin, and granitic xenoliths occur in the margin. The mineralogy of the chilled margin is quartz, albite, biotite, actinolite and epidote. The actinolite is more pleochroic than that of STOP 6. Note the downdip mineral streaking. The metagabbro is probably of late Precambrian or Early Cambrian age.

46.7 Exposure of fairly coarse augen gneiss on left. View of Three Top Mountain (5,075-feet) ahead. This mountain is held up by amphibolite that is part of the upper Precambrian stratified sequence on the southeast flank of the anticlinorium.

48.2 Junction with NC 88. **Turn right** and follow NC 88 upstream in the valley of the North Fork of the New River. Two-tenths of a mile east along NC 88 (behind us now) is exposure of garnet-bearing augen gneiss.

49.8 **Left turn** on unmarked paved road at Creston.

STOP 10 at turn. Walk ahead several hundred feet on NC 88. Higher grade basement rocks. Augen gneiss and mafic rocks. Some mafic rocks are younger than the augen gneiss and presumably belong to the same group of late Precambrian or Early Cambrian intrusives that were exposed in STOPS 6, 8, and 9. Other mafic rocks may be older. The important feature here is that the metamorphic grade is higher. Micas are coarser-grained and the mafic rocks contain megascopic hornblende.

Continue on side road across the North Fork of the New River (one-lane bridge). Follow paved road, right and upstream at Creston Methodist Church.

50.1 Pavement ends. **Turn left** up side valley of Three Top Creek.

50.7 Outcrops on left on far side of Three Top Creek of recrystallized flaser gneiss (Cranberry).

50.9 **STOP 11:** Pelitic schist at base of the Roan and Carolina Gneisses of former usage (Keith, 1903). These layered sulfidic schists and gneisses are the lowest exposed rocks in this valley of the stratified rocks on the southeast limb of the anticlinorium. The mineral assemblage in the schist includes quartz, plagioclase, muscovite, biotite, garnet, kyanite, staurolite, tourmaline, pyrite, and chalcopyrite, which places these rocks in the kyanite-staurolite zone of regional metamorphism. Amphibolites are interlayered with the schist and gneiss a short distance ahead.

This suite of layer gneiss, schist and amphibolite contrasts markedly with the rocks in the core of the anticlinorium. By reconnaissance mapping, they have been traced northeast to the vicinity of Fries, Virginia where the metamorphic grade is lower, and they rest nonconformably on sheared quartz monzonite of the Cranberry.

End of formal field trip. For those wishing to spend more time, we will continue up the valley of Three Top Creek with stops to examine exposures of layered mica gneiss, schist and amphibolite. Those wishing to start home from here had better consult me or someone familiar with the local geography. We are a long way from most places! NC 88, which we left at STOP 10, goes to West Jefferson to the east and to Trade, Tennessee on US 421 to the west. The dirt road up the valley on Three Top Creek crosses a 3,500-foot saddle and ends at Todd on NC 194, a secondary road between Boone and West Jefferson.

REFERENCES

Brobst, D.A., 1962. Geology of the Spruce Pine District, Avery, Mitchell and Yancey Counties, North Carolina: US Geol. Survey, Bull. 1122-A, 26.

Brown, W.R. 1958. Geology and mineral resources of the Lynchburg quadrangle, Virginia: Virginia Division Mineral Resources Bulletin 74, 99p.

Bryant, Bruce, 1962. Geology of the Linville quadrangle, North Carolina – Tennessee – A preliminary report: US Geological Survey Bulletin 1121-D, 30p.

Bryant, Bruce, 1963. Geology of the Blowing Rock quadrangle, North Carolina: US Geol. Survey Quadrant Map GQ-243.

Bryant, Bruce and Reed, J.C.Jr., 1962. Structural and metamorphic history of the Grandfather Mountain area, North Carolina – A preliminary report: Am Jour. Science, Vol. 260, pp.161-180.

Carrington, T.J., 1961. Preliminary study of rhythmically layered, tuffaceous sediments, near Konnarock, southwestern Virginia: Mineral Industries Jour. (Virginia Polytech Institute) Vol. 8, No.2, pp.1-6.

Davis, G.L., Tilton, G.R., and Wetherill, G.W., 1962. Mineral ages from the Appalachian province in North Carolina and Tennessee: Jour. Geophys. Research, Vol, 67, pp.1987-1996.

Eckelman, 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., Vol.254, pp.288-315.

Glaessner, M.F., 1963. The dating of the base of the Cambrian: Jour. Geol. Soc. India, Vol. 4, pp.1-11.

Harland, W.B. and Rudwick, M.J.S., 1964. The great infra-Cambrian ice age: Sci. Am., Vol. 211, pp.28-36.

Hopson, C.A., 1964. The crystalline rocks of Howard and Montgomery counties In the Geology of Howard and Montgomery Counties: Maryland Geol. Survey, Baltimore, Md., pp.27-337.

Issacs, K.N., 1962. Interpretation of airborne magnetometer survey in southwestern Virginia for the Commonwealth of Virginia, Department of Conservation and Economic Development, Division of Mineral Resources; Philadelphia, Aero Services Corp., pp. 36, fold map, scale 1:250,000.

Jonas, A.I., and Stose, G.W., 1939. Age relation of the Precambrian rocks in the Catoctin Mountain-Blue Ridge and Mount Rogers anticlinoria in Virginia: Am. Jour. Sci., Vol. 237, pp.575-593.

Keith, Arthur, 1903. Description of the Cranberry quadrangle (North Carolina-Tennessee): US Geol. Survey Geol. Atlas, Folio 90.

King, P.B., 1955. A geologic section across the southern Appalachians – An outline of the geology in the segment in Tennessee, North Carolina and South Carolina, In Russell R.J., editors, Guides to southeastern geology: New York, Geological Society America, pp.332-373.

King, P.B., 1959. The evolution of North America: Princeton, New Jersey, Princeton Univ. Press, 190p.

King, P.B., and Ferguson, H.W., 1960. Geology of northeastern most Tennessee: US Geol Survey Prof. Paper 311, 136p.

Laurence, R.A. and Palmer, A.R., 1963. Age of the Murray Shale and Hesse Quartzite on Chilhowee Mountain, Blount County, Tennessee: US Geol. Survey Prof. Paper 475-C, pp. C53-C54.

Miller, R.L., 1944. Geology and manganese deposits of the Glade Mountain district, Virginia: Virginia Geol. Survey, Bull. 61, 150p.

Neuman, R.B. and Nelson, W.H., 1965. Geology of the western Great Smoky Mountains, Tennessee: US Geol. Survey Prof. Paper 349-D, 81p.

Rankin, D.W., 1960. Paleogeographic implications of deposits of hot ash flows: International Geol.Cong., 21st, Copenhagen 1960, Report, pt.12, pp 19-34.

Rankin, D.W., 1967a, Precambrian stratigraphy in the Blue Ridge of Ashe and Watauga Counties, northwestern North Carolina (abs.): Geol. Soc. America, Southeastern Section, Program for Annual Meeting, 49p.

Rankin, D.W., 1967b, The stratigraphic and structural position of the upper Precambrian Mount Rogers volcanic group, Virginia, North Carolina and Tennessee (abs.): Geol. Soc. America, Southeastern Section, Program for Annual Meeting, 49p.

Riecken, C.C., 1966. Level of emplacement of the Striped Rock Granite pluton, Grayson County, Virginia (abs.): Geol. Soc. America, Southeastern Section, Program for Annual Meeting, 40p.

Stose, A.J., and Stose, G.W., 1957. Geology and mineral resources of the Gossan Lead district and adjacent areas: Virginia Div. Mineral Resources Bull. 72, 233p.

Tilton, G.R., Wetherill, G.W., and Davis, G.L., and Bass, M.N., 1960. 1,000-million year old minerals from the eastern United States and Canada: Journal Geophysical Research, Vol. 65, pp. 4173-4179.

Virginia Division Mineral Resources, 1963. Geologic map of Virginia: Charlottesville, scale 1:500,000.