ORIGIN and CORRELATION of the PUMPKINVINE CREEK FORMATION: A NEW UNIT in the PIEDMONT of NORTHERN GEORGIA

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ABSTRACT

The Pumpkinvine Creek Formation is an easily traceable and structurally important unit of mafic metavolcanic and metasedimentary rocks in the Piedmont of Georgia north of the Brevard Fault Zone. Southwest of Emerson, the Pumpkinvine Creek Formation and the overlying Canton Schist constitute the boundary between the Talladega Series and the Dallas belt lithologies. Northeast of Emerson, the Pumpkinvine Creek Formation and the Canton Schist constitute the boundary between the Great Smoky Group and the Dallas belt lithologies.

Four deformational events and one progressive regional metamorphic event have been recognized in the Pumpkinvine Creek Formation. Faulting, as evidenced by cataclastic textures, appears partially responsible for some retrogression of the original metamorphic event.

Whole-rock analyses of amphibolites from the Pumpkinvine Creek Formation along with relict textures are indicative of an igneous parent. Trace element concentrations and rare-earth element data suggest that the amphibolites of the Pumpkinvine Creek Formation originally were abyssal tholeiites that were deposited in either an ocean ridge or back-arc basin environment. Interlayered craton-derived metasedimentary rocks favor a back-arc basin environment.

Amphibolites similar to the Pumpkinvine Creek Formation have been mapped southwestward from Draketown to the Alabama line. These amphibolites are believed to be correlative with the Pumpkinvine Creek Formation and also the Hillabee Greenstone in Alabama. If the correlations are correct, this linear belt of mafic metavolcanic rocks is continuous for more than 260 kilometers (km) (162 miles (mi)) making it one of the most persistent units in the Georgia-Alabama Piedmont.

INTRODUCTION

The Pumpkinvine Creek Formation is an interlayered sequence of mafic metavolcanic and metasedimentary rocks that crop out near the southeastern border of the Talladega Series* (Crickmay, 1936) and Great Smoky Group in northwestern Georgia (fig. 1). The Pumpkinvine Creek Formation has been mapped for 48 km (30 mi) in Georgia from southwestern Paulding to central Cherokee County (Crawford, 1976, 1977a, & 1977b; McConnell, 1978, unpublished data). The type locality of the Pumpkinvine Creek Formation is just southeast of Pumpkinvine Creek along Interstate 75 and U.S. 41 (fig. 2) in southeastern Bartow County. Rocks of similar lithology and stratigraphic position can be traced southwestward along strike in Georgia for an additional 48 km (30 mi) to the Alabama line. The Pumpkinvine Creek Formation is well exposed and lies within an easily definable lithologic sequence for most of its length.

The most important feature of the Pumpkinvine Creek Formation is its role in the tectonic framework of the area. The Pumpkinvine Creek Formation along with the structurally overlying Canton Schist crops out along the boundary between the Talladega Series and rocks of the Dallas belt (Higgins and Zietz, 1975) in the southwest part of the study area and continues to the northwest where it lies along the boundary between the Great Smoky Group and Dallas belt lithologies. Therefore, the Pumpkinvine Creek Formation along with the Canton Schist lies just southeast of the geologically complex area where rocks of the Talladega Series abut the rocks of the Great Smoky Group.

*Based on unpublished mapping by T.J. Crawford, R.H. Weimer, Jr. and K.I. McConnell; rocks of the so-called Talladega Series in Georgia are known now to be divisible into several mappable units (formations), but at this time it is preferable to await the results of mapping in progress before defining and naming these units.

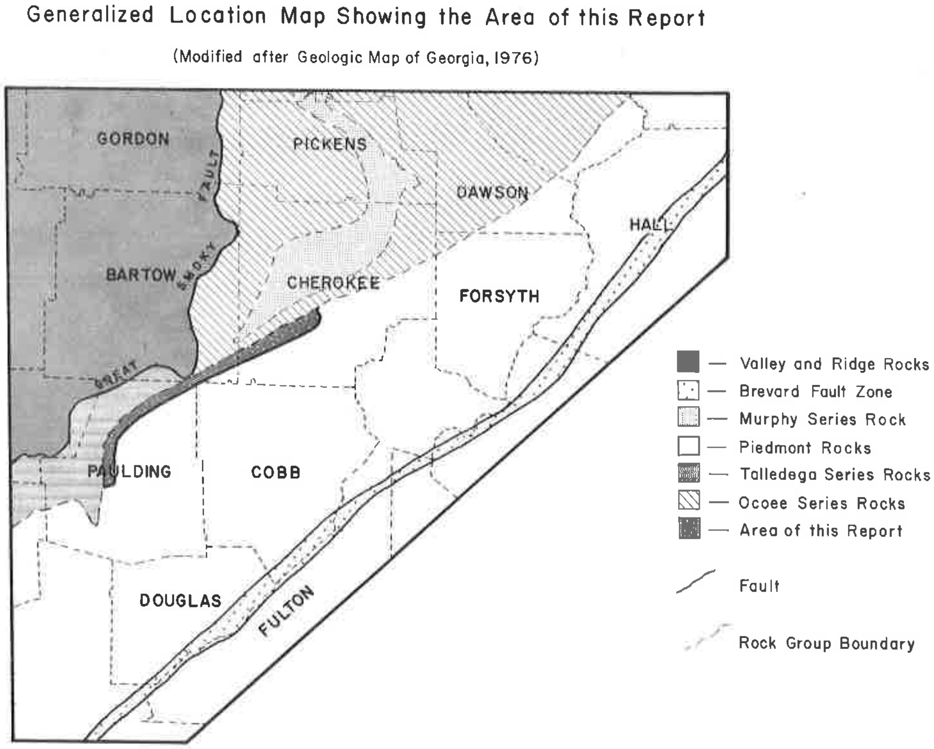

Figure 1 Generalized location map showing the area of this report.

Figure 2 Type locality of the Pumpkinvine Creek Formation along Interstate 75 just south of Pumpkinvine Creek in Bartow County.

ACKNOWLEDGEMENTS

This report represents the results of several years of mapping in and around the Lake Allatoona area as part of the geologic mapping program of the Georgia Geologic Survey. The interpretation of the regional relationship was greatly aided by the many discussions with, and the geologic mapping of John Costello. Many thanks are due to the United States Geological Survey for providing most of the chemical data. The manuscript was significantly improved by the insight and formal reviews of Thomas J. Crawford (West Georgia College), Michael W. Higgins (United States Geological Survey), and Richard P. Sanders (West Georgia College).

PREVIOUS WORK

In the past, rocks of the Pumpkinvine Creek Formation have been grouped together with other amphibolites and hornblende gneisses of the Piedmont in regional reports on amphibolites or economic mineral occurrences. In the late 1800's and early 1900's, interest in the gold and sulfide deposits of the "Dahlonega Gold Belt", of which the Pumpkinvine Creek Formation is a part, spawned numerous reports on the amphibolites in this area. The first known reference to the rocks currently defined as the Pumpkinvine Creek Formation was Yeates and others' (1896) report on the **Gold Deposits of Georgia**. They refer to gold deposits in Bartow and Cherokee Counties as being associated with hornblende schists that are interpreted here to be part of the Pumpkinvine Creek Formation. Since then, several reports on gold and sulfide deposits have referred to these same hornblende schists (Jones, 1909; and Shearer and Hull, 1918).

Stratigraphically, amphibolites of the Pumpkinvine Creek Formation originally were included in the "Roan gneiss" by Bayley (1928). The "Roan gneiss" was used to refer to Archean mafic rocks by Keith (1907) in his Nantahala folio. Later, Crickmay (1952) included rocks of the Pumpkinvine Creek Formation in his Wedowee-Ashland Belt. This belt, as described by Crickmay (1952), was composed of rocks of the Ashland, Wedowee and Canton Schists. More recently, Hurst (1973) included these same amphibolites in his Ashland Group.

Finally, the amphibolites of the Pumpkinvine Creek Formation have not escaped the controversy over the origin of amphibolites. In the past 30 years the amphibolites of the Pumpkinvine Creek Formation have been interpreted to be both metasedimentary (Kesler, 1950; Kesler and Kesler, 1971; and Fairley, 1973) and metaigneous (Yeates and others, 1896; Shearer and Hull, 1918; Hurst and Jones, 1973; and Jones and others, 1973). The origin of the Pumpkinvine Creek Formation is discussed in detail in a later section.

FORMATION DESCRIPTION

The Pumpkinvine Creek Formation is an interlayered unit of predominantly fine-grained amphibolite interlayered with thin layers of felsic gneiss and sericite phyllite (fig. 3). The map pattern suggests that the Pumpkinvine Creek Formation could be as much as 38 m (125 ft) thick, but isoclinal folding and local repetition by faulting in the formation suggest that the thickness probably is much less. In the area of this report, the outcrop pattern of the Pumpkinvine Creek Formation defines a large-scale overturned antiform. Detailed mapping is needed to confirm the presence of this fold. However, the absence of the Galts Ferry gneiss northeast of what is probably the nose of the fold and the striking lithologic similarities of the two amphibolite units, interpreted to be its limbs, strongly support the existence of a fold. The northwestern limb of the fold is believed to be, in part, faulted out.

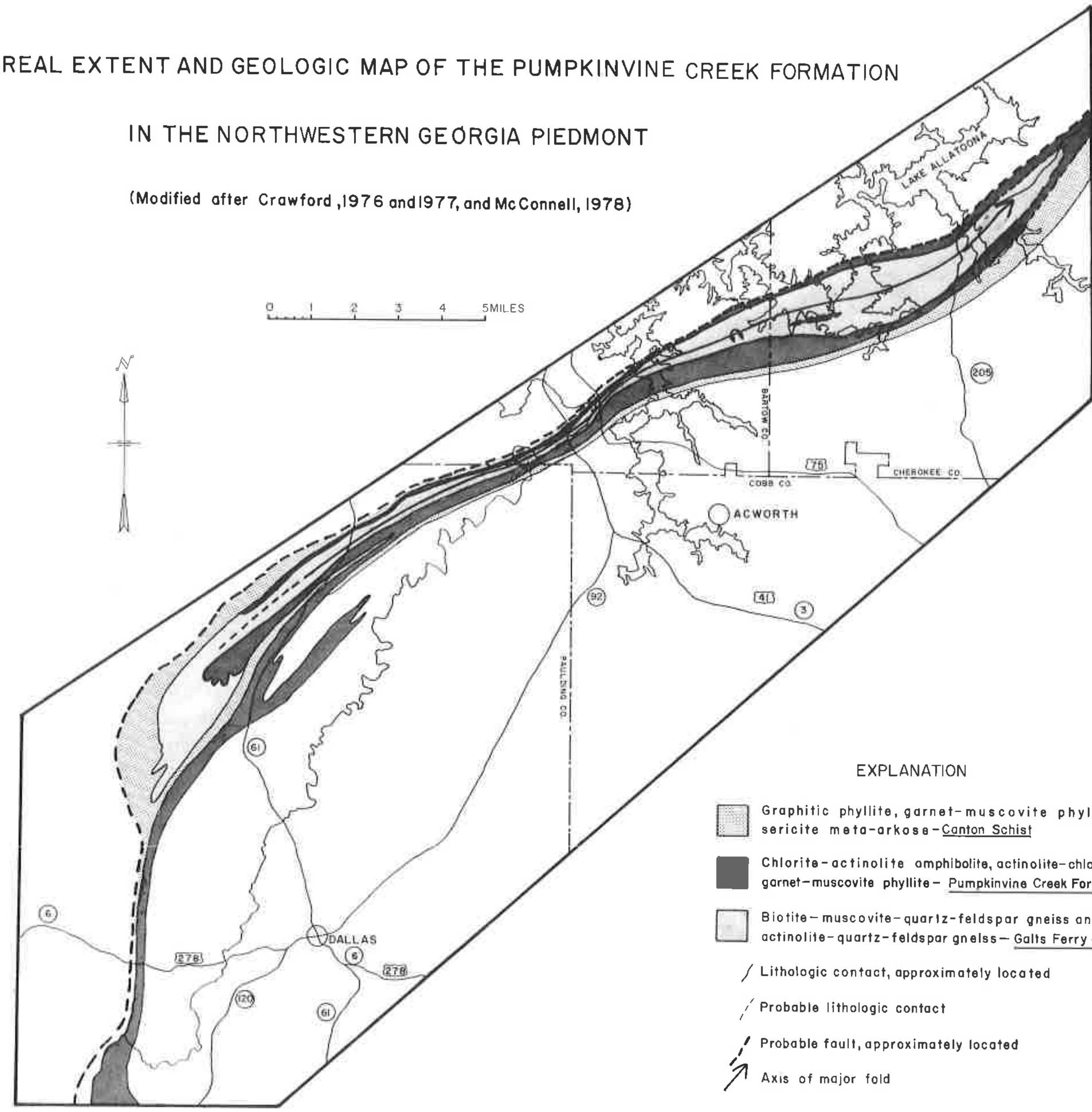

Figure 3 Generalized geologic map and areal extent of the Pumpkinvine Creek Formation.

Initially, the Pumpkinvine Creek Formation appears to be a uniformly gray, fine-grained amphibolite. Closer examination allows the formation to be broken down into four lithologic subdivisions or members:

1) Chlorite-hornblende amphibolite.
2) Garnet-hornblende-plagioclase gneiss.
3) Mylonite gneiss.
4) Sericite phyllite.

The Pumpkinvine Creek Formation is composed primarily of chlorite-hornblende amphibolite. Mineralogically, this member is composed of epidote, chlorite, hornblende, quartz and albite with accessory amounts of calcite and pyrite. The amphibolite varies to a porphyroblastic hornblende-chlorite phyllite with distinctive needle-like hornblende porphyroblasts.

Within the mafic rocks are layers of more felsic garnet-hornblende-plagioclase gneiss. These units commonly are a foot or less (0.3 m) in thickness. The garnet-hornblende-plagioclase gneiss also contains needle-like hornblende porphyroblasts (fig. 4), but is characterized by subhedral plagioclase laths (relict phenocrysts?) and poikiloblastic garnets.

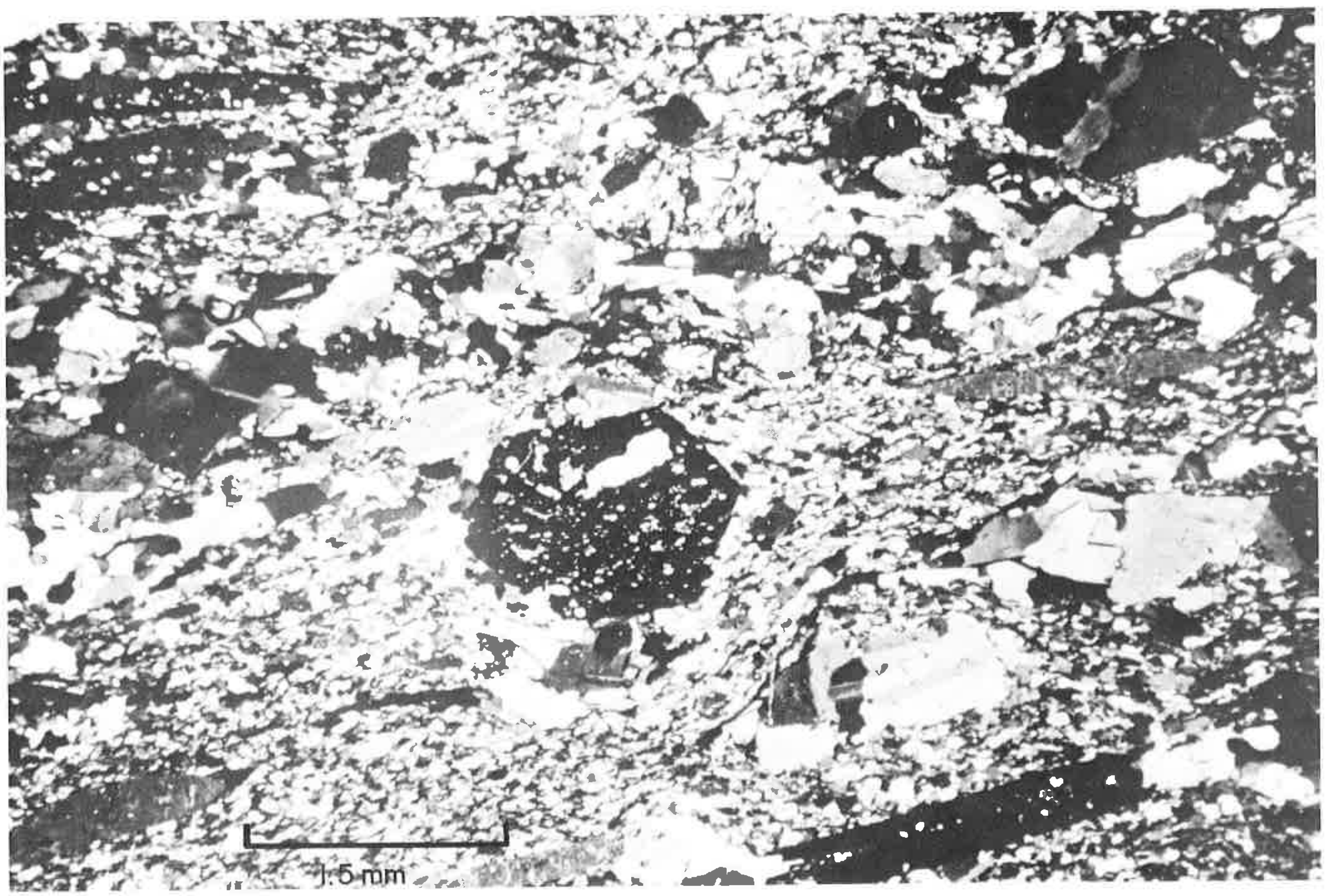

Figure 4 Photomicrograph of the garnet-hornblende-plagioclase gneiss member of the Pumpkinvine Creek Formation.

Also present in the Pumpkinvine Creek Formation are what appear, in hand sample, to be layers of sericitic meta-arkose with characteristic rounded blue quartz clasts. Thin sections of this rock show that the feldspar grains have been rounded, and in some cases broken during cataclasis. Quartz clasts have well-defined crush trails (fig. 5), and are interlayered with wispy bands of sericite, chlorite and biotite. This rock is believed to be a mylonite gneiss derived from an arkosic sedimentary parent. An interesting feature of this member is the presence of the rounded blue quartz clasts. A possible source for these clasts is the 1,000 m.y.-old Corbin gneiss (Odom and others, 1973) approximately one mile to the north, which is characterized by blue quartz grains.

Sericite phyllite is locally present in the Pumpkinvine Creek Formation. It occurs primarily in outcrops along the shore of Lake Allatoona where the units are generally less than 6 m (20 ft) thick, and can be traced for short distances (<10 m). The phyllite is composed primarily of fine-grained sericite and quartz with accessory biotite, chlorite, feldspar and calcite. The sericite phyllite may be interlayered with other members of the formation, but similarities with surrounding units suggest that it also could be infolded into the Pumpkinvine Creek Formation.

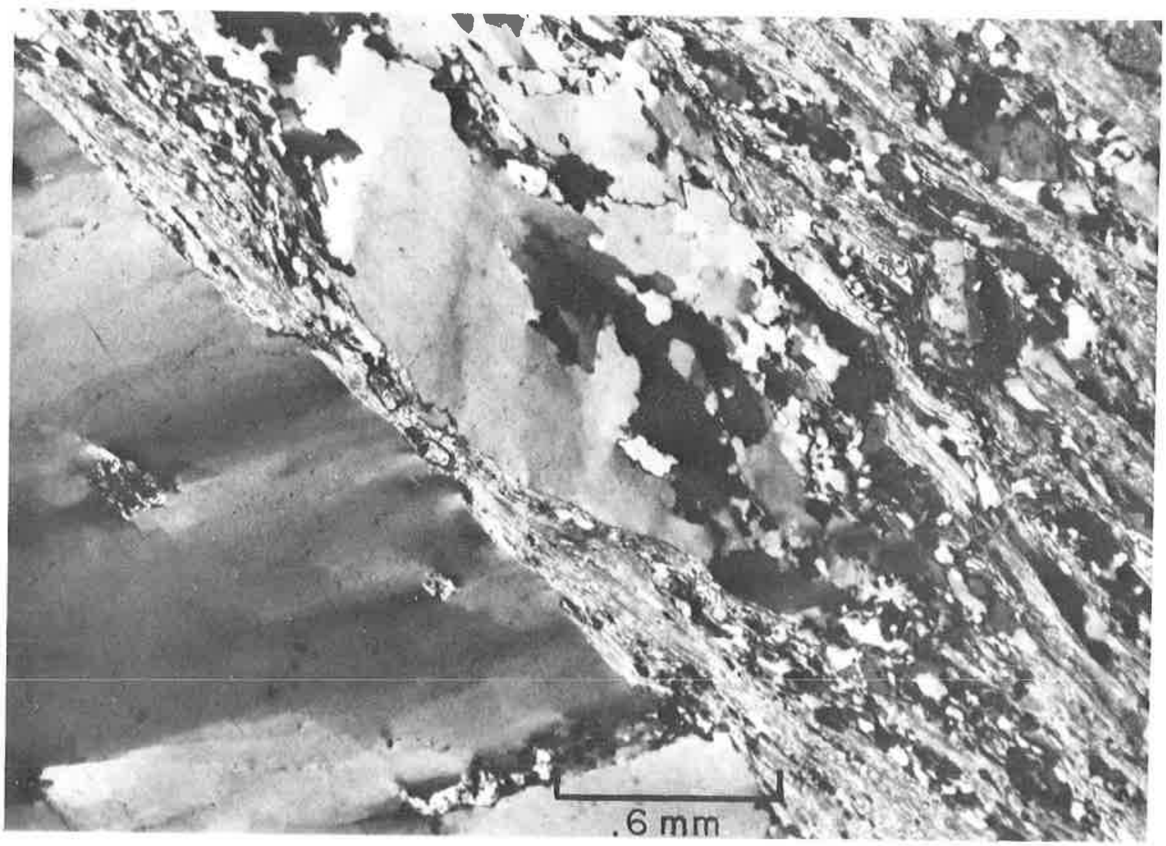

Figure 5 Photomicrograph of the mylonite gneiss member of the Pumpkinvine Creek Formation showing well-developed undulose extinction and crush trails.

METAMORPHISM AND FOLDING

Mineral assemblages in the mafic members of the Pumpkinvine Creek Formation are indicative of at least one episode of upper greenschist to lower amphibolite facies (Greenschist-Amphibolite Transition Zone of Turner, 1968) metamorphism. Both garnet and biotite are present in the more felsic members and in the surrounding rocks. Garnet is unaltered, but biotite is commonly surrounded by and appears to be altered to chlorite. In addition, in areas of sulfide mineralization the amphibolites have been altered to chlorite phyllites. This suggests that the Pumpkinvine Creek Formation was, at least in part, progressively metamorphosed to upper greenschist to lower amphibolite facies and then retrograded to lower greenschist facies by a second event, probably related to the aforementioned mineralization. Faulting evidenced by granulated quartz and feldspar in some of the lithologies of the formation also may have played a role in the retrogression in a manner similar to that described by Bryant (1966).

Folding in the Pumpkinvine Creek Formation and the surrounding rocks is complex with at least four generations present. The outcrop pattern of the formation defines a large-scale overturned antiform (fig. 3) believed to represent a first generation fold. First generation folds trend northeast-southwest, are predominantly isoclinal, and probably occurred contemporaneously with metamorphism as evidenced by the development of an axial-plane schistosity. Transposition of most of the original layering occurred during this event and folds of this generation are generally observed as intrafolial folds (fig. 6). Second and third generation chevron folds give the Pumpkinvine Creek Formation an accordion-like appearance in outcrop (fig. 7). Each has a well-developed crenulation cleavage. Second generation folds are coaxial with the first generation (fig. 8), but axial trends are somewhat distorted by subsequent folding. Third generation folds trend northwest-southeast and plunge moderately to the southeast (fig. 9). Fourth generation folds are late open warps whose axial traces trend northwest-southeast. These folds are rarely observed in the field, but a very large fourth generation fold is evident in the western part of figure 3. Here the outcrop pattern of the Pumpkinvine Creek Formation and associated lithologies bends to the southwest.

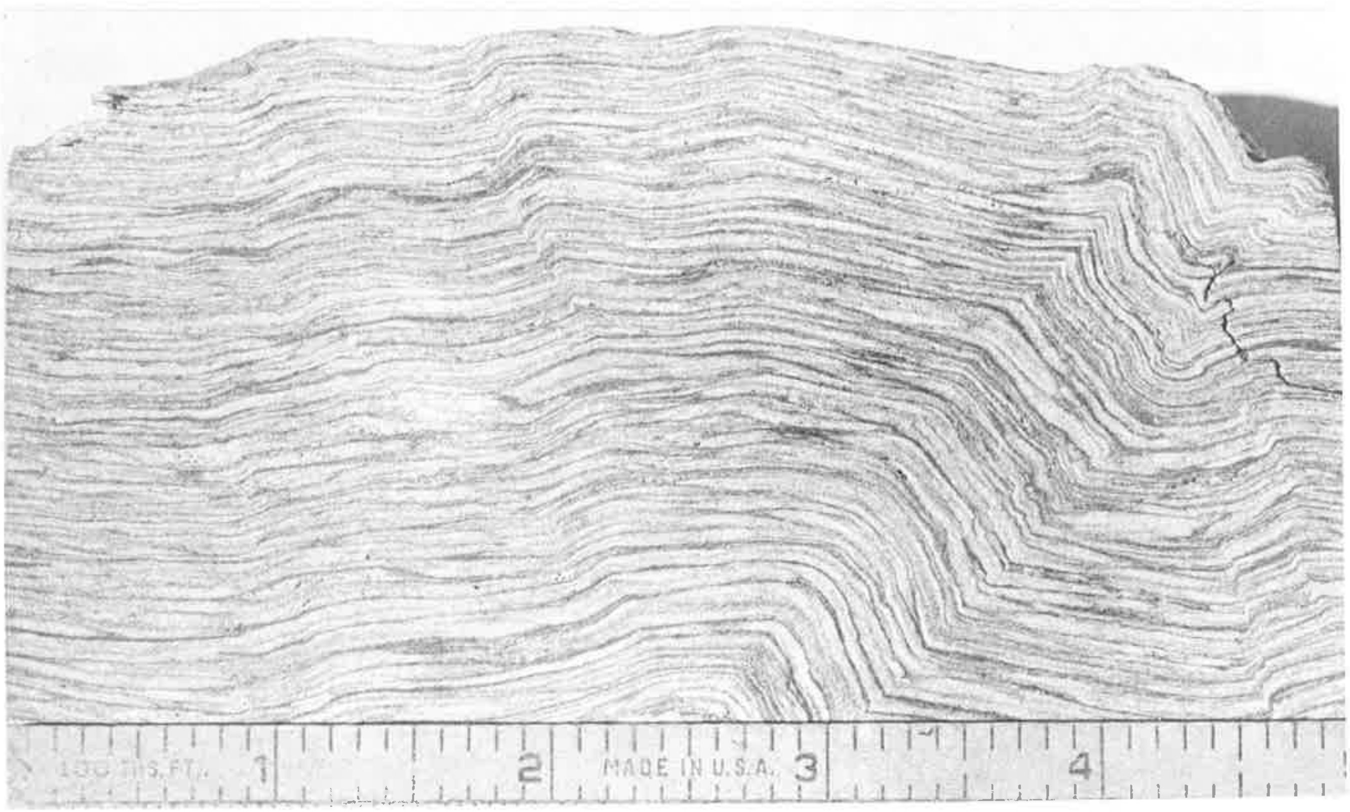

Figure 6 Rock slab showing intrafolial folds believed to be related to first generation folding.

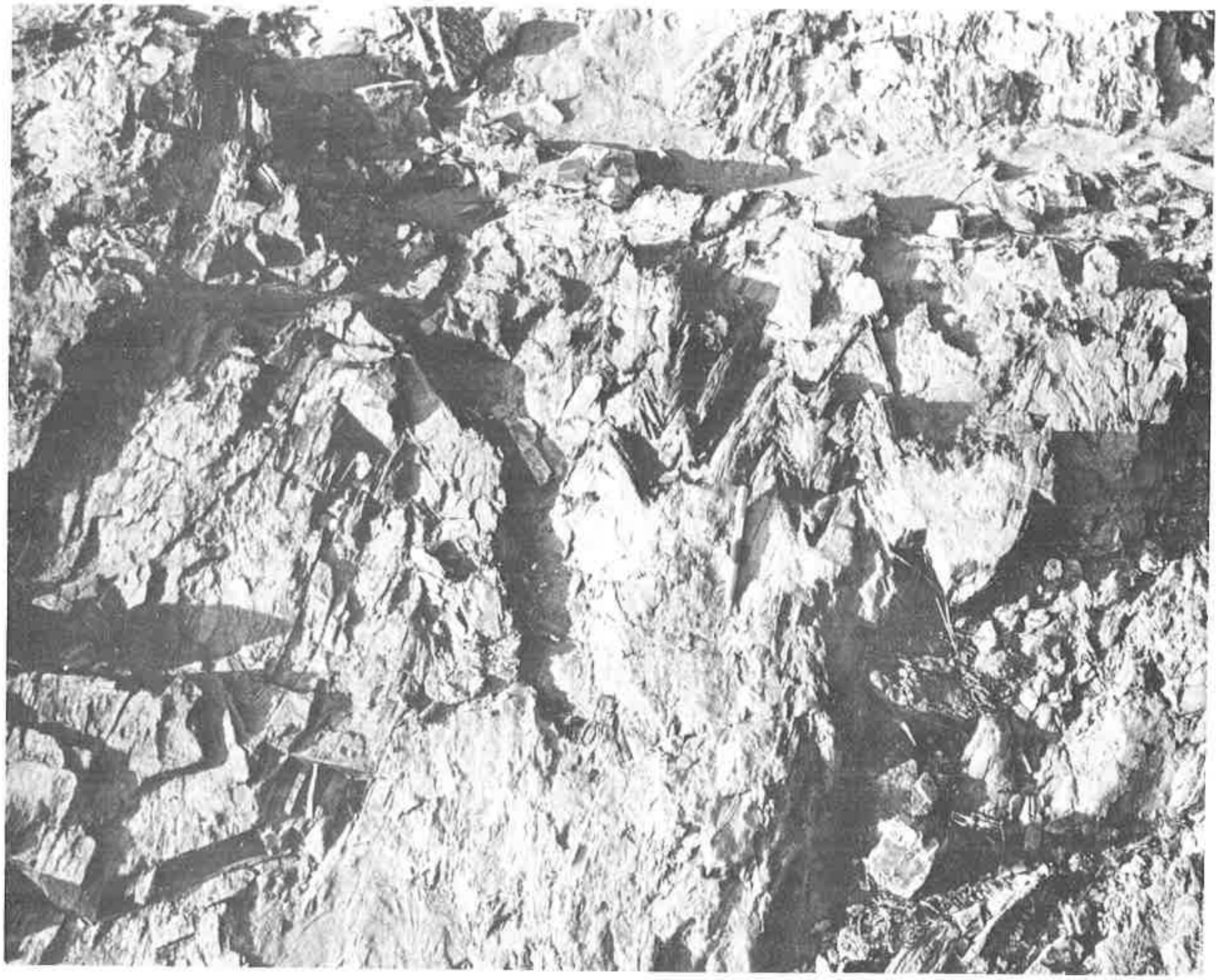

Figure 7 Chevron folding in an amphibolite outcrop of the Pumpkinvine Creek Formation.

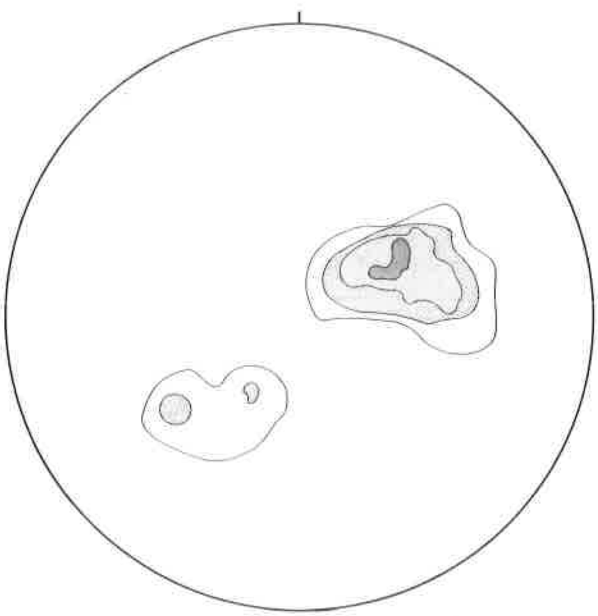

Figure 8 Fabric diagram of second generation fold axes and lineations, 125 observations; contour intervals @ 2%, 6%, 10%, and 16%.

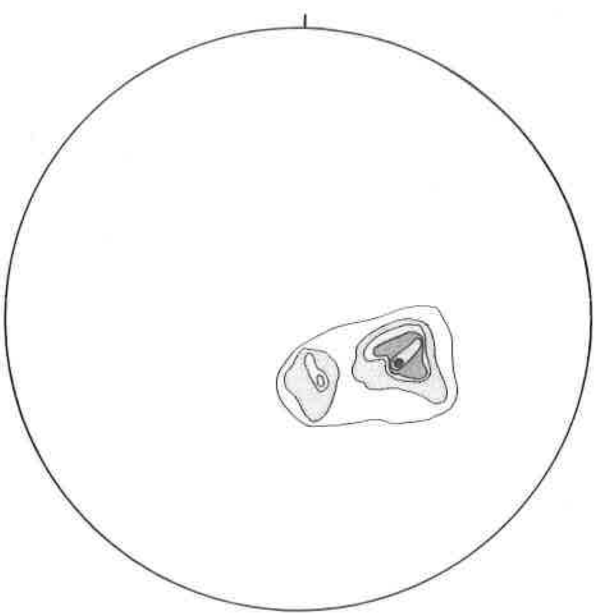

Figure 9 Fabric diagram of third generation fold axes and lineations, 28 observations; contour intervals @ 8%, 10%, and 16%.

CONTACT RELATIONS

Contacts with the units structurally above and below the Pumpkinvine Creek Formation are well exposed along the shores of Lake Allatoona. Structurally beneath the Pumpkinvine Creek Formation is a massive, compositionally felsic to intermediate gneiss informally termed the Galts Ferry gneiss. The Galts Ferry gneiss is for the most part a biotite-quartz-feldspar gneiss, but varies to a compositionally banded hornblende-quartz-feldspar gneiss. The banding is locally offset and drag-folded along small faults (fig. 10). The contact between the Pumpkinvine Creek Formation and the Galts Ferry gneiss along the southeast limb of the fold is denoted by a pronounced linear valley for most of its length. This, along with locally intense shearing in the gneiss (T.J. Crawford, personal commun., 1977) suggested a fault contact (McConnell, 1978). However, exposures along the shore of Lake Allatoona show that the contact is concordant and sharp with local interlayering (fig. 11). The contact is folded (fig. 12) and several outcrops show amphibolite infolded into the Galts Ferry gneiss. The northwestern contact between the Pumpkinvine Creek Formation and the Galts Ferry gneiss is poorly exposed, but where it is observed in saprolite it appears concordant and somewhat gradational.

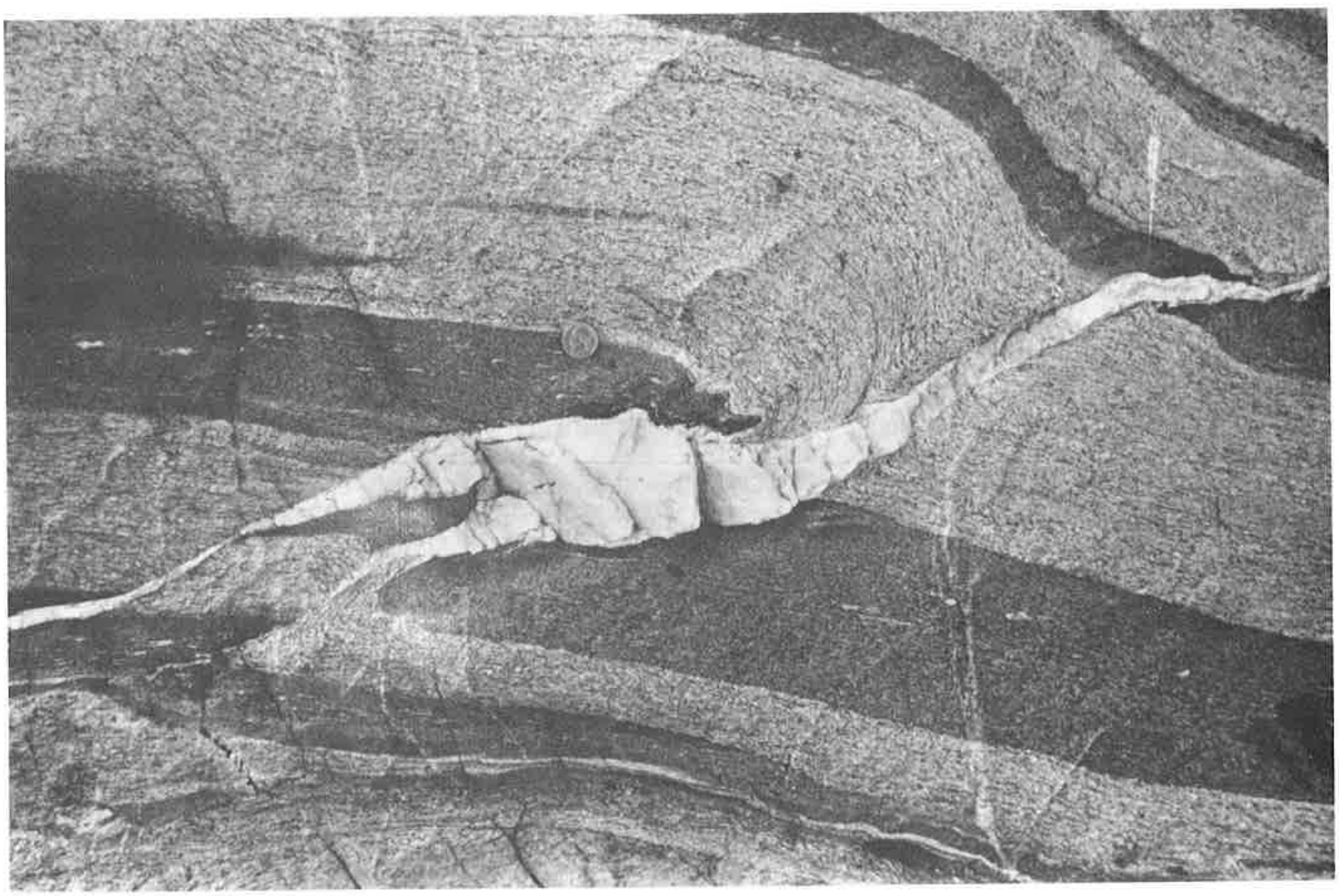

Figure 10 Photograph showing offset along small faults in the Galts Ferry gneiss.

Figure 11 Photograph of an interlayered contact between the Pumpkinvine Creek Formation and the Galts Ferry gneiss.

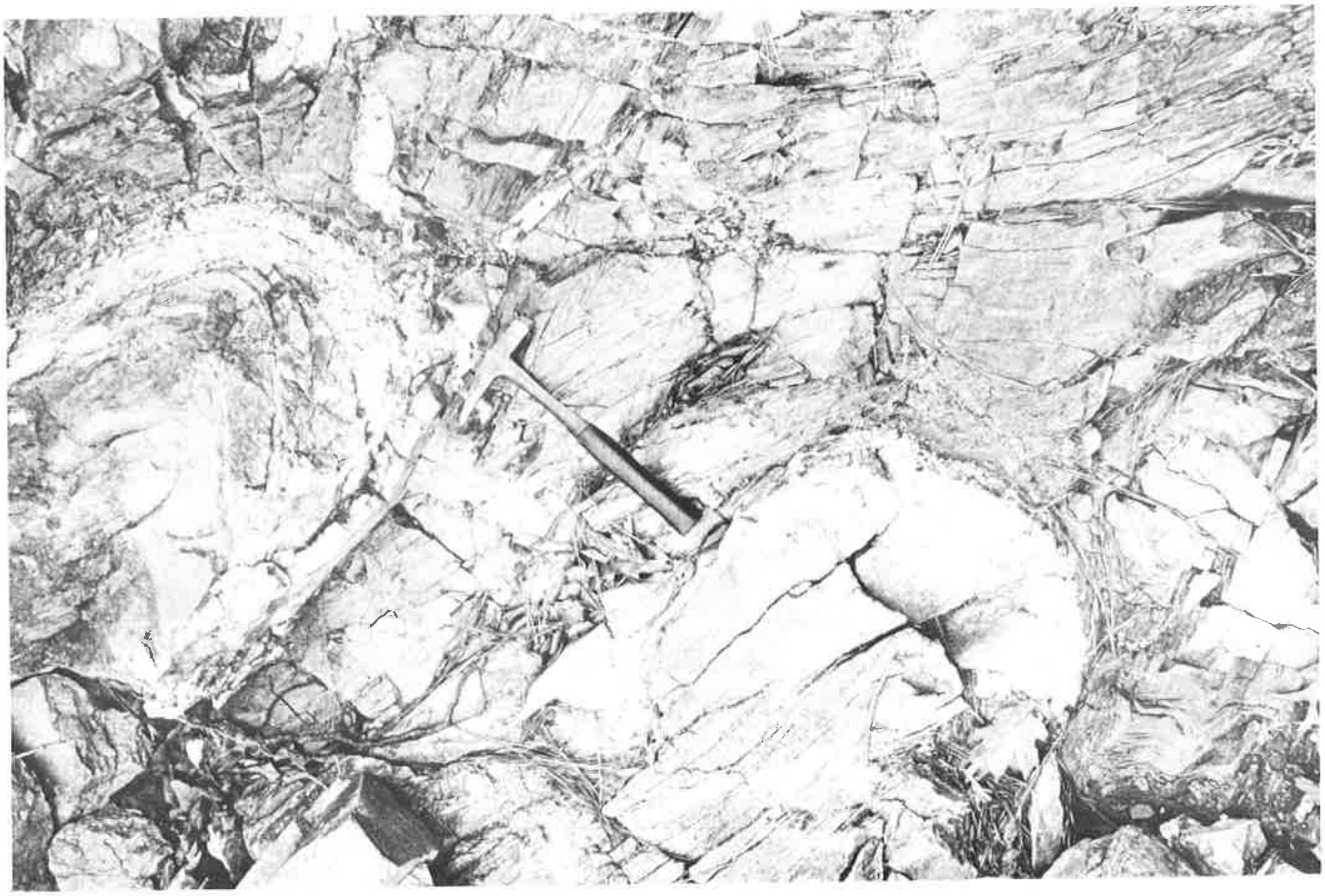

Figure 12 Photograph showing the infolding of the amphibolite of the Pumpkinvine Creek Formation into the Galts Ferry gneiss.

Structurally above the Pumpkinvine Creek Formation is a mixed unit composed primarily of garnet-sericite phyllite. The sericite phyllite contains substantial amounts of biotite, chlorite and calcite, and is interlayered with meta-arkose, graphitic phyllite and quartzite. The unit is characterized by graphitic phyllite which is prominent in the northeast but decreases to the southwest. This unit was previously termed the Canton Schist by Bayley (1928). The Canton Schist is faulted out along the northeastern part of the northwest limb of the major fold shown in figure 3, but Crawford (1976) has mapped a similar graphitic phyllite-sericite phyllite unit along the northwest limb in Paulding County. On the southeast limb, the contact with the Pumpkinvine Creek is sharp, generally concordant and folded. However, in some localities the contact is denoted by the presence of intensely sheared phyllites that exhibit a well-developed "button" texture.

AGE

The age of the amphibolite in the Pumpkinvine Creek Formation has drawn much speculation. Very little stratigraphic or isotopic data is available on which to base an age interpretation. Various ages have been suggested: for example, Late Precambrian (Hurst, 1973) and Lower Cambrian (Kesler, 1950). Recent uranium-lead analyses of zircons from the Hillabee Greenstone in Alabama (a probable correlative of the Pumpkinvine Creek Formation) indicate that the Hillabee is approximately 450 million years old (Russell, 1978). However, this Pb-207/Pb-206 date is preliminary and is taken from a unit within the Hillabee that has undergone cataclasis. More recently, hornblendes from a sample of the Pumpkinvine Creek Formation have given an Ar40/Ar39 total age of 313 ± 10 m.y. (Robert Dooley, personal commun.). This age probably represents a cooling age for the amphiboles and provides an upper limit on the age of the Pumpkinvine Creek Formation.

CORRELATION

The unique structural position of the Pumpkinvine Creek Formation between Dallas belt lithologies to the southeast and the Talladega Series and Great Smoky Group to the northwest suggests that it can be correlated with units in similar positions along strike. Southwestward from the type locality of the Pumpkinvine Creek Formation, rocks of similar lithology have been mapped intermittently across Paulding and Haralson Counties to the Georgia-Alabama line (Hurst and Crawford, 1969; Crawford, 1976 and 1977a & b; Cressler, 1970; and Weimer, 1976). In Alabama, greenstones termed the Hillabee Greenstones are in the same structural position and are compositionally (see figs. 13 through 17) and mineralogically similar to the Pumpkinvine Creek Formation. The Hillabee has been mapped for a distance of 165 km (103 mi) across the Piedmont of Alabama (Tull and others, 1977) to the Coastal Plain overlap.

While initially the correlation of the Hillabee Greenstone and the Pumpkinvine Creek Formation appears straightforward, complications arise with respect to faulting and the relationship to the Piedmont lithologies to the southeast. The Hillabee Greenstone in Alabama is believed to be stratigraphically above the Talladega Series, but in fault contact with the overlying Ashland Supergroup along the Hollins Line (Tull and others, 1977). In Georgia, the picture apparently is more complex and much depends primarily on where the line between the Piedmont lithologies and the Talladega Series is drawn. In the type area of the Pumpkinvine Creek Formation, faulting does not appear to be limited to a single zone, but is distributed along a series of imbricate thrusts (McConnell and Costello, 1979). Cataclastic textures are evident in the Pumpkinvine Creek Formation and in the rocks to the northwest and southeast. These textures suggest that faulting took place throughout the area. This interpretation is similar to what Neathery and Reynolds (1973) have suggested occurred in the Hillabee Greenstone.

The boundary between the Talladega Series and Piedmont lithologies, in this report, would be placed along the northwestern border of the Pumpkinvine Creek Formation. The southeastern contact of the Pumpkinvine Creek Formation does not have the abrupt metamorphic grade change that has been observed by Tull and others (1977) with respect to the southeastern border of the Hillabee Greenstone in Alabama. Therefore, unless the Canton Schist is included in the Talladega Series, the Pumpkinvine Creek Formation could be in stratigraphic conformity with the Dallas belt (i.e., Ashland Supergroup) lithologies.

Northeastward from the type locality of the Pumpkinvine Creek Formation, similar lithologies can be traced along the trend of the old Dahlonega Gold Belt to the Georgia-North Carolina line (Georgia Geologic Survey, 1976). However, recent reconnaissance mapping (McConnell and Costello, unpublished data) indicates that these amphibolites are a continuation of amphibolites of the Dallas belt that occur to the southeast of the Pumpkinvine Creek Formation.

ORIGIN

Early workers believed that the Pumpkinvine Creek Formation and other amphibolites in this part of the Piedmont were intrusive (Yeates and others, 1896, p. 285; Shearer and Hull, 1918, p. 10-11; and Bayley, 1928, p. 28-29). However, in 1950 Kesler suggested that the amphibolites were metamorphosed marls. He changed this interpretation somewhat when chemical analyses of the amphibolites indicated that they were similar to tholeiitic basalts (Kesler and Kesler, 1971). Kesler and Kesler (1971) suggest that the amphibolites of the Pumpkinvine Creek Formation originated from "ordinary sedimentary materials containing little or no basaltic debris"; nevertheless, their analyses indicate that the amphibolites were, in fact, derived from volcanic rocks. More recently, relict igneous textures and structures (pillows and amygdules) observed by Hurst and Jones (1973) provide further evidence that the amphibolites of the Pumpkinvine Creek Formation are of igneous origin.

Igneous textures found in the field are supported by both major element chemistry (table 1) and rare-earth element analyses (table 2) of amphibolites from the Pumpkinvine Creek Formation. The results of 10 major element analyses of amphibolites from the Pumpkinvine Creek Formation compare well with the average values of tholeiitic basalts given by Nockolds (1954). Rare-earth element analyses from five samples of greenstone from the Pumpkinvine Creek Formation also support an igneous origin (table 2). When plotted against chondrites (fig. 13) the rare-earth elements of the Pumpkinvine Creek Formation show a relatively straight trend and depleted light rare-earth levels. These analyses also show an as yet unexplained negative anomaly with respect to holium. The rare-earth trends of the composite of North American shales (Haskin and Haskin, 1968) and a composite of para-hornblende schists (Higgins, unpublished data) are distinctly different from that of the Pumpkinvine Creek Formation which is similar to the trends expressed by basalts, particularly oceanic basalts (Gottfried and others, 1978).

Table 1. Chemical analyses and normative analyses of amphibolites from the Pumpkinvine Formation.

	AC-10B	AC-10	104-1	CHE-240	CA-1*	CA-4*	CA-6*	CA-10*	CA-12*	CA-14*
SiO_2	48.46	49.86	48.64	47.50	50.80	46.60	49.00	48.60	46.50	46.90
Al_2O_3	14.50	14.50	15.50	17.50	14.30	12.30	15.10	15.20	13.00	15.30
Fe_2O_3	4.83	5.14	4.00	5.11	2.90	2.30	2.30	3.10	3.50	1.80
FeO	7.85	8.70	8.05	7.59	8.50	8.20	8.90	7.50	8.40	8.40
MgO	7.50	7.20	7.80	7.20	6.90	7.50	9.00	8.60	5.50	8.40
CaO	11.30	6.90	8.62	7.06	9.50	13.40	9.30	11.10	15.00	10.10
Na_2O	2.35	3.80	3.28	3.28	3.70	2.80	3.10	2.60	1.70	3.30
K_2O	0.22	0.12	0.25	0.25	0.16	0.08	0.11	0.10	0.12	0.15
H_2O	1.34	1.68	1.36	1.92	0.90	1.50	1.80	1.40	1.20	2.20
TiO_2	1.25	1.30	2.00	1.60	1.40	1.00	1.10	0.96	1.40	0.87
P_2O_5	0.10	0.30	0.01	0.10	0.17	0.12	0.11	0.10	0.16	0.10
MnO	0.19	0.22	0.22	0.24	0.21	0.23	0.20	0.19	0.27	0.21
CeO_2					0.36	4.00			3.20	2.20
TOTAL	99.89	99.72	99.73	99.35	99.80	100.03	100.02	99.45	99.95	99.93

	AC-10B	AC-10	104-1	CHE-240	CA-1*	CA-4*	CA-6*	CA-10*	CA-12*	CA-14*
Q	0.710	0.262				0.184			5.661	
C										
OR	1.301	0.711	1.481	0.778	0.947	0.473	0.650	0.594	0.709	0.887
AB	19.907	32.245	27.830	29.131	31.371	23.686	26.226	22.122	14.392	27.943
AN	28.397	22.215	26.904	26.153	21.982	20.751	26.956	29.672	27.500	26.510
NE										
WO	11.303	4.237	6.643	8.008	9.123	8.202	7.705	10.457	10.717	3.783
EN	18.699	17.982	14.596	12.534	15.107	18.673	12.166	15.598	13.705	10.329
FS	8.723	10.020	6.450	5.646	9.927	11.930	7.055	7.268	10.729	6.365
FO			3.422	4.117	1.480		7.178	4.161		7.432
FA			1.666	2.044	1.071		4.588	2.137		5.047
MT	7.011	7.473	5.815	6.313	4.213	3.334	3.334	4.520	5.077	2.612
HM										
IL	2.377	2.476	3.809	3.269	2.664	1.899	2.089	1.833	2.660	1.653
TN										
PF										
RU										
AP	0.237	0.713	0.024	0.456	0.403	0.284	0.260	0.238	0.379	0.237
CC				0.046	0.820	9.094			7.281	5.007
TOTAL	98.666	98.334	98.640	98.494	99.110	98.510	98.209	98.600	98.811	97.806

*Samples provided by Michael W. Higgins (U.S.G.S.) and analyzed in the laboratory of the U.S. Geological Survey.

ND=Not Determined.

Table 2. Rare earth element concentrations (ppm) in the Pumpkinvine Creek Formation

	PUMPKINVINE CREEK FORMATION					
Element	AC-10	AC-10B	CHE-204	CHE-104-1	PAC*	NASC+
LA	5.5	4.5	9.0	8.0	34.0	27
CE	16.0	10.0	19.0	22.0	62.7	32
ND	12.0	11.5	17.0	17.0	32.3	31
SM	3.9	3.0	4.7	4.7	7.3	5.7
EU	1.19	.96	1.38	1.36	2.1	1.24
GD	--	--	--	--	5.5	5.2
TB	.92	.72	.95	1.21	.95	.85
HO	.75	.60	.80	.90	.90	1.04
TM	.79	.69	.68	.64	.52	.50
YB	3.7	2.85	1.9	2.7	1.69	3.1

(Analyses performed in the U.S. Geological Laboratories in Reston, Va. by neutron activiation).

*Para-Amphibolite Composite (Michael W. Higgins, unpublished data).
+Composite of 40 North American shales (Haskin and Haskin, 1966).

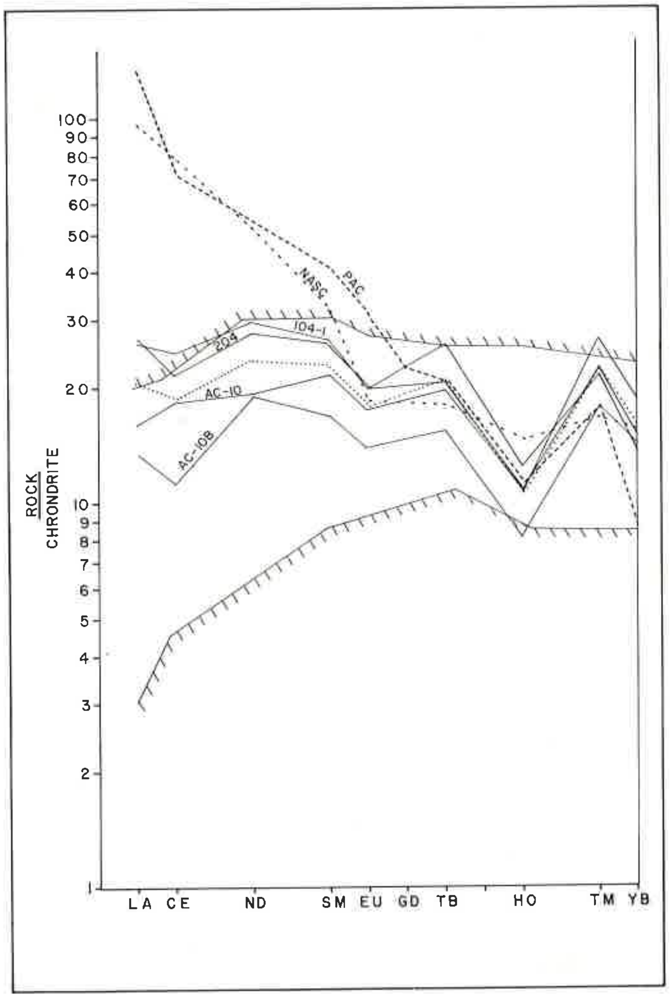

Figure 13

Rare-earth element data for the Pumpkinvine Creek Formation plotted against chondrites. NASC = composite of North American Shales (Haskin and Haskin, 1968); PAC = paramphibolite composite ((Higgins, unpublished data); and Avg. = average of four samples of the Pumpkinville Creek Formation). Region between dashed lines is the field for modern oceanic tholeiites (Bryan et.al., 1976).

TECTONIC SETTING

While results of the rare-earth analyses approximate the trend of an oceanic basalt, they do show higher overall levels of rare-earth elements and do not have the distinct depletion in light rare-earth elements characteristic of oceanic basalts. Recent work by Pearce (1975), Miyashiro (1974), and Miyashiro and Shido (1975) has shown that certain trace elements provide a mechanism for determining tectonic setting. Figure 14 (after Miyashiro, 1975) shows that for TiO vs. FeO*/MgO the analyses of the Pumpkinvine Creek Formation lie, for the most part, in the abyssal tholeiite field. Twenty analyses of the Hillabee Greenstone (Tull and others, 1978) also are plotted for comparison. With some exceptions, they too plot in or near the abyssal tholeiite field. Plots of Ni vs. FeO*/MgO and Cr. vs. FeO*/MgO (figs. 15 & 16), after Miyashiro and Shido (1975), also show that the majority of Pumpkinvine Creek samples lie in the abyssal tholeiite field. The plot of TiO_2 vs. Cr (fig. 17), after Pearce, shows that the majority of both the Pumpkinvine Creek Formation and Hillabee Greenstone lie on the ocean floor basalt field.

It is apparent from the above that it can not be said with complete certainty which tectonic setting the Pumpkinvine Creek and its possible correlative, the Hillabee Greenstone, are related to. However, it is apparent that these rocks are chemically similar to abyssal tholeiites and may represent rocks derived in either an ocean ridge or back-arc basin environment. The presence of craton-derived metasediments interbedded with the amphibolites of the Pumpkinvine Creek Formation (the mylonitic gneiss of presumed metasedimentary origin) would suggest the latter case.

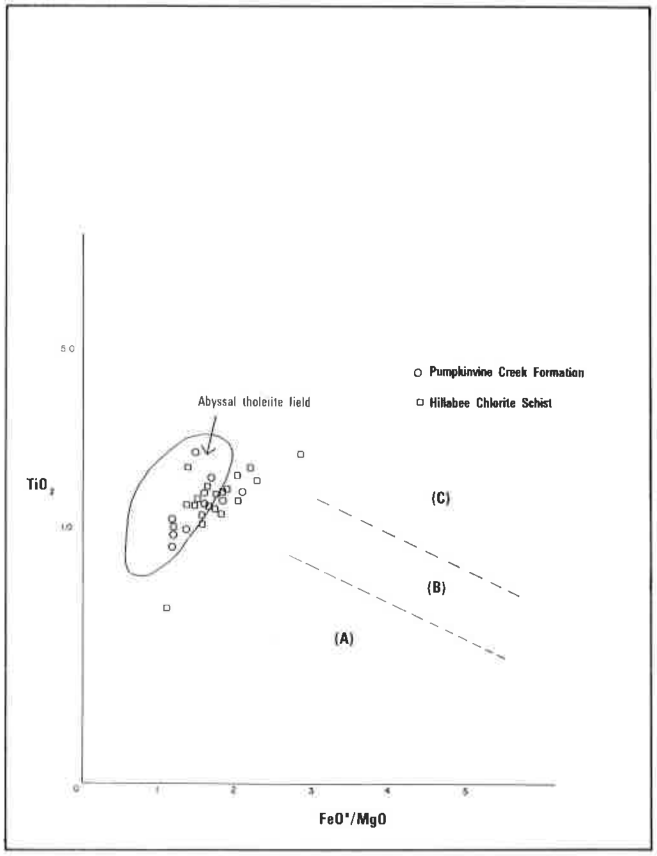

Figure 14 Discrimination of volcanic rock types based on TiO^2 vs FeO*/MgO (after Miyashiro, 1975). A=calc-alkalic series; B = calc-alkalic and theoleiitic series; and C = theoleiitic series.

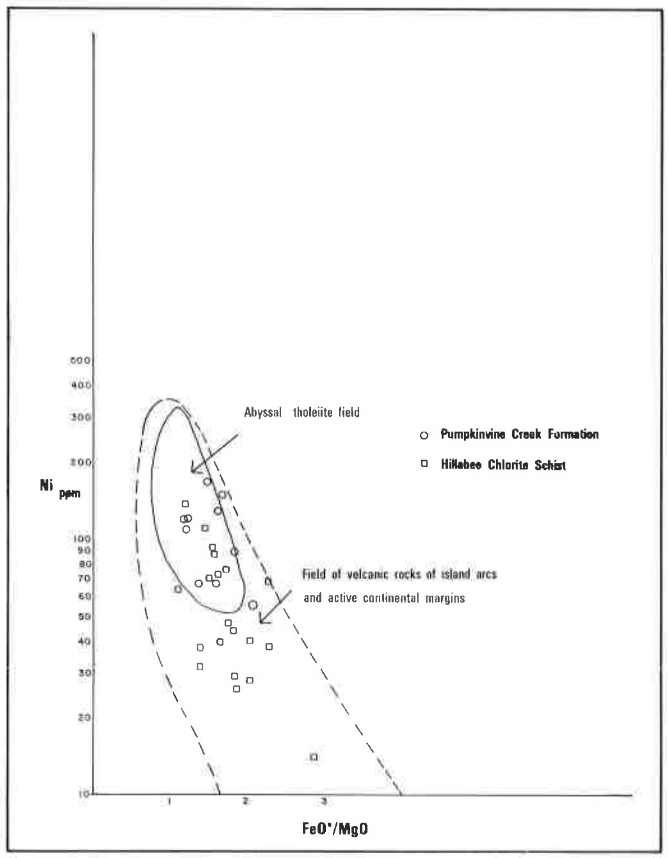

Figure 15 Discrimination of volcanic rock series based on the Ni vs FeO*/MgO relationship (after Miyashiro and Shido, 1975).

($FeO^* = FeO + .9Fe_2O_3$)

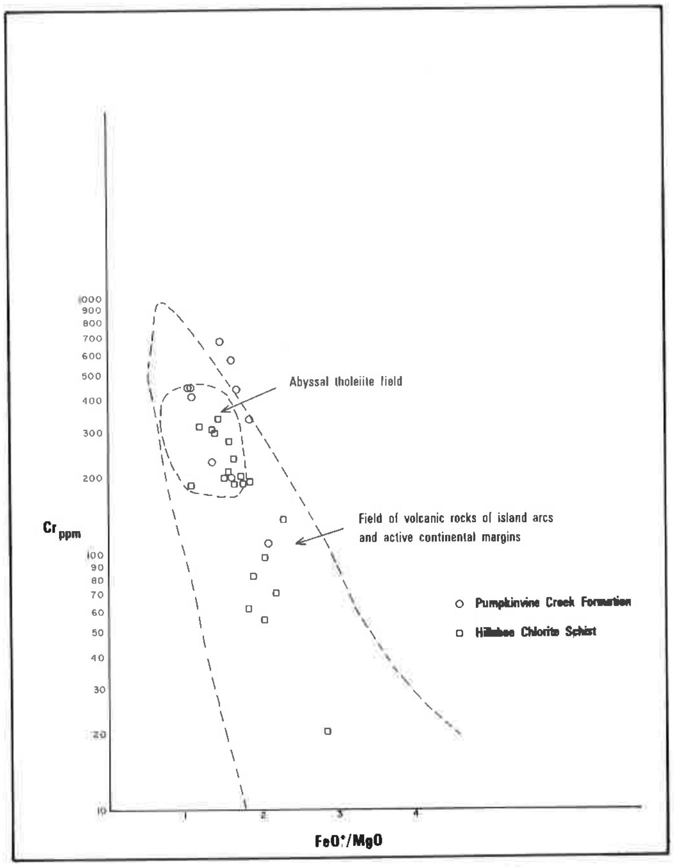

Figure 16 Discrimination of volcanic rock series based on the Cr vs FeO*/MgO relationship (after Miyashiro and Shido, 1975).

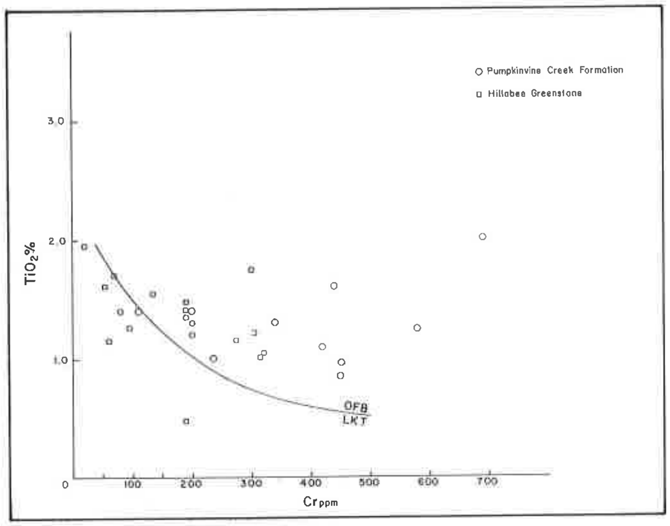

Figure 17 Discrimination of ocean floor basalts (OFB) vs low potassium tholeiites (LKT) on the basis of Cr vs TiO^2 (after Pearce, 1975).

CONCLUSION

The Pumpkinvine Creek Formation provides an easily traceable and stratigraphically important unit in the northern Piedmont of Georgia. The Pumpkinvine Creek Formation lies along the southern border of both the Talladega Series in the southwest and the Great Smoky Group to the northeast. It thus provides an identifiable unit on which to tie future investigations on the relationship of the Great Smoky Group to the Talladega Series where they appear to intersect just southeast of Cartersville. The Pumpkinvine Creek Formation also represents an important link in a linear belt of amphibolites and greenstones that extends from northeastern Georgia to the Hillabee Greenstone in Alabama and the Coastal Plain overlap. The chemical character and relict igneous features of these rocks along with their linear outcrop belt suggest that they represent an extensive episode of basaltic volcanism that occurred in the southeastern Piedmont of Georgia prior to 313 + 10 m.y. ago.

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